U.S. Fish & Wildlife Service

Final Supplemental Environmental Impact Statement

Translocation of Southern Sea Otters

Prepared by
U.S. Fish & Wildlife Service
Ventura Fish and Wildlife Office
Ventura, California

November 2012

Volume 1

This page intentionally left blank.

Final Supplemental Environmental Impact Statement

Translocation of Southern Sea Otters

Responsible agency:

U.S. Fish and Wildlife Service
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, California 93003
(805) 644-1766

For additional information, contact:

Lilian Carswell, at the above address,
or by email: Lilian_Carswell@fws.gov

Abstract:

The purpose of this final Supplemental Environmental Impact Statement (final SEIS) is to reevaluate the effects of the southern sea otter translocation plan, as described in the U.S. Fish and Wildlife Service's 1987 environmental impact statement on the translocation of southern sea otters. Using information obtained over the decades since the plan's implementation, we evaluate the impacts of alternatives to the current translocation program, including termination of the program or revisions to it. The need for action stems from our inability to meet the goals of the southern sea otter translocation program. Contrary to the primary recovery objective of the program, the translocation of sea otters to San Nicolas Island has not resulted in an established population sufficient to repopulate other areas of the range should a catastrophic event affect the mainland population. Additionally, maintenance of a management zone has proven to be more difficult than anticipated and hinders or may prevent recovery of the southern sea otter. The affected area includes Santa Barbara, Ventura, Los Angeles, Orange, and San Diego Counties in California.

Suggested citation:

U.S. Fish and Wildlife Service. 2012. Final Supplemental Environmental Impact Statement on the Translocation of Southern Sea Otters. Ventura Fish and Wildlife Office, Ventura, California. 348 pp. + front matter and appendices.

This page intentionally left blank.

Table of Contents

List of Tables

Table of Figures

Acronyms and Abbreviations used in this Document

BO	biological opinion
BOEM	Bureau of Ocean Energy Management
CDFG	California Department of Fish and Game
CIMRI	Channel Islands Marine Research Institute
CINP	Channel Islands National Park
cm	centimeter
CP	Carpinteria
CPFV	Commercial Passenger Fishing Vessel
DSEIS	draft supplemental environmental impact statement
ESA	Endangered Species Act
FSEIS	final supplemental environmental impact statement
ft	feet
kg	kilogram
km	kilometers
m	meters
mi	miles
mm	millimeters
MMPA	Marine Mammal Protection Act
MPA	Marine Protected Area
NCCP	Natural Community Conservation Plan
NMFS	National Marine Fisheries Service
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
OSP	Optimum Sustainable Population level
OX	Oxnard
P.L. 99-625	Public Law 99-625
PC	Point Conception
PV	present value
PVA	population viability analysis
RDSEIS	revised draft supplemental environmental impact statement
SB	Santa Barbara
SCB	Southern California Bight
Secretary	Secretary of the Interior
SEIS	supplemental environmental impact statement
SNI	San Nicolas Island
SNI	San Nicolas Island
SSO	southern sea otter
State	State of California
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

Executive Summary

Background

The southern sea otter (*Enhydra lutris nereis*) was listed as a threatened species under the Endangered Species Act of 1973, as amended (16 U.S.C 1531 *et seq.*) (ESA) in 1977. Threats to the species included its small population size, its greatly reduced range, and the potential risk of oil spills (42 FR 2968). A recovery plan for the southern sea otter was approved in 1982. This plan identified the translocation of southern sea otters as an effective and reasonable recovery action. The purpose of translocation was to establish southern sea otters in one or more areas within historic habitat, thereby minimizing the possibility that a single natural or human-caused catastrophe, such as an oil spill, could adversely affect a significant portion of the population.

Under the ESA, the Secretary of the Interior (Secretary) has inherent authority to establish new or translocated populations of listed species. Section 10(j) of the ESA provides the Secretary with additional flexibility to relax the protective provisions of the ESA when translocating a population of a listed species by allowing the Secretary to designate the translocated population as an experimental population. However, the southern sea otter is protected under both the ESA and the Marine Mammal Protection Act of 1972, as amended (MMPA), and at the time, the MMPA did not contain similar provisions. This inconsistency was resolved in the case of the southern sea otter by the passage of Public Law (P.L.) 99-625 (Fish and Wildlife Programs: Improvement; Section 1. Translocation of California Sea Otters) on November 7, 1986 (Appendix A). P.L. 99-625 specifically authorized the development of a translocation plan for southern sea otters (to be administered in cooperation with the affected State) and incorporated provisions intended to minimize conflicts between translocated sea otters and 1) shellfish fisheries and 2) the Department of Defense (DOD). These provisions included the establishment of a translocation zone, into which sea otters would be moved to establish an independent population, and a surrounding management zone, from which sea otters would be removed.

In May, 1987, we, the U.S. Fish and Wildlife Service (USFWS), published a final environmental impact statement that analyzed the impacts of a program to translocate southern sea otters from the central coast of California to areas of northern California, southern Oregon, or San Nicolas Island off the coast of southern California. We identified San Nicolas Island as our preferred translocation site and subsequently issued a record of decision announcing our intent to implement a translocation plan, which included moving sea otters to San Nicolas Island and designating a management zone in accordance with P.L. 99-625.

Between August 1987 and March 1990, we released 140 sea otters at San Nicolas Island. Many of these animals left the island; some returned to central California; some took up residence in southern California; and some died. Many were never accounted for. In 2010, 46 independent[1] sea otters were counted at San Nicolas Island. Virtually all of these sea otters are believed to be offspring of the animals that remained at the island.

[1] The term "independent" refers to any sea otter beyond the weaning stage (*i.e.*, all but dependent pups).

We discontinued translocating sea otters to San Nicolas Island in 1990 but continued to remove sea otters from the designated management zone until 1993. As specified by P.L. 99-625, sea otters were to be removed from the management zone using non-lethal means and returned to either San Nicolas Island or the central California coast. The purpose of the management zone was to minimize conflicts between translocated sea otters and shellfish fisheries. Any sea otter found south of Point Conception (in Santa Barbara County) and outside of the translocation zone was to be removed. Between 1993 and 1997, few sea otters were reported in the management zone; however, natural range expansion of the mainland sea otter population resulted in large numbers of sea otters entering the management zone in 1998.

By 1998, many factors related to the status of the southern sea otter population had changed since initiation of the program, and the program did not appear to be meeting the recovery objectives outlined for it. In light of this new information, we consulted with the southern sea otter recovery team and sought public comment on the future of the program. We subsequently reinitiated Section 7 consultation under the ESA (Appendix B) and completed a draft evaluation of the translocation program. The Section 7 consultation resulted in a July 2000 biological opinion that determined that containment of southern sea otters was not consistent with the requirement of the ESA to avoid jeopardy to the species. On January 22, 2001, we issued a policy statement regarding the capture and removal of southern sea otters in the designated management zone (66 FR 6649). The policy statement advised the public that we would not capture and remove southern sea otters from the management zone pending completion of our reevaluation of the southern sea otter translocation program, which would include the preparation of a Supplemental Environmental Impact Statement (SEIS) and release of a final evaluation of the translocation program that contained an analysis of program failure criteria.

In 2005, we released a draft SEIS. Continuing efforts to resolve stakeholder concerns forestalled publication of a final SEIS for several years. On September 30, 2009, two environmental groups filed suit against the USFWS under provisions of the Administrative Procedures Act, alleging that we had unreasonably delayed a decision on the translocation program. Publication of a final SEIS on the translocation program is part of the settlement agreement we reached with plaintiffs on November 23, 2010. In order to ensure that our analysis reflects current conditions, we revised the draft SEIS and released it for public comment on August 26, 2011 (76 FR 53381; 76 FR 53453). The initial 60-day comment period for the revised draft SEIS closed on October 24, 2011. The comment period was reopened between November 4, 2011 and November 21, 2011 (76 FR 68393). This final SEIS incorporates changes based on comments we received during the comment period.

Purpose and Need for Action

The purpose of this SEIS is to evaluate the effects of the southern sea otter translocation plan as described in our 1987 environmental impact statement, using information obtained over the decades since the plan's inception, and to evaluate the impacts of alternatives to the current translocation program, including termination of the program or revisions to it.

The need for action stems from our inability to meet the goals of the southern sea otter translocation program. Contrary to expectations and to the primary recovery objective of the program, the translocation of sea otters to San Nicolas Island has not resulted in an established population sufficient to repopulate other areas of the range should a catastrophic event affect the mainland population. Additionally, maintenance of a management zone has proven to be more difficult than anticipated and hinders or may prevent recovery of the southern sea otter.

Issues and Alternatives

Issues and concerns expressed during the scoping process, the comment period on the 2005 draft SEIS, and the comment period on the revised draft SEIS generally fell within four categories: (1) economic effects on fisheries and tourism; (2) effects on the nearshore marine ecosystem (including federally listed abalone species); (3) effects on the southern sea otter population; and (4) effects on other agency activities. These categories encompass all of the potentially significant effects associated with the translocation program and are the focus of this document. We analyze six alternatives:

- **No Action Alternative**: Maintain the status quo. This alternative serves as the baseline for comparison with all other alternatives;
- **Alternative 1**: Resume implementation of the 1987 southern sea otter translocation plan;
- **Alternative 2**: Implement a modified southern sea otter translocation program with a smaller management zone;
- **Alternative 3A**: Terminate the southern sea otter translocation program based on a failure determination pursuant to 50 CFR §17.84(d) ***and*** remove all sea otters residing within the translocation and management zones at the time the decision to terminate is made;
- **Alternative 3B**: Terminate the southern sea otter translocation program based on a failure determination pursuant to 50 CFR §17.84(d) ***and*** remove only sea otters residing within the translocation zone at the time the decision to terminate is made;
- **Alternative 3C (Preferred Alternative)**: Terminate the southern sea otter translocation program based on a failure determination pursuant to 50 CFR §17.84(d) ***and*** do not remove sea otters residing within the translocation or management zones at the time the decision to terminate is made.

Impacts of the Alternatives

Throughout this document, we compare the effects of each alternative to those of the No Action Alternative (the status quo projected outward over time), which functions as a baseline. The quantitative analysis is limited to a 10-year horizon because of the numerous sources of uncertainty involved in projecting sea otter range expansion and socioeconomic impacts beyond that time period. See section 6.1.3 for a detailed explanation of why we limit the quantitative analysis to 10 years. We provide a qualitative description of all impacts expected to occur beyond the 10-year time horizon.

We characterize quantified effects in terms of significance, which we derive by evaluating anticipated effects within their regional contexts. Chapter 5 defines the terms, ranging from "very low" to "very high," used to characterize the significance of quantified effects for each category of impact topics. Some effects are too uncertain or complex to quantify reasonably, even within the 10-year horizon. In these instances, we do not assign a term to indicate the significance. In Chapter 6 and its concluding summary tables, we analyze anticipated effects of the alternatives. For effects that cannot be reasonably quantified, including all those expected to occur beyond the 10-year horizon, we provide a qualitative description only. A brief summary of the biological and socioeconomic effects associated with each alternative within 10 years is included in table 0-1 below. For a summary table of effects that includes long-term impacts (those occurring beyond 10 years), see Tables 6-78 and 6-79.

TABLE 0-1 SUMMARY OF BIOLOGICAL AND SOCIOECONOMIC IMPACTS BY ALTERNATIVE (10-YEAR PROJECTION)

		No Action	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C (Preferred Alternative)
Nearshore Marine Ecosystem			**Significance criteria not defined**				
Candidate, Threatened, and Endangered Species	**White Abalone**		**Low (+)**	**Very low (+)**	**Very Low (+)**		**No change from No Action**
	Black Abalone		**Moderate (+)**	**Very low (+)**	**Moderate (+)**		**No change from No Action**
	Southern Sea Otter		**High (-)**	**High (-)**	**Moderate (-)**	**Moderate (-)**	**No change from No Action to Low (+)**
Commercial Fisheries	**Sea Urchin Fishery**		**Low (+)**	**Very Low (+)**	**Very Low (+)**		**No change from No Action**
	Spiny Lobster Fishery		**Low (+)**	**Low (+)**	**Very Low (+)**		**No change from No Action**
	Crab Fishery		**Moderate (+)**	**Low to Moderate (+)**	**Very Low (+)**		**No change from No Action**
	Sea Cucumber Fishery		**Moderate (+)**	**Low (+)**	**Low (+)**		**No change from No Action**
	Halibut Fishery		**No change from No Action**	**No change from No Action**	**No change from No Action to High (-)**		
	White Seabass Fishery		**No change from No Action**	**No change from No Action**	**No change from No Action to Very High (-)**		
Marine Aquaculture			**Significance criteria not defined**				
Seafood Processing Industry			**Low (+)**	**No change from No Action to Very Low (+)**	**Very Low (+)**		**No change from No Action**
Kelp Harvest			**Significance criteria not defined**				
Recreational fishing	**Lobster Fishing**		**Very Low (+)**	**No change from No Action to Very Low (+)**	**Very Low (+)**		**No change from No Action**
	Finfish Fishing		**Significance criteria not defined**				
Abalone Fishery Restoration			**Significance criteria not defined**				
Ecotourism and Non-Market Value			**Significance criteria not defined**				
Federal and State Agency Programs			**Significance criteria not defined**				

Note: The significance of predicted effects for each impact topic is described with a term ranging from "very low" to "very high." These terms are defined in Chapter 5. The symbols (+) and (-) indicate whether the effect is beneficial or adverse. Where a range of effects is possible but contingent on other occurrences, we characterize the significance as a range representing the minimum and maximum potential impact within 10 years. Many effects are difficult or impossible to quantify. Although we describe qualitatively the effects expected to occur beyond 10 years in Chapter 6, "Environmental Consequences," and summarize them in Tables 6-78 and 6-79 at the end of that chapter, we do not characterize them in terms of significance and thus do not include them in this summary table.

Translocation Program Evaluation

Our future direction depends in large part on the final evaluation of the southern sea otter translocation program. A final evaluation of the program is included as Appendix C to this Final SEIS. We solicited comments on the 2005 draft program evaluation concurrently with comments on the main body of the 2005 draft SEIS. We also solicited comments on the revised draft program evaluation, published in 2011, concurrently with comments on the main body of the revised draft SEIS in 2011. The final program evaluation takes into account comments received during the respective comment periods.

The primary purpose of the translocation program was to bring southern sea otters closer to recovery and to eventual delisting. The translocation program evaluation compares the results of the translocation program against the goals for which it was undertaken and the failure criteria established for its assessment. The final evaluation concludes that the translocation program has failed to fulfill its primary purpose and that recovery and management goals for the species cannot be met by continuing the program (Appendix C).

A second purpose of the translocation program was to obtain data for assessing translocation and containment techniques, population dynamics, the ecological relationships of sea otters and the nearshore community, and the effects on the donor population of removal of individual sea otters for translocation. Much valuable information has been gathered to date, primarily related to the efficacy of the translocation and containment methods used during implementation of the 1987 translocation plan. The translocation and containment results themselves indicate that the primary recovery goal of the translocation program, the establishment of a sea otter population that could serve as a source for future translocations, may not be achievable. In light of the observed degree of dispersal and mortality resulting from the translocation to San Nicolas Island, it no longer appears reasonable to assume that a sea otter population could be reestablished simply by moving 25 animals annually over a 3-year period. Information gained as a result of translocation and containment efforts is an important element in our shift in recovery strategy from translocation to natural range expansion, as described in our Final Revised Recovery Plan for the Southern Sea Otter (USFWS 2003), which is incorporated by reference.

The San Nicolas Island sea otter colony remains small, and its future is uncertain. Even if it were to become "established," the resulting population would not likely be sufficient to ensure survival of the species should the parent population be adversely affected by a catastrophic event.[2] Recovery of the southern sea otter will ultimately depend on the growth and expansion

[2] The translocation rule at 50 CFR 17.84(d)(1)(vi) defines an "established experimental population" of southern sea otters as "an estimated combined minimum of 150 healthy male and female otters residing within the translocation zone, little or no emigration into the management zone occurring, and a minimum annual recruitment to the experimental population in the translocation zone of 20 sea otters for at least 3 years of the latest 5 year period, or replacement yield sufficient to maintain the experimental population at or near carrying capacity during the post-establishment and growth phase or carrying capacity phase of the experimental population." The logic underlying this definition is explained in the preamble to the final rule: "The Service does not consider the mere presence of sea otters in the translocation zone an indication that a new population is established. If a catastrophic event were to decimate a portion of the parent population, it is possible that the relocated otters could be used to restore the damaged portion of the parent population; however, it would also likely eliminate the value of the new population to serve as a reserve colony for providing stock to restore subsequently damaged areas and it could eliminate the reproductive viability of the colony such that the remaining animals could not be self-sustaining. Therefore, to be

of the southern sea otter's range. While there are conflicts between an expanding sea otter population and shellfish fisheries that have developed in the absence of sea otters, attempting to limit the movements of sea otters has proven to be difficult and ineffective, and maintenance of a "no-otter" management zone compromises the ability of the species to recover.

The Preferred Alternative and "Environmentally Preferable" Alternative—Alternative 3C

Alternative 3C is our preferred alternative. Alternative 3C would recognize that the translocation program has failed and would allow sea otters to remain in areas where they now reside without any further attempts at removal. This alternative would ultimately provide the maximum benefit for southern sea otter recovery.

We have also identified Alternative 3C as the "environmentally preferable" alternative, as defined under the National Environmental Policy Act. While the regulatory change in the status of sea otters in the Southern California Bight may result in indirect effects on gill and trammel net fisheries if additional depth restrictions are adopted in the future, we believe that, on balance, Alternative 3C causes the least damage to the biological and physical environment, in that it would allow a "keystone species" to return to its former range off southern California and would help to restore the natural functioning of the nearshore marine ecosystem.

Under Alternative 3C, conflict between natural sea otter range expansion and shellfish fisheries would likely continue to occur. However, in light of the now-well-established capacities of sea otters to return rapidly to areas from which they have been removed, it is clear that our ability to influence sea otter movements by means of capture and removal is limited, and continuing efforts to remove sea otters non-lethally from areas where they choose to reside appears to be futile.

To mitigate regulatory effects that may occur under this alternative, if chosen, we are working with the DOD to identify possible mutually agreeable solutions. We also propose to work closely with the California Department of Fish and Game (CDFG), National Marine Fisheries Service (NMFS), and affected fishers to develop fishery management strategies, where feasible, that would minimize effects on individuals. Finally, we recognize our affirmative responsibilities under the ESA and fully support recovery efforts for endangered white and black abalone. To lessen the risk that natural range expansion of sea otters (which is occurring under baseline conditions and would continue to occur if Alternative 3C were selected) could interfere with recovery efforts for white and black abalone, we are committed to working closely with NMFS to share information that may affect recovery actions for this species. Specifically, we are working with NMFS to convene a working group composed of managers and scientists that have southern sea otter and abalone expertise to benefit the recovery of abalone and sea otters. We are also pursuing a Memorandum of Understanding with NMFS to formalize this and other

considered established it must be a reproductively viable unit, capable of maintaining itself even if 25 animals are removed each year for 1 to 3 years or replacement yield is sufficient to maintain the experimental population at or near carrying capacity during the post-establishment and growth phase or carrying capacity phase for the purposes of repairing damage to the parent population" (52 FR 29754; August 11, 1987).

cooperative efforts to facilitate the recovery of sea otters alongside the recovery of endangered abalone.

Introduction

Sea otters once ranged along the North Pacific rim from the northern Japanese islands to mid-Baja California, Mexico. Shortly after the discovery of sea otters by European explorers, a lucrative fur trade began. Traders from China, Russia, England, the United States, Mexico, and Native American nations expanded trade routes to exploit sea otters as a resource and to claim new territories for their respective countries. In little more than a century, the fur trade brought sea otters to the brink of extinction. With sea otters extirpated from most of their historic range, the fur trade collapsed.

A remnant colony of about 50 sea otters survived in California. Taxonomists identified this population as the southern sea otter, *Enhydra lutris nereis*, distinguishing it from other remnant populations remaining in Russia and Alaska. On January 14, 1977, we listed the southern sea otter as a threatened species under the ESA on the basis of its small population size, its greatly reduced range, and the potential risk to sea otters from oil spills (42 FR 2968). We established a recovery team for the species in 1980 and approved a recovery plan on February 3, 1982 (USFWS 1982). In the recovery plan, we identified the translocation of southern sea otters as an effective and reasonable recovery action, acknowledging that a translocated southern sea otter population could impact shellfish fisheries that had developed in areas formerly occupied by southern sea otters.

The intent behind translocation was to reintroduce sea otters to historic habitat and thereby to reduce the possibility that sea otters would become extinct in California. Several translocations of sea otters from Alaska to the Pacific northwest had demonstrated that new populations could be established by moving sea otters to a new area. Although success was not guaranteed, we believed that a well-organized and executed southern sea otter translocation plan would benefit the species and ultimately contribute to its recovery.

In the course of planning for the translocation of southern sea otters, we became aware of a conflict between the ESA and the MMPA. Both acts provided protection for the southern sea otter, but at the time the MMPA did not allow for the establishment of experimental populations. The matter was brought before the U.S. Congress and resulted in the passage of Public Law 99-625. Public Law 99-625 allowed (but did not require) USFWS to develop and implement a southern sea otter translocation plan that included provisions to minimize conflict between sea otters and shellfish fisheries.

We completed a final EIS for southern sea otter translocation in May 1987 and published a record of decision and final rule establishing the translocation program in August of the same year (Appendix D). The 1987 environmental impact statement evaluated the expected environmental impacts at several potential translocation sites. We selected San Nicolas Island, a small island off the southern California coast owned by the U.S. Navy/DOD, as the preferred site and began to capture and move sea otters to the island in August of the same year.

More than two decades have passed since the first translocations of sea otters to San Nicolas Island were undertaken, during which time we have gained considerable information. However, contrary to initial expectations, we failed to achieve the recovery objectives of the program. We concluded in a biological opinion in 2000 that implementation of the containment component of the program would likely jeopardize the continued existence of the species (Appendix B). In this final SEIS, we summarize what we have learned regarding sea otter translocation and evaluate the biological and socioeconomic effects of several alternatives, including the program's termination.

Comments expressed during the scoping process and received during the comment periods on the 2005 draft SEIS and 2011 revised draft SEIS indicate that there are widely divergent views on whether sea otters should be allowed to recolonize their historic range. The translocation plan attempted to balance multiple needs while implementing a recovery action for sea otters. Our experience with the translocation program over the more than two decades since its implementation has differed significantly from what we anticipated under the 1987 plan, and it has prompted our reevaluation of the program and consideration of alternatives to it, including termination. Success or failure of our next course of action will depend on our ability to effect change in the context of sea otters' natural behaviors.

Chapter 1. Purpose and Need

1.1 Purpose for Action

The purpose of this SEIS is to assess options for the future of the southern sea otter translocation program that will ultimately result in recovery of the species under the ESA and attainment of the southern sea otter's Optimum Sustainable Population level (OSP) under the MMPA. These options include revisions to the program and termination of it. Our assessment includes a reevaluation of the expected impacts at San Nicolas Island that were described in our 1987 environmental impact statement, based on current information obtained since the plan's inception. It also includes an evaluation of impacts of alternatives for the future of the translocation program.

1.2 Need for Action

The need for action stems specifically from our inability to meet the goals of the southern sea otter translocation program initiated in 1987. The purpose of the translocation program was to establish a colony of sea otters at a location outside the parent range that would enhance recovery of the species. A secondary purpose was to acquire information on transportation and containment techniques, population dynamics, ecological relationships, and effects on the donor population. We have gained valuable new information as a result of the translocation program, but contrary to the primary recovery objective of the program, the translocation of sea otters to San Nicolas Island has not resulted in the establishment of a viable, independent colony of sea otters sufficiently removed from the parent population to serve as a safeguard for the population as a whole in the event of a natural or human-caused event, such as an oil spill. In our draft translocation program evaluation (Appendix C) we determine that the translocation program has failed to fulfill its primary purpose as a recovery action and that our recovery and management goals for the species cannot be met by continuing the program.

Since completion of the final environmental impact statement and the signing of the record of decision for the translocation of southern sea otters in 1987, changed circumstances and new information have come to light. The translocation of sea otters to San Nicolas Island has been much less successful than expected; large groups of sea otters are periodically moving into the designated management zone; capturing and moving sea otters out of the management zone (containment) has proven to be more difficult than anticipated; we determined in a biological opinion issued in July 2000 (Appendix B) that containment of sea otters would likely jeopardize the species' continued existence; and the southern sea otter recovery team recommended against additional translocations of sea otters and called instead for a fundamentally different strategy for recovery of the species. This change in strategy is reflected in our Final Revised Recovery Plan for the Southern Sea Otter (USFWS 2003). The 2003 recovery plan revision recommends allowing southern sea otters to expand naturally in number and distribution to levels that will secure the persistence of the species in the event of a major oil spill or series of smaller spills.

Several overarching needs also help to define the alternatives considered here. These include the need under the ESA to ensure that our actions are not likely to jeopardize the continued existence of the southern sea otter and, additionally, to meet our mandate to bring the southern sea otter to recovery; the need to implement recovery actions as specified in the southern sea otter recovery plan (USFWS 2003); the need to comply with Public Law 99-625; and the need to bring the southern sea otter population to its OSP under the MMPA.

Chapter 2. Background

2.1 History of the Translocation Program

On January 14, 1977, we, USFWS, listed the southern sea otter as a threatened species under the ESA (16 U.S.C 1531 *et seq.*) on the basis of its small population size, its greatly reduced range, and the potential risk of oil spills (42 FR 2968). We established a recovery team for the species in 1980[3], and we approved a recovery plan for the species on February 3, 1982 (USFWS 1982). In the recovery plan, we identified the translocation of southern sea otters as an effective and reasonable recovery action, acknowledging that a translocated southern sea otter population could affect shellfish fisheries that had developed in areas formerly occupied by southern sea otters. The objectives of southern sea otter translocation, as stated in the 1982 recovery plan, included: (1) establishing a second colony (or colonies) sufficiently distant from the parent population such that a smaller portion of the southern sea otter population would be jeopardized in the event of a large-scale oil spill; and (2) establishing a database for identifying the optimal sustainable population level for the southern sea otter. We anticipated that translocation would ultimately result in a larger population size and a more continuous distribution of animals throughout the southern sea otter's historic range.

Section 10(j) of the ESA specifically authorizes translocation of a listed species to establish experimental populations. However, the southern sea otter is protected under both the ESA and the MMPA, and at the time the MMPA did not contain similar translocation provisions. This inconsistency was resolved in the case of the southern sea otter by the passage of P.L. 99-625 (Fish and Wildlife Programs: Improvement; Section 1. Translocation of California Sea Otters) on November 7, 1986, which specifically authorized development of a translocation plan for southern sea otters, to be administered in cooperation with the affected State.

The Congressional Record for P.L. 99-625 provides insight into the purpose of this legislation (H.R.4531). Authorization for the translocation of southern sea otters was clearly prompted by a desire to protect the species and to promote its recovery. However, Congress also recognized the potential for conflict between a translocated sea otter population and fisheries and other resource uses. To address this concern, Congress included in P.L. 99-625 a requirement that any southern sea otter translocation plan authorized under this legislation must include the designation of a management zone that would surround the translocation zone. Sea otters entering the management zone were to be captured using non-lethal means and moved outside the management zone.

If the Secretary of the Interior chose to develop a translocation plan under P.L. 99-625, the plan was to include: (1) the number, age, and sex of southern sea otters proposed to be relocated; (2) the manner in which southern sea otters were to be captured, translocated, released, monitored, and protected; (3) specification of a zone into which the experimental population would be introduced (translocation zone); (4) specification of a zone surrounding the translocation zone

---

[3] In 2004, the recovery team and its associated technical consultants group were disbanded and a Recovery Implementation Team (composed of scientists, managers, representatives of non-governmental organizations, and stakeholders) convened to implement recovery actions listed in the revised recovery plan. The Recovery Implementation Team was disbanded in 2008.

that did not include range of the parent population or adjacent range necessary for the recovery of the species (management zone); (5) measures, including an adequate funding mechanism, to isolate and contain the experimental population; and (6) a description of the relationship of the implementation of the plan to the status of the species under the ESA and determinations under Section 7 of the ESA. The purposes of the management zone were to: (1) facilitate the management of southern sea otters and the containment of the experimental population within the translocation zone; and (2) prevent, to the maximum extent feasible, conflicts between the experimental population and shellfish fisheries within the management zone. Any sea otter found within the management zone was to be treated as a member of the experimental population. We were required to use all feasible non-lethal means to capture sea otters in the management zone and to return them to the translocation zone or the range of the parent population.

In May 1987, we published a final environmental impact statement that analyzed the impacts of establishing a program to translocate southern sea otters from their then-current range along the central coast of California to the northern coast of California, southern coast of Oregon, or San Nicolas Island off the coast of southern California. We identified translocation to San Nicolas Island as our preferred alternative. A detailed translocation plan meeting the requirements of P.L. 99-625 was included as an appendix to our 1987 environmental impact statement. Also in August of 1987, we published implementing regulations for the translocation program (52 FR 29754; 50 CFR 17.84(d)). These regulations define the translocation and management zones, provide the framework for the program, and include a set of criteria for determining if the translocation should be considered a failure.

Groups of southern sea otters were moved from the coast of central California to San Nicolas Island starting on August 24, 1987. In December 1987, in coordination with CDFG, we began capturing and moving sea otters that entered the designated management zone.

Between August 1987 and March 1990, we released 140 southern sea otters at San Nicolas Island. Because of unexpected mortalities and high emigration encountered during the first year, we amended our regulations for the translocation program in 1988 (53 FR 37577; September 27, 1988). The amendments were intended to minimize sea otter stress, to improve the survival of translocated animals, and to minimize dispersal of sea otters from the translocation zone. Specifically, we provided more flexibility in selecting the ages of sea otters for translocation, eliminated the restriction to capture sea otters only within an August to mid-October time frame, eliminated the requirement to move a specified number of southern sea otters previously implanted with transmitters, provided the flexibility either to transport sea otters immediately or to hold them on the mainland before releasing them at San Nicolas Island, and eliminated the requirement to translocate a minimum of 20 sea otters at a time. Based on data collected during the first year of translocation, we believed that younger sea otters were more likely to remain at San Nicolas Island (Rathbun *et al.* 1990). The second year of the translocation effort focused on the translocation of younger sea otters. These animals were transported in smaller groups (one to four animals) to minimize the time they were held in captivity. Once at the island, they were immediately released from shore in the vicinity of other sea otters. By the end of the second year, a total of 126 sea otters had been moved to San Nicolas Island, but only 17 were observed at the island (USFWS 1989, USFWS 1990). Even with modifications to the program in place, emigration from the island by newly translocated animals continued to be high. As of March 1991, approximately 14 independent (non-pup) sea otters (10 percent) were thought to remain at the island. Some sea otters died as a result of translocation; many swam back to the parent population; and some moved into the management zone. The fate of half of the sea otters taken to San Nicolas Island was never determined. In 1991, we stopped translocating sea otters to San Nicolas Island due to high rates of dispersal and poor survival. However, we continued monitoring the sea otters remaining in the translocation zone.

From December 1987 to February 1993, 24 sea otters were captured and removed from the management zone and returned to the parent range. Eleven of these animals had been translocated to San Nicolas Island, four were offspring of sea otters translocated to San Nicolas Island, and at least three swam into the management zone from the parent range. The origins of the remaining six animals were uncertain; they had either moved down from the parent range or were offspring of sea otters translocated to San Nicolas Island. Two of the sea otters captured and removed from the management zone returned to it after traveling hundreds of kilometers, only to be recaptured and moved again.

In February 1993, two sea otters that had been recently captured in the management zone were found dead shortly after their release in the range of the parent population. In total, four southern sea otters were known or suspected to have died within two weeks of being moved from the management zone. We were concerned that sea otters were dying as a result of our containment efforts; therefore, in 1993 we suspended all sea otter capture activities in the management zone to evaluate sea otter capture and transport methods. We recognized that available capture techniques, which proved to be less effective and more labor-intensive than originally predicted, were not an efficient means of containing southern sea otters. From 1993 to 1997, few sea otters were reported in the management zone, and there appeared to be no immediate need to address sea otter containment. In 1997, CDFG notified us that it intended to end its southern sea otter research project and would no longer be able to assist if we resumed capturing sea otters in the management zone.

In 1998, a group of approximately 100 southern sea otters moved from the parent range into the northern end of the management zone. At the same time, range-wide counts of the southern sea otter population indicated a decline of approximately 10 percent between 1995 and 1998. In light of the decline in the southern sea otter population, we were concerned about the potential effects on the parent population of moving the large number of southern sea otters that had moved into the management zone. We asked the southern sea otter recovery team, a team of biologists with expertise pertinent to southern sea otter recovery, for their recommendation regarding the capture and removal of sea otters in the management zone. The recovery team recommended that we not move sea otters from the management zone to the parent population because moving large groups of sea otters and releasing them within the parent range would be disruptive to the social structure of the parent population (DeMaster 1998). We agreed with their recommendation.

In order to notify stakeholders of our intended course of action, we held two public meetings in August 1998. At these meetings, we provided information on the status of the translocation program, solicited general comments and recommendations, and announced that we intended to reinitiate consultation under Section 7 of the ESA for the southern sea otter containment program and to begin the process of evaluating the failure criteria established for the translocation program.

We distributed a draft Section 7 consultation on the southern sea otter containment program to interested parties for comment on March 19, 1999, and issued a final biological opinion on July 19, 2000. Our reinitiation of consultation was prompted by the receipt of substantial new information on the population status, behavior, and ecology of the southern sea otter that revealed adverse effects of containment that were not previously considered. In the biological opinion, we cited the following information and circumstances as prompting reinitiation: (1) in 1998 and 1999, southern sea otters moved into the management zone in much greater numbers than in previous years; (2) analysis of carcasses indicated that southern sea otters were being exposed to environmental contaminants and diseases that could be affecting the health of the mainland population throughout California; (3) range-wide counts of southern sea otters indicated that numbers were declining; (4) recent information, in particular the observed effects of the Exxon Valdez oil spill, indicated that southern sea otters at San Nicolas Island would not be isolated from the potential effects of a single large oil spill; and (5) the capture and release of large groups of southern sea otters could result in substantial adverse effects on the parent population. The biological opinion concluded with our assessment that continuation of the containment program would likely jeopardize the continued existence of the species on the grounds that: (1) reversal of the southern sea otter's population decline was essential to the survival and recovery of the species, whereas continuation of containment could cause the direct deaths of individuals and disrupt social behavior in the parent range, thereby exacerbating population declines; and (2) expansion of the southern sea otter's distribution was essential to the survival and recovery of the species, whereas continuation of the containment program would artificially restrict the range to the area north of Point Conception, thereby increasing the vulnerability of the species to oil spills, disease, and stochastic events.

On January 22, 2001, we issued a policy statement regarding the capture and removal of southern sea otters in the designated management zone (66 FR 6649). Based on our July 2000 biological opinion, we determined that the containment of southern sea otters was not consistent with the requirement of the ESA to avoid jeopardy to the species. The notice advised the public that we would not capture and remove southern sea otters from the management zone pending completion of our reevaluation of the southern sea otter translocation program, which would include the preparation of a supplement to our 1987 Environmental Impact Statement and the release of a final evaluation of the translocation program that contained an analysis of failure criteria.

2.2 Scoping and Issues

On July 27, 2000, we published in the *Federal Register* a notice of intent to prepare an SEIS on the southern sea otter translocation program (65 FR 46172). The notice of intent announced that public scoping meetings would be held on August 15, 2000 in Santa Barbara, California and on August 17, 2000 in Monterey, California. On July 27, 2000, we distributed a press release that identified the scoping meeting dates, times, and locations to wire services at *Associated Press* (San Francisco) and *Bay City News*, reporters in coastal counties of California, local radio and television stations, and other interested parties. We posted formal notices of the meetings in the

Santa Barbara News Press, *The Independent* (Santa Barbara), *The Coast Weekly* (Monterey) and the *Monterey Herald*.

The purpose of the scoping meetings was to solicit information to be used to define the overall scope of the SEIS, to identify significant issues to be addressed, and to identify alternatives to be considered. We provided a brief presentation on the National Environmental Policy Act process and information related to the southern sea otter translocation program at each session, reserving the remainder of the time for public statements. We also solicited written comments and requested that these be sent to us by electronic or regular mail by September 30, 2000. A total of 61 individuals attended scoping sessions held in Santa Barbara, and 43 individuals attended scoping sessions in Monterey.

We met with the technical consultants to the southern sea otter recovery team to discuss scoping of the SEIS on September 26, 2000. We reviewed comments received during the scoping meetings and solicited additional information from the group. In April 2001, we published a scoping report and distributed it to scoping meeting participants and other interested parties (Appendix E).

Copies of all written comments received during the scoping period are available upon request to USFWS. Generally, issues and concerns fell into four primary categories: (1) economic impacts to fisheries and tourism, (2) impacts to the nearshore marine ecosystem, (3) impacts to the southern sea otter population, and (4) impacts to other agency activities. All of these areas are evaluated further in this SEIS.

Worldwide temperature change, water quality, oil spill risk and mitigation measures, and impacts to wetlands were also identified during scoping. Although we agree that these are important areas of concern, we do not analyze them further in this SEIS because they are beyond the scope of the document or our ability to effect change.

2.3 Information Received during the Comment Period on the 2005 Draft SEIS

We announced the availability of the draft SEIS and the beginning of the public comment period on October 7, 2005 (70 FR 58737). The comment period was originally scheduled to end on January 5, 2006 (70 FR 58737). On December 30, 2005, we announced the extension of the comment period to March 6, 2006 (70 FR 77380) based on requests for a 30-day or 60-day extension of the comment period by fishing and environmental groups. We accepted oral and written testimony during public hearings held in Santa Barbara, California, on November 1, 2005, and Monterey, California, on November 3, 2005. During the 5-month comment period, we received approximately 20,000 comments from interested individuals and organizations. A list of commenters, a summary of comments received, and our responses to those comments are given in Appendix G to the revised draft SEIS.

2.4 Information Received during the Comment Period on the 2011 Revised Draft SEIS

We announced the availability of the revised draft SEIS and a proposed rule to implement the preferred alternative on August 26, 2011 (76 FR 53381). The comment period was originally scheduled to end on October 24, 2011 (76 FR 53381). On November 4, 2011, we announced a reopening of the comment period until November 21, 2011 (76 FR 68393), based on a request for a 45-day extension by the California Sea Urchin Commission. Court settlement deadlines prevented us from granting the full 45-day extension; however, the reopened comment period allowed us to accept public comments for 18 additional days. We accepted oral and written testimony during public hearings held in Ventura, California on September 27, 2011, Santa Barbara, California, on October 4, 2011, and Santa Cruz, California, on October 6, 2011. Approximately 190 people attended the public hearings, and 68 provided testimony. During the 78-day comment period, we received 6,843 comment letters, postcards, and emails from interested individuals and organizations. Among the comment letters were 5 petitions with 12,514 signatories. Appendix G to the final SEIS includes a list of commenters and summaries of comments received on the revised draft SEIS, as well as our responses to these comments.

Our assessment of impacts in this final SEIS has been revised based on substantive information submitted. Where we did not make changes in response to a substantive comment, we explain our reasoning in our response. Electronic copies of all comments submitted during the comment period may be obtained from the Ventura Fish and Wildlife Office, 2493 Portola Road, Suite B, Ventura, California 93003.

2.5 Consistency Determination

On June 14, 2012, by a unanimous vote, the California Coastal Commission concurred with the consistency determination that the Service submitted for the termination of the southern sea otter translocation program. The Commission found the project to be consistent to the maximum extent practicable with the California Coastal Management Program.

Chapter 3. Alternatives Including the Preferred Alternative

3.1 Introduction

The final environmental impact statement on the translocation of southern sea otters (USFWS 1987) considered six alternatives: 1) translocation of southern sea otters to San Nicolas Island, California; 2) translocation to northern California; 3) translocation to southern Oregon; 4) translocation in conjunction with restriction and management of sea otters between Point Sal and Point Conception, California; 5) increased protection of the sea otter population to reduce the threat of oil spills; and 6) no action. We designated Alternative 1, the translocation of southern sea otters to San Nicolas Island, as the preferred alternative in the draft and final versions of the environmental impact statement and subsequently selected it as the best alternative for implementation in the record of decision (52 FR 29784). We began implementing the translocation program in August 1987, when the first sea otters were captured for translocation.

In this SEIS, we do not consider alternative sites for translocation but instead evaluate options for the future of the existing translocation program. We address the following alternatives in this SEIS:

- **No Action Alternative**: Maintain the status quo
- **Alternative 1**: Resume implementation of the 1987 southern sea otter translocation plan
- **Alternative 2**: Implement a modified southern sea otter translocation program with a smaller management zone
- **Alternative 3A**: Terminate the southern sea otter translocation program based on a failure determination pursuant to 50 CFR §17.84(d) ***and*** remove all sea otters residing within the translocation and management zones at the time the decision to terminate is made
- **Alternative 3B**: Terminate the southern sea otter translocation program based on a failure determination pursuant to 50 CFR §17.84(d) ***and*** remove only sea otters residing within the translocation zone at the time the decision to terminate is made;
- **Alternative 3C (Preferred Alternative)**: Terminate the southern sea otter translocation program based on a failure determination pursuant to 50 CFR §17.84(d) ***and*** do not remove sea otters residing within the translocation or management zones at the time the decision to terminate is made.

Several alternatives were proposed during scoping but are not evaluated in this SEIS because they do not meet our purpose and need for action. They include the following: place a moratorium on shellfisheries; establish no-take zones for fisheries; develop educational programs to encourage people to use alternative food sources and reduce seafood consumption; petition the U.S. Navy/DOD to include San Nicolas Island within the Channel Islands National Park (CINP); establish a captive breeding program and reintroduce sea otters to other sites in California and Mexico; and move sea otters north or translocate sea otters to a location closer to the parent population. One modification to Alternative 2 was proposed during the comment period on the 2005 draft SEIS: to expand the modified management zone to include San Miguel Island and

Santa Rosa Island. At the end of this chapter, we explain why we do not perform a detailed analysis of these alternatives.

3.2 Description and Comparison of Alternatives

The alternatives described in this section are presented in a detailed table included at the end of this chapter, Table 3-1, which gives a summary of actions by alternative. The discussion that follows is intended to give a general sense of the relationship of the alternatives with each other. For a detailed analysis of effects, see Chapter 6, "Environmental Consequences."

3.2.1 Baseline (Status Quo)—The No Action Alternative

The baseline reflects the translocation program as it exists today. Currently, maintenance of the management zone is suspended (66 FR 6649), and we are not moving sea otters to San Nicolas Island.

We discontinued maintenance of the management zone in 1993, in part because of concerns that containment was resulting in the deaths of moved animals. For several years, few sea otters moved into the management zone, and containment was not an issue. However, the seasonal movement of large numbers of sea otters into and out of the management zone beginning in 1998 prompted us to reinitiate consultation under Section 7 of the ESA on the containment portion of the translocation program. Our subsequent evaluation of sea otter containment pursuant to Section 7 of the ESA found that continuing containment would likely jeopardize the continued existence of the species (Appendix B). We have determined that we will not remove sea otters from the designated management zone pending reevaluation of the translocation program, including completion of this SEIS (66 FR 6649).

Under the No Action Alternative, the translocation program would continue to exist as currently implemented (*i.e.*, we would take no action to supplement the colony at San Nicolas Island or to resume maintenance of the management zone). Public Law 99-625 provides statutory exemptions from prohibitions against the incidental take of sea otters in the management zone (in the case of otherwise lawful activities) or translocation zone (in the case of defense-related activities). These exemptions would continue to exist.

3.2.2 Alternative 1—Resume Implementation of 1987 Translocation Plan

Alternative 1 would entail resuming implementation of the southern sea otter translocation program as originally designed. The final rule for the establishment of an experimental population of southern sea otters (52 FR 29754) and corresponding regulations (50 CFR §17.84(d)) include a detailed description of the southern sea otter translocation plan. The translocation plan describes the establishment of a population at San Nicolas Island in terms of four stages: a transplant stage, an initial growth and reestablishment stage, a post-establishment and growth stage, and a final stage, the point at which the translocated sea otter population would reach carrying capacity (an ecological state in which the numbers of sea otters remain relatively constant and in balance with the available food supply).

Movement of the first groups of sea otters from central California to San Nicolas Island in 1987 marked the initiation of the southern sea otter translocation program. Although we never

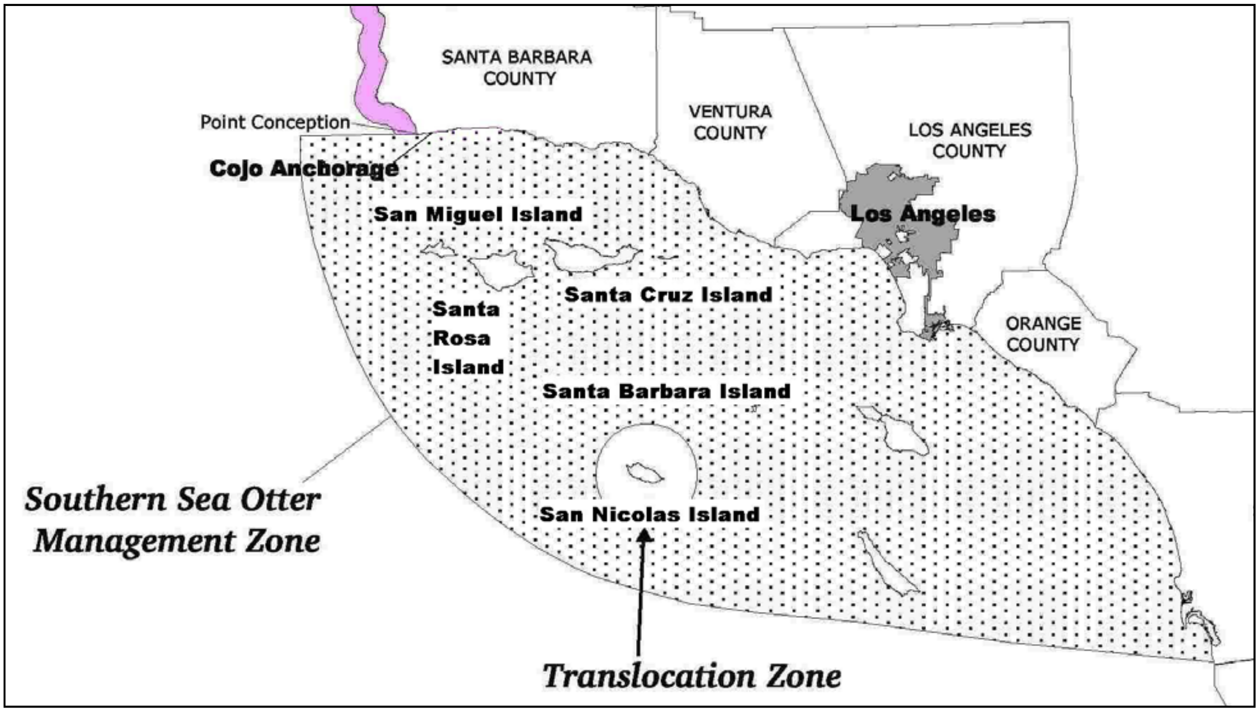

Figure 3-1 Management zone (Alternative 1)

completed the transplant phase because the colony never attained the requisite core population size of 70 sea otters (due to high rates of dispersal), we discontinued efforts to move sea otters to San Nicolas Island in 1991, effectively ending the transplant phase at that time. The colony is currently in the growth and reestablishment stage as defined in the plan. While monitoring of the experimental colony at San Nicolas Island and research on related ecosystem changes on the island have continued to the present as envisioned under the 1987 plan (with the exception that far fewer sea otters than expected are present at the island to cause such changes), full implementation of the southern sea otter translocation program would also require containing the colony within the translocation zone and maintaining the designated management zone from Point Conception to the Mexican border (Figure 3-1) free of sea otters. Given the small founding size of the colony and the fact that renewed maintenance of the management zone would preclude the possibility of genetic exchange with the parent population in perpetuity, we would likely need to consider additional translocations of sea otters to ensure adequate genetic diversity within the island colony.

Selection of Alternative 1 would require that we resume capturing and removing sea otters found in the management zone. Containment would be accomplished by methods similar to those utilized until the suspension of capture efforts in 1993. Funding for containment efforts would be drawn from existing funds as budgeted by Congress or other funding mechanisms as could be developed, such as state or private funding.

The management zone includes about 96 percent of the nearshore area of the Southern California Bight. Before this alternative could be implemented, we would need to reinitiate consultation under Section 7 of the ESA to assess the effects of containment on southern sea otters. For a summary of specific actions to be taken under this alternative, see Table 3-1.

3.2.3 Alternative 2—Implement Modified Translocation Program with Smaller Management Zone

Alternative 2 is similar to Alternative 1, but with an important difference. Under Alternative 2, the southern sea otter translocation plan would be implemented as originally written, but the designated management zone would be reduced in size.

The management zone would be reduced in size from its current designation, which extends from Point Conception to the Mexican border but excludes San Nicolas Island. The modified management zone would include the coastline from the city of Santa Barbara south to the Mexican border and include all islands except San Miguel, Santa Rosa and San Nicolas (Figure 3-2).

The new designation would reflect recognized biogeographic boundaries and allow for limited sea otter range expansion. The reduction in size of the management zone would provide additional habitat for the recovery of the species (relative to Alternative 1) while retaining a modified management zone to minimize conflicts with existing fisheries. The modified management zone includes about 78 percent of the nearshore area of the Southern California Bight. Sea otter containment would resume in the newly designated management zone and would be accomplished by methods similar to those utilized until the suspension of capture efforts in 1993. Funding for containment efforts would be drawn from existing funds as budgeted by Congress or other funding mechanisms as could be developed, such as state or private funding.

USFWS would not need congressional approval to reconfigure the zone, as the management zone is defined by regulation and could be modified through the promulgation of new

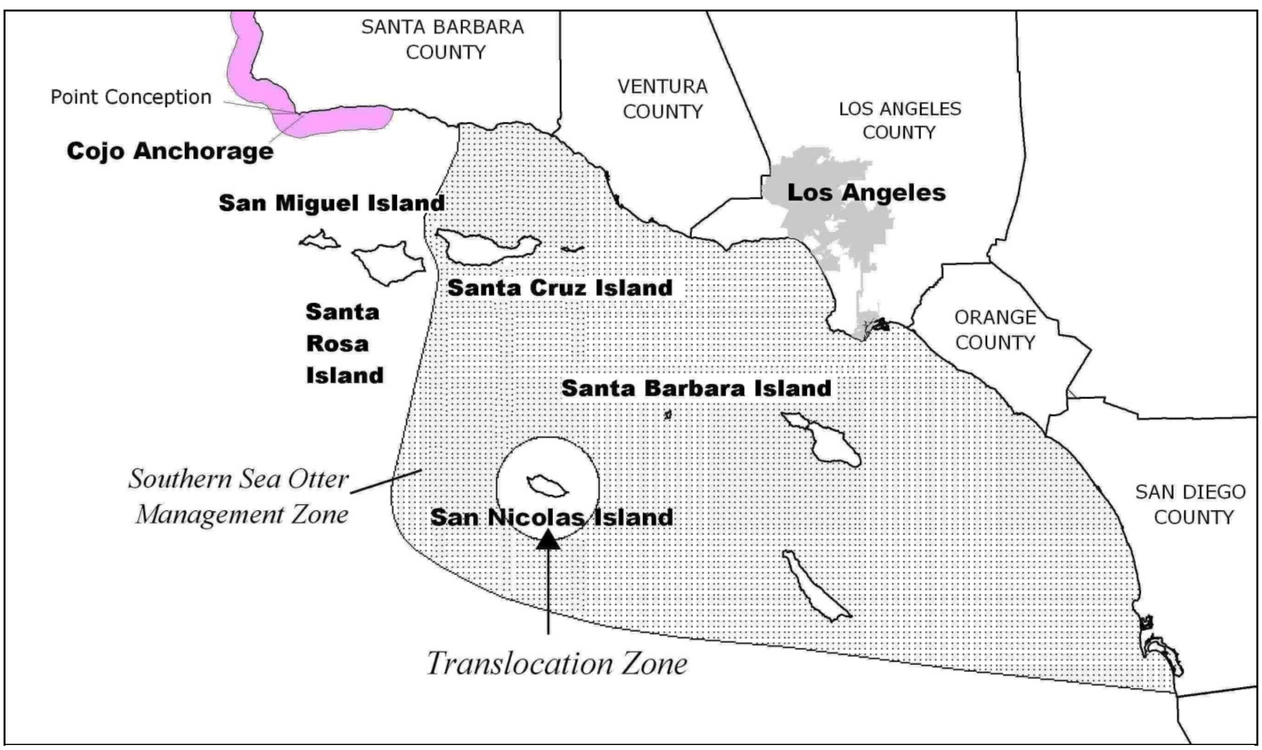

Figure 3-2 Modified management zone (Alternative 2)

regulations. However, Alternative 2 would require a proposed rulemaking to change the existing regulations at 50 CFR 17.84(d) in order to re-delineate the boundaries of the management zone. Before this alternative could be implemented, we would need to reinitiate consultation under Section 7 of the ESA to assess the effects of containment on southern sea otters. For a summary of specific actions to be taken under this alternative, see Table 3-1.

3.2.4 Alternatives 3A-3C—Terminate Translocation Program

Specific failure criteria are defined in the southern sea otter translocation plan and may be found at 50 CFR §17.84(d)(8). Alternatives 3A-3C require finalization of the draft evaluation of the translocation program (addressing established failure criteria) in consultation with CDFG and the Marine Mammal Commission (MMC) and a rulemaking to delete the regulations at 50 CFR 17.84(d). A draft evaluation, in which we concluded that the translocation program has failed, was included as Appendix C to the 2005 draft SEIS. We sought comments on the draft program evaluation as well as on the draft SEIS. CDFG and the MMC submitted comments expressing support for termination of the program. A revised draft evaluation of the translocation program, which took into account these and other substantive comments, was included as Appendix C to the revised draft SEIS. Concurrent with the release of the revised draft SEIS, we issued a proposed rule to terminate the program and to allow sea otters at San Nicolas Island and in the management zone to remain there upon termination of the program. After additional consultation with CDFG and the MMC, we have now finalized the translocation program evaluation. Our conclusion remains that the program has failed.

If the program were terminated, all southern sea otters, regardless of their physical location, would be treated as members of the same population for the purposes of the ESA and the MMPA. The standard prohibitions and authorizations under the ESA and the MMPA would once again apply, and the special rule governing the translocation plan (50 CFR §17.84(d)) would no longer apply.

To mitigate conflicts with commercial fisheries, we would propose to work cooperatively with CDFG and NMFS (as these agencies deem appropriate and feasible) and affected fishers to explore possible fishery management strategies that would minimize the effects of Alternatives 3A, 3B, or 3C, if selected, on individuals in the affected fisheries.

To mitigate effects of the change in ESA consultation requirements at San Nicolas Island and in the management zone on the U.S. Navy/DOD, we would propose to develop a programmatic Biological Opinion for activities that may affect sea otters there or to seek other potential mutually agreeable solutions. Although future Naval program requirements may change, necessitating multiple consultations over time, programmatic consultations can cover anticipated activities until these requirements change, thereby minimizing the regulatory burden on the Navy associated with ESA compliance with respect to sea otters.

Finally, we recognize our affirmative responsibilities under the ESA and fully support recovery efforts for endangered white and black abalone. To lessen the risk that natural range expansion of sea otters could interfere with recovery efforts for ESA-listed abalone, we are committed to working closely with NMFS to share information that may affect recovery actions for this species. Specifically, we are working with NMFS to convene a working group composed of managers and scientists that have southern sea otter and abalone expertise to benefit the recovery of endangered abalone and sea otters. We are also pursuing a Memorandum of Understanding with NMFS to formalize this and other cooperative efforts to facilitate the recovery of sea otters alongside the recovery of endangered abalone.

3.2.5 Alternative 3A—Terminate Translocation Program; Remove All Sea Otters Residing within the Translocation and Management Zones at the Time the Decision to Terminate is Made

The southern sea otter translocation plan as implemented by the special rule at 50 CFR §17.84(d) specifically outlines actions to be taken should the translocation program be declared a failure (50 CFR §17.84(d)(8)(vi)). Subject to the outcome of a future Section 7 consultation, Alternative 3A would implement these actions as described in the plan and rule. All sea otters within the translocation zone would be captured and all healthy sea otters placed in the range of the parent population. Efforts to maintain the management zone free of sea otters would be temporarily reinitiated and then curtailed after all reasonable efforts were made to remove sea otters residing in the management zone at the time of the decision to terminate the program. A joint consultation between CDFG and USFWS would determine when all reasonable efforts had been made and additional efforts would be futile (50 CFR §17.84(d)(8)(vi)). For a summary of specific actions to be taken under this alternative, see Table 3-1.

3.2.6 Alternative 3B—Terminate Translocation Program; Remove Only Sea Otters Residing within the Translocation Zone at the Time the Decision to Terminate is Made

Under Alternative 3B, subject to the outcome of a future Section 7 consultation, all sea otters remaining within the translocation zone at San Nicolas Island would be captured and all healthy sea otters placed in the range of the parent population. Efforts to maintain the management zone free of sea otters would not be reinitiated. For a summary of specific actions to be taken under this alternative, see Table 3-1.

3.2.7 Alternative 3C (Preferred Alternative)—Terminate Translocation Program; Do Not Remove Sea Otters Residing within the Translocation or Management Zones at the Time the Decision to Terminate is Made

Under Alternative 3C, no sea otters within the translocation zone or management zone would be removed following the decision to declare the translocation program a failure. Efforts to maintain the management zone free of sea otters would not be reinitiated. We have concluded intra-Service Section 7 consultation and determined that Alternative 3C would be “not likely to adversely affect” the southern sea otter. For a summary of specific actions to be taken under this alternative, see Table 3-1.

3.3 Alternatives identified during scoping but not analyzed further in this SEIS

The following alternatives were proposed during the scoping period but will not be considered further in this SEIS because they are beyond the scope of this SEIS or do not meet the purpose and need of the proposed project, which is to evaluate the existing southern sea otter translocation program and proposed modifications to it:

1. *Place a moratorium on shellfisheries.* Placing a moratorium on shellfisheries would not meet the intended purpose of this SEIS. We believe that the intent of this suggested alternative is to address concerns that shellfish fisheries are potentially depleting food resources available for sea otters. We have no evidence that competition with fisheries is limiting growth of the sea otter population at San Nicolas Island or limiting potential range expansion into southern California.

2. *Establish no-take zones for fisheries.* Establishing no-take zones for fisheries would not meet the intended purpose of this SEIS. However, the establishment of Marine Protected Areas (MPAs) throughout California is proceeding independently in compliance with the Marine Life Protection Act of 1999, which directs the State to redesign California's system of MPAs to function as a network. The latest information on the establishment of MPAs in California may be found at http://www.dfg.ca.gov/mlpa/intro.asp.

3. *Develop educational programs to encourage people to use alternative food sources and reduce seafood consumption.* We believe that the intent of this suggested alternative is to address the global issue of marine resource allocation. As such, this alternative is beyond the scope of this SEIS and does not meet the purpose and need for action we have identified. The purpose of this SEIS is to assess options for the future of the southern sea otter translocation program based on new information gained over the more than two decades since its inception, not to address marine resources *per se*.

4. *Petition the U.S. Navy to allow inclusion of San Nicolas Island within the Channel Islands National Park.* We believe that the intent of this suggested alternative is to provide additional protection to the translocated population of southern sea otters. Under the existing translocation program, sea otters within the boundaries of CINP receive less protection than do those found in the translocation zone at San Nicolas Island. This alternative would not result in a significant modification to the translocation program.

5. *Establish a captive breeding program and reintroduce sea otters to other sites in California and Mexico.* We are not considering the reintroduction of sea otters to other sites in California and Mexico. The southern sea otter recovery team recommended that we not consider additional translocations at this time because it is expected that the expansion of sea otters in California will occur more rapidly if the population is allowed to expand of its own accord than it would under a recovery program that includes translocating sea otters (USFWS 2003). This alternative is therefore beyond the scope of this SEIS and does not meet our purpose and need for action.

6. *Move sea otters north or translocate sea otters to a location closer to the parent population.* The purpose of this SEIS is to assess options for the future of the southern sea otter program based on new information gained over the more than two decades since its inception. We are not considering alternate translocation sites. Therefore, this alternative is beyond the scope of this SEIS and does not meet our purpose and need for action.

3.4 Alternative identified during the comment period on the 2005 Draft SEIS but not analyzed further in this SEIS

Modify Alternative 2 so that the management zone includes San Miguel Island and Santa Rosa Island. This modification would address the fact that the translocation program was not intended to limit range expansion of the parent population and would also minimize negative economic impacts on fisheries. We are not considering a modified Alternative 2 as described at this time because it affords little unoccupied habitat into which the mainland population could expand, and thus is not sufficiently different from Alternative 1 to warrant independent analysis.

3.5 Alternative identified during the comment period on the 2011 Revised Draft SEIS but not analyzed further in this SEIS

Modify Alternative 2 into a new Alternative 2B, which would modify the current management zone by excluding from that zone the area from Point Conception to Oxnard along the coast to a distance of three miles offshore.

The potential effects of the proposed Alternative 2B are substantially similar to those of alternatives already analyzed in the document. Therefore, a separate analysis is not necessary. Like Alternative 1, the proposed Alternative 2B would require enforcement of a management zone in perpetuity, prevent any future sea otter range expansion to the Channel Islands, and retain the translocated sea otter colony at San Nicolas Island. Like Alternative 2, the proposed Alternative 2B would allow limited range expansion along the mainland coastline in southern California and retain the translocated sea otter colony at San Nicolas Island. Whereas Alternative 2 truncates this mainland range expansion at Santa Barbara, the proposed Alternative 2B truncates this mainland range expansion slightly further (35 mi or 56 km) east, at Oxnard. The impacts of mainland range expansion to Oxnard are evaluated under the No Action Alternative and Alternatives 3B and 3C. Although the proposed Alternative 2B is not similar to Alternative 3C, in that Alternative 3C terminates the translocation program and allows for unimpeded natural range expansion while allowing sea otters to remain at San Nicolas Island, the effects would be substantially similar to those presented for Alternative 3C within 10 years because sea otters are expected to expand their range only to Carpinteria (lower bound) or Oxnard (upper bound) within this period.

TABLE 3-1 SUMMARY OF ACTIONS BY ALTERNATIVE

	No Action	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C (Preferred Alternative)
Decision on translocation program	None	Resume implementation as described in original plan	Resume implementation with modification	Declare failure		
Translocation zone and associated regulations	Translocation zone exists; no prohibition of incidental take of sea otters for defense-related activities in translocation zone; standard prohibitions and authorizations under ESA and MMPA, including those applicable to incidental take of sea otters, apply to other activities			No translocation zone; standard prohibitions and authorizations under ESA and MMPA, including those applicable to incidental take of sea otters, apply to all activities		
Mgmt. zone and associated regulations	Mgmt. zone exists; standard prohibitions and authorizations under ESA and MMPA apply to all activities, except no prohibition against incidental take of sea otters in mgmt. zone		Modified mgmt. zone exists; standard prohibitions and authorizations under ESA and MMPA apply, except no prohibition against incidental take of sea otters in modified mgmt. zone	No mgmt. zone; standard prohibitions and authorizations under ESA and MMPA, including those applicable to incidental take of sea otters, apply to all activities		
Management of sea otters at SNI	Continue monitoring	Continue monitoring; if needed, supplement colony to ensure genetic diversity		Remove sea otters from SNI (short-term)		Do not remove sea otters from SNI; continue monitoring
Management of sea otters in management zone	None (maintenance remains suspended)	Remove all sea otters in mgmt. zone in perpetuity	Redefine mgmt. zone; remove all sea otters from modified mgmt. zone in perpetuity	Remove sea otters in mgmt. zone at time of decision (short-term)	Do not remove sea otters in mgmt. zone	
Mitigation measures	None	No additional measures proposed		Work with CDFG and/or NMFS to develop strategies to minimize effects on individual fishers		
						Develop programmatic BO with U.S. Navy/DOD for activities that may affect sea otters at SNI or seek other mutually agreeable solutions
Regulatory actions needed to implement	N/A	Intra-Service consultation under Section 7 of ESA for sea otters				No further consultation required because we have determined "not likely to adversely affect" relative to baseline
		Consult with NMFS under Section 7 of ESA for white abalone and black abalone if determine action "may affect" these species				No consultation required because we have determined "no effect" relative to baseline
		No change to regulations at 50 CFR 17.84(d)	Amend regulations at 50 CFR 17.84(d)4 to re-delineate mgmt. zone	Amend regulations at 50 CFR 17.84(d)		

SNI=San Nicolas Island
SCB=Southern California Bight
CDFG=California Department of Fish and Game
BO=biological opinion
ESA=Endangered Species Act
MMPA=Marine Mammal Protection Act
NMFS=National Marine Fisheries Service
mgmt. zone=management zone

Chapter 4. Description of the Affected Environment

4.1 Introduction

Implementation of alternatives identified in Chapter 3 may affect marine ecosystems in the Southern California Bight, human activities that depend on the marine environment, and the southern sea otter population throughout California. Our final environmental impact statement for the translocation of southern sea otters (USFWS 1987) and subsequent record of decision addressed the biological and socioeconomic environment of several translocation sites, including San Nicolas Island. This final SEIS updates information contained in our 1987 EIS, 2005 draft SEIS, and revised draft SEIS and evaluates several alternatives not considered in the original (1987) document. Many key documents are incorporated by reference.

4.2 Physical Environment

The Southern California Bight is formed by a bend in the coastline between Point Conception, California and a point just south of the Mexican border (Figure 4-1). The sharp curve creates a large surface eddy, with the subarctic waters of the California Current flowing southward offshore and the Southern California Countercurrent flowing northward near the shore. Beneath the surface circulation in the Southern California Bight, the California Undercurrent carries

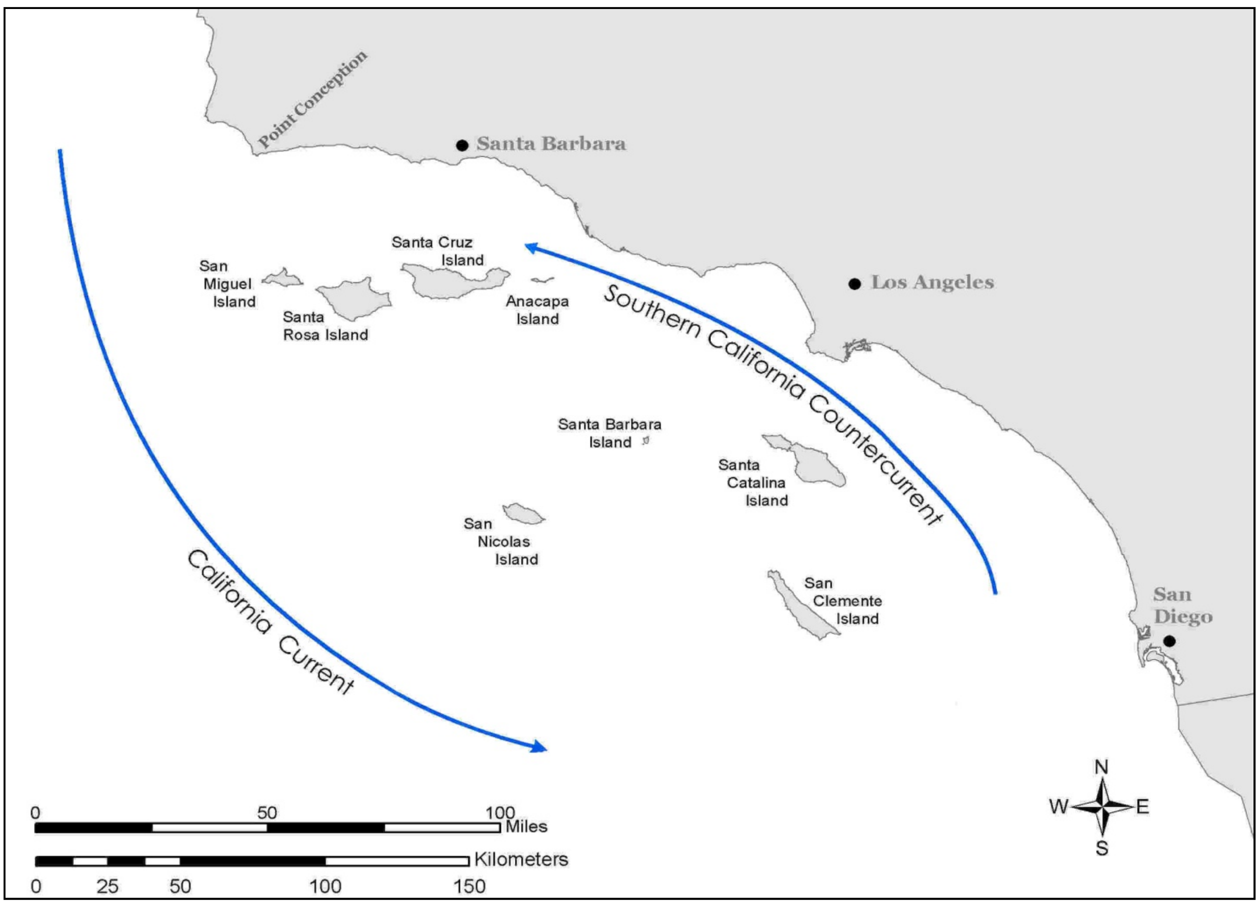

Figure 4-1 Main surface currents of the Southern California Bight

equatorial waters poleward (Hickey 1993). Upwellings of cool, nutrient-rich water occur seasonally, when warmer surface waters are driven offshore by winds (Hickey 1993). The combination of currents in the Southern California Bight produces a rich transition zone, or ecotone, that supports 74 percent (492) of the algal species (Murray and Bray 1993) and 87 percent (481) of the fish species (Horn 1974 in Cross and Allen 1993) known from California. The Southern California Bight also supports more than 5000 bottom-dwelling invertebrate species (Dailey *et al.* 1993a).

The Southern California Bight includes eight islands: San Miguel, Santa Rosa, Santa Cruz, Anacapa, San Nicolas, Santa Barbara, Santa Catalina, and San Clemente. Complex patterns of water mixing generate unique conditions at each of the islands, but they can be divided into three relatively distinct biogeographic zones. Using sea surface temperatures derived from satellite infrared photographs taken from 1982 to 1992, Engle (1994) placed San Miguel and Santa Rosa Islands in the coldest group; Santa Cruz, Anacapa, and San Nicolas Islands in the intermediate group; and Santa Barbara, Santa Catalina, and San Clemente Islands in the warmest group. Analyses of algal (Murray *et al.* 1980) and macroinvertebrate (Seapy and Littler 1980) assemblages at the islands have revealed similar patterns, although both of these authors placed San Nicolas Island in the cold-water group. A detailed description of the oceanographic conditions in the Southern California Bight can be found in Hickey (1993). Further information on the biogeography of the Southern California Bight can be found in Seapy and Littler (1980), Murray *et al*. (1980), and Kanter (1980).

4.3 Biological Environment

4.3.1 OVERVIEW

The waters of the Southern California Bight are inhabited by a rich diversity of organisms. A comprehensive discussion of these is available in Dailey *et al.* (1993b). In this section (4.3) we give a brief overview of shallow water marine communities but give detailed information only for species that may be affected by the alternatives under consideration. Possible effects are primarily indirect, as they stem largely from sea otter natural range expansion and predation, which may cause changes in invertebrate populations and associated changes in interspecific competition or kelp distribution.

4.3.1.1 Shallow Water Marine Communities

The nearshore areas of the Southern California Bight can generally be classified as either rocky or sandy, based on the dominant substrate in an area. The offshore islands are dominated by rocky habitat, whereas the nearshore areas of the mainland are dominated by sandy habitat (Thompson *et al.* 1993). Rocky and sandy habitat types are associated with distinct assemblages, or communities of organisms. Habitats composed of mixed substrate have elements of both of these groups.

A vertical zonation cuts across all substrate types but is most obvious in areas of continuous rocky habitat (Thompson *et al.* 1993). Nearshore depth zones are characterized as either intertidal or subtidal, depending on whether they are exposed to air during low tides or occur below the low-tide line, respectively. Just as different substrate types are associated with different assemblages, intertidal and subtidal zones are associated with characteristic communities of organisms.

Common organisms in rocky intertidal areas include various species of algae (*e.g., Enteromorpha* spp., *Egregia menziesii*, *Eisenia arborea*), surfgrass (*Phyllospadix* spp.), barnacles (*e.g., Chthamalus* spp., *Balanus glandula*, *Tetraclita rubescens*), littorines and limpets (*e.g., Littorina planaxis, Collisella digitalis*), mussels (*e.g., Mytilus californianus*), anemones (*e.g., Anthopleura elegantissima*), snails (*e.g., Nucella emarginata*, *Acanthina spirata*), sea stars (*e.g., Pisaster ochraceous*), and purple sea urchins (*Strongylocentrotus purpuratus*) (Thompson *et al.* 1993). Black abalone (*Haliotis cracherodii*), formerly a spatial dominant in lower rocky intertidal areas, have been devastated by withering syndrome (a disease that causes atrophy of the foot muscle and other symptoms) and are now federally listed as endangered (74 FR 1937).

Rocky subtidal areas provide anchorage for kelp species (Murray and Bray 1993) and habitat for sea urchins (*Strongylocentrotus* spp., *Centrostephanus coronatus*, *Lytechinus anamesus*), sea stars (*e.g., Pisaster giganteus*), crabs (*e.g., Cancer* spp.), spiny lobsters (*Panulirus interruptus*), several species of abalone (*Haliotis* spp.), and octopus (*Octopus* spp.) (Thompson *et al.* 1993, CINMS 2002c). Kelp forest fishes are numerous but include blacksmith (*Chromis punctipinnis*), garibaldi (*Hypsypops rubicunda*), opaleye (*Girella nigricans*), kelp bass (*Paralabrax clathratus*), California sheephead (*Semicossyphus pulcher*), kelp surfperch (*Brachyistius frenatus*), and rockfish (*Sebastes* spp.) (Foster and Schiel 1985, CINMS 2002c).

Species associated with sandy intertidal habitat include amphipod beach hoppers (*Orchestoidea* spp.), isopods (*e.g., Excirolana chiltoni*), beetles (*Thinopinus pictus*), polychaetes (marine annelid worms, *e.g., Nephtys californica*), sand crabs (*Emerita analoga*, *Lepidopa californica*), clams (*e.g., Donax gouldi, Tivela stultorum*), snails (*e.g., Olivella biplicata*), and nemerteans (ribbon worms) (Thompson *et al.* 1993). Amphipods (*e.g., Paraphoxus* spp.), polychaetes, sea stars (*Astropecten* spp., *Pisaster* spp.), sand dollars (*Dendraster excentricus*), sea pens (*e.g., Stylatula elongata*), snails (*e.g., Nassarius fossatus*, *Polinices altus*), and a variety of crabs occur in sandy subtidal areas (Thompson *et al.* 1993). A great variety of fishes is found in sandy-bottom habitat, including rays, sand dabs, and turbot (CINMS 2002c).

A review of benthic invertebrates and their general distribution in the Southern California Bight can be found in Thompson *et al.* (1993). Murray and Bray (1993) review benthic macrophytes (macroalgae, seagrasses, and halophytes) of the Southern California Bight. Cross and Allen (1993) provide an overview of fishes in the Southern California Bight.

4.3.1.2 Southern Sea Otter Prey Consumption

Southern sea otters forage in shallow waters, usually in depths of 25 meters (m) (82 feet (ft)) or less, and only rarely in depths exceeding 40 m (131 ft) (Riedman and Estes 1990). More recent work utilizing time depth recorders has provided additional documentation of typical sea otter dive depths in California that are not subject to the potential shallow-water bias associated with shore-based observations (Tinker *et al.* 2006a, Chapter 6). Tinker *et al.* (2006a, Chapter 6) documented that about 50 percent of all foraging dives by both males and females occurred between 4 m (13 ft) and 12 m (39 ft) in depth. Females at the center of the mainland range, near San Simeon, had a mean dive depth of 8.75 m ± 1.81 m (28.71 ft ± 5.94 ft), whereas males had a mean dive depth of 12.40 m ± 4.66 m (40.68 ft ± 15.29 ft) at San Simeon and 14.90 m ± 7.26 m (48.88 ft ± 23.82 ft) at the southern end of the range near Point Conception. Critical foraging habitat (the depth range including 95 percent of recorded foraging dives) was shallowest for females at the center of the range, 2-20 m (7-66 ft), deeper for males at the center of the range, 2-35 m (7-115 ft), and slightly deeper still for males near Point Conception, 2-40 m (7-131 ft).

As a group, sea otters consume a wide variety of prey, but the majority of their diet is composed of sessile macroinvertebrates. A list of potential sea otter prey species known to be present at San Nicolas Island is given in our final environmental impact statement (USFWS 1987), and a list of observed prey items for southern sea otters statewide is given in Riedman and Estes (1990). In newly reoccupied areas in central California, southern sea otters are known to have consumed primarily abalone (*Haliotis* spp.), rock crabs (*Cancer* spp.), and large red sea urchins (*S. franciscanus*) (reviewed in Riedman and Estes 1990). Diversity in prey selection increases as populations of preferred prey items decline (Riedman and Estes 1990; Bodkin and Ballachey 1996; Estes *et al.* 2003b; Tinker *et al.* 2006a, Chapter 5). Prey selection depends also on the individual sea otter (dietary preferences are highly individualized) and on the habitat (Riedman and Estes 1990; Estes *et al.* 2003b; Tinker *et al.* 2006a, Chapter 5). In sandy habitats, for instance, sea otters prey substantially on bivalve mollusks (Riedman and Estes 1990).

Data on prey consumption by southern sea otters in southern California waters are limited. We are aware of no information on the prey composition of southern sea otters before their extirpation from the Southern California Bight. Observations made during the early years of the translocation program at San Nicolas Island (USFWS 1990) and again at San Nicolas Island in 2004 and 2006 (Bentall 2005, Bentall pers. comm. 2007) provide the best available predictor of sea otter prey consumption if they recolonize their former southern California range (Figure 4-2). These observations revealed that sea otter prey consumption changed over time, with an early emphasis on red and purple sea urchins, giant rock scallops, and abalone. Recent foraging observations indicate that sea otters there are now consuming primarily red sea urchins and kelp crabs; to a lesser extent, cancer crabs, snails, and purple sea urchins; and to a much lesser extent, spiny lobsters and abalone (Bentall 2005).

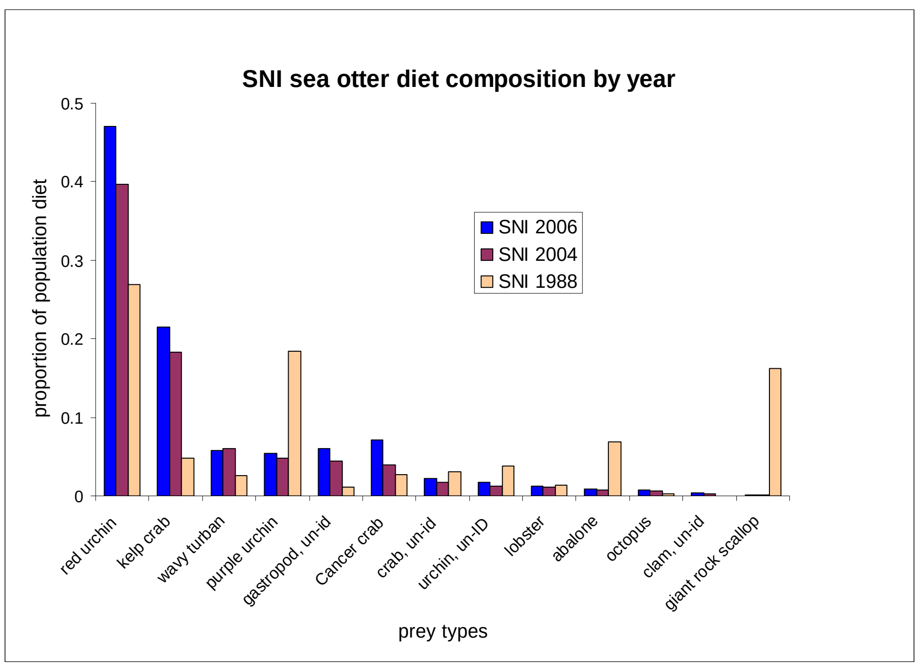

Figure 4-2 Species consumed by sea otters at San Nicolas Island, 1988, 2004, and 2006
Source: Bentall, unpub. data

4.3.2 NEARSHORE MARINE ECOSYSTEM

4.3.2.1 Giant Kelp

Giant kelp (*Macrocystis pyrifera*), in its large sporophyte phase, is a fleshy brown macroalgae that plays a major role in the nearshore marine ecosystems of southern California (Foster and Schiel 1985). Forests of giant kelp are composed of numerous individual kelp plants, each with a well-developed holdfast that serves as an anchor and up to 100 fronds. Fronds consist of a stem-like stipe and multiple leaf-like blades. The blades have gas-filled pneumatocysts at their base, which buoy the fronds to the water's surface (Figure 4-3). Under ideal growing conditions (high nutrient levels and temperatures between 50 and 60 degrees Fahrenheit), giant kelp can elongate up to 0.6 m (2 ft) per day, reaching more than 46 m (150 ft) in length (Bedford 2001). The fronds from multiple plants can combine to form extensive floating surface canopies.

Giant kelp forests support complex communities of organisms (Figure 4-4). Invertebrates, fishes, and many species of birds and marine mammals, both resident and migratory, use kelp forests in a variety of ways: as feeding grounds, nurseries, or cover from predators. Non-resident communities of organisms make use of the kelp detritus that results when pieces detach during storms (Foster and Schiel 1985). Individual kelp plants may shelter hundreds of invertebrate species, with numbers of individuals reaching tens of thousands (Duggins 1988). Giant kelp provides an important food source for many invertebrates (such as sea urchins and abalone) and fishes (such as opaleye and halfmoon (*Medialuna californiensis*)), which may consume live plants or detritus (Foster and Schiel 1985, Bedford 2001).

Giant kelp occurs in relatively shallow areas from 6 to 37 m (20 to 121 ft) deep that are protected from excessive water motion (Bedford 2001) (Figure 4-5). Since the plants require a solid substrate for the attachment of holdfasts, they are usually found only in rocky areas. However, some kelp (considered by some to be a distinct species, *M. angustifolia*) along the coastline of Santa Barbara and Ventura counties has been able to establish on worm tubes in soft sediment and on low-relief rock (Foster and Schiel 1985, Murray and Bray 1993).

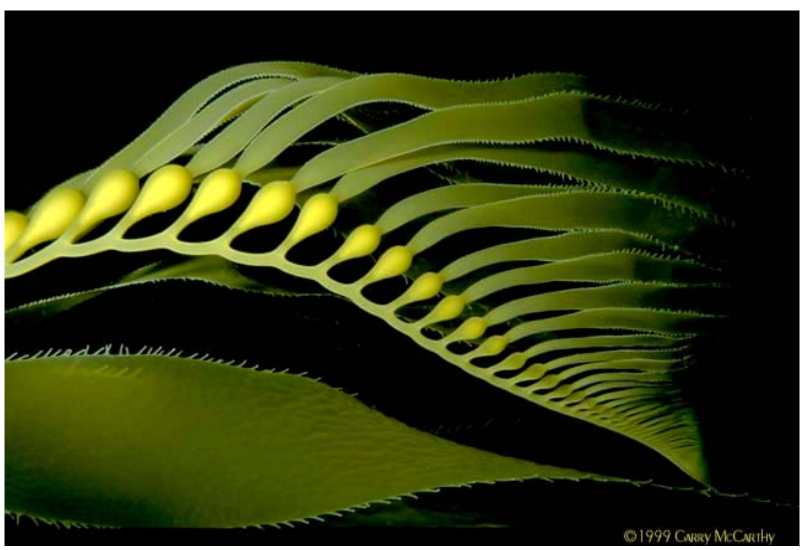

Figure 4-3 Developing pneumatocycsts on kelp frond
Photo © Garry McCarthy. www.underwater-photos.com Used by permission

Even in areas with suitable substrate, the distribution of giant kelp can fluctuate dramatically as a result of wave motion, silting, turbidity and light availability, high temperature/low nutrient conditions, and grazing by herbivores (Foster and Schiel 1985). El Niño events, which bring warm water conditions northward along the coast, can dramatically affect kelp distribution through damage to

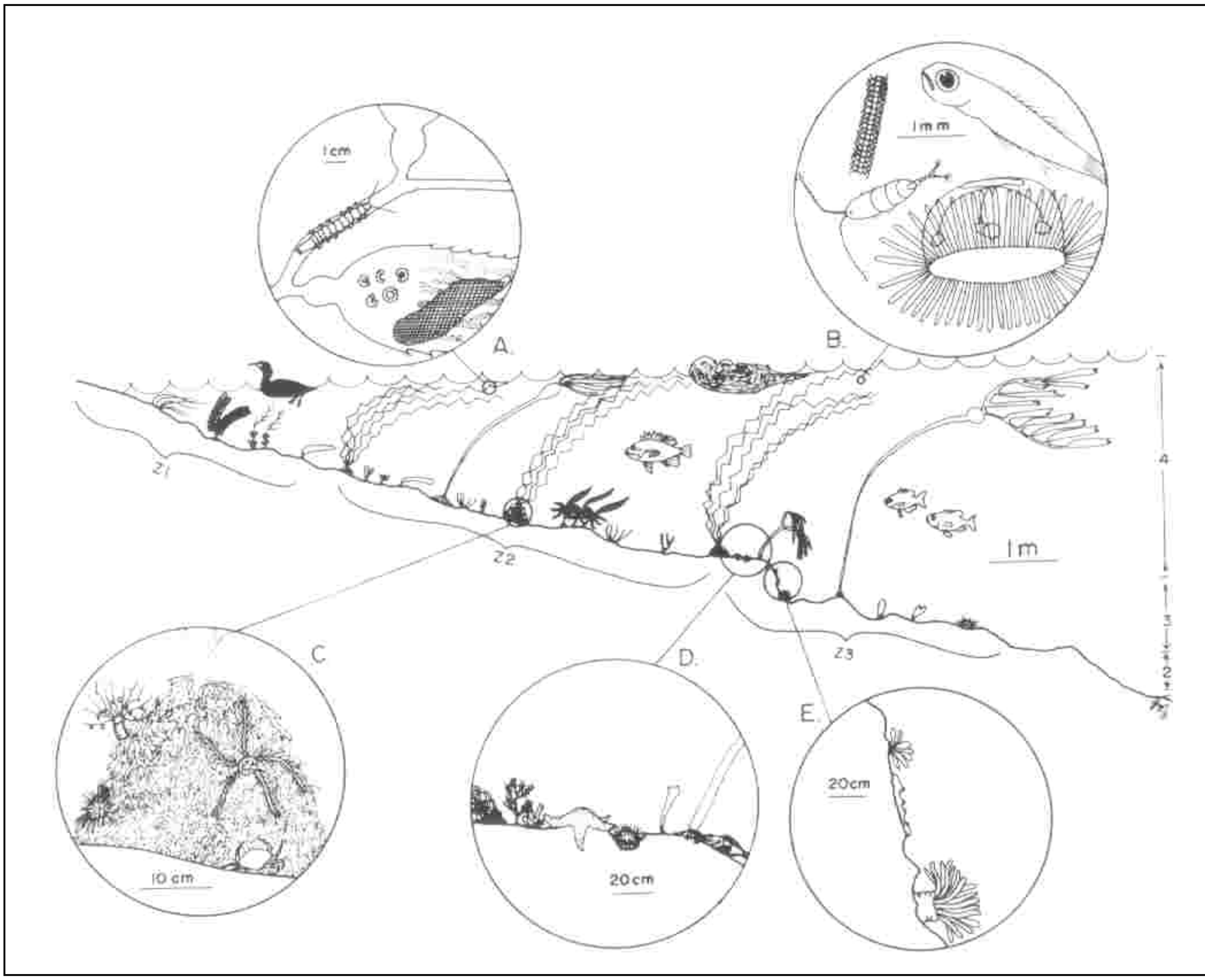

Figure 4-4 Generalized kelp forest community
Adapted from Foster and Schiel (1985)
Z1, Z2, and Z3 represent general zonal associations along a depth gradient (inshore, within, and offshore of the kelp forest, respectively). Circular diagrams represent the following associations:
A: Animals associated with the surface of Macrocystis and other seaweeds
B: Planktonic animals (phytoplankton, zooplankton, larval fish)
C: Animals found in Macrocystis holdfasts (small sea urchins, brittle stars, crustaceans, polychaetes)
D: Animals found typically on horizontal surfaces (sea stars, urchins, benthic fishes, understory algae)
E: Animals found typically on horizontal surfaces (sponges, tunicates, bryozoans, sea anemones)
Some organisms in the diagram do not co-occur at any one site.

Figure 4-5 Giant kelp forest
Photo © Kip F. Evans. Used by permission

plants from the increased wave action associated with storms and through increases in warm, nutrient-poor water (Bedford 2001). Sedimentation, pollution, and disease can also affect the survival of kelp forests (Bedford 2001).

The Kelp Forest Monitoring Program of CINP collects detailed annual data on kelp forests at 33 long-term monitoring sites around Santa Barbara, Anacapa, Santa Cruz, Santa Rosa, and San Miguel Islands. These data are available online at http://science.nature.nps.gov/im/units/medn/reports/index.cfm.

4.3.2.2 Sea Urchins

Sea urchins are marine invertebrates belonging to the phylum Echinodermata.[4] Largely herbivorous, they occupy low-intertidal or subtidal depths and play a key role in southern California kelp communities.

Figure 4-6 Red sea urchin surrounded by purple sea urchins
Photo by Sherry Ballard, © California Academy of Sciences. Used by permission

Sea urchins are characterized by a hard test, or shell, with radiating spines that are used for locomotion, burrowing, or defense (Figure 4-6). Interspersed with the spines are pedicellariae (small pinchers) and tube feet, which are used for respiration, locomotion, and grasping. The mouth, located on the lower surface of the body, is equipped with a complex jaw apparatus called "Aristotle's lantern," which is used for grazing or scraping food and (in purple urchins) for excavating burrows (Durham *et al.* 1980). Urchins may be rare in one area and abundant in another, but overall, red (*Strongylocentrotus franciscanus*) and purple (*S. purpuratus*) urchins are common in the Southern California Bight. White (*Lytechinus anamesus*) urchins are also common in the Southern California Bight, though they have a patchy distribution. The warm-water diadematid urchin *Centrostephanus coronatus* has increased dramatically in abundance in southern California waters since the mid-1980s and by the early 2000s had become common in the southern portions of the Southern California Bight to about mid-Santa Cruz Island (Kushner pers. comm. 2002).

The spawning of sea urchins is variable but generally occurs during winter in southern California, when large numbers of gametes are released into the sea. Success of fertilization is highly dependent on population density (Kalvass and Rogers-Bennett 2001). Fertilized eggs develop into pelagic larvae, which spend an estimated six to eight weeks in a planktonic phase. During this phase, the minute larvae are carried by ocean currents and may disperse long distances from their parent population before settling and metamorphosing into bottom-dwelling juveniles (Kalvass and Rogers-Bennett 2001). Having survived the high-mortality pelagic phase and early settlement period, sea urchins encounter new predators and other dangers but are potentially long-lived. A study using tetracycline tagging and ^{14}carbon analysis has shown that red sea urchins may live for 100 or even 200 years, although in southern California few red sea urchins reach the age of 50 (Ebert and Southon 2003).

Sea urchins are generally viewed as the subtidal grazers having the greatest impact on macrophytes in the Southern California Bight (Murray and Bray 1993). In food-rich conditions, when there is an abundance of drift kelp (in southern California, primarily pieces of *Macrocystis pyrifera* that break off live plants and drift down to the bottom), sea urchins tend to remain

---

[4] Echinoderms (spiny-skinned animals) are characterized by the presence of a water-vascular system and a spiny calcareous endoskeleton. Most of the animals in this phylum exhibit bilateral symmetry as juveniles but develop five-part radial symmetry as they mature. The phylum Echinodermata includes five classes: sea stars, sea cucumbers, brittle stars, and sea urchins (all of which occur intertidally or subtidally) and sea lilies (which occur in deep water) (Abbott and Haderlie 1980a).

stationary. However, when food is scarce, hungry sea urchins may aggregate and go in search of food, feeding on the holdfasts and other parts of live kelp plants, thereby denuding areas of kelp and ultimately replacing them with urchin "barrens" (reviewed in Thompson *et al.* 1993). The ecological relationship between sea urchins and kelp abundance is addressed in greater detail in section 6.2.2.

Sea urchins are limited by predation, disease, and human harvest. Known predators include sea otters, spiny lobsters (*Panulirus interruptus*), sea stars, crabs, and fishes such as sheephead (Kalvass and Rogers-Bennet 2001). Sunflower stars (*Pycnopodia helianthoides*) and spiny lobsters (where not fished to low levels) have been shown to be important predators of sea urchins in the Channel Islands, and in turn predation has been correlated with lower rates of density-dependent bacterial disease in sea urchins (Lafferty and Kushner 2000). Red urchin populations in the Southern California Bight are additionally limited by human harvest, which has significantly reduced densities in many areas of the northern Channel Islands (Kalvass and Rogers-Bennett 2001). Purple urchins have been subject to only limited harvest, and other urchin species in California have not been commercially exploited (Kalvass and Rogers-Bennett 2001). Human harvest of sea urchins is addressed further in section 4.4.2.2.

The distribution of sea urchins in southern California falls roughly along a depth gradient, with purple urchins occurring shallowest (in the low intertidal and upper subtidal zones); red urchins predominating at intermediate depths; and *C. coronatus* occurring in subtidal waters deeper than 10m (Thompson *et al.* 1993). White urchins often occur on sandy or muddy bottoms and at depths of 2 to 300m (Durham *et al.* 1980). No estimate of absolute sea urchin abundance is available for the Southern California Bight, but the Kelp Forest Monitoring Program of CINP gives a year-to-year picture of the relative abundance of these species at 33 sites throughout five of the Channel Islands (San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara). In 2010, 4 of the 33 sites were dominated by purple and red sea urchins; 1 by red sea urchins; 4 by purple sea urchins; 3 by purple sea urchins, red sea urchins, and brittle stars (*Ophiothrix spiculata*); and 1 was an open area with a moderately high density of red sea urchins (Kushner *et al.* 2010). Of the remaining sites, 1 was half purple and red sea urchins and half mature kelp forest; 2 were dominated by brittle stars; 3 were in a state of apparent transition toward kelp forest; and 14 were dominated by kelp.

4.3.2.3 California Spiny Lobsters

California spiny lobsters (*Panulirus interruptus*) (Figure 4-7) are marine invertebrates belonging to the phylum Arthropoda. They are warm-water crustaceans that function as predators and scavengers. California spiny lobsters live in subtidal areas of the Southern California Bight. Unless otherwise noted, the following information is derived from Barsky (2001).

California spiny lobsters have long antennae and, like other crustaceans, a hard exoskeleton. Growth requires regular molting, during which spiny lobsters are particularly vulnerable to predators. Growth rates of California spiny lobsters are variable and depend on size and sex of the lobster as well as on food availability. Larger animals grow more slowly, and sick or injured animals can stop growing entirely until they have recovered. California spiny lobsters generally reach maturity at five or six years of age and may live to age 20 (females) or 30 (males). During mating, which occurs between November and May, the male attaches a sperm packet to the

Figure 4-7 California spiny lobster
Photo by Shane Anderson. Used by permission

underside of the female's carapace, which she uses to fertilize eggs that are attached to the underside of her tail (generally in May and June). Tiny pelagic larvae hatch from the eggs and are carried in ocean currents to distances of 560 km (348 mi) offshore and to depths of more than 120 m (394 ft). After five to nine months, the larvae become juveniles that resemble tiny adults. Assisted by eddies, juveniles swim inshore and settle in shallow vegetated reefs, especially subtidal surfgrass beds (Engle 1979). Mature lobsters move to rocky habitat.

California spiny lobsters play an important role in subtidal ecosystem dynamics. Hiding by day in rocky crevices, usually in groups, these predators and scavengers emerge at night to feed on a variety of marine organisms, including algae, snails, mussels, clams, sea urchins, fish, and injured or vulnerable (newly molted) lobsters. At a marine reserve at Anacapa Island (closed to lobster fishing) lobsters substantially reduced sea urchin densities (Lafferty and Kushner 2000). Predators of California spiny lobsters include octopuses (*Octopus* spp.), several species of large fishes (including sheephead, cabezon (*Scorpaenichthys marmoratus*), kelp bass, rockfishes, and giant sea bass (*Stereolepis gigas*)), California moray eels (*Gymnothorax mordax*), horn sharks (*Heterodontus francisci*), leopard sharks (*Triakis semifasciata*), and sea otters. Commercial fishing and sport fishing represent an additional source of mortality for California spiny lobsters. Human harvest is addressed in section 4.4.2.3

California spiny lobsters occupy rocky areas from the intertidal zone down to below 70m and range from Monterey Bay, California to Mexico. The majority of the population occurs south of Point Conception. Most of the spiny lobster population migrates annually, moving to offshore waters deeper than 15 m (49 ft) beginning in late October and November but returning to shallower, warmer waters less than 9 m (30 ft) in depth, where lobster eggs develop more rapidly, during March, April, and May. The population size of California spiny lobsters is unknown.

4.3.2.4 Sand Crabs

Like California spiny lobsters, sand (or mole) crabs (*Emerita analoga*) are arthropods of the Subphylum Crustacea. Sand crabs can be extremely numerous in sandy intertidal areas of the Southern California Bight and are the foundation for much of the sandy intertidal food web.

Sand crabs are beige or grayish crustaceans with a domed, oval carapace and two pairs of antennae. Reaching about 3.5 centimeters in carapace length, mature females are larger and grow faster than males. Sand crabs are believed to reach sexual maturity at about one year of age and to live for 2-3 years. Breeding occurs mainly from March to November. After hatching from bright orange eggs, the pelagic larvae molt several times and drift widely on ocean currents before coming ashore. Most sand crab larvae arrive on southern California beaches from April to July (Herbinson and Larson 2001).

Sand crabs aggregate in large groups in sandy, wave-exposed areas. They move along the length of the beach with the motion of sand, some also migrating up and down the beach with the tide. While feeding, sand crabs lie buried in sand with only their eyes and first antennae exposed as waves wash over them; as waves retreat they extend their long, feathery second antennae to strain food particles from the backwash. They consume the particles by wiping their antennae through their mouthparts (Herbinson and Larson 2001). Dead sand crabs are an important food for spiny mole crabs (*Blepharipoda occidentalis*) and the beach isopod *Cirolana linguifrons*. Live sand crabs are important prey for shorebirds (including the western snowy plover *Charadrius alexandrinus nivosus*), fishes, swimming crabs (*Portunus xantusii xantusii*), and sea otters. Sand crabs have been used by humans for bait, but the harvest in California has fluctuated significantly, averaging only about 10 kilograms (22 pounds) annually since 1977 (Herbinson and Larson 2001).

Sand crabs occur intertidally along sandy beaches exposed to surf from Alaska to Baja California, Mexico, as well as in Peru and Chile. Isolated populations occur at the tip of the Gulf of California and in Argentina. The southern California population is believed to be extensive, with large congregations occurring near jetties and piers, though its size has not been determined (Herbinson and Larson 2001).

4.3.2.5 Rock and Sheep Crabs

Rock and sheep crabs are marine arthropods of the Subphylum Crustacea. Unless otherwise noted, the following information is derived from Morris *et al.* (1980). Many brachyurans, or “true” crabs, occur in the nearshore waters of southern California, including rock crabs (*Cancer* spp.) and sheep crabs (*Loxorhynchus grandis*) (Figure 4-8). Rock crabs belong to the family Cancridae, whereas sheep crabs are the largest member of the spider crab family, the Majidae. Rock and sheep crabs generally occur in rocky areas, but some occur in sandy areas. Dungeness crabs (*Cancer magister*) are considered rare south of Point Conception (Hankin and Warner 2001) and will not be considered here.

Figure 4-8 Sheep crab
Photo by Shane Anderson. Used by permission

“True” crabs are generally characterized by a short, broad cephalothorax (fused head and thorax) covered by a carapace, although the cephalothorax of species in the spider crab family tends to be longer than wide. Like other crustaceans, crabs must molt to grow, and they are able to regenerate lost limbs in the process. Molting slows as crabs increase in size and age, and some species (such as sheep crabs and other members of the family Majidae) are believed to stop molting entirely upon reaching maturity (Culver and Kuris 2001). Fertilized crab eggs hatch into tiny pelagic larvae, which swim actively and live as part of the plankton. After several molts, the larvae become juveniles that settle to the bottom.

Rock crabs are predators and scavengers, preying on snails, clams, abalone, barnacles, and oysters (Parker 2001). In turn, they serve as food for such fishes as cabezon, barred sand bass

(*Paralabrax nebulifer*), a number of species of rockfish, octopus, sea stars, and sea otters (Parker 2001). Humans are also a significant predator on rock crabs. The commercial rock crab fishery has had localized effects on rock crab size and abundance (Parker 2001).

Sheep crabs consume mollusks and echinoderms (Foster and Schiel 1985). Predators of small sheep crabs are thought to include cabezon, sheephead, octopus, sharks, and rays, with large sheep crabs presumed safe from most predators, but these assumptions have not been confirmed by observations in the wild (Culver and Kuris 2001). Sheep crabs are subject to human-caused mortality as bycatch and as the target of crab fisheries (Culver and Kuris 2001).

Rock crabs inhabit the low intertidal zone to depths of more than 90m and range from Alaska to Baja California, Mexico, with yellow rock crabs (*C. anthonyi*) preferring sandy areas and brown (*C. antennarius*) and red (*C. productus*) rock crabs preferring rocky habitat (Parker 2001). Yellow rock crabs are most abundant off southern California; brown and red rock crabs are more abundant in central and northern California, respectively (Parker 2001). Rock crab stock sizes are unknown (Parker 2001). Sheep crabs occur in waters from 6 to 122 m (20 to 400 ft) deep between Marin County, California and Baja California, Mexico, but their greatest numbers occur off southern California (Culver and Kuris 2001). Large populations occur off Los Angeles and San Diego (Culver and Kuris 2001).

4.3.2.6 Abalone

Abalone are marine invertebrates of the Phylum Mollusca. Unless otherwise noted, the following information is derived from Haaker *et al.* 2001.

Abalone are typically sedentary herbivorous marine snails of the genus *Haliotis* (Morris *et al.* 1980). These gastropods are characterized by the possession of an enlarged, muscular foot and a flattened spiral shell with a row of holes over the mantle cavity that allows for the expulsion of waste materials and water from the gills (Morris *et al.* 1980). Seven species of abalone occur in California: black (*Haliotis cracherodii*), red (*H. rufescens*), pink (*H. corrugata*), green (*H. fulgens*), white (*H. sorenseni*), flat (*H. walallensis*), and pinto (*H. kamtschatkana*. Threaded abalone (*H. assimilis*) were formerly considered to be a distinct species but are now considered to be a southern subspecies of pinto abalone. Flat and pinto abalone are generally restricted to the cooler waters north of Point Conception and will not be considered further here. White abalone were listed as endangered under the Endangered Species Act (ESA) in 2001 (66 FR 29046) due to human over-exploitation. Black abalone were listed as endangered under the ESA in 2009 (74 FR 1937) due primarily to human over-exploitation and disease. Black abalone and white abalone are addressed further under “Candidate, Threatened, and Endangered Species.”

Abalone are relatively long-lived; some may survive for two to four decades. Their growth is variable, but laboratory observations have revealed a general growth rate of approximately 2.5 cm (1 in) per year for the first five years, with growth slowing thereafter. Red abalone (Figure 4-9), the largest species of abalone in the world, have been known to reach a shell length of more than 30 cm (12 in). Other abalone species in southern California generally reach sizes of less than 20 cm (8 in) (Morris *et al*. 1980). Size at sexual maturity is also variable. Red abalone typically reach sexual maturity at about 13 cm (5 in); green at about 9 cm (3.5 in); and black at about 5 cm (2 in).

Abalone are broadcast spawners, with both sexes releasing gametes into seawater at the same time. For reproduction to succeed, adults must be numerous and close enough to each other to compensate for dilution, which can reduce the chances for fertilization. Although abalone can move, low population numbers or physical barriers can prevent aggregation and hence successful reproduction. The settlement of larvae occurs several days to a week after fertilized eggs hatch, and, to be successful, requires that the larvae encounter suitable substrate.

Juvenile abalone feed on the films of bacteria or microscopic plants, whereas adults subsist mainly on live and drift algae, for which they sometimes compete with sea urchins. Sea urchin grazing has been reported to limit abalone distribution. Predators of abalone include octopuses, sea stars, crabs, lobsters, fishes (such as sheephead and cabezon), sea otters, and other species. Human exploitation has significantly affected the five abalone species that have been subject to commercial and recreational harvest in southern California: white, black, green, pink, and red. With the exception of a limited sport fishery for red abalone north of San Francisco County, the California abalone fishery was closed in 1997 after the serial depletion of abalone populations (CDFG 2005c).

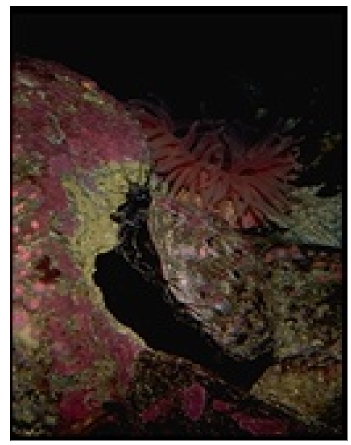

Figure 4-9 Red abalone (pictured with sea anemone) Photo by Gerald and Buff Corsi, © California Academy of Sciences. Used by permission

The distribution of abalone is determined largely by temperature. Of the abalone that occur in the Southern California Bight, black abalone occur shallowest, in the mid to low intertidal zone. Pink, green, and red abalone inhabit progressively deeper areas of rocky intertidal to subtidal habitat (Thompson *et al.* 1993). White abalone occur deepest, in substrata between 18 to 61 m (60 to 200 ft) below the surface (Thompson *et al.* 1993). Red abalone are generally found in the cooler waters of the northwestern Channel Islands and near upwellings along the mainland. Withering syndrome, a disease caused by bacteria, is believed to affect all the species of California abalone to some extent, but its incidence and effects have been most devastating in black abalone. Warmer-than-average water temperatures appear to intensify the spread and symptoms of the disease. All five species of abalone formerly exploited by humans are currently at low levels in the Southern California Bight, and threaded abalone, though never commercially exploited, have always been rare. White, black, and green abalone have nearly been extirpated in southern California waters. Red and pink abalone have been reduced to remnant populations at the Channel Islands.

4.3.2.7 Clams and Mussels

Like abalone, clams and mussels are marine invertebrates of the Phylum Mollusca. Unless otherwise noted, the following information is derived from Morris *et al.* (1980).

Clams and mussels are bilaterally symmetrical mollusks of the class Bivalvia. Numerous species of clams and mussels occur in southern California waters. Sandy or muddy substrates in the low intertidal and subtidal zones are habitat for littleneck (*Prothothaca staminea*), Washington (*Saxidomus nuttallii*), jackknife (*Tagelus californianus*), Pacific gaper (*Tresus nuttallii*) and

Pismo (*Tivela stultorum*) clams, among others. California mussels (*Mytilus californianus*) are some of the most common invertebrates on rocky shores and sometimes occur in mixed beds with Mediterranean mussels (*M. galloprovincialis*, formerly thought to be *M. edulis*) in more protected areas (Richards and Trevelyan 2001) (Figure 4-10). Clams and mussels are generally sedentary, but some species can use their muscular foot to burrow into soft sediment, bore into hard substances, or glide along substrates much like snails. Many bivalves attach to solid substrates by means of byssal threads, organic threads secreted by glands near the base of the foot. Siphons in some bivalves facilitate the circulation of water, which is crucial to respiration and feeding.

Littleneck, Washington, jackknife, Pacific gaper, and Pismo clams have a planktonic larval period, after which they settle to the substrata and lead a relatively sedentary existence. Littleneck clams usually spawn in southern California between March and July and can reach a maximum shell length of 7 to 8 cm (2.8 to 3.1 in) (Reilly 2001). Washington clams spawn between spring and fall and grow to a length of almost 18 cm (7 in) (Moore 2001a). Jackknife clams spawn year round, with an apparent peak in early spring, and reach maturity at a shell length of 6 to 12 cm (2.4 to 4.7 in) (Emmett *et al.* 1991). Gaper clams spawn beginning in spring at two to three years of age and may attain a length of 25 centimeters (Moore 2001b). Pismo clams spawn generally from June to September and grow continuously throughout their lives, reaching a shell length of about 11 cm (4.3 in) in five to nine years (Pattison 2001). California and Mediterranean mussels spawn year round, producing free-swimming larvae that metamorphose and settle onto substrates within a few weeks (Richards and Trevelyan 2001). The growth rate of mussels depends primarily on food availability rather than temperature, and they can reach a shell length of about 5 cm (2 in) in six to eight months (Richards and Trevelyan 2001).

Figure 4-10 Mussels (pictured with gooseneck barnacles)
Photo by Sherry Ballard, © California Academy of Sciences. Used by permission

Clams and mussels feed by filtering organic and inorganic particles from the water by means of an enlarged pair of gills (ctenidia). Clams may burrow deeply in sandy or muddy substrates but are limited by the length of their siphons, which need to be long enough to reach the water above. Competition for space influences the growth and survival of mussels (Richards and Trevelyan 2001). Predators of clams and mussels include sea stars, snails, crabs, shorebirds, sea otters, and humans.

Littleneck clams inhabit bays, coves, and cobble areas in the mid- to low-intertidal zones of the outer coast and generally occur within about 15 cm (6 in) of the surface (Reilly 2001). They are abundant along the West Coast, with the cobble beach at San Onofre supporting one of the most productive populations in the state (Reilly 2001). Washington clams range from Humboldt Bay, California to Baja California, Mexico and prefer mud or sandy mud bottoms in protected areas such as bays and estuaries (Moore 2001a). No total population estimate exists for Washington clams in California (Moore 2001a). Jackknife clams inhabit bays, estuaries, and lagoons near the mean low tide level in mud or muddy sand flats and are numerically important in these areas

(Emmett *et al.* 1991). Gaper clams live in fine sand or sandy-mud bottoms in intertidal and subtidal bay, estuary, and sheltered outer coastal areas (Moore 2001b). Local densities of gaper clams have been determined, but no statewide population estimate exists (Moore 2001b). Pismo clams range from Monterey Bay to Baja California, Mexico (including Santa Cruz and Santa Rosa Islands) and generally inhabit intertidal and offshore sandy substrates to water depths of 25 m (82 ft) (Pattison 2001). California and Mediterranean mussels are common in intertidal and subtidal areas and attach to solid substrates, such as rocks or pilings; they can reestablish a climax community in areas completely cleared of mussels in about 2.5 years (Morris *et al.* 1980; Richards and Trevelyan 2001).

4.3.2.8 Fishes

Unless otherwise noted, the following information is derived from Cross and Allen (1993).

A great diversity of marine fishes occurs in the Southern California Bight, with 481 species known to occur in the area. Their distribution is determined largely by water temperature, with some species generally limited to areas either north or south of Point Conception because of prevailing temperature regimes. The boundary applies more strongly to southern species than to northern species, however, because northern species can compensate for the higher water temperatures further south by moving to deeper waters and utilizing areas of upwelling. Nevertheless, fish distributions can shift with changes in water temperature that occur on seasonal, annual, or multiple-year (El Niño) cycles (Schultze 2001). Fishes commonly associated with the warmer waters of southern California include California sheephead, California scorpionfish (*Scorpaena guttata*), calico rockfish (*Sebastes dallii*), and treefish (*Sebastes serriceps*) (Schultze 2001).

More than 125 fish species utilize rocky reefs and associated kelp forest habitat in the Southern California Bight (Figure 4-11). The abundance of some fishes, such as kelp surfperch (*Brachyistius frenatus*), kelp bass (*Paralabrax clathratus*), giant kelpfish (*Heterostichus rostratus*), and kelp rockfish (*Sebastes atrovirens*), is directly related to kelp density. Kelp forests provide important habitat for some juvenile fishes, including kelp bass, giant kelpfish, and kelp surfperch. Other common kelp forest fishes include blacksmith (*Chromis punctipinnis*), garibaldi (*Hypsypops rubicundus*), senorita (*Oxyjulis californica*), halfmoon, opaleye, blue rockfish (*Sebastes mystinus*), California sheephead, and the surfperches (Family Embiotocidae) (Foster and Schiel 1985).

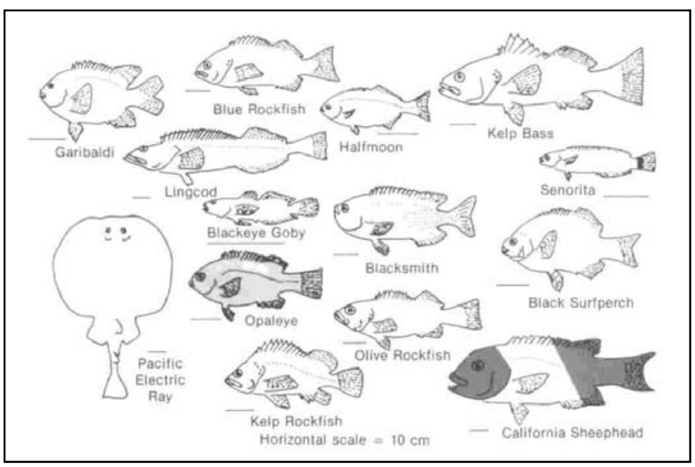

Figure 4-11 Common kelp forest fishes
Source: Foster and Schiel 1985 (redrawn from Miller and Lea 1972)

For additional information on the life history and population status of kelp forest fishes in the Southern California Bight, see Cross and Allen (1993), Leet *et al.* (2001), and "Nearshore Finfish Profiles" at the CDFG Marine Region homepage (http://www.dfg.ca.gov/marine/nearshorefinfish.asp).

4.3.3 CANDIDATE, THREATENED, AND ENDANGERED SPECIES

The candidate, threatened, and endangered species that occur in the Southern California Bight are given in Table 4-1A. With the exception of white and black abalone, there are no known significant interactions between sea otters and the other species listed here.

TABLE 4-1A CANDIDATE, THREATENED, AND ENDANGERED SPECIES IN THE SOUTHERN CALIFORNIA BIGHT

	Species	Status	Year Listed
Invertebrate	White abalone (*Haliotis sorenseni*)	Endangered	2001
	Black abalone (*Haliotis cracherodii*)	Endangered	2009
	Green abalone (Haliotis fulgens)	Species of Concern	2004
	Pink abalone (*H. corrugata*)	Species of Concern	2004
Reptile	Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	1970
	Green sea turtle (*Chelonia mydas*),	Threatened	1978
	Loggerhead sea turtle, North Pacific DPS (*Caretta caretta*),	Endangered	2011
	Olive-ridley sea turtle (*Lepidochelys olivacea*)	Threatened	1978
Bird	Western snowy plover (*Charadrius alexandrinus nivosus*)	Threatened	1993
	California least tern (*Sterna antillarum browni*)	Endangered	1970
	Brown pelican (*Pelecanus occidentalis*)	Endangered Delisted	1970 2009
Mammal	Steller sea lion (*Eumetopias jubatus*)	Threatened	1990
	Guadalupe fur seal (*Arctocephalus townsendi*)	Threatened	1985
	Southern sea otter (*Enhydra lutris nereis*)	Threatened	1977
	Blue whale *(Balaenoptera musculus)*	Endangered	1970
	Fin whale *(Balaenoptera physalus)*	Endangered	1970
	Gray whale *(Eschrichtius robustus)*	Endangered Delisted	1970 1994
	Humpback whale *(Megaptera novaeangliae)*	Endangered	1970
	North Pacific right whale (*Eubalaena japonica*)	Endangered Endangered	2008 1970
	Sei whale *(Balaenoptera borealis)*	Endangered	1970
	Sperm whale *(Physeter macrocephalus)*	Endangered	1970

Species occurring in the Southern California Bight that are not formally listed under the ESA but are recognized as "species of concern" are given in Table 4-1B. With the exception of green and pink abalone, there are no known significant interactions between sea otters and the other species listed here.

TABLE 4-1B SPECIES OF CONCERN IN THE SOUTHERN CALIFORNIA BIGHT

	Species	Status	Year Listed
Fish	Basking shark *(Cetorhinus maximus)*	Species of Concern	2010
	Bocaccio *(Sebastes paucispinis)*	Species of Concern	1999
	Cowcod *(Sebastes levis)*	Species of Concern	2004
Invert.	Green abalone (Haliotis fulgens)	Species of Concern	2004
	Pink abalone (*Haliotis corrugata*)	Species of Concern	2004

We discuss white abalone, black abalone, and southern sea otters below. We address green and pink abalone along with other abalone species under "Federal and State Agency Programs" under the heading "Restoration of Depleted Abalone Species (Not Federally Listed)."

4.3.3.1 White Abalone

White abalone (Figure 4-12) are the deepest living of *Haliotis* species that occur along the west coast of North America (Hobday and Tegner 2000). Their range extends from Point Conception, California in the north to Punta Abreojos, Baja California, Mexico, in the south (Hobday and Tegner 2000). They have a high, oval shell with a row of pores (the largest three to five of which are open) spiraling to the highest part of the shell. They may live 35 or 40 years, with a growth rate (based on observations of a few individuals in the laboratory) of about 2.5 cm (1 in) per year for the first five years of life and slower growth thereafter (Haaker *et al.* 2001). White abalone shell lengths of almost 25 cm (10 in) have been reported in California (Hobday and Tegner 2000). Spawning occurs in winter with the simultaneous release of gametes (eggs or sperm) by male and female individuals, although the trigger for release remains unknown. As with other species of abalone, reproductive success depends on the density of individuals, the period of spawning, the quantity of gametes produced, and good settlement conditions for the larvae (Haaker *et al.* 2001). Juvenile white abalone are thought to be cryptic, but the habitat used by adult white abalone (rock-sand interfaces of boulders and low-relief rocky reefs) provides no crevice refuge from predation. White abalone are herbivorous, feeding on bacterial and diatom films as juveniles and deep-water kelp (both attached and drift) as adults. They have been observed at the borders between rocky and sandy substrate, where drift kelp is easier to capture. Some evidence suggests that white abalone may move into deeper waters as they age (NMFS 2008).

White abalone have a depth range of 5-60 m (16-197 ft) (Cox 1960), but current remnant populations are most common between 30-60 m (98-197 ft) (NMFS 2008). Remotely operated

Figure 4-12 White abalone
Photo courtesy of Channel Islands National Marine Sanctuary. Used by permission

vehicle surveys by Butler *et al.* (2006) found highest numbers of white abalone at depths of 40-50 m (131-164 ft) at Tanner Bank and at depths of 30-40 m (98-131 ft) at Cortes Bank. Factors controlling the depth distribution of white abalone are not well understood but are thought to include competition and predation (at the upper limit) and water temperature and food availability (at the lower limit) (Hobday and Tegner 2000). Under historical environmental conditions, white abalone may have been restricted to waters deeper than 25 m (82 ft) as a result of sea otter predation or competition from pink abalone (Tutschulte 1976, cited in NMFS 2008).

Predators of white abalone include sea stars, octopus, crabs, lobsters, and fishes such as sheephead, cabezon, and bat rays. Sea otters are important predators of abalone generally, but typical sea otter foraging depths overlap only partially with the depth range of white abalone. Fifty percent of all sea otter foraging dives are 4-12 m (13-39 ft) in depth, whereas more than 95 percent of all foraging dives are 2-40 m (7-131 ft) in depth (Tinker *et al.* 2006, Chapter 6). Predation by sea otters is not thought to have been an important factor in the decline of white abalone because of the depth range of white abalone and because in recent times, *i.e.*, since approximately 1850 (Scammon 1968), sea otters have been absent from nearly all of the geographic range of white abalone (NMFS 2008). In contrast, human harvest, which began commercially in the late 1960s after the serial depletion of red, pink, and green abalone populations, has affected white abalone significantly and is believed to be the primary cause of dramatic reductions in white abalone abundance (Karpov *et al.* 2001, 66 FR 29046). Annual white abalone landings totaled 144,000 pounds in 1972 but subsequently declined, reaching very low levels by the early 1980s (Haaker *et al.* 2001).

White abalone were federally listed as endangered in 2001 because of dramatic declines in abundance due primarily to overharvesting for human consumption (66 FR 29046). A recovery plan was completed in 2008 (NMFS 2008). Currently, white abalone are nearly extirpated, with no appreciable recruitment having occurred since the late 1960s or early 1970s and most individuals likely reaching the end of their life span. Concern for the viability of the species stems from the fact that most individuals are large, indicating an absence of recent recruitment, and because most individuals are too far from their nearest neighbor, more than 2 m (7 ft), to ensure successful fertilization. Even in the absence of human harvest, which has been illegal since the closure of the white abalone fishery in 1996, remaining white abalone are at risk because of severe Allee effects (animals may be too far apart for successful fertilization to occur) due to reduced concentrations of individuals and because of natural mortality (from old age and predators such as fishes, octopuses, and sea stars) (CDFG 2005).

4.3.3.2 Black Abalone

Black abalone (Figure 4-13) occur in rocky intertidal habitat to depths of approximately 6 m (20 ft), often in areas heavily pounded by surf. They are relatively long-lived and can reach an age of 25 years or more. They have a smooth bluish-black or gray shell, generally with 5 to 9 (but sometimes as many as 14) open pores flush with the shell surface. Growth is believed to vary with stress, food availability, and climate but is most rapid during the first 5 to 10 years of life. Although maximum shell lengths can exceed 20 cm (8 in) (Morris *et al.* 1980), most individuals are sexually mature at less than 5 cm (2 in). Black abalone spawn in spring and early summer and may spawn again in the fall. Newly settled larvae, juveniles, and abalone up to 10 cm (4 in) in length usually remain cryptic, inhabiting deep fissures or areas beneath rocks. When not subject to harvesting or predation pressure, larger abalone can aggregate in large numbers on rocks or in tidepools (Haaker *et al.* 2001).

Adults feed primarily on drift algae, whereas juveniles consume bacterial films. Black abalone are subject to predation at every stage of life. Planktonic larvae may be consumed by predators such as planktivorous fishes and zooplankton, and newly metamorphosed abalone are consumed by a broad range of small benthic invertebrates (reviewed in Van Blaricom *et al.* 2009). Predators of small cryptic abalone include gastropods, octopuses, lobsters, sea stars, sea urchins, fishes, shore crabs, and shorebirds (reviewed in Van Blaricom *et al.* 2009). The rocky intertidal habitat inhabited by black abalone is well within the range of sea otter predation, although cryptic and inaccessible habitats provide refuge for the species. Predators of emergent black abalone include sea stars, fishes, sea otters, and humans.

Figure 4-13 Black abalone
Black abalone, which once occurred in abundance in intertidal areas, are now rare in the Southern California Bight. Photo by Glenn Allen. Used by permission

Black abalone were historically found from at least northern California to the tip of Baja California, Mexico, but the species was most abundant south of Monterey, particularly in the Channel Islands (74

FR 1937). The human-caused extirpation of southern sea otters from most of their former range is believed to have been responsible for the large aggregations of black abalone evident in California and Mexico during the nineteenth and twentieth centuries (Haaker *et al.* 2001). Beginning in 1850, black abalone (as well as red and green abalone) were collected from the intertidal zone by Chinese immigrants for local consumption or export. Concerns about overfishing led to the prohibition of shallow-water abalone fishing in 1900 (Rogers-Bennett *et al.* 2002). Twentieth-century commercial harvests began in the late 1960s at the Channel Islands and reached a zenith of almost 2 million pounds statewide in 1973. By 1990, however, landings had declined to 13 percent of the average annual catch of the 1970s and early 1980s (687,000 pounds). Due to a combination of overfishing and disease (discussed below), the black abalone fishery was closed in 1993 (Neuman *et al.* 2010). An estimated 3.5 million individuals were taken in the commercial and recreational black abalone fisheries before these fisheries were closed (Rogers-Bennett *et al.* 2002). As a consequence of the relatively low value of black abalone compared to other abalone species, the collapse of black abalone stocks occurred late in the serial depletion that characterized the commercial abalone fishery as a whole before its complete closure (for all species) in 1997 (Haaker *et al.* 2001).

The dramatic decline in abundance of black abalone has been exacerbated by a disease called withering syndrome. Caused by a Rickettsia-like prokaryotic organism (*Candidatus Xenohaliotis californiensis*) that affects the epithelial cells of the gastrointestinal tract, withering syndrome results in malnutrition, loss of tissue mass, and death (74 FR 1937). Withering syndrome began affecting black abalone populations in southern California in the mid-1980s and had spread northward into areas of the coast north of Point Conception by the early 2000s (Bergen and Raimondi 2001). The disease has eliminated black abalone from large areas of its former range, including the mainland coast of southern California (Haaker *et al.* 2001, Miner *et al.* 2006). Elevated seawater temperature, while not believed to be necessary for the occurrence of withering syndrome and the onset of mass mortality, is thought to promote these conditions (Bergen and Raimondi 2001, Raimondi *et al.* 2002). Mass mortalities appear to be followed by recruitment failure, either as a result of limited dispersal of larvae, lack of appropriate settlement habitat (due to changes in intertidal species assemblages following the elimination of adults), or the continued effects of the disease agent (Miner *et al.* 2006). Significant declines in abundance (more than 90 percent) have occurred at most (76 percent) of the long-term monitoring sites in California (Tissot 2007, cited in Van Blaricom *et al.* 2009).

NMFS added black abalone to its list of candidate species in 1999 (64 FR 33466) and listed it as endangered under the ESA in 2009 based on a number of risks, particularly:

> 1) the spread of and mortality caused by a disease called withering syndrome;
> 2) low adult densities below the critical threshold density required for successful spawning and recruitment;
> 3) elevated water temperatures that have accelerated the spread of withering syndrome;
> 4) reduced genetic diversity that will render extant populations less capable of dealing with both long- and short-term environmental or anthropogenic challenges; and
> 5) illegal harvest. (74 FR 1937)

A final status review report was issued in 2009 (Van Blaricom *et al.* 2009). Critical habitat was proposed in 2010 (75 FR 59900) and finalized on October 27, 2011 (76 FR 66806). A recovery plan has not yet been published.

4.3.3.3 Southern Sea Otters

INTRODUCTION

Southern sea otters (Figure 4-14) presently occupy the Southern California Bight only in relatively small numbers. As of December, 2011, 48 independent (non-pup) animals reside year-round at San Nicolas Island, and seasonal movements bring groups of sea otters from the mainland range into and out of areas to the southeast of Point Conception. During the 2012 spring census, 10 pups were counted southeast of Point Conception, suggesting that a permanent breeding colony has likely been established in the management zone (http://www.werc.usgs.gov/seaottercount). In this section, we address sea otters in the mainland range as well as those at San Nicolas Island because both the mainland population and the island colony will be affected by the alternatives under consideration.

Figure 4-14 Southern sea otters
Credit: Jeff Foott. Used by permission

LISTING HISTORY

The southern sea otter was listed as threatened in 1977 (42 FR 2965). Critical habitat was not designated. The factors leading to the listing included the southern sea otter's reduced population size and range and increased tanker traffic and the corresponding potential for oil spills. The rulemaking also acknowledged the potential degradation of habitat caused by pollution or competition with humans. The southern sea otter is also considered "depleted" under the MMPA by virtue of its listing status under the ESA and designated as a Fully Protected Species under California State law (California Fish and Game Code §4700). Fully protected species may not be taken[5] or possessed, except under a few narrow circumstances.

GENERAL ECOLOGY

The sea otter is the second largest member of the family Mustelidae and the second smallest marine mammal. The only marine mammal that is smaller is the South American marine sea otter (*Lutra felina*). Southern sea otters can weigh up to 40 kg (88 lb) and attain lengths of 140

[5] Under California State law, "take" means to "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill" (California Fish and Game Code § 86).

cm (55 in). Males are larger than females. Southern sea otters have a typical life span of 11-15 years (Riedman and Estes 1990), although one animal translocated to San Nicolas Island in 1987 as a juvenile was documented (in 2006) to have reached at least 19 years of age in the wild (U.S. Geological Survey (USGS) unpub. data).

Unlike most other marine mammals, sea otters have little subcutaneous fat. They depend on their clean, dense, water-resistant fur for insulation against the cold. Sea otters also maintain a high level of internal heat production to compensate for their lack of blubber. Consequently, their energetic requirements are high, and they are estimated to consume an amount of food equivalent to 23 to 33 percent of their body weight per day (Riedman and Estes 1990). Contamination of the fur by oily substances can destroy its insulating properties and lead to hypothermia and death. The loss of the insulating properties of the fur greatly heightens the adverse effects of oil spills on southern sea otters and is one of the reasons that increased tanker traffic and the potential for oil spills was considered in the listing of the species.

Sea otter habitat is typically defined by the 40 m (131 ft) isobath (Laidre *et al.* 2001). Depending on local bathymetry, most southern sea otters reside within 2 km (1.2 mi) of shore. The density of southern sea otters within most of the population's range is most likely related to substrate type. Rocky habitats that are topographically heterogeneous and support kelp forests are likely to support the greatest diversity and abundance of sea otter food resources, which include abalone, rock crabs, sea urchins, kelp crabs, clams, turban snails, mussels, octopus, barnacles, scallops, sea stars, and chitons. Rocky bottom habitats support an average equilibrium density of 4.65-5.62 individuals per square kilometer, whereas areas with sandy bottoms and areas of mixed habitat support average equilibrium densities of 0.84-1.32 and 0.44-1.16 individuals per square kilometer, respectively (Laidre *et al.* 2001).

Southern sea otters forage in both rocky and soft-sediment communities in water depths generally 25 m (82 ft) or less, although individuals occasionally move into deeper water. They occasionally make dives of up to 100 m (328 ft), but the vast majority of feeding dives (about 95 percent) occur in waters less than 40 m (131 ft) in depth (Tinker *et al.* 2006a). Dive depth and dive pattern vary by sex (males tend to make dives greater than 25 m (82 ft) more frequently than females), geographic location and diet specialization (Tinker *et al.* 2006a, Tinker *et al*. 2007).

Their mobility, forelimb dexterity, and ability to crush large invertebrates, either with their teeth or rocks, enable sea otters to prey on most invertebrates (Figures 4-15 and 4-16). The best refuges for invertebrates from predation by sea otters appear to be in deep holes and crevices in rocky areas or deep water (*e.g.,* Lowry and Pearse 1973, Hines and Pearse 1982). Shallow water may also provide refuge for invertebrates; southern sea otters failed to find an "unusually dense concentration of Pismo clams (that occupied a very narrow band of habitat in the high intertidal (zone)) ... for several years" (CDFG 1999a). The energetic inefficiency of consuming small prey items may also protect invertebrates of small size, although specialists who prey on small items may be able to compensate for low energetic return with increased efficiency (Tinker *et al.* 2006a, Chapter 5; Tinker et al. 2007).

Because of their ability to eat large quantities of marine invertebrates, sea otters play an extremely important role in the nearshore marine community. Although other factors are also

Figure 4-15 Southern sea otter eating crab
Credit: Jeff Foott. Used by permission

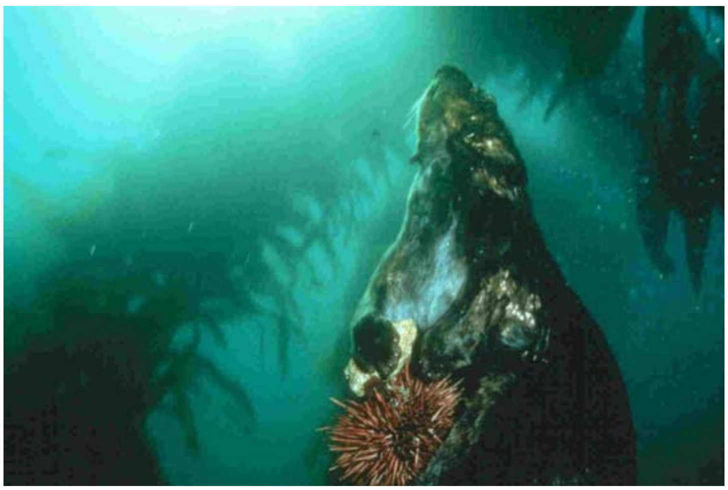

Figure 4-16 Southern sea otter surfacing with red sea urchin and rock tool
Credit: Jeff Foott. Used by permission

involved, kelp forests appear to grow profusely in suitable areas where sea otters reduce the number and size of sea urchins (see section 6.2.2.2 for a detailed discussion of the relationship between sea otters and kelp abundance). In turn, kelp forests provide shelter and food for various species of fish, which become established in areas where kelp forests regenerate.

The annual patterns that characterize the movements of southern sea otters along the coast are complicated and vary between males and females. The home ranges of southern sea otters tend to consist of several heavily used areas with travel corridors between them. Animals often remain in an area for a long period of time and then suddenly move long distances. These movements can occur at any time of the year (Riedman and Estes 1990). Sub-adult male southern sea otters have the largest home ranges, followed by adult males, sub-adult females, and adult females (Tinker *et al.* 2006a, Chapter 3). Compared to males, most female southern sea otters are more sedentary. Occasionally, females travel long distances; 3 tagged adult females routinely moved between Monterey and Santa Cruz, a distance of 40 to 50km, for over 4 years. Juvenile males move further from natal groups than do juvenile females. Aggressive behavior exhibited towards the juvenile males by breeding males may be partially responsible for their more extensive travels (Ralls *et al.* 1996). Jameson (1998) noted that adult male sea otters are territorial and exclude juvenile and subordinate males from their territories. However, females move freely across these territories. Generally, southern sea otters occupy territories on a seasonal basis. Many males migrate to the range peripheries during the winter and early spring, apparently to take advantage of more abundant prey resources, but then return to the range center during the period when most breeding occurs (June to November) in search of estrous females (Jameson 1989; Tinker *et al.* 2006a, Chapter 6; Tinker *et al.* 2006b).

Several explanations have been proposed for the differences in movements between the sexes. Males may accrue some social benefit from gathering in male social groups. Widely traveling males may have greater opportunity to find females. On the other hand, more sedentary females may derive some benefit from expending less energy traveling and being more intimately familiar with localized food resources. Males that move to the periphery of their range may benefit from abundant food resources in areas where southern sea otters do not occur year-round. These seasonal trips to the edges of the range may also be attempts to establish new home ranges. Also, increased competition for suitable territories and the reduced number of estrous females may be responsible, at least in part, for the migration of males to the end of the range (Riedman and Estes 1990).

Reproduction

Southern sea otters mate and pup throughout the year. The northern and southern portions of the population seem to exhibit different mating peaks. A peak period of pupping occurs from January to March, and a secondary pupping season occurs in late summer and early fall. Pupping is seasonally uniform in the Monterey Bay area (Riedman *et al.* 1994). Parental care is provided solely by the female.

Distribution and Population Trends

Sea otters once occurred along the North Pacific rim from the northern Japanese islands to mid-Baja California, Mexico. Southern sea otters occupied the southern portion of this range. Historically ranging from at least Oregon in the north (Valentine *et al.* 2008) to Punta Abreojos, Baja California, Mexico in the south, the southern sea otter population in California prior to exploitation is thought to have numbered about 16,000 animals (CDFG 1976; Laidre *et al.* 2001).

Following near-extinction as a result of exploitation during the 18th and 19th centuries, sea otters were legally protected from take in 1911 through the International Fur Seal Treaty. Subsequently, northern sea otters (*E. l. kenyoni*) recolonized most of the available habitat through the Kuril Islands, Kamchatka Peninsula, and across the North Pacific rim to about Prince William Sound. Populations had recovered to levels at or near carrying capacity throughout much of this region by the late 1980s but declined precipitously over large areas of western Alaska during the 1990s (Estes *et al.* 1998). Once containing more than half of the world's sea otters, this population segment underwent an overall population decline of at least 55–67 percent since the mid-1980s. In some areas within southwest Alaska, the population declined by over 90 percent during this period (Doroff *et al.* 2003; Estes *et al.* 2005). The likely cause of these declines is a shift in the prey resource base for killer whales from Steller sea lions and harbor seals, populations of which have recently collapsed across the western North Pacific, to sea otters (Estes *et al.* 1998). USFWS listed the southwest Alaska Distinct Population Segment (DPS) of the northern sea otter *(Enhydra lutris kenyoni)* as threatened on August 9, 2005 (70 FR 46366).

Figure 4-17 shows the historic and current distribution of sea otters throughout the species' range. The historic range of the species southeastward from Prince William Sound to central Baja California, Mexico remains uninhabited except for translocated colonies in southeast Alaska, British Columbia, and Washington (which grew at rates of 17 to 20 percent annually through the 1990s (Estes 1990)); the remnant population of southern sea otters in central California; and the translocated colony at San Nicolas Island (which has grown at an average annual rate of about 7 percent since 1993, when it numbered 12 independent animals). Information on the distribution and abundance of sea otters in California prior to 1990 is summarized by Riedman and Estes (1990). Although both range and numbers have increased

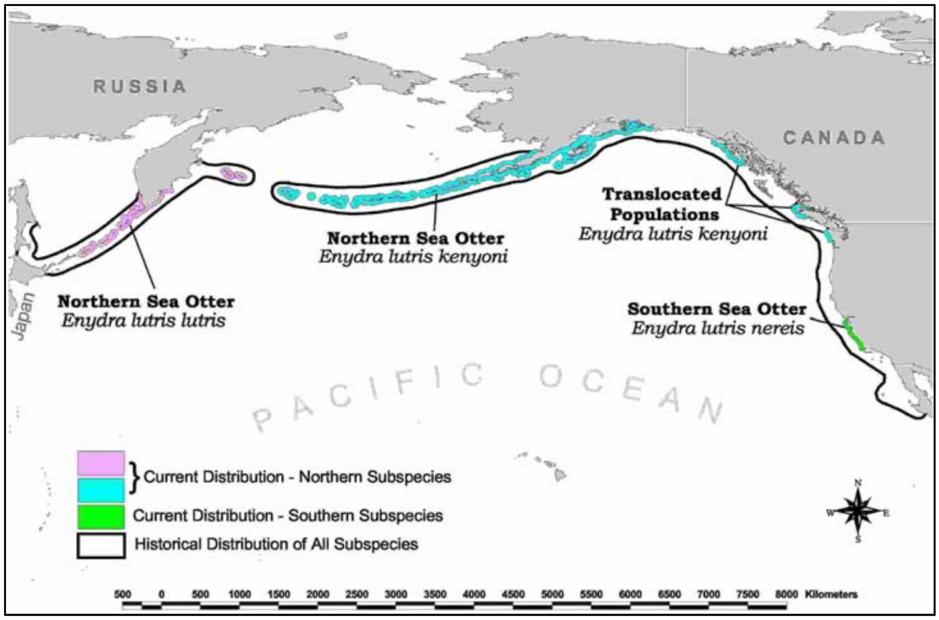

Figure 4-17 Historic and current range of the sea otter

during the 20th century, these variables are not well correlated. In particular, whereas population abundance has declined during several periods, distribution evidently has not retracted during these periods. Range delineation has been somewhat arbitrary because individuals frequently wander well beyond the distributional limits of most of the rest of the population. However, the geographic range of the southern sea otter has expanded considerably since 1938, at which time most individuals occurred from about Bixby Creek in the north to Pfeiffer Point in the south (Wild and Ames 1974). The range currently extends from San Mateo County in the north to Santa Barbara County in the south. Although sea otters are occasionally sighted outside of this range (as far north as Pt. Reyes Headlands and Bodega Bay, and as far south as Los Angeles and the Channel Islands), these sightings generally represent the transient movements of individual animals, almost always males, and are not considered part of the permanent range.[6] Since the mid-1990s, when sea otters moved south of Point Conception, the distribution at the southern end of the range has been particularly variable from year to year (Harris, pers. comm).

Sea otter abundance varies considerably across the range, with the highest densities occurring in the center part of the range (Monterey peninsula to Estero Bay), where sea otters have been present for the longest (Figure 4-18). Sea otter densities tend to be most stable from year-to-year in rocky, kelp-dominated areas that are primarily occupied by females, dependent pups, and territorial males. In contrast, sandy and soft-bottom habitats (in particular those in Monterey Bay, Estero Bay, and Pismo Beach to Pt. Sal) tend to be occupied by males and sub-adult animals of both sexes (but rarely by adult females and pups), and are more variable in abundance from year to year (Tinker pers. comm. 2008). This variation is apparently driven in part by the long-distance movements and seasonal redistribution of males (Tinker *et al.* 2006b). The variability of counts at the south end of the range is also related to seasonal movements: many males migrate to the range peripheries during the winter and early spring, apparently to take advantage of more abundant prey resources, but then return to the range center during the period

[6] To ensure consistency in the delineation of future range boundaries, a new range definition was adopted in 2008: the mainland range limits are now defined as the points farthest from the range center (to the north and south) at which 5 or more otters are counted within a 10-kilometer contiguous stretch of coastline (as measured along the 10-meter bathymetric contour) during the two most recent spring censuses, or at which these same criteria were met in the previous year (http://www.werc.usgs.gov/seaottercount).

when most breeding occurs (June to November) in search of estrous females (Jameson 1989; Tinker *et al*, 2006a, 2006b).

Standardized range-wide counts of southern sea otters were initiated in 1982. The survey data consist of uncorrected counts and thus do not represent population abundance estimates. Rather, they are used to assess trends. From 1983 to 2012, the spring population count increased from 1,277 animals to 2,792 animals (the 2011 count was not completed due to poor weather) (Figure 4-19). However, the pattern of change was highly inconsistent, with periods of growth, stability and decline. The 3-year running average is the index recommended by the recovery team to reduce the influence of variable survey conditions and to allow for the assessment of long-term population trends (USFWS 2003). Based on three-year running averages of the annual spring counts, population performance has been mixed over the past several years, increasing between 2006 and 2008 and then decreasing between 2008 and 2010. Since 2010, population growth has averaged 1.5 percent per year, but the longer-term trend (since 2006) is essentially flat (http://www.werc.usgs.gov/seaottercount). Most of the increase that occurred from 2006-2008 occurred at the south end of the range (south of Estero Bay), with a slower rate of growth in the north and center of the range where densities are highest, suggesting that sea otters may be approaching local carrying capacity in some areas (Tinker *et al.* 2006b, Tinker *et al.* 2008b). Since then, the lack of growth in the center portion of the range has continued, but a declining trend has been evident south of Cayucos. This declining trend likely reflects the dramatic increase in shark-bite deaths over the past 5 years in the areas between Estero Bay and Pismo Beach (http://www.werc.usgs.gov/seaottercount). Data show that sea otters at San Nicolas Island are larger and spend less time foraging than those in the central part of the range, providing additional evidence that food limitation may be a factor in the recovery of southern sea otters in central California (Bentall 2005, Tinker *et al.* 2008b).

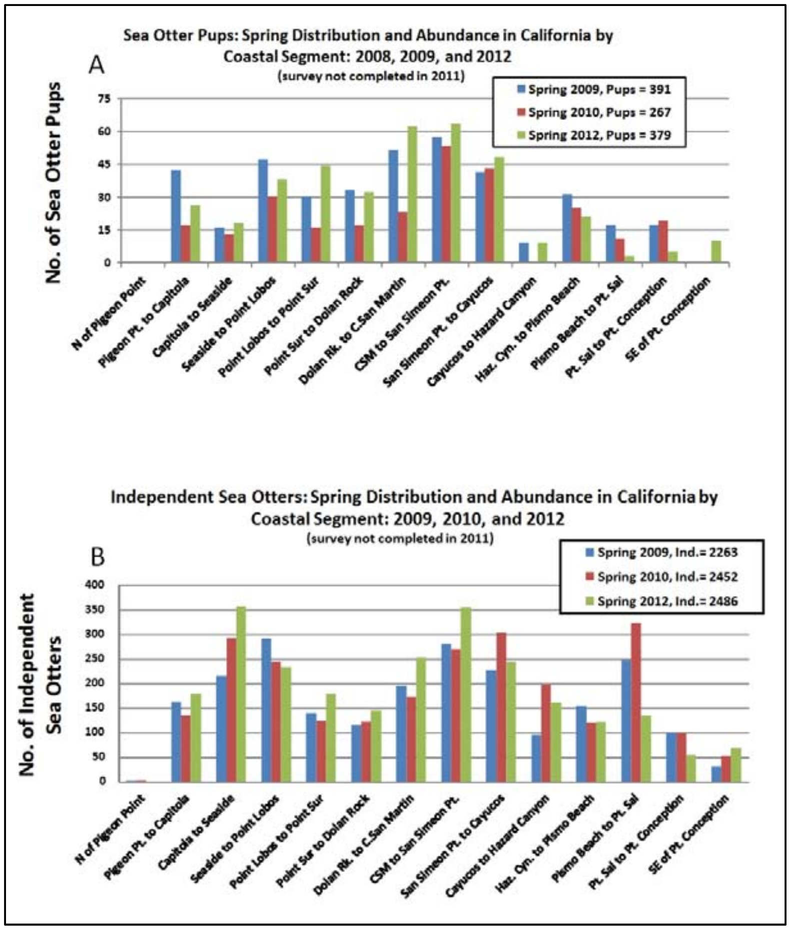

Figure 4-18 Distribution and abundance of sea otters in California plotted by coastal segment for spring 2009, 2010, and 2012
A) Counts of independent otters only (excluding dependent pups)
B) Counts of dependent pups
Source: USGS (http://www.werc.usgs.gov/seaottercount)

MORTALITY

An effort to document all southern sea otter strandings (live and dead sea otters that wash ashore) has been underway since 1968. While nearly all stranded sea otters are found dead, a small proportion is retrieved live and is included in the stranding database. Assessment of sea otter mortality in recent years is based almost exclusively on information obtained from beach-cast carcasses (Estes *et al.* 2003a). Relative mortality (measured by dividing the number of carcasses retrieved in a given year by the number of otters counted in the spring survey of that same year) suggests that mortality was roughly constant at about 5 percent during the period when the population was growing (from about 1985 through 1995) but was somewhat higher during periods of apparent decline (*i.e.*, the early 1980s and from 1996 through 1999). During the last several years, relative mortality has remained high, 8-10 percent (Figure 4-20; note that because the spring count was not completed in 2011, the relative number of strandings cannot be calculated for that year).

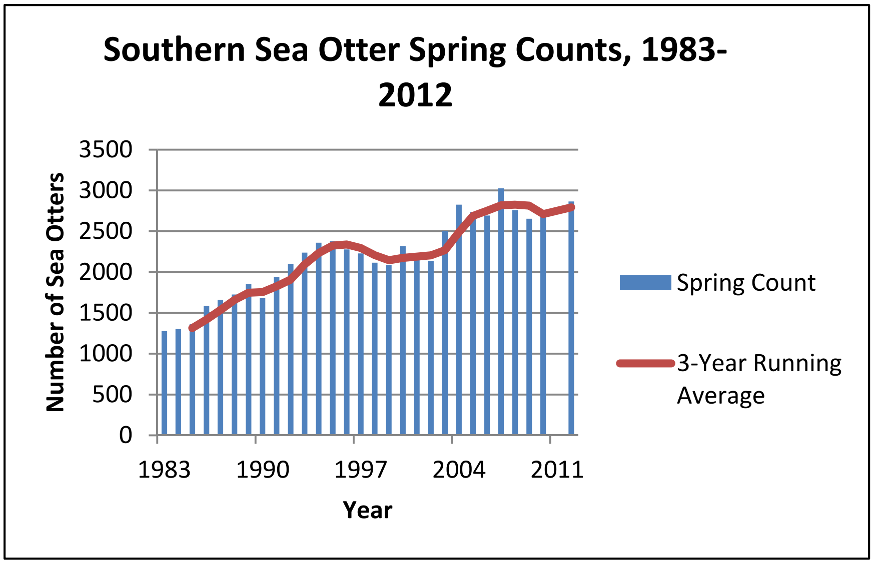

Figure 4-19 Southern sea otter counts 1983-2012 (mainland population)
Data source: USGS (http://www.werc.usgs.gov/seaottercount)

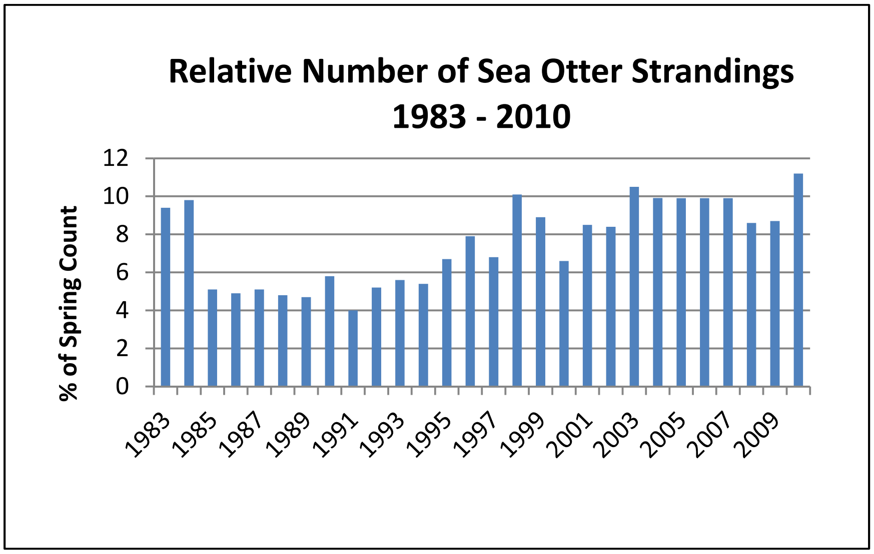

Figure 4-20 Strandings of southern sea otters relative to the spring count, 1983-2010
Data source: U.S. Geological Survey unpub. data. Because the spring count was not completed in 2011, the relative number of sea otter strandings for that year cannot be calculated.

Estes *et al.* (2003a) reported that elevated mortality appeared to be the main reason for both sluggish growth and periods of decline in southern sea otters. A period of decline from 1976 to 1984 was likely due to incidental mortality in set-net fisheries (Estes *et al.* 2003a), and an analysis by Tinker *et al.* (2006b) indicated that increased mortality of sub-adult and prime-age females, particularly in the northern and central part of the range, was responsible for the period of decline from 1995-2000. Based on analysis of beach-cast carcasses, it appears that the two causes of death most important for limiting population growth are white shark attacks and infectious disease (Gerber *et al.* 2004), with the prevalence of disease appearing to be unusually high (Thomas and Cole 1996, Estes *et al.* 2003, Kreuder *et al.* 2003). The occurrence of infectious disease in sea otters resulting from land-borne pathogens appears to be related synergistically to exposure to harmful algal blooms and to nutritional stress (food limitation). These factors often interact in complex ways that are just beginning to be understood. For example, lower per-capita food availability leads to poorer body condition and greater reliance on sub-optimal prey, which increases exposure and susceptibility to novel disease-causing pathogens, which may be further exacerbated by chronic domoic acid exposure) (Johnson *et al.* 2009, Tinker pers. comm. 2012).

One such disease-causing pathogen is the protozoan *Toxoplasma gondii*, a parasite that is shed in the feces of both wild and domestic cats (Miller *et al.* 2002). The pathways by which sea otters are becoming exposed to *T. gondii* are more complex than were at first recognized. Until recently, it was believed that cats (both domesticated and wild) were the only definitive host for this protozoal parasite. However, the widespread exposure of other marine mammals to *T. gondii*, including those whose habitat is mostly pelagic and distant from human population centers, as well as recent laboratory analyses, have suggested that there may be a definitive host in the marine environment (*e.g.*, Jensen *et al.* 2010). The relative contribution of parasites from wild felids versus domestic or feral cats is also an outstanding question (one that is currently under investigation) (*e.g.*, Miller *et al.* 2008). Finally, recent research indicates that *T. gondii* is only one of a number of closely related protozoan parasites that infect sea otters (*Sarcocystus neurona* is another), and genetic work has revealed that in many cases sea otters and other marine mammals actually have co-infections of multiple parasite species (*e.g.*, Gibson *et al.* 2011, Colegrove *et al.* 2011). Other sources of disease in sea otters include acanthocephalan worms (*Profilicollis* spp; Mayer *et al*. 2003), bacterial and viral infections, domoic acid toxicity, and cardiac lesions (Kreuder *et al.* 2005). The degree of exposure to chemical contaminants such as polychlorinated biphenyls (PCBs) may play a role in driving patterns of disease mortality (Kannan *et al.* 2006, 2007). Food limitation and nutritional deficiencies likely also contribute to sea otter mortality, either as a consequence of dietary specialization by increasing levels of exposure to protozoal pathogens (as discussed above) or directly (Bentall 2005, Tinker *et al.* 2006, Tinker *et al.* 2008b, Johnson *et al.* 2009).

Harmful algal blooms pose an apparently increasing risk to southern sea otters. In 2003, the relative number of strandings exceeded 10 percent of the spring count. No one cause appears to have been responsible for the increase in mortality, although intoxication by domoic acid produced by blooms of the alga *Pseudonitzchia australis* appears to have been an important contributor (Jessup *et al.* 2004). The ocean discharge of freshwater microcystins (persistent biotoxins produced by cyanobacteria of the genus *Microcystis*) has been linked to the deaths of 21 sea otters, with the earliest known case occurring in 1999 and the greatest number of cases occurring in 2007 (Miller *et al.* 2010).

The potential exists for sea otters to drown in traps set for crabs, lobsters, and finfish, but only limited documentation of mortalities is available. Hatfield and Estes (2000) summarize records of 18 sea otter mortalities in trap gear, 14 of which occurred in Alaska. With the exception of one sea otter, which was found in a crab trap, all of the reported Alaska mortalities involved Pacific cod traps and were either recorded by National Marine Fisheries Service (NMFS) observers or reported to NMFS observers by fishers. Four sea otters are known to have died in trap gear in California: one in a lobster trap near Santa Cruz Island in 1987; a mother and pup in a trap with a 10-inch diameter opening (presumed to be an experimental trap) in Monterey Bay in 1987; and one in a rock crab trap 0.5 miles off Pt. Santa Cruz, California (Hatfield and Estes 2000). In 1995, USGS began opportunistic efforts to observe the finfish trap fishery in California. These efforts were supplemented with observations by CDFG in 1997 and two hired observers in 1999. No sea otters were found in the 1,624 traps observed (Hatfield and Estes 2000). However, a very high level of observer coverage would be required to see any indication of trap mortality, even if mortality levels were high enough to substantially reduce the rate of population growth (Hatfield *et al.*et al. 2011).

Controlled experiments conducted by the USGS and the Monterey Bay Aquarium demonstrated that sea otters could enter a baited commercial finfish trap with inner trap funnel openings of 14 cm (5.5 in) in diameter (Hatfield and Estes 2000). Hatfield *et al.* (2011) confirmed that some sea otters exposed to finfish, lobster, and mock Dungeness crab traps in a captive setting could succeed in entering them. Based on experiments with carcasses and live sea otters, they concluded that finfish traps with 13 cm (5 in) diameter circular openings would largely exclude diving sea otters; that circular openings of 14 to 15.2 cm to (5.5 to 6 in) in diameter and rectangular openings 10.2 cm (4 in) high (typical of Dungeness crab pots) could allow the passage of sea otters up to about 2 years of age; and that the larger fyke openings of spiny lobster pots and finfish traps with openings larger than 13 cm (5 in) could admit larger sea otters. Reducing the fyke-opening height of Dungeness crab traps by 2.5 cm (1 in) to 7.6 cm (3 in) would exclude nearly all diving sea otters while not significantly affecting the number or size of harvested crabs (Hatfield *et al.* 2011).

Since January 2002, CDFG has required 12.7 cm (5 in) sea otter exclusion rings to be placed in live-fish traps used along the central coast from Pt. Montera in San Mateo County to Pt. Arguello in Santa Barbara County. No rings are required for live-fish traps used in the waters south of Point Conception, and no rings are currently required for lobster or crab traps regardless of their location in California waters.

Shootings and boat strikes are relatively low but persistent sources of mortality. Other rare sources of mortality include debris entanglement, interactions with recreational fishing gear (fishing line and/or fish hook ingestion), and complications associated with research activities (USGS and CDFG unpub. data).

4.4 Socioeconomic Environment

4.4.1 OVERVIEW: USE VALUE, NON-USE VALUE, AND REGIONAL ECONOMIC CONTEXT

The socioeconomic environment of the Southern California Bight may be viewed in terms of its use value and its non-use value. The two types of value are not always easily distinguished, and many activities combine elements of both. Nevertheless, it is a useful exercise to categorize the types of value and benefit that exist because the less tangible benefits are often overlooked. Examples of different types of value and benefit are summarized in Table 4-2. The following discussion of use and non-use values is based largely on the discussion of these values in Boardman *et al.* (1996).

TABLE 4-2 TYPES OF SOCIOECONOMIC BENEFIT IN THE SOUTHERN CALIFORNIA BIGHT`

Type of Value	Benefit Category	Example
Use	Rivalrous consumption	Commercial fishing
	Non-rivalrous consumption (direct)	Whale-watching
	Non-rivalrous consumption (indirect)	Viewing a film on kelp forest communities
Non-use	Altruistic existence value: gift to current generation	Others able to watch whales
	Altruistic existence value: gift to future generation	Future others able to watch whales
	Pure existence value: good has intrinsic worth	An intact marine ecosystem is important regardless of the benefits humans may derive from it

Source: Adapted from Boardman *et al.* (1996).
SCB=Southern California Bight

Use value derives from human use of the physical and biological environment and includes both rivalrous and non-rivalrous consumption. Rivalrous consumption (also known as destructive consumption) is the most obvious source of use value and pertains to the extraction of goods from the environment. Examples of rivalrous consumption in the biological environment of the Southern California Bight include commercial fishing and kelp harvesting. This type of consumption permanently removes individual organisms or parts of organisms from the environment. The value derived from this type of consumption can generally be estimated with high reliability because the goods obtained are traded on markets.

Non-rivalrous consumption refers to activities that do not remove or destroy organisms. These activities are "non-rivalrous" because the value that one person derives from a good does not diminish another person's ability to derive benefit from the same good. The distinction between rivalrous and non-rivalrous consumption is sometimes made in terms of consumptive versus non-consumptive uses. These uses can occur onsite or offsite.

Non-rivalrous uses of the Southern California Bight that occur *onsite* include marine mammal and bird watching, tidepooling, kayaking, observational diving, and photography. Although these activities are not intended to cause harm to the organisms being observed, they may sometimes have such effects, and in these cases they cannot be considered to be strictly non-rivalrous. The value derived from non-rivalrous onsite activities is somewhat difficult to estimate because the goods derived are not generally traded on markets, but it can be quantified (with varying degrees of reliability) in terms of the time and travel costs people are willing to pay to perform these activities. However, the opportunity cost approach always leads to the underestimation of the full value of a resource because it does not capture the consumer surplus of the activities. That is, most of the value of many environmental goods and services resides precisely in their non-market value.

Non-rivalrous consumption that occurs *offsite* includes watching films, viewing photographs, or reading accounts of a particular organism or environment (although the extent to which offsite non-rivalrous consumption constitutes “use” or “non-use” may be debatable). The value of the benefits derived from this kind of consumption is much more difficult to quantify.

Indirect use-value may also occur in the form of ecosystem services. For instance, kelp forests provide numerous direct and indirect benefits, including a dampening of wave action (Lovas and Torum 2001) that may reduce coastal erosion, carbon storage that can moderate climate change (Gao and McKinley 1994, Wilmers *et al.* 2012), and improved habitat for numerous invertebrate and fish species.

Non-use value refers to the benefits derived from simply knowing that a particular environment or organism exists. For example, people may want to preserve wilderness areas or to restore ecosystems so that they can be appreciated by other people now living (altruistic existence value) or by future generations (bequest value).

A third kind of non-use value is pure existence value: the belief that animals, plants, and environments have intrinsic worth regardless of their utility for humans. Pure existence value is “biocentric” rather than “anthropocentric,” in that living organisms and their habitats are valued for their own sake. Non-use values are difficult to quantify, but they are an important part of the social environment of the Southern California Bight.

For those activities that can be quantified monetarily, the regional economy provides a context that allows for the assessment of the relative economic contribution of these activities. Table 4-3 summarizes total personal income and per capita personal income for the coastal counties of the Southern California Bight.

TABLE 4-3 TOTAL PERSONAL INCOME AND PER CAPITA PERSONAL INCOME, SOUTHERN CALIFORNIA COASTAL COUNTIES

County	Total Personal Income for 2008 (thousands of 2009$)	Per Capita Income
Santa Barbara County	$19,289,156	$47,786
Ventura County	$37,052,824	$46,621
Los Angeles County	$411,846,094	$42,115
Orange County	$154,566,498	$51,709
San Diego County	$140,345,814	$46,483
Total	$763,100,387	

Data source: U.S. Department of Commerce, Bureau of Economic Analysis (www.bea.gov)

The following discussion of the socioeconomic environment of the Southern California Bight focuses on commercial fisheries, marine aquaculture, seafood processing, kelp harvest, recreational fishing, abalone fishery restoration, ecotourism and non-market value, and federal and state agency programs (U.S. Fish and Wildlife Service, Channel Islands National Park, Channel Islands National Marine Sanctuary, California Department of Fish and Game, U.S. Navy/DOD, and U.S. Minerals Management Service).

4.4.2 Commercial Fisheries

4.4.2.1 Overview

Commercial fishing occurs at various locations throughout the Southern California Bight. Numerous species of fish and shellfish are commercially taken in nearshore waters (waters approximately 40 m (131 ft) or less in depth) using a variety of gear types. The best information on commercial catch comes from CDFG, which collects information on the amounts, types, locations, and ex-vessel values (the amount paid to fishers for their raw catch) of fish caught each year. These data are organized by numbered statistical blocks (see section 6.2.4, Figure 6-4). Landings (the number of pounds of fish caught and delivered to shore) are recorded by statistical block in pounds and dollar amount received.

Ex-vessel values represent the best available measure of the value of commercial fisheries (the combined value taken in by all vessels), but certain deficiencies of this measure should be borne in mind. Ex-vessel value is a measure of the gross revenues taken in by commercial fishers and does not account for operating costs. Because operating costs vary among fisheries, ex-vessel values for different fisheries are not strictly comparable. Additionally, operating costs are often not available for the calculation of net revenues. Because ex-vessel values reflect gross rather than net revenues and thus fail to account for the savings in boat fuel and labor that could be re-employed elsewhere if commercial fishing activity were reduced, they overestimate the gain to commercial fishers (Thomson 2001).

The commercial fisheries that will likely be affected by the alternatives under consideration are the sea urchin, lobster, crab, sea cucumber, halibut, white seabass, and (if attempts are made to reopen the fishery in the future) abalone fisheries. Table 4-4 compares ex-vessel revenues for these fisheries (excluding the commercial abalone fishery, which was closed completely in 1997) in southern California from 2000-2009 to the total personal income for the coastal counties bordering the Southern California Bight. To be properly compared to total personal income, ex-vessel values should be adjusted upwards with a multiplier (appropriate to the county where the catch was landed) that translates ex-vessel value into income. Leeworthy and Wiley (2002) give multipliers of 2.1 for sea urchins, 2.0 for spiny lobsters, and 2.8 for crab landed and processed in Ventura County, but multipliers are different for each fishery and county where catch is landed. Hackett *et al.* (2009) give multipliers of 1.97 for sea urchins, 2.01 for lobster and crab, and 2.06 for gillnet fisheries (*e.g.*, halibut and white seabass) for southern California counties (http://www.dfg.ca.gov/marine/economicstructure.asp). While multipliers differ somewhat for each fishery and county, it is clear that each of these fisheries accounts

TABLE 4-4 REVENUES OF POTENTIALLY AFFECTED SOUTHERN CALIFORNIA FISHERIES AND TOTAL PERSONAL INCOME, SOUTHERN CALIFORNIA COASTAL COUNTIES (THOUSANDS OF 2009$)

Fishery	Average Annual Ex-Vessel Fishery Revenue for SCB 2000-2009	Total Personal Income for 2008 Southern California Coastal Counties
Sea Urchin	$7,390	$763,100,387
Lobster	$6,784	$763,100,387
Crab	$1,590	$763,100,387
Sea Cucumber	$188	$763,100,387
Halibut	$1,161	$763,100,387
White Seabass	$646	$763,100,387

Data source: U.S. Department of Commerce, Bureau of Economic Analysis (www.bea.gov), California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a). See Chapter 6 of this SEIS for annual ex-vessel revenues by fishery for 2000-2009.
SCB = Southern California Bight

for only a small proportion of the regional economy, on the order of thousandths of one percent.

The following sections provide a general description of the commercial fisheries for sea urchin, lobster, crab, and sea cucumber, and the gill and trammel net fisheries for halibut and white seabass. Current landings and ex-vessel revenue data for these fisheries are presented in detail in Chapter 6.

4.4.2.2 Sea Urchin Fishery

Unless otherwise noted, the following information is derived from Kalvass and Rogers-Bennett (2001) and CDFG (2004). Sea urchins have been harvested since the early 1970s in northern and southern California, where in the absence of sea otter predation sea urchin populations reached commercially exploitable levels. The commercial sea urchin fishery in southern California was initiated in 1971, when harvesting began as part of a NMFS program to develop fisheries for species identified as “underutilized.” The fishery was viewed, in part, as a way to reduce destructive grazing on kelp by sea urchins, which were formerly killed by applications of quicklime, by divers with hammers, and by removal with suction dredges after baiting with kelp (Foster and Schiel 1985). The sea urchin fishery is based primarily on harvests of red sea urchins (*Strongylocentrotus franciscanus*), but purple urchins (*S. purpuratus*) have also been taken since the mid-1980s in very low numbers, averaging about 64,000 kg (140,000 pounds) annually for all of California. Red urchins are preferred to purple urchins because of the size and quality of their gonads (also known as roe or *uni*). Most of the sea urchin catch is exported to the Japanese market, where urchin gonads are sold as a delicacy. However, some roe is used in the growing domestic sushi market.

Landings are dependent on a variety of factors, especially because the sea urchin’s market value is in the gonads, not the body. Roe quality is primarily dependent on a sea urchin’s access to kelp, which is its primary food source. If there is a food shortage (usually due to an El Niño event), sea urchins go into a “starvation mode,” where nutrients are allocated for survival, thereby causing atrophy and discoloration of the gonads. While urchin populations may persist at high densities, fishers will not expend fishing effort if the quality of the roe is low. Roe is extremely perishable, and short transport times are essential to the maintenance of quality (Kato and Schroeter 1985 in Price and Tom 1995).

The southern California sea urchin fishery expanded rapidly after its inception. Supplemented with fishers displaced from the declining abalone dive fishery, it reached its first peak in 1981 with landings of 11 million kilograms (25 million pounds). The 1982-1983 El Niño, which brought warm waters detrimental to kelp, the primary food of sea urchins, contributed to decreases in urchin landings until 1985-1986, when landings increased again. In 1990, landings reached a second peak of more than 12 million kilograms (27 million pounds). However, during the 1990s, the sea urchin catch for southern California suffered declines, averaging about 4.5 million kilograms (10 million pounds) per year. Urchin harvests were affected during this period by two El Niño events and a weakening yen. Effort and harvests shifted during the late 1990s from the northern Channel Islands (which supplied 80-90 percent of the landings from 1973-1977) to the southern islands of San Nicolas and San Clemente and the area off San Diego, although recent evidence suggests that the trend may be reversing with the recovery of kelp beds at the northern Channel Islands following the 1997-1998 El Niño. However, region-wide declines have occurred. Fishing has significantly reduced densities of red sea urchins in many areas, and catch-per-unit of effort has decreased. In the northern Channel Islands, the percentage of legal-sized red urchins in areas surveyed decreased from 15 to 7.2 percent between 1985 and 1995. According to Kalvass and Rogers-Bennet (2001), harvests of sea urchins have "exhibited a pattern resembling the serial depletion that characterized the decline and collapse of the abalone fisheries in the mid-1990s." The red sea urchin fishery in southern California has become fully exploited throughout its range, and evidence suggests it may be overfished in portions of southern California (CDFG 2004).

4.4.2.3 Spiny Lobster Fishery

Unless otherwise noted, the following information is derived from Barsky (2001) and CDFG (2004). Spiny lobsters have been commercially fished in southern California waters since the late nineteenth century. Currently, they are caught in traps constructed of wire mesh, which are baited with fish and weighted with cement, steel, or bricks. Lobster traps are required to have an approved destruct-device to ensure that they do not continue to capture marine organisms if lost or abandoned, and they must also have escape ports to facilitate the escape of undersize lobsters, those with a carapace length of less than 8.26 cm (3.25 in). Buoys bearing the trapper's license number followed by the letter P mark trap locations. Lobster traps are placed in relatively shallow, rocky areas from Point Conception south to Mexico and off the islands and banks of southern California. Some areas at Santa Catalina Island and in Santa Monica and Newport bays are closed to lobster fishing, as are some marine life refuges and reserves. The largest numbers of lobsters are taken at the beginning of the season, which starts in early October; effort and catch decline sharply in January through mid-March, when the season ends. Landings are usually highest in San Diego County, followed by Los Angeles/Orange and Ventura/Santa Barbara counties. Since 1997, a formal restricted access program has been in place for the commercial fishery. Two thirds of the lobster permits, which were previously non-transferable, became transferable without restriction in 2005 (Neilson 2011). All lobster fishers must have an operator permit, and all deckhands must have a lobster crewmember permit. Most of the lobster catch has been destined for Asian and French markets in recent years, although efforts to reestablish domestic markets have been undertaken because of depressed economies overseas.

Commercial landings of spiny lobsters for the state of California have been marked by fluctuations that reflect a number of factors, including market influences, weather patterns, the health of the population, and harvest regulations. Landings reached a high of 476,000 kg (1.05 million pounds) in the 1949-50 season. This record catch was followed by a quarter century of general decline. Landings remained between 181,000 kg (400,000 pounds) and 227,000 kg (500,000 pounds) during much of the 1980s and between 272,000 kg (600,000 pounds) and 363,000 kg (800,000 pounds) through much of the 1990s. Landings for the state of California reached a peak of 440,000 kg (970,000 pounds) in 1997-1998 but dropped to 231,000 kg (510,000 pounds) in 1999-2000. By the mid-2000s, they had rebounded to about 318,000 kg (700,000 pounds).

4.4.2.4 Crab Fishery

Commercial crab landings in the nearshore areas of the Southern California Bight are based largely on catches of rock crabs (*Cancer spp.*) and, to a much lesser extent, spider crabs (*Loxorhynchus grandis*). Sand crabs (*Emerita analoga*) are caught for bait but the annual catch is negligible, averaging only 10 kg (22 pounds) per year since 1977 (Herbinson and Larson 2001). Dungeness crabs (*Cancer magister*) are fished only in central and northern California (Hankin and Warner 2001) and will not be discussed further here.

Unless otherwise noted, the following information on rock crabs is derived from Parker (2001) and CDFG (2004). Rock crabs of three species are fished along the coast of California: yellow rock crab (*Cancer anthonyi*), brown rock crab (*C. antennarius*), and red rock crab (*C. productus*). Yellow rock crabs, which prefer soft-bottom habitat, are most abundant in southern California, whereas brown and red rock crabs are most abundant in central and northern California, respectively. More than 85 percent of the rock crab landings in California come from Morro Bay and south. Rock crabs are caught in traps made from either wire mesh or molded plastic. Most traps are set at depths of 27 to 75 m (90 to 240 ft) in open sandy areas or near rocky substrate and are left submerged for 48 to 96 hours. Vessels are generally small, and 200 or more traps may be fished by a single boat. Current regulations require traps to have escape rings of 8.26 cm (3.25 in) in diameter and require crabs kept to have a minimum carapace length of 10.8 cm (4.25 in). Rock crab landings for the entire state of California steadily increased from 1950 to 1986, when they totaled over 907,000 kg (2 million pounds). Statewide landings for 1999 were 358,000 kg (790,000 pounds) and have averaged 544,000 kg (1.2 million pounds) annually since 1991.

Unless otherwise noted, the following information on sheep crabs is derived from Culver and Kuris (2001) and CDFG (2004). Sheep crabs (*Loxorhynchus grandis*) are fished primarily over sandy bottoms, with effort concentrated in the Santa Barbara Channel and off the northern Channel Islands. Crabs are caught for the live whole crab market using traps. Traps are set in waters 9 to 21 m (30 to 70 ft) deep in spring and summer and in depths of 37 to 73 m (120 to 240 ft) in the fall and winter. Claws for the claw fishery come from set gill-nets, where the crab is usually killed in the claw removal process. Sheep crabs were not a significant fishery before 1984, when they were landed primarily as by-catch. Landings peaked in 1988 at over 45,000 kg (100,000 pounds) of live crabs and an additional 44,000 kg (96,000 pounds) of claws. Claw landings decreased dramatically to 2,300 kg (5,000 pounds) annually after a ban on gill nets in shallow waters was phased in between 1990 and 1994. Whole crab landings remained at about 34,000 kg (75,000 pounds) annually during this period.

4.4.2.5 Sea Cucumber Fishery

Unless otherwise noted, the following information on the sea cucumber fishery is derived from Rogers-Bennett and Ono (2001) and CDFG (2008c). The sea cucumber fishery in California targets two species, *Parastichopius californianus*, the California or giant red sea cucumber, and *P. parvimensis*, the warty sea cucumber. In southern California, the former is caught primarily by trawling, whereas the latter is caught almost exclusively by diving. Landings were first reported in the late 1970s. Until 1982, annual landings remained under 45,000 kg (100,000 pounds), but a shift in effort from Santa Catalina Island to the Santa Barbara Channel was accompanied by an increase in landings to 64,000 kg (140,000 pounds) annually, after which they fluctuated between approximately 23,000 and 73,000 kg (50,000 and 160,000 pounds) annually for nearly a decade. In 1991, landings reached nearly 272,000 kg (600,000 pounds), and in 1996 they peaked at nearly 408,000 kg (900,000 pounds). Whereas trawl effort decreased in the late 1990s, dive effort increased due to effects of the commercial abalone fishery closure, depressed sea urchin landings associated with El Niño conditions, and a poor export market. In 2002, combined trawl and dive sea cucumber landings reached another peak of 429,000 kg (944,700 pounds). During the mid-2000s, the trawl catch remained relatively stable, while the dive fishery declined to an average of 136,000 kg (300,000 pounds) of warty sea cucumber annually. The reduction in diver catch has been attributed to a shift in diver effort from warty sea cucumbers to red sea urchins, particularly at the northern Channel Islands. The market for sea cucumbers is primarily foreign, with the majority of sea cucumbers being shipped to Asia. A permit to harvest sea cucumbers was required beginning in 1992, and in 1997 permits began to be issued by gear type, with a limited number of permittees in the fishery.

4.4.2.6 Gill and Trammel Net Fishery

Gill and trammel nets were used increasingly from the 1960s to the mid-1980s to catch rockfish, California halibut, white seabass, California barracuda, soupfin shark, angel shark, white croaker, and other nearshore species. At the peak of gill and trammel net use in 1985, 1,122 permits were issued (Schultze 2001). Because of conflicts with sport fisheries and mortality to seabirds and marine mammals due to entanglement in the nets, California citizens voted in a 1990 initiative to ban gill-net fishing in shallow waters, resulting in the Marine Resources Protection Act of 1990 (California Constitution Article 10B). This ban took full effect in 1994. With respect to southern California, it prohibits the use of gill and trammel nets in waters less than 70 fathoms or within one mile, whichever is less, around the Channel Islands, and generally prohibits the use of gill and trammel nets within three nautical miles offshore of the mainland coast from Point Arguello to the Mexican border (Marine Resources Protection Act 1990). Two fisheries account for most nearshore gillnet landings in the Southern California Bight: halibut and white seabass.

4.4.2.6.1 Halibut Fishery

California halibut (*Paralichthys californicus*) are flatfish that are fished both commercially and recreationally in primarily central and southern California. Some halibut fishing also occurs near the Channel Islands. The record high annual landing of 2.1 million kg (4.7 million pounds) in 1919 decreased to 431,000 kg (950,000 pounds) by 1932 and has averaged approximately 408,000 kg (900,000 pounds) since. Three main gear types have been used to catch halibut: bottom trawl, set gill net and set trammel net, and hook-and-line. Since the implementation of gill and trammel net depth restrictions, hook-and-line landings have increased, especially in the San Francisco area. Mesh size on entangling nets used to catch California halibut must be at least 8.5 inches. The recreational fishery is pursued using hook-and-line and spear gun (CDFG 2004).

4.4.2.6.2 White Seabass Fishery

White seabass (*Atractoscion nobilis*) have been fished commercially for more than a century. Landings have fluctuated between millions of pounds and fewer than 45,000 kg (100,000 pounds), with a general trend of decline from 1959 to 1982, and a general trend of increase during the past decade. Currently, most white seabass are caught in the Southern California Bight, although in 2010 and 2011, significant landings occurred in central California. Gear types used to catch white seabass historically have included gill nets, hook-and-line, and round haul nets. Drift gillnets are currently the main gear used, although some fish are caught commercially using hook-and-line (CDFG 2001). A White Seabass Fishery Management Plan was adopted in

2002 by the Fish and Game Commission. Every year CDFG prepares an annual report for the Commission with a review of the fishery and status of the resource.

4.4.2.7 Live-Fish Trap Fishery

The live-fish trap fishery emerged during the late 1980s in southern California waters, targeting shallow-water species, including California sheephead, cabezon, kelp greenling (*Hexagrammos decagrammus*), rock greenling (*Hexagrammos lagocephalus*), California scorpionfish, a number of species of nearshore rockfish, and moray eels. Since then, the trap fishery has expanded northward and has targeted greater numbers of fish species. Numbers of trap fishery participants have also increased. In 1999, live-fish trap landings accounted for 7 percent of live/premium fish landings statewide. Since 1996, the southern California trap fishery has operated on a limited entry basis (Schultze 2001). The number of participants in live-catch fisheries has dropped by more than half since 1994, although the average price of live fish has increased (Lucas 2006). Due to concern that live-fish traps had the potential to trap and drown sea otters, a regulation requiring the use of 12.7 cm (5 in) sea otter exclusion rings in live fish traps went into effect for waters north of Point Conception in January 2002, but no regulations requiring such rings are in effect for southern California waters. The effectiveness of exclusion rings has not been documented. Despite continuing concerns about possible interactions between sea otters and trap fisheries, there are insufficient data to determine the effects that these traps could have on sea otters in the context of the alternatives under consideration. Therefore, we do not address the live-fish trap fishery further in this SEIS.

4.4.3 MARINE AQUACULTURE

Marine aquaculture refers to the process of culturing, growing, and harvesting ocean-living species in a controlled setting. Marine aquaculture can be conducted in the ocean in cages, on the seafloor, or suspended in the water column, or on land in ponds or tanks (http://www.nmfs.noaa.gov/aquaculture/what_is_aquaculture.html). It can be also be used to support commenrcial and recreational fisheries as well as to enhance wild stocks and habitats. Commercial marine aquaculture facilities in California are primarily focused on the production of shellfish such as abalone, clams, oysters, and mussels (CDFG 2010c). Abalone are grown in tanks on land or in cages suspended in the water column (Ebert 2001). Oysters are grown out in bays at privately owned or leased sites, with most oyster production occurring in areas north of Point Conception (Conte and Moore 2001). Much of the statewide mussel harvest comes from offshore platforms in the Santa Barbara Channel, with cultured mussels coming primarily from Tomales Bay and Agua Hediona Lagoon near Carlsbad (Richards and Trevelyan 2001).

Production of oysters, abalones, and mussels in California declined after peaking in 1994, 1996, and 1997, respectively (Wendell 2001). From 1992-1997, statewide mussel production grew from 85,000 kg (187,000 pounds) to 214,000 kg (471,000 pounds) but then dropped by almost 50 percent in 1998 due to El Niño conditions (Richards and Trevelyan 2001). Statewide mussel production returned about $500,000 annually in 1996 and 1997 but dropped to $280,000 in 1998 (Richards and Trevelyan 2001). Colder water regimes from 1999-2000 improved mussel recruitment (CDFG 2010c). Mussel production peaked in 2002, with returns of $1.2 million, but oil platform harvest ceased entirely by 2008, reducing statewide annual returns to $965,000 (CDFG 2010c). Expanding sustainable marine aquaculture is a priority identified in NOAA’s Ten Year Strategic Plan, National Marine Aquaculture Policy, and National Shellfish Initiative.

4.4.4 SEAFOOD PROCESSING INDUSTRY (SEA URCHINS)

Information on the income earned from processing or marketing commercial fish and shellfish landings is usually not available, but ex-vessel value is equal to the cost to dealers of procuring fish and provides the best available measure of value (Thomson 2001). Sea urchins require fairly intensive processing and packaging before their roe reaches Japanese markets (Price and Tom 1995). Fourteen sea urchin processing facilities are located in California, 12 of which are in southern California (Sea Urchin Harvesters Association-California 2003). For the 10 southern California sea urchin processing facilities for which information could be found, 9 qualified as "small" processing groups (producing estimated group annual sales of $1 million to $5 million), and 1 qualified as "very small" (producing estimated group annual sales of $100,000 to $1 million) (Radtke and Davis 2000).

4.4.5 KELP HARVEST

Giant kelp is harvested commercially for the production of algin, which is used as an additive in food, plaster and cement, textiles, paper, cosmetics, and pharmaceuticals. It is also used in marine aquaculture operations as food for abalone and for the production of herring-roe-on-kelp in the San Francisco Bay. Giant kelp supports a major industry in California. In 2001, the kelp harvesting industry was valued at more than $30 million annually (CDFG 2004).

Kelp harvest occurs along the coast from San Diego to Monterey Bay, but the vast majority of kelp is harvested from southern California waters by the San Diego based company ISP Alginates, Inc. (formerly Kelco). Annual kelp harvests fluctuate because of climate and growth cycles as well as market conditions of supply and demand. During the 1970s, the California harvest averaged almost 142,000 metric tonnes (157,000 tons) annually, whereas during the 1980s, the average annual harvest amounted to only about half that because of damage to kelp beds resulting from El Niño conditions and storm activity. By 1989 and 1990, statewide harvests had climbed again to more than 118,000 metric tonnes (130 thousand tons) and 136,000 metric tonnes (150 thousand tons), respectively. International competition brought harvest levels down again during the 1990s to about 64,000 metric tonnes (70 thousand tons) annually (Bedford 2001, CDFG 2004).

The Southern California Bight has historically had the highest levels of giant kelp canopy when compared to the central and northern regions of the state because of favorable environmental conditions (periodic upwelling, the broad, shallow continental shelf, good bottom substrate, and the protection from storms afforded by Point Conception and the Channel Islands) (CDFG 2000a). From 1989-1999, the area near Cojo Anchorage was the second-highest-producing kelp bed in the state, with more than 91 thousand metric tonnes (100 thousand tons) harvested (CDFG 2000a). The beds surrounding San Nicolas Island (107 and 108) have also been important kelp harvesting areas, yielding between 9 and 73 thousand metric tonnes (10 and 80 thousand tons) from 1989-1999 (CDFG 2000a). As of 2008, however, only one kelp bed in southern California was reported as leased (CDFG 2009).

4.4.6. RECREATIONAL FISHING

Southern California is a leading recreational fishing area along the west coast. Recreational fishing refers to both sport and subsistence fishing and includes hook-and-line fishing; dive, spear, and net fishing; and clamming. Recreational fisheries in the Southern California Bight access nearshore and offshore areas, targeting both bottom fish and mid-water species. Recreational fishing may occur from man-made structures, such as jetties and piers; from beaches; from commercial passenger fishing vessels (CPFVs); or from private boats. Common landings in southern California include sea basses (Family Serranidae) and tuna/mackerel (Family Scombridae), Pacific barracuda (*Sphyraena argentea*), California scorpionfish and jacks (Family Carangidae), and rockfishes (Thomson 2001).

Although sport and scientific catch of sea urchins occurs, the recreational fishery for purple sea urchins is considered “minor” (CDFG 2004), and the magnitude of the total sea urchin catch for sport and scientific purposes has not been reported. The extent of the recreational mussel harvest is unknown (CDFG 2010c). Whereas digging (and diving) for Pismo clams is considered to be an important sport fishery, and whereas healthy populations of Pismo clams occur in southern California waters, the number of people participating in this recreational fishery is also unknown (CDFG 2008). Sand crabs are targeted at low levels as bait, but the commercial harvest in California averaged only about 10 kg (22 pounds) annually from 1977 to 1999 (Herbinson and Larson 2001), and levels of recreational harvest have not been reported. There is no major recreational fishery for rock crab or sheep crab (CDFG 2004). Because of low interest and/or the lack of information on participation in these recreational fisheries, we do not consider them further in this document.

An economically significant sport fishery for lobsters does occur in southern California waters. As with commercial lobster trapping, recreational fishing for lobsters is most intensive and most successful during October (Barsky 2001). Lobsters are caught by means of dives made from CPFVs, private vessels launched from harbors, and small vessels launched from shore. Lobsters may also be caught by means of dives made directly from shore and by hoop nets deployed from shores, piers, and vessels. During the past several years, hoop-netting has emerged as an important component of the recreational lobster fishery. Along the coastline from Point Conception to Carpinteria, a majority of recreational effort and catch is not from CPFVs but by means of the other methods listed above. There is a daily bag and possession limit of seven lobsters per person. In both the recreational and commercial fisheries, lobsters must exceed a carapace length of 82.6 mm (3.25 in) to be retained (CDFG 2011).

Skippers of CPFVs are required to submit logbooks containing information on target species, number of fish caught, fishing method, and location fished for each fish taken. Additionally, since 2008, every person who goes lobster diving or hoop netting has been required to carry a lobster report card and to record data for each trip, including month, day, location, gear type, and the number of lobsters retained, regardless of the mode of fishing (such as from CPFVs, private boats boats, piers, etc.) (CDFG 2011). Lobster report cards are used to monitor recreational spiny lobster catch, fishing effort, and the gear used in the recreational fishery. These report cards are a separate entity from the CPFV logs and provide data that overlap partially with the data collected from CPFV logs (each CPFV passenger, if diving or hoop-netting for lobster, is required to carry a lobster report card, but many lobster divers and hoop-netters do not utilize CPFVs). Approximately 27,500 cards were sold in 2008, 31,000 in 2009, and 29,000 in 2010 (CDFG 2011). The number of lobster report cards sold may be used to estimate recreational fishery effort, but there is additionally an unknown number of poachers retaining lobsters illegally (CDFG 2011). Due to low report card return rates (*e.g.*, 22 percent in 2008, 14 percent in 2009, 13 percent in 2010, and 14 percent in 2011), these data represent only a small portion of the recreational lobster fishing community, and it is not currently possible to produce an unbiased estimate of effort by method, such as sport diving versus hoop netting (Buck pers. comm. 2012). CDFG is investigating ways to increase report card return rates (Buck pers. comm. 2012).

CDFG began efforts to develop a spiny lobster Fishery Management Plan (FMP), as required by the Marine Life Management Act, in 2010 (http://www.dfg.ca.gov/marine/lobsterfmp/). Development of the plan is expected to take several years.

4.4.7 Abalone Fishery Restoration

Unless otherwise noted, the information presented here is derived from Haaker *et al.* (2001). Abalone have been exploited in southern California since pre-colonial times. Archaeological evidence indicates significant use of abalone by California Indians along the mainland and at the Channel Islands before the arrival of European settlers. During the 1850s, Chinese immigrants developed an intertidal abalone fishery that targeted black (*Haliotis cracherodii*) and green (*H. fulgens*) abalone. In 1900, shallow waters were closed to commercial harvest, and the intertidal fishery ended. Japanese free-divers and hard-hat divers began exploitation of deeper water abalone in the first few decades of the twentieth century. This fishery reached a peak in landings in 1935. By 1942, the fishery had declined significantly with the wartime relocation of Japanese-Americans to camps. In southern California, commercial abalone fishing was prohibited between 1913 and 1943, but the fishery was opened thereafter to increase food production during the war. In the post-war years, the abalone fishery was managed as a single entity, which had the effect of obscuring the serial depletion of individual abalone species.

Five of the seven species of abalone that occur in California have been commercially fished during the twentieth century: black, red (*H. rufescens*), pink (*H. corrugata*), green, and white (*H. sorenseni*). Since the mid-twentieth century, commercial landings data for abalone species in California have demonstrated a pattern of intensive exploitation followed by collapse. Pink abalone (*H. corrugata*) landings reached a peak in 1952 of almost 1.8 million kilograms (4 million pounds) but declined by 1990 to one percent of their previous average annual landings (over 907,000 kg or 2 million pounds between 1950 and 1970). Green abalone landings reached their maximum in 1971 at over 454,000 kg (1 million pounds) but declined rapidly thereafter to only 6 percent of their previous average annual landings (almost 227,000 kg or 500,000 pounds from 1968 to 1972). White abalone landings peaked in 1972 at 65,000 kg (144,000 pounds) but declined rapidly thereafter. Black abalone landings reached a maximum in 1973 of almost 907,000 kg (2 million pounds) but declined by 1990 to 13 percent of their previous average annual landings (almost 318,000 kg or 700,000 pounds between 1972 and 1984). Red abalone have been the most resilient species in the face of sustained commercial exploitation, although matters are somewhat obscured by the fact that red abalone was the only species recorded in landings data between 1916 and 1943. Red abalone landings declined by 1990, at which point they were only 17 percent of their previous average annual levels (over 907,000 kg or 2 million pounds between 1931 and 1967). Advances in diving equipment and boats increased the efficiency of commercial abalone exploitation and contributed to the depletion of stocks and the continual expansion of fishing grounds. During this same period, sea otter reoccupation of historic range along the central coast of California resulted in the displacement and concentration of fishing pressure to other areas of California.

The abalone fishery was closed in 1997, with the exception of a sport-only fishery for red abalone that continues north of San Francisco County. A final Abalone Recovery and Management Plan (ARMP) was adopted by the Fish and Game Commission in 2005 (CDFG 2005c) and is hereby incorporated by reference. The Fish and Game Commission is currently considering the potential for a limited red abalone fishery at San Miguel Island (CDFG 2005c, McCreary *et al.* 2010).

4.4.8 Ecotourism and Non-Market Value

Domestic and international travelers spent $95.1 billion in California in 2010, supporting 873,000 jobs and accounting for combined earnings of $29.9 billion (Dean Runyan Associates 2011). Travel spending generated $2.1 billion in local taxes and $4 billion in state taxes (Dean Runyan Associates 2011). Ocean-dependent tourism and recreation constituted 54.3 percent of California's ocean economy, more than transportation, construction, living resources, minerals, and ship and boat building combined (Kildow *et al.* 2009). Expenditures for wildlife-watching activities in the state of California are the highest of any state and totaled about $4.2 billion in 2006 (U.S. Department of the Interior *et al.* 2006). The number of people participating in wildlife watching in 2006 was more than three times the number of people participating in recreational fishing and hunting in California (U.S. Department of the Interior *et al.* 2006).

The attractiveness of boats and harbors, and particularly the presence of wildlife, contribute significantly to coastal tourism. Ecotourism in the nearshore waters of the Southern California Bight is based primarily on the gray whale migration and on tours of ecologically significant areas. Some operators also conduct trips during the blue whale and humpback whale season in the summer and early fall (Hoyt 2001). Whale watching in the Channel Islands National Marine Sanctuary (CINMS) accounted for 25,984 person days of recreation activity in 1999 and generated more than $1.5 million in total revenue (Leeworthy and Wiley 2002). More generally, non-consumptive recreation in CINMS (which includes whale watching, non-consumptive diving, sailing, and kayaking/island sightseeing) yielded a total revenue of about $2.6 million in 1999 (Leeworthy and Wiley 2002). Loomis (2006) estimated benefits of at least $1.5 million in direct tourism income and at least $3.4 million in annual non-market economic benefits to California households related to an expansion of sea otters along the mainland coastline over the next 10 years.

4.4.9 Federal and State Agency Programs

The following sections describe relevant aspects of federal and state agency programs that may be affected by the alternatives under consideration.

4.4.9.1 U.S. Fish and Wildlife Service

The mission of USFWS is "working with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people." In the case of endangered or threatened species like the southern sea otter, we are required to promote the recovery of the species as defined by the ESA and the MMPA. Generally, the goal of the ESA is to ensure the recovery of listed species so that they are no longer in danger of extinction or likely to become in danger of extinction in the foreseeable future. Under the MMPA, federal agencies are charged with managing marine mammals to their Optimum Sustainable Population level (or maximum net productivity level). For the southern sea otter, the Optimum Sustainable Population level is believed to be greater than the population level needed to achieve recovery under the ESA. Our final revised recovery plan for the southern sea otter identifies a population size of 3,090 as necessary to consider delisting of the species under the ESA and gives the lower bound of the Optimum Sustainable Population level as approximately 8,400 animals for the California coast (USFWS 2003).

4.4.9.2 Channel Islands National Park

CINP includes five of the eight Channel Islands and spans 249,353 acres, half of which are underwater. The park is home to more than 2,000 species of terrestrial plants and animals, a wide range of marine life, and archaeological and cultural resources dating back 10,000 years. According to the *Strategic Plan for Channel Islands National Park*, the park's mission is to "protect and interpret the natural ecosystems and cultural values of the Channel Islands and adjacent marine waters (…)." The park lies within a United Nations Biosphere Reserve, designated in 1976, which includes all eight Channel Islands (www.unesco.org/mab). The "Park Mission Goals" specify that natural, scenic, and cultural resources should be "protected, restored, understood, and maintained and managed within their broader ecosystem and cultural context" (CINP n.d.).

4.4.9.3 Channel Islands National Marine Sanctuary

CINMS (Figure 4-21) is one of 12 National Marine Sanctuaries in the United States. Completely surrounding Channel Islands National Park, CINMS extends from mean high tide to approximately 11 km (6 nmi) offshore San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara Islands. The sanctuary also lies within the United Nations Biosphere Reserve (www.unesco.org/mab). Sanctuary waters host more than 27 species of cetaceans (dolphins and whales), 5 species of pinnipeds (seals and sea lions), 60 species of birds, and 23 species of sharks (CINMS 2002b). The mission of the National Marine Sanctuary Program is "to conserve and enhance biodiversity, ecological integrity and cultural legacy of areas of special national significance through comprehensive long term management and outreach" (CINMS 2002a). The National Oceanic and Atmospheric Administration (NOAA) issued final regulations, effective July 29, 2007, that establish additional marine reserves and one marine conservation area in the federal-waters portion of the Sanctuary (from the boundary of state waters out to 11 km or 6 nmi).

Figure 4-21 Channel Islands National Marine Sanctuary

4.4.9.4 California Department of Fish and Game

California Department of Fish and Game activities that may be affected by sea otters are diverse. These activities include general fisheries management or restoration, efforts to protect rare species (such as abalone and southern sea otters), and the implementation of Marine Protected Areas. Background on white and black abalone and sea otters is given under "Candidate, Threatened, and Endangered Species." Commercial fisheries and the now-closed abalone fishery are discussed under "Commercial Fisheries." Marine Protected Areas and the restoration of depleted abalone species (other than the federally listed species described above) are discussed here.

MARINE PROTECTED AREAS

Marine Protected Areas (MPAs) are areas of the ocean that are reserved for the protection and restoration of habitats and ecosystems, the conservation of biological diversity, the protection of ocean life, the enhancement of recreational and educational opportunities, the establishment of a reference point against which changes in the environment elsewhere can be measured, and the rebuilding of depleted fisheries (McArdle *et al.* 2003). Twelve MPAs at the Channel Islands were designated by the California Fish and Game Commission in 2002. NOAA expanded the MPA network into deeper waters in 2006 and 2007, resulting in 13 MPAs (Figure 4-22). Of these 13 MPAs, 11 are "marine reserves," where no fishing or kelp harvesting is allowed, and 2 are "conservation areas," in which limited recreational fishing and lobster trapping are allowed. As described in the *Final Environmental Document for Marine Protected Areas in NOAA's Channel Islands National Marine Sanctuary* (Ugoretz 2002), the Channel Islands MPAs are intended to meet multiple objectives. These objectives include an ecosystem biodiversity goal, a socio-economic goal, a sustainable fisheries goal, a natural and cultural heritage goal, and an education goal (Ugoretz 2002). The Channel Islands MPAs are also intended to meet the requirements of recent state legislation emphasizing ecosystem management, such as the Marine Life Management Act (Chap. 1052, Stats. 1998) and the Marine Life Protection Act (Chap. 1015, Stats. 1999) (Ugoretz 2002).

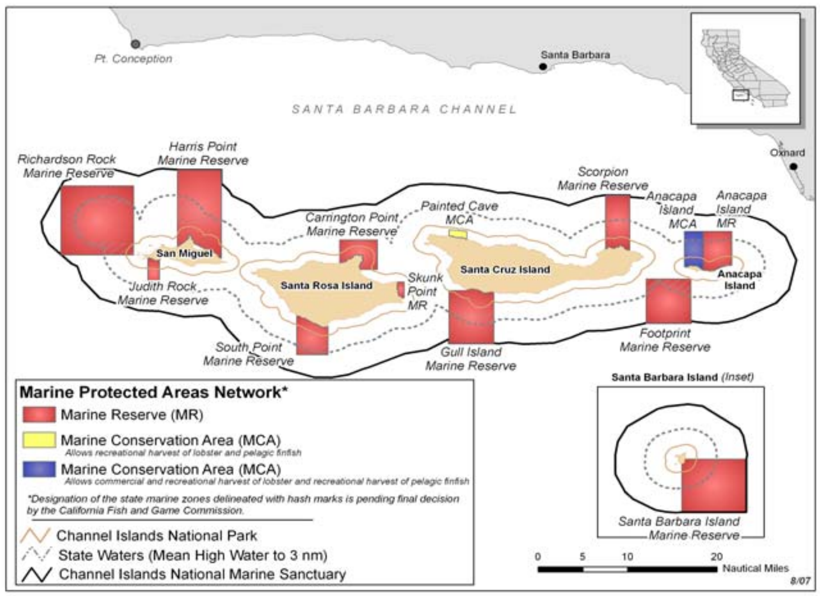

Figure 4-22 Channel Islands National Marine Sanctuary Marine

The establishment of additional MPAs throughout California is proceeding in compliance with the Marine Life Protection Act, which directs the state to redesign California's system of MPAs to function as a network. On December 15, 2010, the California Fish and Game Commission adopted regulations to create 49 MPAs and 3 special closures in southern California (from Point Conception to the Mexican border) (Figure 4-23). This 917-square km (354-square mi) network includes 13 MPAs and 3 special closures previously established at the northern Channel Islands and represents approximately 15% of the region. These new MPAs became effective as of October 1, 2011. The latest information on the establishment of MPAs in California may be found at http://www.dfg.ca.gov/mlpa/intro.asp.

RESTORATION OF DEPLETED ABALONE SPECIES (NOT FEDERALLY LISTED)

In December 2005, CDFG published a final Abalone Recovery and Management Plan (ARMP) for all seven species of abalone (red, black, green, pink, white, pinto, and flat) in California (CDFG 2005c). White and black abalone have been federally listed as endangered and are discussed separately under "Candidate, Threatened, and Endangered Species." State recovery efforts for red, green, pink, pinto, and flat abalone are discussed here. The ARMP projects

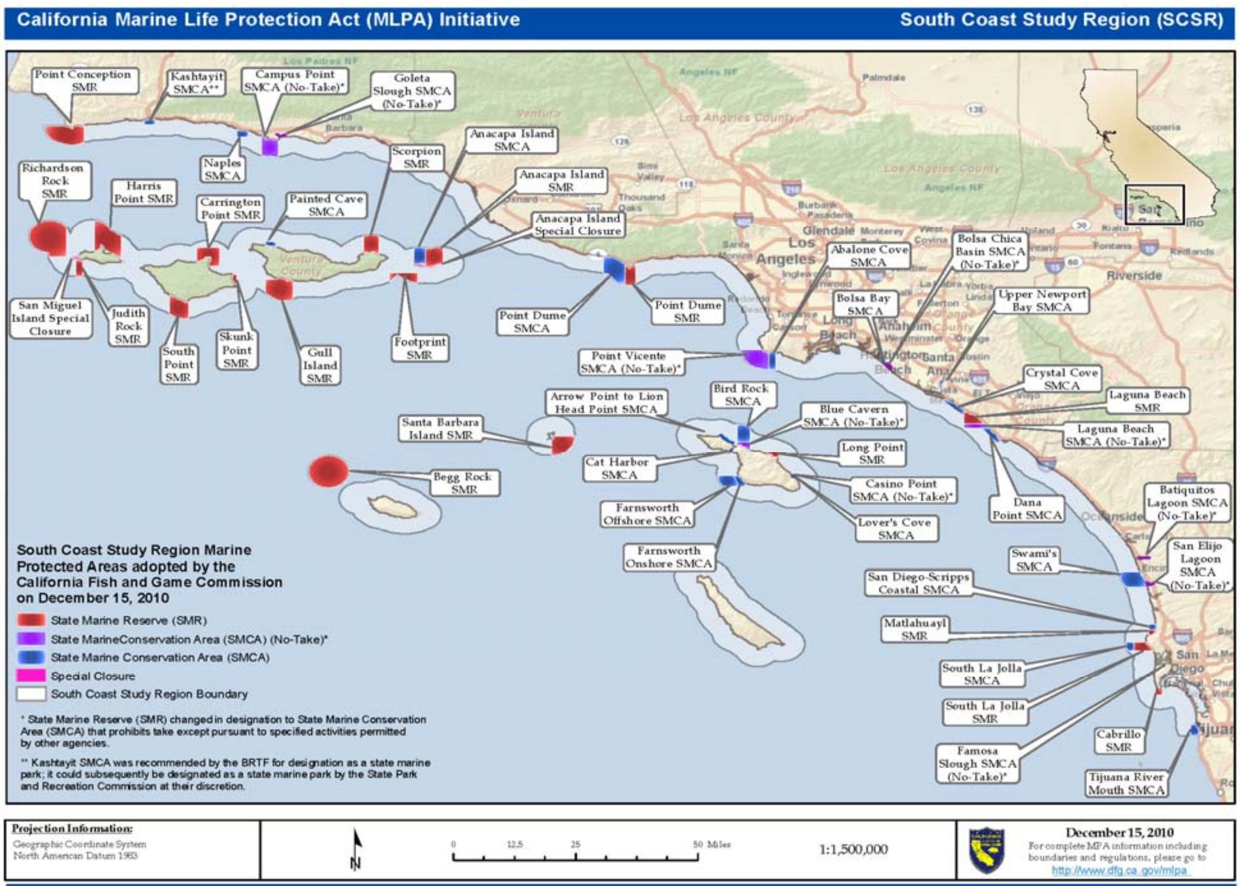

Figure 4-23 South Coast Study Region Marine Protected Areas adopted by the California Fish and Game Commission effective October 1, 2011.
Source: CDFG (http://www.dfg.ca.gov/mlpa/pdfs/scmpas121510.pdf)

recovery times and key recovery areas for each species of abalone considered in the plan (see Table 6-25 in section 6.2.9). According to these projections, abalone populations will require 6 to 20 (or more) years to meet Criterion 1, which will be achieved when abalone reach a broad size distribution over their former range. As the ARMP notes, the first step towards the recovery of abalone populations was the closure of the fishery, and a continuation of the closure until a species has recovered is an "underlying tenet" of the plan (CDFG 2005c). Enhancement activities include translocation or aggregation of adult stocks, larval outplanting, captive breeding to obtain large individuals for outplanting, and the establishment of MPAs.

4.4.9.5 U.S. Navy/Department of Defense

The U.S Navy allowed sea otters to be translocated to San Nicolas Island in 1987 provided it was given certain exemptions under the ESA at San Nicolas Island and under the ESA and MMPA in the management zone (see section 4.4.10 for a detailed description of these exemptions). The waters and airspace of the Southern California Bight are used intensively for military-related operations. The U.S. Navy and U.S. Air Force conduct military operations throughout the Pt. Mugu Sea Range (Figure 4-24), which extends over 93,240 square km (36,000 square mi), including San Nicolas Island and portions of the northern Channel Islands but excluding most of the Santa Barbara Channel. The Naval Air Warfare Center Weapons Division at Pt. Mugu carries out extensive operations in the sea range, as does Vandenberg Air Force Base.

The Navy uses the Pt. Mugu Sea Range to test guided missiles and other weapons systems as well as the ships and aircraft that serve as platforms to launch them. The sea range supports fleet training exercises, small-scale amphibious warfare training, and special warfare training. Annual numbers of events are as follows: 6,115 research, development, test, and evaluation events; 4,893 training events; 5,775 operational events, and 254 maintenance check events (U.S. Navy pers. comm. 2008). In addition to the current test and training operations conducted on the sea range, the Naval Air Warfare Center Weapons Division at Pt. Mugu proposes to accommodate Theater Missile Defense test and training activities and an increase in the current level of fleet training exercises and special warfare training. The Navy intends to modernize facilities at Pt. Mugu and

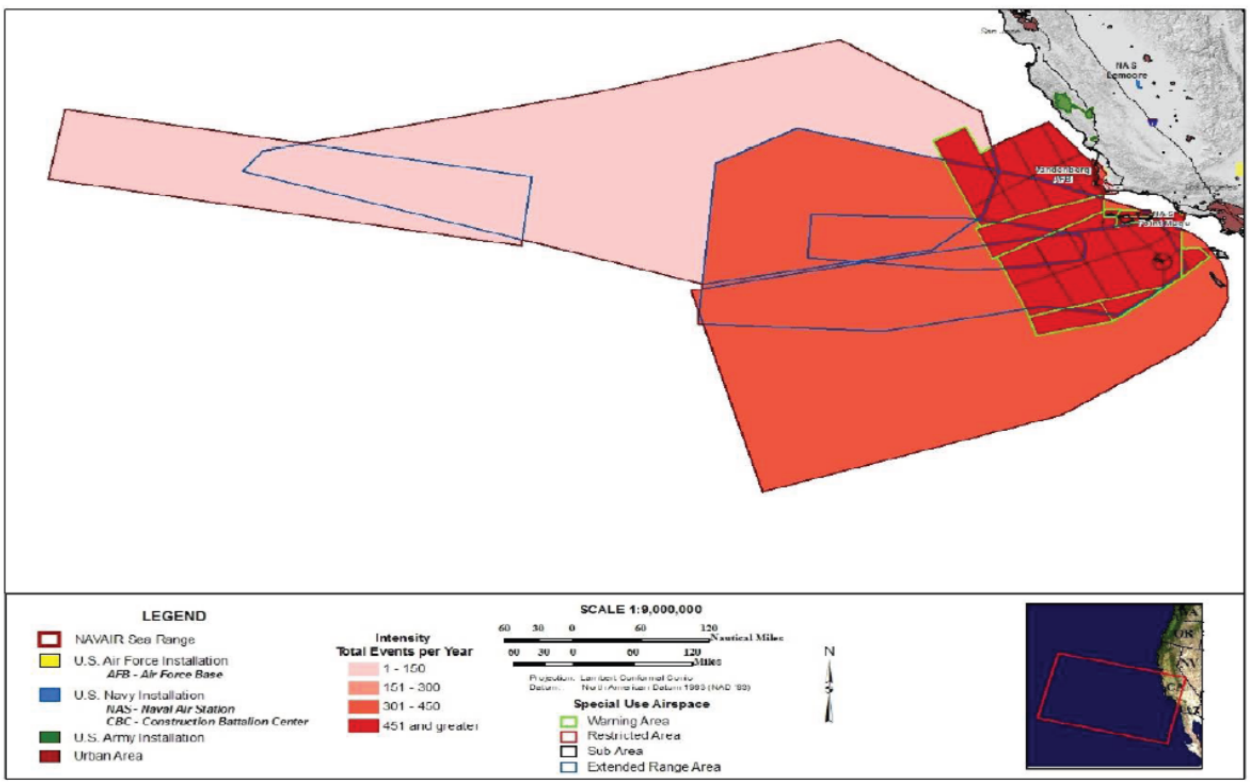

Figure 4-24 Pt. Mugu Sea Range and intensity of use

Figure 4-25 SOCAL range complex

San Nicolas Island to increase the capacity of the sea range to support existing and future operations. The Navy submitted a final environmental impact statement/overseas environmental impact statement to this effect in 2002 (U.S. Department of Defense 2002).

The Southern California (SOCAL) Range Complex (Figure 4-25) is also partly located in the Southern California Bight. The SOCAL Range Complex is a suite of existing land ranges (on San Clemente Island) and training areas, surface and subsurface ocean ranges and operating areas, and military airspace that is centrally managed and controlled by the U.S. Navy. The complex encompasses ocean operating areas and military Special Use Airspace. It extends more than 1000 km (600 nmi) to the southwest in the Pacific Ocean and covers approximately 411,588 square km (120,000 square nmi) of ocean area. The SOCAL Range Complex includes the land ranges and training areas on San Clemente Island and near-island ocean operating areas and ranges. The mission of the SOCAL Range Complex is to support Navy, Marine Corps, and joint (multi-service) training by maintaining and operating range facilities and by providing range services and support to the military services (http://www.socalrangecomplexeis.com/#SOCAL). The number and type of annual operations within three nautical miles of San Clemente Island are summarized in Table 4-5.

TABLE 4-5 NUMBER AND TYPE OF ANNUAL OPERATIONS AT SAN CLEMENTE ISLAND

Operations	Number of Annual Events	Near-future Requirement
Anti-air warfare	3,622	3,989
Anti-submarine warfare	1,673	2,971
Anti-surface warfare	32	40
Amphibious warfare	5,252	5,334
Mine warfare	61	798
Naval special warfare	8,691,281	--
Strike warfare	176	216
Airfield operations	25,120	27,400
Research, development, testing, and training	374	407

Data source: U.S. Navy pers. comm. 2008

4.4.9.6 Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management (BOEM) (formerly known as the U.S. Minerals Management Service or MMS) issues leases for oil and natural gas exploration and development and alternative energy production on the United States' Outer Continental Shelf (OCS). In California, this includes all waters from 4.8 km to 322 km (3 to 200 mi) off the coast.

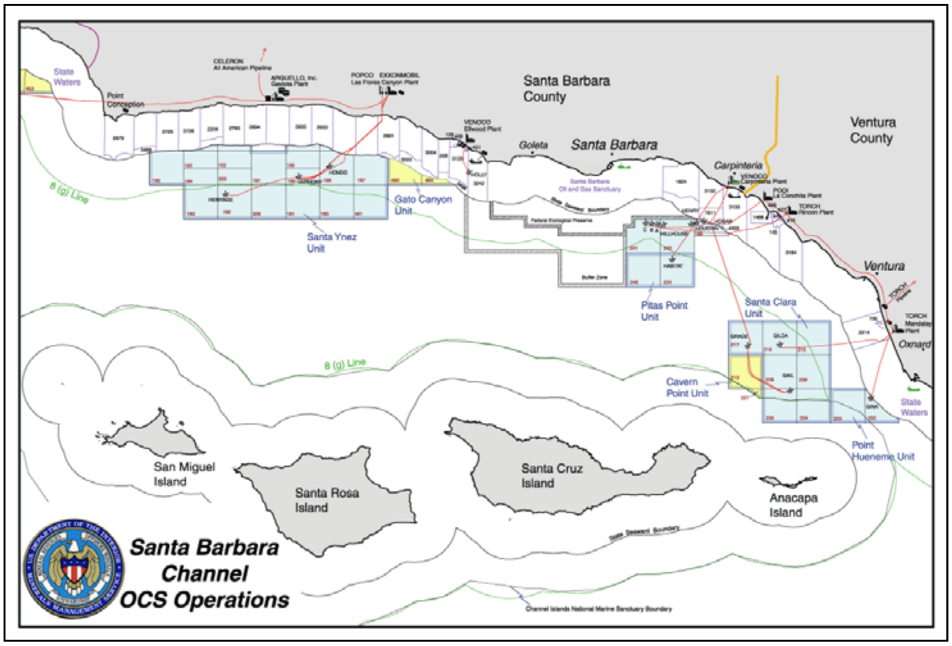

Figure 4-26 Oil leases off Santa Barbara and Ventura Counties

Currently, there are 23 OCS oil and gas platforms off the coast of California. Four platforms are located in the Santa Maria Basin north of Point Conception, 15 are located in the Santa Barbara Channel (Figure 4-26), and 4 are located in San Pedro Bay off Long Beach (Figure 4-27). In 2008, these platforms cumulatively produced an average of 66,000 barrels of oil and 128 million cubic feet of natural gas per day (BOEM pers. comm. 2010).

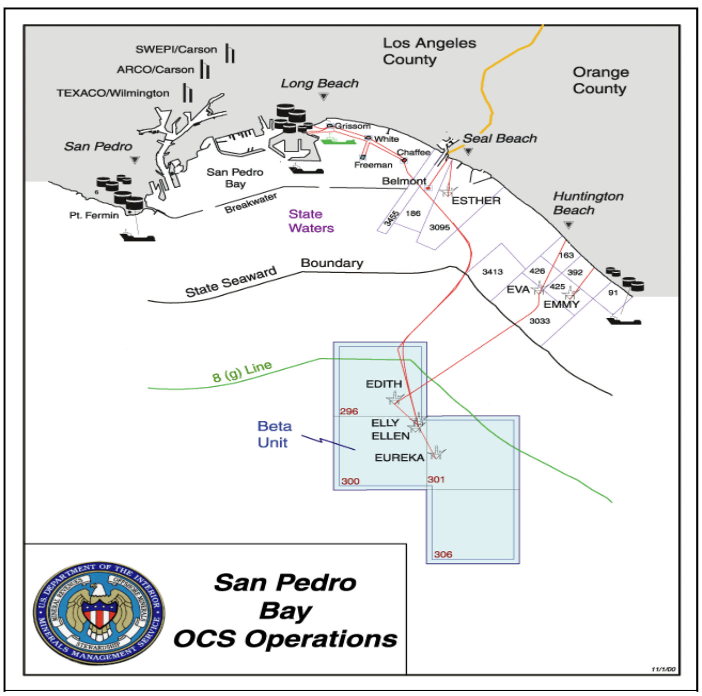

Figure 4-27 Oil leases off Los Angeles and Orange Counties

Although significant reserves of oil and gas remain, the physical presence of the oil industry offshore California will likely diminish over the next several decades. Developed fields on the Pacific OCS are nearing the limits of their economic productivity, existing undeveloped leases have not been allowed to proceed, and new leases are not being offered at this time. Some companies may initiate decommissioning of platforms within the next 5-10 years (BOEM pers. comm. 2010).

The Energy Policy Act of 2005 (EPAct) gave the Secretary of the Interior the authority to grant easements and rights-of-way for alternative energy-related activities on the OCS. BOEM is the lead agency for leasing OCS lands and coordinating their permitting processes with other executive agencies for offshore alternative energy development. BOEM may also authorize alternate uses of existing offshore oil and gas facilities for alternative energy production or other authorized marine related purposes. Currently, there are no existing BOEM OCS alternative energy leases in California. Interest in development of offshore alternative energy facilities is increasing; however, the future of this nascent industry is uncertain in California. Many proposals are likely to be introduced and reviewed over the next decade (BOEM pers. comm. 2010).

4.4.9.7 National Marine Fisheries Service

National Marine Fisheries Service activities that occur within or overlap with the nearshore areas of the Southern California Bight are diverse. These activities include implementing recovery actions for federally listed threatened and endangered species and managing federal fisheries. Information on endangered white and black abalone and NMFS-led recovery efforts for these species is given under "Candidate, Threatened, and Endangered Species." Federally managed fisheries are discussed here.

Federally managed fisheries that overlap nearshore areas of the Southern California Bight are described in the Fishery Management Plans (FMPs) for Highly Migratory Species, Coastal Pelagic Species, Pacific Groundfish, and Salmon. These FMPs are available at http://www.pcouncil.org/ and are hereby incorporated by reference. Here we briefly describe the fisheries.

The Highly Migratory Species fishery targets tunas (north Pacific albacore, yellowfin, bigeye, skipjack, and northern Bluefin), sharks (common thresher, pelagic thresher, bigeye thresher, shortfin mako, blue), billfish/swordfish (striped marlin, Pacific swordfish), and dorado (mahi-mahi) using a variety of gear types, including troll gear (towing lines with multiple hooks behind a vessel), drift gillnets (panels of netting suspended vertically in the water by floats, with weights along the bottom), harpoons, pelagic longline (a main horizontal line that has shorter lines with baited hooks attached to it), coastal purse seine (an encircling net that is closed by means of a purse line threaded through rings on the bottom of the net), and large purse seine. The recreational portion of the fishery consists of private vessels and charter vessels using hook-and-line gear.

The Coastal Pelagic Species fishery targets Pacific sardine (*Sardinops sagax*), Pacific (chub) mackerel (*Scomber japonicus*), northern anchovy (*Engraulis mordax*), jack mackerel (*Trachurus symmetricus*), and market squid (*Loligo opalescens*) generally using "round-haul" gear, including purse seines, drum seines, lampara nets, and dip nets.

The Pacific Groundfish fishery targets 64 species of rockfish (including widow, yellowtail, canary, shortbelly, and vermilion rockfish, bocaccio, chilipepper, cowcod, yelloweye, thornyheads, and Pacific Ocean perch), 12 species of flatfish (including soles, starry flounder, turbot, and sanddab), six species of roundfish (lingcod, cabezon, kelp greenling, Pacific cod, Pacific whiting, and sablefish), six species of sharks and skates (leopard shark, soupfin shark, spiny dogfish, big skate, California skate, and longnose skate), and other species (including ratfish, finescale codling, and Pacific rattail grenadier) using mostly trawl gear but also troll, longline, hook and line, pots, gillnets, and other gear.

The Salmon fishery targets mainly Chinook and coho salmon. The recreational fishery occurs in the ocean, in the inland marine environment (Puget Sound, Strait of Juan de Fuca, coastal bays) and in freshwater (including Columbia River Buoy 10). The commercial portion includes treaty Indian and non-Indian ocean troll, Puget Sound seine and gillnet, Washington coastal bays gillnet, Lower Columbia non-Indian gillnet, Mid-Columbia treaty Indian gillnet. The Tribal Ceremonial and Subsistence portion (utilizing gillnet, dip net, and hook and line), occurs in Puget Sound, Washington coastal rivers and bays, the Columbia River and its tributaries, and the Klamath River and Trinity River.

4.4.10 Regulatory Environment

The southern sea otter is listed as a threatened species under the ESA, and is therefore considered a depleted species under the MMPA. The state of California also recognizes the southern sea otter as a fully protected mammal in California Fish and Game Code section 4700 and as a protected marine mammal under California Fish and Game Code section 4500. Under all of these laws, take of southern sea otters is generally prohibited. There are provisions under the ESA and the MMPA for permitting certain types of incidental take upon consultation with USFWS; however, California’s designation of southern sea otters as a fully protected species prohibits any form of take, as defined under state law, with narrow exceptions for scientific research.

As a free-standing act of Congress, Public Law 99-625 changed the status of sea otters residing in certain areas with respect to the ESA and the MMPA. In the designated management zone, take incidental to otherwise legal activities, including commercial fisheries, is not subject to consultation requirements and is not considered a violation of either the ESA or the MMPA. With the exception of defense-related activities, take within the translocation zone is prohibited unless authorized under the ESA and the MMPA.

To accommodate Public Law 99-625 and to support the southern sea otter translocation program, the state of California added Section 8664.2 to the Fish and Game Code. This section provides additional protection for translocated sea otters in the form of gill/trammel net restrictions and prohibitions on the discharge of firearms (except by state, local, or federal employees in the performance of their official duties) at San Nicolas Island. This section also allows for incidental take of sea otters found in the management zone by means of specific exemptions from Fish and Game Code section 4700.

Chapter 5. Definitions of Significance

This SEIS determines, where possible, the significance of impact to which biological entities or socioeconomic activities would be subject as a result of the alternatives under consideration. The determination of significance takes into consideration the context of the potential impact.

Significance criteria are given only for those impact topics where the effects can be predicted with some reasonable certainty. Significance criteria are not defined for marine aquaculture because efforts to produce shellfish on nearshore open-ocean leases (the primary form of marine aquaculture in the Santa Barbara Channel that may potentially be affected by sea otters within the next 10 years) are extremely limited and because effects of sea otter foraging on these leases are expected to be localized and sporadic (see section 6.2.5). Significance criteria are not defined for kelp harvest and finfishing because: 1) the abundance of kelp and finfish is influenced by a number of biotic and abiotic factors in the ocean environment, some of which cannot be predicted with any reasonable accuracy; 2) the development of kelp in areas recolonized by sea otters would likely take 10 or more years (see section 6.2.7), whereas significance criteria are defined only for effects occurring within 10 years; and 3) the expected enhancement of finfish abundance is dependent on the change in abundance of kelp. Significance criteria are not defined for abalone fishery restoration because of the uncertain baseline for abalone fishery restoration; the Abalone Recovery and Management Plan (CDFG 2005c) does not provide projections of when the abalone fishery might be reopened (a limited red abalone fishery at San Miguel Island is under consideration but occurs outside the area where sea otters are projected to extend their range within the next 10 years). Significance criteria are not defined for ecotourism/non-market value because we have insufficient information to predict the correlation between numbers and location of sea otters and the additional revenue that would potentially accrue to ecotourism operations and because we do not have sufficient information to establish a regional context for non-market values. Finally, significance criteria for effects on agency programs are not defined because these effects and programs are various and cannot be meaningfully compared with a single set of criteria. The lack of significance criteria should not be interpreted to mean that these impact topics are less important than those to which significance criteria have been assigned. While we have not assigned significance criteria to these impact topics, we address each of them qualitatively under each alternative discussed in Chapter 6.

Where the significance has been defined, a term is included in text and tables to describe its severity. This impact may be either adverse or beneficial and is identified as such when the term is used. Definitions of these terms are provided in Table 5-1. The percentages associated with each term describing significance (*e.g.,* a change of less than 1 percent = Very Low; a change of between 1 percent and 10 percent = Low, etc.) are generally similar to those used in reference to effects on commercial fishing in our 1987 final environmental impact statement. However, that document defined the regional context as San Luis Obispo, Santa Barbara, and Ventura Counties, while acknowledging that effects were probably distributed over a larger southern California area. Because the alternatives under consideration directly concern the nearshore waters of the Southern California Bight, we define the regional context as the Southern California Bight.

TABLE 5-1 DEFINITIONS OF SIGNIFICANCE REPRESENTED BY TERMS USED IN THIS DOCUMENT

		Very High	High	Moderate	Low	Very Low
Nearshore Marine Ecosystem		Uncertain; significance not defined*				
Candidate, Threatened, and Endangered Species		Long-term, large scale adverse effects on the species	Key segments of the population or key behaviors affected; would likely change the prospects of recovery of the species	Local population effects that would not likely change the prospects of recovery of the species	Some individuals may be affected but no effect at local population level	Change in abundance that cannot be measured against natural variation in population size
Commercial Fisheries		Change in ex-vessel revenues for the SCB commercial fishery greater than 30 percent	Change in ex-vessel revenues for the SCB commercial fishery of 21-30 percent	Change in ex-vessel revenues for the SCB commercial fishery of 11-20 percent	Change in ex-vessel revenues for the SCB commercial fishery of 1-10 percent	Change in ex-vessel revenues for the SCB commercial fishery of less than 1 percent
Marine Aquaculture		Uncertain; significance not defined*				
Seafood Processing Industry (Sea Urchins)		Change in sea urchin inputs to the processing industry greater than 30 percent	Change in sea urchin inputs to the processing industry of 21-30 percent	Change in sea urchin inputs to the processing industry of 11-20 percent	Change in sea urchin inputs to the processing industry of 1-10 percent	Change in sea urchin inputs to the processing industry of less than 1 percent
Kelp Harvest		Uncertain; significance not defined*				
Recreational Fishing	**Lobster Fishing**	Change in number of lobster fishing trips for the SCB recreational lobster fishery greater than 30 percent	Change in number of lobster fishing trips for the SCB recreational lobster fishery of 21-30 percent	Change in number of lobster fishing trips for the SCB recreational lobster fishery of 11-20 percent	Change in number of lobster fishing trips for the SCB recreational lobster fishery of 1-10 percent	Change in number of lobster fishing trips for the SCB recreational lobster fishery of less than 1 percent
	Finfish Fishing	Uncertain; significance criteria not defined*				
Abalone Fishery Restoration		Uncertain; significance criteria not defined*				
Ecotourism/non-market value		Uncertain; significance criteria not defined*				
Agency Programs		Significance criteria not defined**				

*Definitions of significance are provided for all biological entities and socioeconomic activities expected to be affected by the alternatives under consideration except those entities or activities where impacts are too uncertain to describe in these terms.
**Significance criteria are not defined for effects on agency programs because these effects and programs are various and cannot be meaningfully compared with a single set of criteria.
SCB=Southern California Bight
Local population level=Change in population densities of some age- or size-classes or in a limited area of the affected species' range
Species level=Change in population densities in a substantial portion of the affected species' range that would likely affect its long-term survival

The significance criteria given in Table 5-1 are used only in reference to effects projected to occur within 10 years. Because of the number of independent factors and uncertainty involved in predictions beyond 10 years, we describe possible long-term effects in qualitative terms only and not in terms of significance. The rationale for limiting the quantitative analysis to 10 years is explained in section 6.1.3. We describe effects of the alternatives under consideration in detail in Chapter 6 and summarize them in in Tables 6-78 and 6-79.

Chapter 6. Environmental Consequences

6.1 Overview

Effects of the alternatives under consideration are described in detail in this chapter. Tables 6-78 and 6-79, at the end of this chapter, summarize biological and socioeconomic impacts by alternative.

6.1.1 Direct, Indirect, and Cumulative Effects

Effects resulting from the alternatives presented in Chapter 3 may be classified as direct or indirect. Either of these, in combination with the effects of past and reasonably foreseeable future actions, may result in cumulative effects.

Direct effects are caused by an action and occur at the same time and place (40 CFR §1508.8). For the alternatives analyzed in this SEIS, direct effects are limited to the potential for injury or death of individual sea otters moved out of the management or translocation zones and effects on agencies where regulatory changes would result from implementation of a specific alternative.

Most effects associated with the alternatives analyzed here are indirect. Indirect effects are reasonably foreseeable effects caused by an action, but they occur later in time or are farther removed in distance than direct effects (40 CFR §1508.8). Indirect effects considered in this SEIS are associated with the distribution of sea otters in the Southern California Bight. Predation on shellfish by sea otters reoccupying historic habitat can cause considerable changes in the demographics of shellfish populations and lead to broader ecological and socioeconomic changes. In the case of ecotourism and non-market (existence) value, indirect effects may result from the mere presence of sea otters in the Southern California Bight. Ultimately, the health and recovery potential of the entire southern sea otter population will be affected indirectly by any alternative that is selected.

Cumulative effects are those resulting from the incremental effects of an action when added to the effects of other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR §1508.7). The effect of sea otter predation on endangered abalone populations in the Southern California Bight, when combined with the effects of past actions that have already driven these populations to low levels, is one example of a cumulative effect considered in this SEIS.

6.1.2 Background

As described in Chapter 2 (Background), USFWS discontinued translocating sea otters to San Nicolas Island in 1990 and suspended capture efforts in the management zone in 1993. In 1998, about 100 sea otters moved into the Cojo Anchorage area near Point Conception at the northern border of the management zone. Although these sea otters left the management zone by mid-summer, about 150 sea otters again moved into the Cojo Anchorage area in January 1999. Smaller groups of sea otters have seasonally moved into and out of the management zone in subsequent years, with expansions and retractions of the range occurring regularly.

The baseline for our analysis assumes that, absent efforts to remove them from the management zone, southern sea otters will continue to expand their range into southern California. At San Nicolas Island, a small colony of approximately 46 independent (non-pup) sea otters persists. The baseline for our analysis with respect to sea otters at the island assumes that this colony will survive and grow at a rate comparable to what has been observed, on average, since 1993.

6.1.3 Timeline for Analysis

In this Final SEIS, we use a 10-year time horizon for the quantitative analysis of effects. The rationale for limiting the quantitative analysis to 10 years is based in part on the extent of uncertainty involved in predicting sea otter range expansion, in part on the indirect nature of most projected impacts (and hence possible changes over time in the relationship between sea otter presence and resultant impacts), and in part on the uncertainty associated with management regimes and economic conditions beyond 10 years.

The uncertainty involved in predicting range expansion stems from 1) the possibility that the model (Tinker *et al.* 2008a), though it is the best available, may not capture all population dynamics that ultimately prove to be relevant to range expansion, and 2) the possibility that future variation in the vital rates and movements of southern sea otters, on which predictions are based, will be different from what has been observed in the past. The uncertainty arising from the indirect nature of most impacts stems from the fact that 1) any departure from predicted range expansion will also change associated impacts and 2) changes in the ecosystem resulting from the presence of sea otters may occur differently than anticipated because of changes in a multitude of other variables unrelated to the presence of sea otters, such as global climate change, the spread of novel diseases or invasive species, or human activity (overexploitation of marine organisms, inputs of pollutants, *etc.*). The uncertainty associated with management regimes and economic conditions results from the fact that 1) fisheries may open, close, or be subject to permit or gear restrictions for reasons unrelated to the presence or absence of sea otters, and 2) commercial fisheries revenues are driven largely by market forces (which are themselves influenced by the global economic environment) that determine consumer demand. Because of these manifold sources of uncertainty, we believe it is unreasonable to attempt to establish a baseline for the impact topics we consider, and thus to attempt to quantify impacts, beyond a limited time horizon. Although the choice of 10 years rather than 5 or 15 years is somewhat arbitrary, a review of past fisheries landings indicates that a 10-year horizon represents a reasonable time frame within which predictions can be made.

It must be noted that not all effects that are expected to occur within 10 years are quantified. Some effects are speculative, depend on numerous independent factors, will occur at unknown magnitudes, or are inherently qualitative in nature; these effects are described in qualitative terms only.

We describe effects that may occur beyond the 10-year time horizon in qualitative terms only. For the purposes of our longer-term analysis, we assume that sea otters will gradually (over the course of many decades) reoccupy the portions of the Southern California Bight open to them under each alternative. This assumption, though reasonable, may be incorrect. Continuous range expansion and growth of the sea otter population are not certain.

6.1.4 Predicting Mainland Range Expansion and Colony Growth at San Nicolas Island (10-year time horizon)

The mainland southern sea otter population is currently distributed over roughly 500km of coastline from San Mateo County in the north to Santa Barbara County in the south. In spring of 2010, approximately 50 sea otters were counted southeast of Point Conception. (http://www.werc.usgs.gov/seaottercount).

Over the past several decades, sea otter range expansion along the mainland coastline has been monitored. These historical data, in combination with spatially-explicit demographic and movement information, serve as the basis for projections of future range expansion into the Southern California Bight. Because extension of the southern sea otter's range along the mainland coastline is essentially linear, this range expansion is expressed in terms of linear sections of coastline. In contrast, at San Nicolas Island, sea otter foraging is limited to a relatively small area surrounding the island, which sea otters are easily capable of circumnavigating. Because of these differences, predictions of the effects of sea otter range expansion and population growth require different strategies for the two different areas. Projections of the likely speed and extent of range expansion along the mainland and colony growth at San Nicolas Island follow.

6.1.4.1 Sea Otter Range Expansion into Southern California

The results of a simulation model (Tinker *et al.* 2008a) afford the best available means of predicting sea otter range expansion into the Southern California Bight. The model is now several years old, and thus far observed range expansion has fallen within the confidence bounds of the published predictions. To ensure that we are basing our analysis of impacts on the most current information available, we use an updated set of predictions generated by the same model but using 2009 and 2010 regional abundance and range boundary data (Tinker pers. comm. 2010).

Over multi-year time scales, the southern sea otter range has generally expanded, at least at its southern end. However, there are also periods of retraction. The range-end definition adopted in 2008 is designed to accommodate brief range retractions. Range limits along the mainland are defined as "the points farthest from the range center (to the north and south) at which 5 or more otters are counted within a 10km contiguous stretch of coastline (as measured along the 10m bathymetric contour) during the two most recent spring censuses, or at which these same criteria were met in the previous year" (http://www.werc.usgs.gov/seaottercount). The 2009 range end was defined as Coal Oil Point because of the presence of sea otters there during the spring censuses of the two previous years. However, due to the continued absence of sea otters from the area in 2010, the official range end retracted to Gaviota State Park. For the purpose of projecting range expansion and its associated impacts in this SEIS, we have chosen to err in the direction of overestimating rather than underestimating range extent. Therefore, we utilize range expansion projections based on the 2009 (more southeasterly) range limit, although for projections of the number of independent (non-pup) sea otters in the Southern California Bight, we initialize the model with the most recent available (2010) data.

There is considerable uncertainty involved in forecasting range expansion. To capture this uncertainty, we present range expansion in terms of upper and lower confidence bounds, which

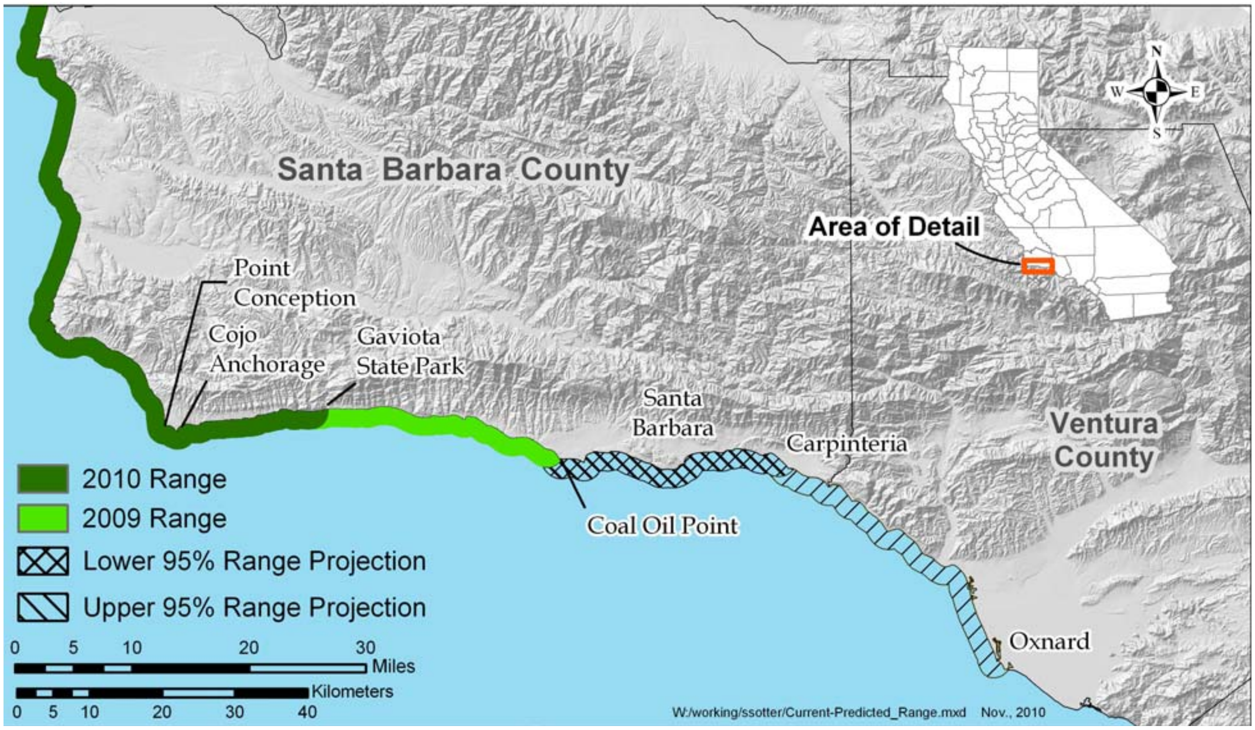

Figure 6-1 Coastal area projected to be affected by sea otter range expansion within the 10-year time horizon.

span 95 percent of the simulation runs. To the extent that the model captures the key population dynamics and that future variation in vital rates and movements is not fundamentally different from the range of variation already observed, these bounds have a 95 percent probability of encompassing the realized range expansion. The model predicts that, by 2021, between 73 and 299 independent sea otters will reside year-round along a stretch of the mainland coastline between Point Conception and the range end, and that the range end will fall somewhere between Carpinteria and Oxnard (Figure 6-1).[7]

The simulation model does not predict whether or when sea otter range expansion to the Channel Islands will occur because there are no known mainland-island or inter-island dispersal rates on which to base such a prediction. There have been no observations at any of the Channel Islands of sea otters that were captured and tagged in the mainland range.[8] Observations of tagged sea

---

[7] Use of the 2009 range end rather than the 2010 range end as the basis for range projections makes a difference only in the case of the lower bound. Based on the 2010 range extent, the lower bound in 10 years would fall just east of Coal Oil Point, whereas based on the 2009 range extent, it would fall near Carpinteria. The upper bound of projected range extent is near Oxnard in projections based on either the 2009 or 2010 range end.

[8] There have been occasional reports of (untagged) sea otters at San Miguel Island in recent years. These animals may be remnants or offspring of the sea otter population originally translocated to San Nicolas Island. During the past decade, as many as two sea otters were reported at San Miguel Island at any one time (in 2005 and 2006), but in other years there were either one or none, and no pups have been observed there (Hatfield, pers. comm. 2007, 2010). Since 2000, two sea otter carcasses have been retrieved at San Miguel Island. In 2001, the carcass of a sea otter that had been translocated to San Nicolas Island in 1987 was recovered there. In 2007, another carcass was documented at the island, but a PIT tag scan and external observation failed to detect any tags or tag scars. From 2007 to the present, no sea otters have been reported at San Miguel Island. Two sea otters were detected at other islands during the past decade, one at Santa Cruz Island in 2006, and one at Anacapa Island in 2007 (Hatfield pers. comm. 2007, 2010).

otters at the Channel Islands have been limited to those that dispersed from San Nicolas Island during the early years of the translocation program (1987-1993), and most of these animals were subsequently captured and relocated to the mainland range.[9]

Although it is conceivable that range expansion to the northern Channel Islands could begin in the short term, several factors suggest that this scenario is not likely. A sensitivity analysis conducted by Tinker *et al.* (2008a) demonstrated that range expansion rates south of Point Conception are driven primarily by female dispersal and survival. Male sea otters are known to make long-distance movements, but female sea otters (particularly reproductive-age females) exhibit much greater site fidelity and are less likely to make long distance movements (Tinker *et al.* 2006a, Chapter 3). Because population growth and subsequent re-colonization of unoccupied habitat requires the presence of reproductive females, range expansion to the islands is limited by female movement patterns. When female sea otters do arrive at the islands, the rate of population growth for the first several years is likely to be slow due to Allee effects (reduced reproductive success at low density) associated with small initial population sizes.

It must be emphasized that individual sea otters can and likely will travel further into the Southern California Bight during the 10-year time horizon. Sporadic, long-distance movements of individual sea otters are impossible to predict, however, and the effects of their foraging activities would not likely be measurable in an environmental or fishery context. Therefore, we do not attempt to quantify the effects of individual far-ranging sea otters.

6.1.4.2 San Nicolas Island Population Growth

Our 1987 environmental impact statement evaluated the effects of a sea otter colony at San Nicolas Island by projecting population growth (at a rate of 5 percent) and estimating the length of coastline that would be occupied by the number of sea otters inhabiting the island each year after translocation (Appendix A in USFWS 1987). The relationship between population size and length of occupied shoreline was based on data from the 1984 spring census of the sea otter population conducted along the central coast of California. We assumed that the percentage of habitat occupied by sea otters corresponded directly to the percentage of shellfish fishery impacts caused by sea otters. For example, we assumed that when 50 percent of the available habitat was occupied by sea otters, shellfish harvests would be reduced by 50 percent.

The impacts on fisheries at San Nicolas Island projected in our 1987 environmental impact statement have not been realized. Even with the translocation of 140 animals to San Nicolas Island, we were unable to achieve and maintain the core population size of 70 sea otters that was to have been the seed of subsequent sea otter population growth. Instead, the colony of sea otters has remained small for many years. Nevertheless, we assume that if the colony persisted at San Nicolas Island, fishery impacts would likely occur at some time in the future.

Despite the uncertainty involved in predicting population growth, particularly of a small colony (which may not follow expected general growth trends because of the effects of demographic

[9] One additional tagged animal was recaptured at San Miguel Island after having been previously captured there as an untagged animal of unknown origin, tagged, and translocated to Monterey Bay (Hatfield, pers. comm.).

and environmental stochasticity[10]), it is necessary for the purposes of our analysis to estimate the potential effects of the existing colony of sea otters on the island's nearshore environment. The determination of impacts at San Nicolas Island used in this SEIS is a modification of the approach used in the 1987 final environmental impact statement. While we assume the same direct relationship between percent occupation of habitat and percent loss of shellfish fisheries, we use a spatial rather than linear approach to quantifying the available habitat at San Nicolas Island. We use a geographic information system (GIS)-based estimation of the area of nearshore habitat surrounding San Nicolas Island and a more-recently-derived estimate of equilibrium density for sea otters in rocky habitat than the one used in the 1987 environmental impact statement. Additionally, we recalculate the population projection using the highest number of independent sea otters counted at San Nicolas Island during 2010 (46) and the observed average annual growth rate of the sea otter colony since 1993, approximately 7 percent. Our projection may result in an overestimate of population size in 10 years because during the past several years the average annual population growth rate has slowed.

Laidre *et al.* (2001) derive carrying capacity as the product of equilibrium density for a type of habitat (rocky, sandy, or mixed) and the amount of that habitat available. Although they give an estimated carrying capacity for the Channel Islands as a whole (approximately 3,300 animals), they do not estimate carrying capacities for the individual islands. To derive the carrying capacity for San Nicolas Island, we use an equilibrium density of 5.12 sea otters per square kilometer (the mean of three equilibrium densities developed by Laidre *et al.* 2001 for rocky habitat) and a GIS-derived habitat area at San Nicolas Island (nearshore waters between the coastline and the 40m isobath) of $97 km^2$. Calculated in this way, the carrying capacity for San Nicolas Island is 497 sea otters.

In the absence of detailed demographic data for the colony at San Nicolas Island, we use a simple exponential model of population growth: $N_t = N_0 e^{rt}$, where N_t is the numbers of sea otters at time t, N_0 is the initial number of sea otters, e is the base of the natural logarithm (a constant, 2.718…), r is the per capita growth rate, and t is the amount of time that has elapsed. For N_0, we use 46, the highest count of independent animals at San Nicolas Island in 2010. For r, we use the observed average annual rate of increase of the colony during the period 1993-2010 (the time between the smallest observed population size of the colony and the present), or about 7 percent. Table 6-1 shows the observed number of sea otters in 2010 and the number of sea otters expected each year for ten years (2012-2021); it also gives an estimate of the percentage of carrying capacity that each number represents. Although fishery impacts may not be detectable until some unknown population threshold is reached, we assume, in the absence of more complete information, that these impacts correspond directly to the percent occupation of available habitat.

[10] Demographic stochasticity refers to the effect of chance on whether a small population will increase or decrease from one year to the next. When a population is small, the chance fate of individual animals (such as the death of several females, or the chance birth of only males in a single year) can overwhelm the probabilities used to predict the growth rate of a large population. Environmental stochasticity refers to annual variation in environmental conditions (such as weather) and more infrequent catastrophic events, both of which can reduce or even eliminate a population. In small populations, the lack of sufficient numbers to buffer these erratic swings may result in their extinction.

TABLE 6-1 PROJECTED NUMBER OF SEA OTTERS AND PERCENT OF CARRYING CAPACITY AT SAN NICOLAS ISLAND		
Year	**Projected number of independent sea otters (7% average annual growth rate)***	**Estimated percentage of carrying capacity**
2012	53	11
2013	57	12
2014	62	12
2015	66	13
2016	71	14
2017	77	15
2018	82	17
2019	89	18
2020	95	19
2021	103	21
*Projections are based on the actual high count of independent (post-weaning) sea otters for 2010 (46).		

6.1.5 Biological and Socioeconomic Impact Topics

The biological and socioeconomic effects analyzed for each alternative are grouped into the following topics:

- Nearshore Marine Ecosystem
- Candidate, Threatened, and Endangered Species
- Commercial Fisheries
- Marine Aquaculture
- Seafood Processing Industry (Sea Urchins)
- Kelp Harvest
- Recreational Fishing
- Abalone Fishery Restoration
- Ecotourism and Non-Market Value
- Federal and State Agency Programs
- Regulatory Environment

6.2 Baseline (Status Quo)—The No Action Alternative

6.2.1 INTRODUCTION

As described in Chapter 2, on January 22, 2001, we issued a policy statement regarding capture and removal of southern sea otters in the designated management zone (66 FR 6649). The notice advised the public that we would not capture and remove southern sea otters from the management zone pending completion of a reevaluation of the southern sea otter translocation program, including the preparation of a SEIS and release of a final evaluation of the translocation program, including an analysis of failure criteria. Based on our July 2000 biological opinion, we determined that containment of sea otters was not consistent with our legal duty under the ESA to avoid jeopardy to the species.

Analysis of the No Action Alternative (hereafter referred to as the baseline) provides the benchmark against which we evaluate the effects of the other alternatives considered in this SEIS. Currently, maintenance of the management zone remains suspended, and sea otters may move freely throughout the Southern California Bight. With no action taken to remove them, over the next 10 years sea otters are predicted to expand their range gradually along the mainland coastline to Carpinteria (lower bound) or Oxnard (upper bound) and to increase in number at San Nicolas Island. In the long-term, over the course of several decades, sea otters may progressively occupy other areas of the Southern California Bight. The following analysis describes the changes that would be expected over time if the present course of action were maintained and serves as a baseline for comparison with the other alternatives under consideration in this SEIS.

6.2.2 NEARSHORE MARINE ECOSYSTEM

6.2.2.1 Overview

The effects of sea otter predation on the nearshore marine ecosystem are described in Chapter VI of our 1987 EIS. Although the reduction of invertebrate prey populations would begin immediately upon the arrival of sea otters in an area, subsequent environmental effects would occur gradually as sea otter densities increased. The environmental changes caused by sea otter predation may be broadly summarized as follows:

1) A considerable reduction in the abundance of invertebrate prey species to depths of 25 m (82 ft), with effects decreasing at depths greater than 25 m (82 ft) and approaching zero at depths greater than 40 m (131 ft);
2) A probable increase in the abundance of kelp in areas where grazing pressure by sea urchins is limiting kelp growth or establishment; and
3) A possible increase in abundance of kelp-canopy-dependent species.

Sea otters reoccupying the nearshore marine environment are expected to enhance biodiversity and the stability and persistence of kelp forest habitat. Kelp forests provide numerous direct and indirect benefits, including reductions in coastal erosion and increases in benthic productivity (Duggins *et al.* 1990) and carbon storage that can moderate climate change (Wilmers *et al.* 2012). The marine environment of southern California has been dramatically affected by human activities, such as the direct removal of many of the animal components of the community and the input of pollution, making it difficult to determine the "natural" functioning of the community (Dayton *et al.* 1998). "Trophic downgrading," or the loss of apex predators from ecological systems, may have far-reaching and unanticipated effects on ecosystem processes (Estes *et al.* 2011). The return of sea otters, apex predators that were historically present in the ecosystem, is expected to enhance ecosystem functioning and to bring the nearshore marine ecosystem to a state more closely resembling its historic (pre-fur-trade), or "natural," condition. Over the next 10 years, if sea otters recolonized the coastline to Carpinteria (lower bound) or Oxnard (upper bound) and the San Nicolas Island colony expanded in size as projected, sea otters would occupy approximately 9-23 percent of the nearshore habitat area within the 40-m (131-ft) isobath in the Southern California Bight. The following discussion provides a more detailed description of the role that sea otters play in the nearshore marine environment and the changes expected to occur in areas of the Southern California Bight reoccupied by sea otters.

6.2.2.2 Sea Otters and the Nearshore Marine Ecosystem

Sea otters are important predators in the nearshore marine ecosystems of the North Pacific Ocean and are generally considered to be a keystone species in these communities (Estes and Palmisano 1974, Palmisano and Estes 1977, Estes *et al.* 1978, Duggins 1980, Palmisano 1983, Estes and Harrold 1988). Keystone species are organisms that have large-scale community effects disproportionate to their abundance (Meffe and Carroll 1997).

The effects that sea otters have on their environment arise largely from predation. Sea otters consume a wide variety of nearshore marine invertebrates (including sea urchins, abalone, crabs, lobsters, clams, and mussels) and exert a strong limiting influence on their prey populations (see section 4.3.1.2, this SEIS; Riedman and Estes 1990). Sea otters tend to restrict prey populations to cryptic and inaccessible habitats, such as deep cracks and crevices in rocky areas, or to deep waters (sea otters usually forage in waters of 25 m (82 ft) or less and only rarely in depths exceeding 40 m (131 ft)) (Riedman and Estes 1990). In sandy areas, bivalves may escape predation by burrowing deeply. Sea otters also tend to select larger prey, which minimizes predation on smaller individuals (Riedman and Estes 1990).

Sea Urchins and Kelp Abundance

Sea urchins are favored prey for sea otters and have a prominent effect on the nearshore marine environment. They are commonly viewed as the most important subtidal grazers of macrophytes (large algae, including kelp) in the Southern California Bight (Murray and Bray 1993). Most overgrazing is ascribed to red and purple sea urchins (Ebeling *et al.* 1985) or to red, purple, and white sea urchins (Engle 1994). While white sea urchins generally consume smaller algae, at sufficient densities (greater than 10 per square meter) they can effectively prevent the reestablishment of kelp once it has disappeared from an area (Durham *et al.* 1980).

In southern California, overgrazing by sea urchins tends to occur when giant kelp (*Macrocystis pyrifera*) becomes scarce. When giant kelp is abundant, sea urchins typically feed on drift kelp, pieces of algae that break off and drift down from the canopy above (Duggins 1980, Harrold and Reed 1985). Under these conditions, sea urchins remain fairly stationary and feed opportunistically, and large numbers of sea urchins may have little effect on attached thalli (Lowry and Pearse 1973, Foster 1975, Cowen *et al.* 1982). However, shortages of drift kelp can cause starving sea urchins to gather together in moving "fronts," which can clear all attached macroalgae in their path (Dean *et al.* 1984, Harrold and Reed 1985, Engle 1994). Intense grazing in areas densely populated by sea urchins can lead to the formation of sea urchin "barrens," areas that are devoid of kelp and are characterized instead by crustose coralline algal assemblages (Dayton 1985, Foster and Schiel 1985, Engle 1994). Monitoring at sixteen sites throughout CINP from 1992-8 revealed that percent cover of algae declined with purple sea urchin density, suggesting that purple sea urchins can structure kelp forest communities (Lafferty and Kushner 2000).

According to a generally accepted sea otter-sea urchin-kelp community ecological paradigm, sea otters function as top predators in a three-level trophic cascade, in which sea otter predation limits populations of herbivorous invertebrates that would otherwise limit kelp and other macroalgae (Van Blaricom and Estes 1988, Estes and Duggins 1995). A number of studies have established a link between sea otter predation on invertebrate herbivores and increased algal abundance at specific sites (McLean 1962, Estes and Palmisano 1974, Estes *et al.* 1978, Simenstad *et al.* 1978, Duggins 1980, Breen *et al.* 1982, Laur *et al.* 1988, Oshurkov *et al.* 1988, Duggins *et al.* 1989, Watson 1993). Recently, Estes and Duggins (1995) have shown that sea otter predation has a broadly generalizable influence on the structure of kelp forests in Alaska.

However, the general applicability of the sea otter-sea urchin-kelp paradigm to ecosystems in California has been questioned (Foster and Schiel 1988, Foster 1990). Foster and Schiel (1988) contend that while sea otters can have a great impact on the abundances of large sea urchins, which can in turn cause great changes in algal assemblages at particular sites, these effects are overshadowed at larger scales by a complex of other factors that can influence kelp distribution, such as water motion, light, nutrient levels, substratum type and availability, and the presence of other sea urchin predators. They point out that the effects of sea urchin grazing are highly variable in the absence of sea otters, and that deforestation by sea urchins in California is the exception rather than the rule (10 to 20 percent of sites surveyed) (Foster and Schiel 1988, Foster 1990).

One complicating factor arises from the fact that several predators besides sea otters can affect sea urchin abundance in southern California. Known predators of sea urchins in the Southern California Bight also include spiny lobsters, sea stars, crabs, and fishes (such as sheephead) (Kalvass and Rogers-Bennet 2001). Sunflower sea stars and spiny lobsters, where not fished to low levels, have been shown to be important predators of sea urchins at the Channel Islands, and in turn predation has been positively correlated with lower rates of density-dependent bacterial disease in sea urchins (Lafferty and Kushner 2000).

Additionally, human harvest has considerably reduced densities of red sea urchins in many areas of the northern Channel Islands (Kalvass and Rogers-Bennet 2001), and it has been suggested by some that human harvest has filled the niche historically occupied by the sea otter. However, commercial fisheries focus harvest effort on commercially valuable species (*i.e.*, red sea urchins) (Kalvass and Rogers-Bennett 2001), whereas sea otters are less selective and prey on a variety of sea urchin species (Riedman and Estes 1990). The selective harvest of red sea urchins may in turn encourage the growth of white and purple sea urchin populations by releasing them from competition (reviewed in Foster and Schiel 1985), allowing them to reach high densities and to maintain some areas as sea urchin barrens. Sea urchins, when starving (as is often the case in the wake of warm-water El Niño episodes, which adversely affect giant kelp) are of little value to the commercial fishery due to the atrophy of their gonads (the consumable portion of the sea urchin). Due to the resulting fluctuations in harvest effort, these sea urchins tend to remain in their established barrens unless removed by some other form of predation, eliminated by disease (Ebeling and Laur 1988), or removed abiotically, such as by a severe storm (Ebeling *et al.* 1985).

The effectiveness with which sea otters limit invertebrate herbivore populations is not in question and is well-established (McLean 1962, Ebert 1968a and 1968b, Lowry and Pearse 1973, Wild and Ames 1974, Gotshall *et al.* 1976, Benech 1977, Pearse and Hines 1979, Ostfeld 1982, Laur *et al.* 1988). Rather, disagreement focuses on the relative importance of the role of sea urchin herbivory in influencing kelp abundance. Rocky habitats in the Southern California Bight may periodically alternate between sea urchin-dominated and kelp-dominated states for reasons unrelated to overgrazing, such as the action of severe storms (Ebeling *et al.* 1985). However, sea otters may strengthen the resilience of kelp forest communities in the face of major perturbations by preventing overgrazing by sea urchins (which can follow the loss of drift kelp due to severe storms or periods of unusually strong sea urchin recruitment) (Van Blaricom 1984). In areas where sea urchin grazing is limiting kelp establishment or growth, the presence of sea otters can generally be expected to result in an increased abundance of kelp.

Rate of Change in Kelp Abundance

The rate at which community-level changes would occur if sea otters became reestablished in southern California waters cannot be predicted with precision, but the development of giant kelp canopies (in areas where sea urchins are limiting kelp abundance) would likely require a minimum of a decade after the restriction of sea urchins to cryptic and inaccessible habitat by sea otter predation. Van Blaricom (1984) proposed that 10 or more years were required for algal communities in central California to reach a seral stage dominated by giant kelp. Dayton and Tegner (1984) concluded that a minimum of 10 years was required for seral replacement in understory patches in the Point Loma kelp forest near San Diego, and that changes in giant kelp abundance occur over longer time scales. On a much smaller scale, Laur *et al.* (1988) experimentally excluded sea urchins from plots in a sea urchin-dominated barren ground at Naples Reef (to the west of Santa Barbara) and found that algal turfs and small kelp plants (*Macrocystis pyrifera* and *Pterygophora californica*) soon overgrew the coralline algal pavements. However, kelp forests differ in structure and species composition both within and between beds in the Southern California Bight (Murray and Bray 1993), and different abiotic and biotic factors can strongly affect rates of kelp growth or reestablishment in specific areas (Dayton *et al.* 1998).

One such biotic factor, which may affect the rate of macroalgal establishment even in the presence of sea otters, is the regularity of sea urchin recruitment. Because of the size-selection of prey by sea otters, regular sea urchin recruitment may dampen the effects of sea otter predation on kelp abundance, at least initially. Estes and Duggins (1995) found that in the Aleutian Islands, the smallest sea urchins (those less than 15 to 20 mm (0.6 to 0.8 in) in test diameter) were avoided by sea otters, resulting in a sufficient abundance of immature and small mature sea urchins to slow the reestablishment of kelp. However, they found that in southeast Alaska, because of irregular recruitment, few sea urchins were small enough to escape predation, and thus kelp growth was strongly enhanced. If sea urchin recruitment in California is less episodic than in Washington, British Columbia, and southeast Alaska, then sea otter predation should be expected to have a more gradual effect on kelp abundance in California than it does in these other areas (Estes and Duggins 1995). However, the ultimate outcome would likely be similar: a considerable increase in the abundance, biomass, and distribution of macroalgae in areas where sea urchins limit kelp.

Kelp Forests and Biodiversity

The importance of macroalgae to nearshore communities is described by Mann (1982), Foster and Schiel (1985), and Duggins (1988). Giant kelp forests are highly productive and can be compared to the most productive of terrestrial systems (Tegner and Dayton 2000). They provide a complex biological structure that supports an extremely rich variety of species (Foster and Schiel 1985). More than 125 species of fish live in and near shallow rock reefs and kelp beds of the Southern California Bight (Cross and Allen 1993). The abundance of fishes on reefs is positively correlated with the presence of kelp and substrate relief. Fishes are more abundant on cobble reefs with higher densities of kelp (23-30 thalli per 100 square meters) than on those with lower densities (8 thalli per 100 square meters) (Larson and DeMartini 1984), and the abundances of fishes such as kelp surfperch, kelp bass, giant kelpfish, and kelp rockfish are directly correlated with kelp density (Cross and Allen 1993).

Sea Urchin–Abalone Interactions

Because there are complex interactions between the species preyed on by sea otters, the effects of sea otter predation on these species are not necessarily unidirectional. Sea urchins have a dual relationship of competition and dependence with abalone, all species of which are currently at low levels in the Southern California Bight due to human overexploitation, disease, and other factors (Haaker *et al.* 2001). Sea urchins and abalone have similar food and habitat preferences and thus compete for these resources. Because adult abalone subsist mainly on live and drift algae, sea urchins have a detrimental effect on abalone when drift kelp is limited because of the tendency of sea urchins to overgraze (Lowry and Pearse 1973). However, abalone may out-compete sea urchins for space when food is plentiful (Lowry and Pearse 1973). On the other hand, several instances have been identified where abalone benefit from the presence of sea urchins. Juvenile abalone may depend on the spine canopy of adult sea urchins for protection from predation where other cover is limited (Tegner and Dayton 1981, Day 1998). Sea urchins also maintain densities of coralline algal turf on kelp forest substrates that are appropriate for the post-larval settlement of abalone (CDFG 2005c).

Abalone and sea urchins share several predators and may indirectly derive benefits from them if predation reduces competition or other forms of predation. Like sea urchins, abalone are preyed on by spiny lobsters, sea stars, crabs, and fishes (such as sheephead), as well as by humans and sea otters (Haaker *et al.* 2001). Although sea otters consume abalone, they also consume large numbers of sea urchins, thereby enhancing kelp forest habitat and reducing sea urchin competition with abalone for food. Sea otter predation on crabs, sea stars, octopuses, and spiny lobsters reduces predation by these organisms on both abalone and sea urchins. In terms of maintaining a healthy population, sea urchins themselves may benefit from sea otter predation through increases in the availability of food (drift kelp) and decreases in disease that tend to follow reductions in sea urchin densities.

The low population levels that currently characterize all species of abalone in southern California (Haaker *et al*. 2001) raise the question of whether the effects of sea otter predation, when added to the primarily anthropogenic influences that have driven abalone populations to low levels, would preclude the survival and recovery of abalone species. Because abalone have coexisted with sea otters for thousands of years (and may even owe their large body size in the North Pacific to the indirect effects of intense sea otter predation pressure; Estes *et al.* 2005b), and because a number of abalone species (red, flat, pinto, black) are found within the range of sea otters along the central coast (Lowry and Pearse 1973, Cooper *et al.* 1977, Hines and Pearse 1982, Rogers-Bennett 2007, Micheli *et al*. 2008), it is unlikely that sea otter predation would pose an extinction threat to abalone species in the Southern California Bight. Nevertheless, two abalone species, white and black, are currently listed as endangered, and we examine the potential direct and indirect effects of sea otter range expansion on white and black abalone recovery efforts in section 6.2.3, "Candidate, Threatened, and Endangered Species." We analyze cumulative effects on white and black abalone in section 6.9.

Establishing the Baseline for the Nearshore Marine Environment

If sea otters reoccupied areas of the Southern California Bight as predicted, community level changes in the nearshore marine ecosystem would take place gradually. Over the next 10 years, an expanding mainland sea otter population would affect invertebrate populations from Point Conception to Carpinteria (lower bound) or Oxnard (upper bound) (see section 6.1.4.1), considerably reducing their densities and restricting individuals to cryptic and inaccessible habitat. Changes in giant kelp abundance in this area of the coast would likely take a decade or more to become noticeable and would occur only in areas where invertebrate herbivory is limiting kelp recruitment and survival. Species dependent on kelp canopy would likely benefit from any increases in kelp abundance. Increases in kelp abundance may also reduce coastal erosion by dampening wave action (Lovas and Torum 2001) and moderate climate change via carbon sequestration (Gao and McKinley 1994, Wilmers *et al.* 2012).

Based on predictions of San Nicolas Island sea otter colony growth and assumptions relating the number of sea otters to effects on invertebrate populations (see section 6.1.4.2), sea otter predation at San Nicolas Island is expected to increase from 11 percent to 21 percent over the next 10 years. This level of predation may not result in measurable changes in the nearshore marine ecosystem over this period.

Whether sea otters would reoccupy other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates (age-specific rates of fecundity and mortality and the age distribution of the population), food supply, and other variables. Those areas reoccupied by sea otters would eventually exhibit the kinds of changes described earlier in this section (6.2.2).

6.2.3 Candidate, Threatened, and Endangered Species

Table 4-1 in Section 4.3.3 includes a list of candidate, threatened, and endangered species found in the Southern California Bight. White abalone, black abalone, and the southern sea otter are the only candidate, threatened, or endangered species that are likely to be affected by the alternatives under consideration in this SEIS. These species are discussed below.

6.2.3.1 White Abalone

White abalone are now rare in California. NMFS listed the species as endangered throughout its range, from Point Conception, California, USA, to Punta Abreojos, Baja California, Mexico, in 2001 (66 FR 29046), citing overharvesting for human consumption as the primary factor in its dramatic decline in abundance. Critical habitat was not designated because the identification of such habitat was expected to increase the risk of poaching (66 FR 29046). Recovery efforts for white abalone have been initiated. NMFS convened a recovery team to identify criteria and tasks for the recovery of white abalone and published a final recovery plan in 2008 (NMFS 2008). CDFG has identified key locations for white abalone recovery, which include three of the Channel Islands (Santa Barbara, Santa Catalina, and San Clemente) and offshore banks (Tanner and Cortes) (CDFG 2005). Although broodstock has been collected for a captive propagation and enhancement program, the recovery plan identifies three factors that are hindering white abalone recovery efforts:

1) lack of funding for a captive propagation and enhancement program;
2) persistent disease problems at the Channel Islands Marine Research Institute since 2002; and
3) an inability to identify mechanisms (*i.e.* adequate funding and streamlining of the permitting process) for establishing multiple scientific research and enhancement facilities, even though a team of international abalone experts has been recommending this approach since 2001 (NMFS 2008).

According to the white abalone recovery plan, "the most significant threat to white abalone is related to the long-term effects that overfishing has had on the species" (NMFS 2008). This threat was removed with the closure of the white abalone fishery in California in 1996, but white abalone have not rebounded. The primary problems facing white abalone are low density, lack of recruitment, and the advanced age of remaining animals (NMFS 2008). Surveys reported by Butler *et al.* (2006) resulted in an estimate of white abalone numbers at the two offshore banks (12,820 at Tanner Bank and 7,360 at Cortes Bank) that is well above what was previously estimated by Hobday *et al.* (2001) for the entire southern California population (2,600 individuals). However, concern for the viability of the species remains because most individuals detected were large, indicating an absence of recent recruitment, and because most individuals were too far from their nearest neighbor (more than 2 m or 6.6 ft) to ensure successful fertilization (Butler *et al.* 2006). As broadcast spawners, abalone (including white abalone) must maintain sufficiently high densities for successful fertilization to occur (Hobday *et al.* 2001).

ESTABLISHING THE BASELINE FOR WHITE ABALONE

Although sea otter range expansion along the central California coast is known to have reduced the population levels and size distributions of some other species of abalone (Wendell 1994), it is unknown precisely what level of additional extinction risk the gradual expansion of sea otters into the Southern California Bight would pose. Since approximately 1850 (Scammon 1968), sea otters have been virtually absent from the range of white abalone. Thus, the ecological strength of the interaction between sea otters and white abalone is unknown. The white abalone recovery plan suggests that sea otters and other abalone predators may conceivably contribute to a "predator pit" dynamic with respect to white abalone. According to the "predator-pit" concept, a species experiences "a refuge from predation when abundance is very low, very destructive predation between an abundance level sufficient to attract interest from predators and an abundance level sufficient to satiate available predators, and, as abundance increases beyond this satiation point, decreasing specific predation mortality and population breakout" (Bakun 2006). However, the recovery plan concludes that "there is uncertainty about the likely patterns of interaction between sea otters and abalone in the context of abalone recovery" (NMFS 2008).

The white abalone recovery plan identifies six broad recovery actions, one of which, Recovery Action 3 (protect white abalone populations and their habitat), could potentially be affected by sea otters. Specifically, an expanding southern sea otter population could negatively affect efforts under Recovery Action 3.3 (protect white abalone populations and habitat as they are discovered or established through enhancement) through predation if white abalone populations naturally recover or are established within the depth range utilized by sea otters and within the geographic area reclaimed by natural sea otter range expansion. The white abalone recovery plan ranks the severity of the risk to white abalone from all combined non-human predation (*i.e.*, fishes, invertebrates, and sea otters) as "moderate" on a scale ranging from low to very high (see Table 5 in the recovery plan, "Threats assessment table for the wild population of white abalone in California"). It also ranks the geographic scope and level of certainty that white abalone would be affected by combined non-human predation as "moderate." The overall priority ranking of this threat is 9 (1 being highest priority, 10 being lowest priority) (NMFS 2008).

It is possible that one or a few sea otters encountering an aggregation of exposed white abalone could hinder local population recovery. However, several factors would appear to temper the overall relative increase in risk to white abalone resulting from the natural range expansion of sea otters into the Southern California Bight. A discussion of these factors follows.

> 1) The depths at which white abalone currently occur and the typical foraging depths of southern sea otters overlap only partially. Adult white abalone may occur at depths of 5-60 m (16-197 ft) (Cox 1960, cited in NMFS 2008), but currently they are most commonly found at depths of 30-60 m (98-197 ft) (NMFS 2008). Remotely operated vehicle surveys of two offshore banks and San Clemente Island by Butler *et al.* (2006) found highest numbers of abalone at depths of 40-50 m (131-164 ft) at Tanner Bank and at depths of 30-40 m (98-131 ft) at Cortes Bank (too few abalone were detected at San Clemente Island to include the area in the analysis). Under historical environmental conditions, white abalone may have been restricted to waters deeper than 25 m (82 ft) as a result of sea otter predation or competition from pink abalone (Tutschulte 1976, cited in NMFS 2008).
>
> Southern sea otters usually forage in waters shallower than those in which white abalone are now found. A study utilizing time depth recorders has provided documentation of typical and maximum sea otter dive depths in California that are not subject to the potential shallow-water bias associated with shore-based observations. This study documented that about 50 percent of all foraging dives by both males and females occurred between 4 m (13 ft) and 12 m (39 ft) in depth. Females at the center of the mainland range, near San Simeon, had a mean dive depth of 8.75 m ± 1.81 m (28.71 ft ± 5.94 ft), whereas males had a mean dive depth of 12.40 m ± 4.66 m (40.68 ft ± 15.29 ft) at San Simeon and 14.90 m ± 7.26 m (48.88 ft ± 23.82 ft) at the southern end of the range

near Point Conception. Critical foraging habitat (the depth range including 95 percent of recorded foraging dives) was shallowest for females at the center of the range, 2-20 m (7-66 ft), deeper for males at the center of the range, 2-35 m (7-115 ft), and slightly deeper still for males near Point Conception, 2-40 m (7-131 ft).

2) The stretch of coastline that sea otters are expected to reoccupy within the next 10 years is at the northernmost end of the white abalone's historic range (the historic range of white abalone extends from Point Conception in the north to Punta Abreojos, Baja California, Mexico in the south). White abalone population centers and key recovery areas are mostly in the southern half of the Southern California Bight (Butler *et al.* 2006, CDFG 2005), well away from areas of the coast where sea otter range expansion is likely to occur within the next 10 years. If the sea otter colony at San Nicolas Island persists, it is predicted to grow by an average of about 7 percent annually. Because the colony appears stable and the number of sea otters at San Nicolas Island will remain well below the estimated carrying capacity of the island over the next 10 years, substantial dispersal of sea otters from the island is unlikely. The white abalone recovery plan (NMFS 2008) does not give an estimated time to recovery; there are also no reliable estimates of the time it would take sea otters to expand their range throughout the Southern California Bight (although historic rates of range expansion indicate that the process would likely occur gradually over the course of several decades). Whether white abalone would reach recovery targets before sea otter range expansion occurred into important white abalone recovery areas is unknown.

3) Offshore banks may provide refuge for white abalone from sea otter predation. Cortes Bank and Tanner Bank, which are located in the southernmost portion of the Southern California Bight well south of the current southerly extent of the southern sea otter's range, have the highest population densities of white abalone among areas surveyed (Hobday *et al.* 2001, Butler *et al.* 2006) and have been identified as key recovery areas (CDFG 2005). After San Clemente Island, these offshore banks were historically the most productive areas for the white abalone fishery, followed by Santa Barbara Island (Rogers-Bennett *et al.* 2002). Tanner and Cortes Banks are shallow enough to support sea otter foraging, and it is possible that sea otters were extirpated from this area with no records to note the exact location, but we are unaware of any evidence to suggest that sea otters occurred there historically.

4) The habitat used by adult white abalone (rock-sand interfaces of boulders and low-relief rocky reefs) provides no crevice refuge from predation (NMFS 2008), but there is some evidence to suggest that white abalone are capable of reproducing at sizes small enough to allow them to take advantage of cryptic and inaccessible habitat. Juvenile white abalone are thought to be cryptic (NMFS 2008); if white abalone become reproductively mature at sizes that allow them to remain in crevice habitat, reproductively viable populations may successfully evade sea otter predation in the areas and depth ranges where the two species could eventually overlap as long as a sufficient amount of this habitat is available. Tutschulte and Connell (1981) reported that white abalone become sexually mature at 4 to 6 years of age at a typical size of 88-134 mm (3.46-5.28 in). Although the age and size at which white abalone become reproductively

> mature depend on a range of environmental conditions, including food availability, some evidence suggests that white abalone are capable of reproducing at a younger age and much smaller size than previously thought, about 22 mm (0.87 in) (in captivity) (McCormick and Brogan 2003).

Under baseline conditions (the ongoing suspension of containment activities), sea otters are expected to expand their range gradually along the coastline between Point Conception and Carpinteria (lower bound) or Oxnard (upper bound) and to increase in number at San Nicolas Island within the next 10 years. Fishery-dependent data indicate that white abalone formerly occurred in these areas, but fishery data collected from 1955-1997 indicate that less than one half of one percent of all white abalone landings came from these areas combined (Hobday *et al.* 2001). Historical abundance data that are fishery-independent are not available. Because relatively low numbers of white abalone occur (both presently and historically) in areas expected to be reoccupied by sea otters over the next 10 years, we do not expect sea otters to affect the white abalone population, as a whole, substantially during this period. However, if within the next 10 years the natural recovery of local white abalone populations occurred in waters within the depth range utilized by sea otters along this stretch of coastline, then it is likely that sea otters would negatively affect these local populations. Similarly, if white abalone recovery efforts included the outplanting of individuals in waters within the depth range utilized by sea otters along this stretch of coastline, then it is likely that sea otter predation would negatively affect this portion of the overall recovery effort.

We recognize our affirmative responsibilities under the ESA and fully support recovery efforts for endangered abalone. To lessen the risk that natural range expansion of sea otters (which would occur both under baseline conditions and under alternatives that terminate the translocation program) will interfere with recovery efforts for white abalone, we are committed to working closely with NMFS to share information that may affect recovery actions for this species. Specifically, we are working with NMFS to convene a working group composed of managers and scientists that have southern sea otter and abalone expertise to benefit the recovery of endangered abalone and the southern sea otter. We are also pursuing a Memorandum of Understanding with NMFS to formalize this and other cooperative efforts to facilitate the recovery of sea otters alongside the recovery of endangered abalone.

The rate at which sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. Given the relative scarcity of white abalone and the regions and depths in which they now occur, opportunities for sea otter and white abalone interaction would likely be limited in the near term, except in those situations noted above. We would not expect sea otters to expand their range into some important white abalone recovery areas for many decades, if ever.[11] See section 6.9.2 for additional analysis of cumulative effects on white abalone.

6.2.3.2 Black Abalone

The extirpation of southern sea otters from most of their former range is believed to have been responsible for the large aggregations of black abalone evident in California and Mexico during the nineteenth and twentieth centuries (Haaker *et al.* 2001). Black abalone were historically

[11] For instance, sea otters may never expand their range to Tanner Bank and Cortes Bank.

found from at least northern California to the tip of Baja California, Mexico, but the species was most abundant south of Monterey, particularly in the Channel Islands (74 FR 1937). However, beginning in the mid-1980s, black abalone populations suffered major declines, prompting a closure of the commercial and recreational fishery in 1993. NMFS added black abalone to its list of candidate species in 1999 (64 FR 33466) and listed it as endangered under the ESA in 2009 based on a number of risks, “especially: (1) the spread of and mortality caused by a disease called withering syndrome; (2) low adult densities below the critical threshold density required for successful spawning and recruitment; (3) elevated water temperatures that have accelerated the spread of withering syndrome; (4) reduced genetic diversity that will render extant populations less capable of dealing with both long- and short-term environmental or anthropogenic challenges; and (5) illegal harvest” (74 FR 1937). A final status review report was issued in 2009 (Van Blaricom *et al.* 2009). Critical habitat was proposed in 2010 (75 FR 59900) and finalized in 2011 (76 FR 66806).

Although this species was harvested for human consumption, its value compared to other abalone species was relatively low. As a consequence, the collapse of black abalone stocks occurred late in the serial depletion that characterized the commercial abalone fishery before its complete closure in 1997 (Haaker *et al.* 2001). Annual landings of black abalone peaked in 1973 at almost 907,000 kg (2 million pounds) but declined by 1990 to only 13 percent of previous levels, which averaged about 318,000 kg (700,000 pounds) annually between 1972 and 1984 (Haaker *et al.* 2001). An estimated 3.5 million individuals were taken in the commercial and recreational fisheries (Rogers-Bennett *et al.* 2002, cited in Van Blaricom *et al.* 2009).

The dramatic decline in abundance of black abalone has been exacerbated by a disease called withering syndrome. Withering syndrome began affecting black abalone populations in southern California in the mid-1980s and had spread northward into areas of the coast north of Point Conception by the early 2000s (Figures 6-2 and 6-3) (Bergen and Raimondi 2001). The disease has eliminated black abalone from large areas of its former range, including the mainland coast of southern California (Haaker *et al.* 2001, Miner *et al.* 2006). Elevated seawater temperature, while not believed to be necessary for the occurrence of withering syndrome and the onset of mass mortality, is thought to promote these conditions (Bergen and Raimondi 2001, Raimondi *et al.* 2002). Mass mortalities appear to be followed by recruitment failure, either as a result of limited dispersal of larvae, lack of appropriate settlement habitat (due to changes in intertidal species assemblages following the elimination of adults), or the continued effects of the disease agent (Miner *et al.* 2006). Significant declines in abundance (more than 90 percent) have occurred at most (76 percent) of the long-term monitoring sites in California (Tissot 2007, cited in Van Blaricom *et al.* 2009).

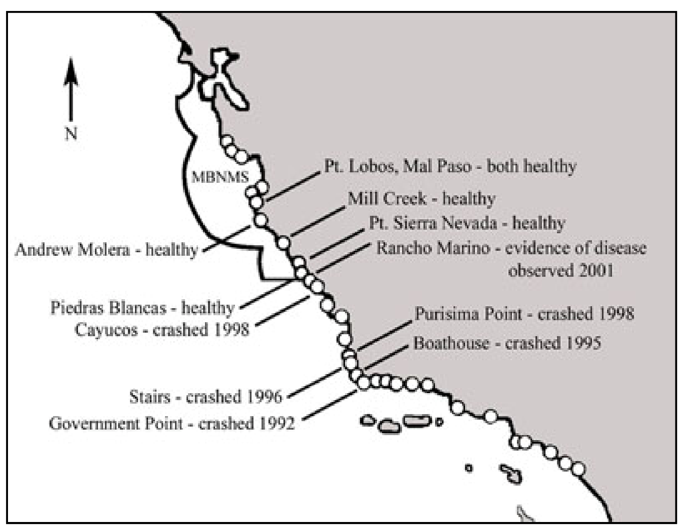

Figure 6-2 Northward progression of withering syndrome, 1992-2001
Source: Bergen and Raimondi (2001)

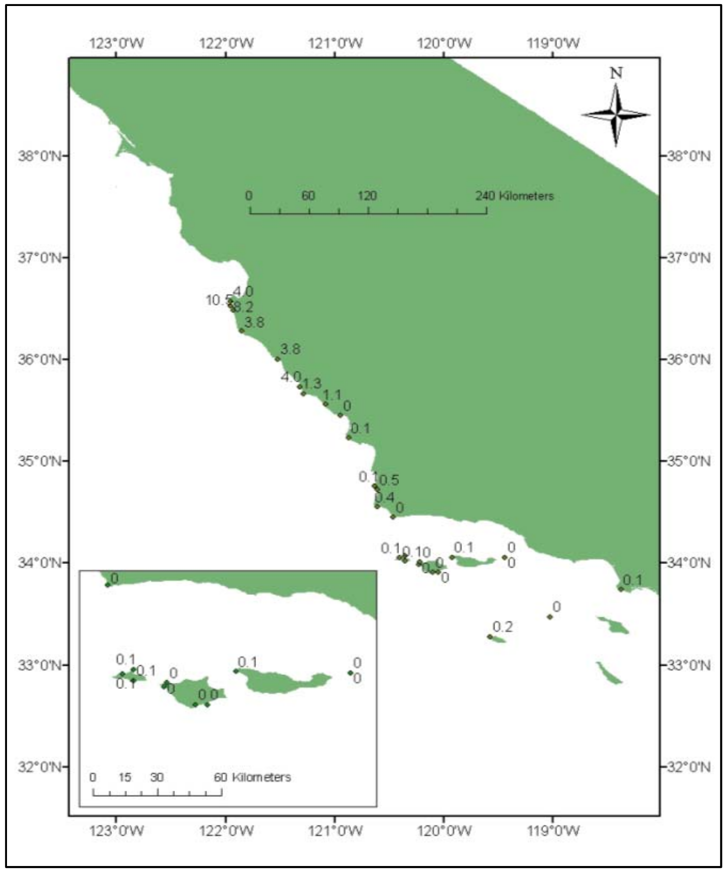

Figure 6-3 Mean density (no./m^2) of black abalone at long-term monitoring sites in California, 2002-2006
Source: Butler *et al.* (2009)

Like other abalone species, black abalone may be preyed upon by sea otters. Black abalone inhabit water depths well within the range of sea otter predation (generally rocky intertidal areas), although cryptic and inaccessible habitats provide refuge for the species. Newly settled larvae, juveniles, and sexually mature individuals up to 100 mm (3.94 in) in length usually remain cryptic, inhabiting deep fissures or areas beneath rocks (Haaker *et al.* 2001). Because black abalone generally become sexually mature at about 50 mm (2 in) in length (Haaker *et al.* 2001), cryptic black abalone are capable of sustaining reproductively viable populations in the presence of sea otters. Micheli *et al.* (2008) found that black and red abalone at eight central California sites, all within sea otter habitat, persisted at low but stable densities when protected from human take (although they did not occur at levels that could support fisheries, even at sites protected from human take). Nearly all (97 percent) of the black abalone encountered during surveys were found in crevice habitat, with significant aggregation of individuals (Micheli *et al.* 2008). Where sea otters and black abalone coexist, abalone are restricted to cryptic and inaccessible habitats that afford protection from sea otter predation, and abalone of the size formerly harvested for human consumption, greater than 150 mm (6 in), are reduced in number.

A considerable portion of the black abalone's range overlaps the current range of the southern sea otter. Whereas southern California stocks have been severely reduced by overfishing and disease in the general absence of sea otter predation, healthy populations of black abalone can still be found in areas within the sea otter's long-established range along the central California coast. The highest black abalone densities occur at northern long-term monitoring sites near the Monterey peninsula, where sea otters have been present for approximately 50 years. In fact, a recent study along the central coast of California (from Pebble Beach to Rancho Marino), where black abalone appear to be unaffected by disease and densities of sea otters and black abalone are relatively high, has found that sea otters do not negatively affect, and in fact may even increase, the abundance of black abalone (Raimondi *et al.* in prep.). This dynamic may be due to an increase in the availability of drift kelp arising from the positive relationship between sea otters and kelp abundance, although it likely holds true only in areas where black abalone populations have access to high quality cryptic habitat and have not been severely depleted by disease (Raimondi *et al.*, in prep.). At San Nicolas Island, where approximately 50 sea otters exist, black abalone at one study site have increased since 2001 (when a mass mortality event associated with withering syndrome reduced abundance to its lowest level), suggesting the possibility of genetically based disease resistance in this local population (Van Blaricom *et al.* 2009).

The severe reduction of black abalone populations as a result of human overexploitation and disease has rendered them more vulnerable to all sources of mortality, including natural sources such as predation by marine organisms. The final status review for black abalone ranks the severity of the overall threat level posed by sea otter predation as "medium" (see Table 6, Van Blaricom *et al.* 2009). It notes that although sea otters are known to prey on black abalone, the quantitative ecological strength of the interaction is poorly understood (Van Blaricom *et al.* 2009). It further notes that the effects of sea otter predation on black abalone populations are difficult to predict because they vary in space and time with the movement of particular sea otters (with individualized prey specializations) into and out of foraging locations (Van Blaricom *et al.* 2009).

Establishing the Baseline for Black Abalone

Under baseline conditions (the ongoing suspension of containment activities), sea otters are expected to expand their range gradually along the coastline between Point Conception and Carpinteria (lower bound) or Oxnard (upper bound) and to increase in number at San Nicolas Island within the next 10 years. Intertidal habitat along much of this section of mainland coastline does not support black abalone. If local recovery of black abalone populations nevertheless occurred within this stretch of coastline in areas lacking sufficient cryptic habitat, whether naturally or as a result of outplanting efforts, sea otters would likely have a detrimental effect on these populations. However, if future recovery actions for black abalone included relocating or aggregating exposed individuals in crevice habitat sufficiently deep to afford protection from sea otter predation, then sea otters would likely have more limited effects on these populations. The effect that a persistent colony of sea otters would have on black abalone at San Nicolas Island is uncertain. As noted above, a population of black abalone that may be partially resistant to withering-syndrome has been detected there (Van Blaricom *et al.* 2009). Observations of sea otter foraging from 2003-2005 indicate that abalone constitute only a very small fraction (less than one percent) of the sea otter diet at San Nicolas Island (Bentall pers. comm. 2008). The fact that sea otters and black abalone historically co-occurred and continue to co-occur at the island suggests that black abalone populations have sufficient refuge from sea otter predation to maintain viable populations there. In its responses to comments in the final critical habitat designation for black abalone, NMFS states, "one of the only places in southern California where black abalone populations have been increasing and where multiple recruitment events have occurred since 2005 (*i.e.*, San Nicolas Island) is also the only place south of Point Conception where a growing population of southern sea otters exists, indicating that black abalone populations can recover and remain stable in the presence of sea otters" (66 FR 66806; October 27, 2011).

We recognize our affirmative responsibilities under the ESA and fully support recovery efforts for endangered abalone. To lessen the risk that natural range expansion of sea otters (which would occur both under baseline conditions and under alternatives that terminate the translocation program) could interfere with recovery efforts for black abalone, we are committed to working closely with NMFS to share information that may affect recovery actions for this species. Specifically, we are working with NMFS to convene a working group composed of managers and scientists that have southern sea otter and abalone expertise to benefit the recovery of endangered abalone and the southern sea otter. We are also pursuing a Memorandum of Understanding with NMFS to formalize this and other cooperative efforts to facilitate the recovery of sea otters alongside the recovery of endangered abalone.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. The effect that sea otters may have on depleted black abalone stocks throughout the area is uncertain. It is unknown how long it might take sea otters to expand their range throughout the Southern California Bight (if this range expansion does indeed occur), and it is unknown whether or how long it will take black abalone populations to increase to the point that they may be considered recovered.[12] Therefore, we cannot state whether black abalone would recover before sea otters expanded their range throughout the Southern California Bight. If sea otters did recolonize the Southern California Bight, historic rates of range expansion indicate that the process would likely occur gradually over the course of several decades, potentially allowing time for black abalone populations to rebound from the effects of human harvest and disease in the absence of predation pressure from sea otters. In areas without sufficient cryptic and inaccessible habitat, into which black abalone populations may have expanded following the human-caused extirpation of sea otters, black abalone will be vulnerable to predation resulting from sea otter range expansion unless recovery actions include the relocation or aggregation of exposed individuals in cryptic habitat. In areas of the Southern California Bight with sufficient cryptic and inaccessible habitat, portions of the black abalone population will be shielded from sea otter predation. In its final rule designating critical habitat for the black abalone, NMFS concluded that "the best available data do not support the idea that sea otter predation was a major factor in the decline of black abalone populations or that it will inhibit the recovery of the species" (76 FR 66806, 66808).

Critical Habitat

Critical habitat for black abalone includes a number of areas both within the current sea otter range and outside the current sea otter range (in southern California waters) (76 FR 66806). One segment of mainland coastline designated as critical habitat (from Montana de Oro State Park in San Luis Obispo County, to just south of Government Point, Santa Barbara County) that overlaps slightly with the action area (the Southern California Bight) has already been recolonized by sea otters. This area of overlap extends along 11.3 km (7 mi) of coastline from Point Conception to just southeast of Government Point. The remainder of the portion of the mainland coastline that sea otters are expected to reoccupy within 10 years has not been designated as critical habitat. All of the Channel Islands have been designated as critical habitat except the military-owned San Nicolas Island and San Clemente Island, which are covered by integrated natural resources management plans (76 FR 66806). If sea otters do recolonize the Southern California Bight gradually over the course of several decades, then their range will overlap with black abalone

[12] A federal recovery plan does not yet exist for black abalone; consequently, formal recovery criteria under the ESA and an estimated time to recovery are not yet available. The State's ARMP (CDFG 2005) does not estimate a time to recovery for black abalone.

critical habitat in southern California, just as it currently overlaps with black abalone critical habitat in central California. The primary constituent elements of critical habitat essential for the conservation of black abalone are: rocky substrate; food resources; juvenile settlement habitat; suitable water quality; and suitable nearshore circulation patterns (76 FR 66806). Of these five elements, only one, food resources, may potentially be affected by sea otters. Sea otters would generally be expected to improve food resources for adult black abalone through predation on sea urchins. However, ecological relationships are complex, and it is likely that numerous positive and negative interactions would occur simultaneously.

6.2.3.3 Southern Sea Otter

In 1977, USFWS listed the southern sea otter as a threatened species under the ESA. The listing was based on the southern sea otter's small population size, its greatly reduced range, its vulnerability to oil spills, and the potential risk of oil spills (42 FR 2965). Our original recovery plan (USFWS 1982) for the species sought to encourage range expansion, and the translocation program, which is also reevaluated in this final SEIS, was an integral part of that plan. However, the translocation program has failed to meet its objectives (Appendix C). The revised recovery plan for the southern sea otter (USFWS 2003) continues to focus on efforts to increase the size of the southern sea otter's population, but it no longer recommends the translocation of sea otters as a means to achieve this goal. Furthermore, the recovery plan acknowledges the recovery team's recommendations to declare the translocation program a failure, to allow natural range expansion to occur, and to allow the colony at San Nicolas Island to remain at the island rather than capturing these sea otters and releasing them in the mainland range (USFWS 2003).

Establishing the Baseline for the Southern Sea Otter

Under baseline conditions, sea otters are expected to continue to expand their range into the Southern California Bight. Over the next 10 years, the southern sea otter's range is predicted to expand gradually along the coastline to Carpinteria (lower bound) or Oxnard (upper bound) (see section 6.1.4.1). Range expansion of the mainland population is expected to result in between 73 (lower bound) and 299 (upper bound) independent sea otters residing year-round south of Point Conception in 10 years. If the colony at San Nicolas Island persists, it is predicted to grow at a rate similar to that observed at the island since the colony's low point in the early 1990s, an average of 7 percent annually (from a projected 53 independent animals in 2012 to 103 in 2021). Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If recolonization occurs, it is expected to occur gradually over the course of many decades.

Like portions of the sea otter's existing range, the marine habitat in the Southern California Bight, particularly along the mainland coastline adjacent to urban centers, has been degraded by a multitude of human activities. It also contains some natural hazards. It has been suggested that restricting range expansion could protect sea otters from these hazards. In what follows we describe the expected baseline (that is, the effects of continued natural range expansion into southern California waters) with respect to several mortality factors that are known, or have been suggested to be, important for southern sea otters. We assess the risks that sea otters will encounter in these new areas relative to the risks encountered by sea otters in the currently occupied range (approximately Pigeon Point to Gaviota State Park). It is important to note, however, that without range expansion and access to additional prey resources, any significant growth of the southern sea otter population as a whole is probably precluded. Although sea otters in the southern portion of the mainland range (south of Cayucos) are not believed to be food limited and are currently subject to high rates of mortality due to white shark bites (see "White shark bites" below), sea otters in the central portion of the range (Monterey to Cayucos) are believed to be food-limited (http://www.werc.usgs.gov/seaottercount). As a consequence, now and increasingly in the future, as sea otter densities increase in the southern portion of the range, many or even most of the sea otters under discussion (the sea otters in the new areas) will likely not exist without range expansion (see "Food limitation" below). Thus, spatially based risks to sea otters resulting from southward range expansion should realistically also be evaluated against the risk of these sea otters not existing at all.

<u>Food limitation</u> Several lines of evidence, including the lack of population growth in the center portion of the range (where sea otters have been long established and densities are highest), suggests that the population in this region is approaching equilibrium abundance (Tinker *et al.* 2008b, http://www.werc.usgs.gov/seaottercount). Per-capita prey availability is greater in unoccupied or recently occupied portions of the sea otters' range than it is in areas that have long been occupied by sea otters (*e.g.,* Bentall 2005, Tinker *et al.* 2008b). Range expansion into areas with with higher per-capita prey availability thus appears to be necessary for population growth. Continued natural range expansion into southern California waters would be expected to result in better body condition of the sea otters utilizing these areas, a higher population growth rate in these areas relative to the population growth rate in the center of the range, and a larger population size overall.

<u>Harmful algal blooms</u> Harmful algal blooms, such as blooms of the domoic-acid producing diatom *Pseudo-nitzschia*, are regular occurrences within the existing central coastal California range of the southern sea otter, just as they are within southern California waters. According to the California Department of Public Health, *Pseudo-nitzschia* was observed at sites representing all coastal counties of California during 2011, with the greatest relative abundances observed in San Luis Obispo County (well within the southern sea otter's current range). Concentrations of domoic acid above the alert level (20 parts per million (ppm)) were detected in 73 samples from four counties: Santa Cruz, San Luis Obispo, Santa Barbara (all within or partially within the current sea otter range) and Ventura (outside the current range but expected to be partially recolonized within 10 years) (http://www.cdph.ca.gov/HealthInfo/environhealth/water/Documents/Shellfish/AnnualReports/Annual_Report_PSP_2011.pdf). Sea otters in southern California waters would thus likely have approximately the same risk of exposure to harmful algal blooms as do sea otters in the currently established range.

<u>White shark bites</u> The proportion of sea otter deaths attributed to white shark bites has increased dramatically over the past five years in the area between Estero Bay and Pismo Beach (http://www.werc.usgs.gov/seaottercount). Before 2001, the cause of death for approximately 8-11 percent of recovered southern sea otter carcasses was determined to be shark bite, and most of the shark-bitten carcasses were found in the northern half of the southern sea otter's range (in the vicinity of Monterey Peninsula and Point Ano Nuevo). Since 2001, the proportion of carcasses attributed to shark bite mortality has averaged 21 percent. Although Point Ano Nuevo has remained a location of high shark-bite mortality, shark-bite deaths in the southern half of the

range have increased (from 6 percent of recovered carcasses before 1990 to 30 percent since 2001). The last five years have also seen an increase in the percentage of female animals among these carcasses (17 percent before 1990 but 37 percent in the past five years) (http://seaotters.com/2012/03/24/sea-otter-mortality-from-white-sharks-in-california/). The reasons for the geographic shift and increase in shark bite mortality are unknown. Adult white sharks, whose diet is composed primarily of marine mammals, are associated with pinniped rookeries, primarily those at Ano Nuevo and the South Farrallon Islands, whereas the Southern California Bight serves primarily as a summer pupping area for pregnant females and a nursery ground for young sharks (Tricas and McCosker 1984, Klimley 1985, both cited in Dewar *et al.* 2003). Young white sharks do not eat mammals but rather invertebrates and fish (Tricas and McCosker 1984, cited in Dewar *et al.* 2003). Thus is is likely that sea otters in southern California waters would have a lower risk of mortality from white shark bites than sea otters in the currently established range.

Protozoal encephalitis The pathways by which sea otters are becoming exposed to protozoal pathogens, such as *Toxoplasma gondii*, are more complex than were at first recognized. Until recently, it was believed that cats (both domesticated and wild) were the only definitive host for this protozoal parasite. However, the widespread exposure of other marine mammals to *T. gondii* (including those whose habitat is mostly pelagic and distant from human population centers) and recent laboratory analyses have suggested that there may be a definitive host in the marine environment (*e.g.*, Jensen *et al.* 2010). The relative contribution of parasites from wild felids versus domestic or feral cats is also an outstanding question (one that is currently under investigation). For instance, Conrad *et al.* (2005) determined that a unique Type X strain of *T. gondii* is responsible for 72 percent of sea otter infections. Miller *et al.* (2008) screened 45 terrestrial carnivores (lions, bobcats, domestic cats and foxes) and 1396 invertebrates (mussels, clams and worms) to determine the distribution of *T. gondii* genotypes and found *T. gondii* strains with Type X alleles only in two mountain lions, a bobcat, and a fox that had been utilizing coastal habitat near Monterey Bay and Estero Bay. The Type X strain was not found in domestic cats. The uncertainty regarding the role of domestic cats as the source of the *T. gondii* oocysts infecting sea otters makes it impossible, given the information currently available, to determine whether sea otters in southern California waters (which border urbanized areas with large domestic cat populations) would have a different risk of exposure to these oocysts than sea otters in the currently established range.

However, it is important to note that the occurrence of infectious disease resulting from protozoal pathogens appears to be related synergistically to exposure to harmful algal blooms and to nutritional stress (food limitation). These factors often interact in complex ways that are just beginning to be understood. For example, lower per-capita food availability leads to poorer body condition and greater reliance on sub-optimal prey, which increases exposure and susceptibility to novel disease-causing pathogens (Johnson *et al.* 2009). This susceptibility may be further exacerbated by chronic domoic acid exposure (Tinker pers. comm. 2012). Because sea otters in southern California waters would have approximately the same risk of exposure to domoic acid as sea otters in the currently established range (see "Harmful Algal Blooms" above) but access to more abundant prey (which results in better body condition, greater resistance to disease, a decreased reliance on sub-optimal prey, and hence a decreased exposure to disease-causing pathogens), it is likely that sea otters in southern California waters would have a lower incidence of disease resulting from the presence of protozoal pathogens such as *T. gondii* in the marine environment than sea otters in the currently established range.

Oiling from Natural Oil Seeps Numerous natural oil seeps occur in the nearshore waters from Point Conception east to the vicinity of Coal Oil Point and elsewhere in the Southern California Bight (Lorenson *et al.* 2009). However, this risk is not unique to the area. Natural oil seeps also occur in other parts of the southern sea otter's range, such as north of Santa Cruz, at several locations along the central coast, and near Point Arguello. The effects of natural oil seeps on sea otters are not well understood. In general, the risk of oiling from natural seeps is expected to be considerably less than that from anthropogenic oil spills. Whereas seeps may cause chronic, low-level stress to marine organisms, they differ in effect from anthropogenic oil spills because of the rate at which oil enters the environment. Seeps release oil slowly enough that natural processes that disperse and degrade the oil can occur, whereas spills release large volumes of oil in a short time, overwhelming these natural mechanisms (County of Santa Barbara Energy Division 2002). The presence of a group of sea otters at Coal Oil Point for extended periods during 2007 and 2008 resulted in no known oil-related strandings. The sub-lethal effects of oiling from natural seeps are largely unknown, but because natural oil seeps occur in other portions of the southern sea otter's range, sea otters in southern California waters would likely have only a slightly higher risk of mortality or sub-lethal effects from natural oil seeps than sea otters in the currently established range.

Oil Spill Risk The final revised recovery plan for the southern sea otter (USFWS 2003) contains an oil spill impact analysis (Ford and Bonnell 1995) as Appendix B. This analysis modeled several oil spill scenarios, including a "reasonable worst case" scenario based on a 250,000 barrel (bbl) spill, roughly the size of the *Exxon Valdez* spill. The scenarios modeled in Appendix B inform the conclusion in the recovery plan that the translocated San Nicolas Island colony could not provide a reasonable safeguard against an oil spill of the magnitude of the *Exxon Valdez,* and that an alternate recovery strategy (allowing natural range expansion) should be adopted. Although numerous offshore oil platforms are located in the Southern California Bight, the threat from oil produced at these platforms will decrease over the next several decades as offshore oil production declines (McCrary *et al.* 2003). Even assuming continued production at late-20th-century levels, the volume of a future spill on the Pacific Outer Continental Shelf resulting from offshore oil production would likely be relatively small, probably less than 200 bbl, and almost certainly less than 500 bbl (McCrary *et al.* 2003). However, an increase in tankering and shipping activities is expected and may pose a growing threat (McCrary *et al.* 2003). In its evaluation of oil spill risk from vessel traffic, the West Coast Offshore Vessel Traffic Risk Management Project found that coastwise traffic density is higher along the section of the west coast between the Strait of Juan de Fuca (at the US/Canadian border) and Los Angeles/Long Beach than either north of the Strait or south of Los Angeles/Long Beach, with highest traffic densities specifically 1) between the Strait of Juan de Fuca and the Columbia River, and 2) between San Francisco and Los Angeles/Long Beach (http://library.state.or.us/repository/2010/201007070951103/index.pdf). Tankering and shipping activities clearly affect the entire existing range of the southern sea otter as well as areas within the Southern California Bight. Therefore, sea otters in southern California waters would likely have a similar risk of exposure to an oil spill as sea otters in the currently established range;

however, the overall (population-level) risk of exposure to a large oil spill would decrease with increased range extent.

Overall, continued natural range expansion would maximize the habitat available for southern sea otter recovery, allow sea otters to exploit areas that are not food-limited, and reduce the species' vulnerability to widespread catastrophic events. According to Doak (2011), the probability that southern sea otters will reach the recovery criterion of 3,090 animals within 10 years if they are allowed to continue to expand their range into southern California waters is 89 percent (77 percent if inter-year correlations in growth rates are considered).

Under the baseline, the management zone and translocation zone continue to exist, even if maintenance remains suspended. Different regulatory provisions apply to sea otters found in the management zone or translocation zone than apply to sea otters existing outside these zones. For a discussion of the regulatory provisions that apply to sea otters under the baseline, see section 6.2.12. For a discussion of our ability to meet our mandates under the ESA and MMPA under baseline conditions, see section 6.2.11.1.

6.2.4 Commercial Fisheries

For a discussion of the regulatory environment (including as it pertains to commercial fisheries) see section 6.2.12. For simplicity and in accordance with convention, all discussions of landings are reported in US/Imperial units only.

Our analysis of commercial fisheries in this document is based largely on commercial fisheries landings data organized by species, year, and statistical block (Figure 6-4). These data represent the amount paid to fishers for their raw catch, which is reported by participants in the commercial fishery to CDFG. The term "annual ex-vessel value" as used in this document means the combined value taken in by all vessels participating in the fishery (it is not a per-vessel value). All references to the southern California fishery cited as CDFG (2002a), CDFG (2005a), CDFG (2006a), CDFG (2008a), and CDFG (2010a) in this document include landings for coastal areas and islands but exclude landings for offshore banks. Other information cited in this document is derived from the 2001 status report produced by CDFG, *California's Living Marine Resources* (Leet *et al.* 2001) and the Annual Status of the Fisheries Reports through 2003 (CDFG 2004), 2006 (CDFG 2008c), and 2010 (CDFG 2010c). The analysis that follows focuses on species that are important commercially and that coincide with the sea otter's primary diet, namely sea urchins, spiny lobsters, crabs (*Cancer* spp.), and sea cucumbers. The analysis also addresses a potential additional closure of gill and trammel net fishing along the coastline if the State or NMFS close additional areas to these gear types to protect sea otters as they expand their range along the coast. This potential closure would likely affect the commercial halibut and white seabass fisheries. The southern California fishery for abalone (*Haliotis* spp.) is currently under a moratorium and is discussed in a separate section entitled "Abalone Fishery Restoration." For additional background information on California fisheries, please refer to section 4.4.2.

6.2.4.1 Baseline Assumptions for Impacts on Fisheries

The following assumptions apply to the analysis of fishery impacts associated with alternatives considered in this SEIS:

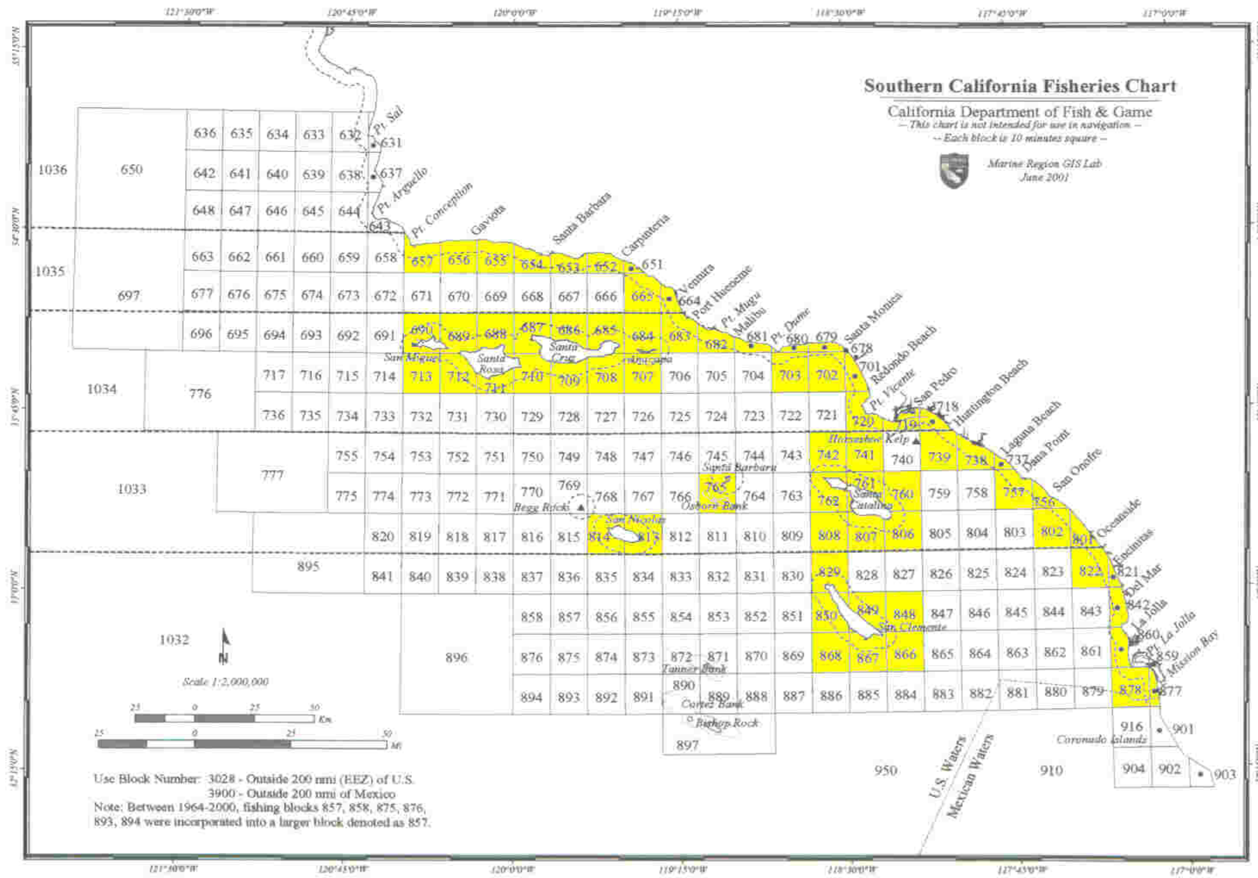

Figure 6-4 California Department of Fish and Game statistical block map, with nearshore blocks highlighted.
Source: CDFG (2001)

1. Over the next 10 years, southern sea otters are expected to extend their range and to approach equilibrium densities along the coastline. The projected sea otter range end within this timeframe is uncertain. Therefore, potential impacts are presented as a range where the lower bound includes the coastline from Point Conception to Carpinteria and the upper bound includes the coastline from Point Conception to Oxnard (see section 6.1.4.1). We assume that shellfish fisheries will be eliminated within these areas during this period. The affected lower bound area corresponds to CDFG statistical blocks 651, 652, 653, 654, 655, 656, and 657. The affected upper bound area corresponds to CDFG statistical blocks 683, 664, 665, 651, 652, 653, 654, 655, 656, and 657 (see Figure 6-4).

2. The halibut and white seabass fisheries will not be affected by sea otter predation. However, the State or NMFS may choose to enact closures to protect sea otters from gill and trammel nets in areas where the management zone and its associated regulations are removed. Because the incidental taking of sea otters in commercial fishing nets is already prohibited within the translocation zone, no change will occur at San Nicolas Island under any of the alternatives. We do not know whether or when the State or NMFS would enact any additional closures. Therefore, we present a range where the minimum estimate represents no protective legislation and the maximum estimate

represents immediate protective legislation along the affected coastline. The affected coastline in this maximum-estimate scenario is assumed to include the area from Point Conception to Port Hueneme. This area contains the upper bound estimate of range expansion within 10 years (to Oxnard) and a small supplementary portion of coastline (approximately to Port Hueneme) that, due to its bathymetry and shape, would likely be included in any depth closure intended to protect sea otters whose range had extended to Oxnard. The maximum estimate further assumes that the State or NMFS will enact an immediate closure of gill and trammel net fishing in the vicinity of the projected sea otter range to depths (104 m or 341 ft) that include all dives of 99 percent of sea otters.[13] Such a closure would primarily affect commercial halibut and white seabass fishers by eliminating any halibut or white seabass catch by gill or trammel net within the affected area. Halibut and white seabass landings made using other types of gear would not be affected. The affected area for the maximum estimate corresponds roughly to CDFG statistical blocks 651, 652, 653, 664, 665, 666, and 683.[14] The statistical blocks from Point Conception to Santa Barbara are not included because the bathymetry of the area is such that the current closure (to three miles from the mainland) is believed to be fully protective of sea otters. Because the statistical blocks of the affected area do not correspond well with bathymetry, we use landings from the entire block unless the anticipated closure overlaps a block only minimally (less than 10 percent), in which case we exclude that block (see Figure 6-13). This approach likely results in an overestimate of maximum impacts.

3. We assume that shellfish resources are fully exploited by commercial/recreational fisheries and, where applicable, sea otter predation. We further assume a perfect inverse relationship between sea otters and shellfish fisheries, so that any increase (decrease) in sea otter predation would lead to a proportional decrease (increase) in fishery harvests. This assumption may lead to an overestimation of impacts, especially during the early phases of sea otter reoccupation of an area (*i.e.*, measurable impacts may occur later in time than projected here).

4. Effects of sea otter habitation along the coastline are assumed to be equally distributed across time and space. For example, we assume that a 50 percent occupation of an area, consisting of *X* blocks, would result in a 50 percent decrease in shellfish harvest across all *X* blocks.

5. We assume that when sea otters permanently reside in a given area, the commercial fisheries for sea urchin, lobster, crab, and sea cucumber will no longer be viable in that area.[15] Although it is unknown whether the presence of sea otters would eliminate the

---

[13] These depths are based on time-depth recorder data from sea otters in the south half of the range (Tinker pers. comm. 2008).

[14] CDFG statistical block 683 includes both Oxnard and Port Hueneme.

[15] Interactions between sea otters and shellfish fisheries are described in Estes and Van Blaricom (1985). They conclude that some shellfish fisheries (*e.g.*, rock crabs, northern razor clams, butter clams, littleneck clams, and mussels) can persist in the presence of sea otters, whereas others (commercial sea urchin and abalone fisheries) cannot. Because there has not been a considerable overlap in the range of southern sea otters and spiny lobsters in the recent past, Estes and Van Blaricom do not draw a conclusion regarding the effects of sea otters on lobster fishing. We conservatively assume that sea otters will eliminate sea cucumber, crab, and lobster fisheries (in

lobster sport fishery entirely, we make the conservative assumption that the sport fishery would also be adversely affected at the same rate as the commercial fishery in areas where sea otters become established. Thus, commercial and recreational fisheries are assumed to be mutually exclusive with, and equally affected by, sea otter predation.

6. To simplify calculations, effects of sea otter reoccupation are assumed to be equally distributed across time. For example, we assume that 10 percent of impacts would accumulate each year, summing to 100 percent in year 10.

7. We assume that once commercial catch is eliminated from a statistical block, any effort expended in another block would not increase total landings for southern California. Thus, the resulting change in landings and ex-vessel revenue may be overestimated.

8. We assume that the sea otter population at San Nicolas Island will increase at a 7 percent average annual growth rate over the next 10 years.

9. At San Nicolas Island, we assume that changes in shellfish fisheries are inversely proportional to changes in the percentage of carrying capacity occupied by the colony. If the colony increased by 7 percent annually, it would grow from a projected 53 animals in 2012 to 103 animals in 2021. With an estimated carrying capacity of about 500 animals, the sea otter population at San Nicolas Island would increase from 11 percent of carrying capacity in 2012 to 21 percent of carrying capacity in 2021, resulting in a 10 percent decrease in commercial shellfish harvests over 10 years.

6.2.4.2 Sea Urchin Fishery

For a description of the commercial sea urchin fishery, see section 4.4.2.2.

Southern California Sea Urchin Fishing Effort

Fishing effort and harvest of sea urchins in the southern California commercial fishery have shifted in recent years from the northern Channel Islands (which supplied 80-90 percent of the landings from 1973-1977) to the southern islands of San Nicolas and San Clemente and the coastline near San Diego. Commercial harvest has considerably reduced densities of red sea urchins in many areas, and catch-per-unit of effort has decreased (Kalvass and Rogers-Bennett 2001). From 2000 to 2009, an annual average of 131 vessels participated in the sea urchin fishery (Leos pers. comm. 2010).

Past Landings and Ex-Vessel Revenues

Table 6-2 summarizes landings and ex-vessel revenues for the southern California sea urchin fishery from 1986-2009. This table also includes specific information for the areas that would likely be affected by sea otter predation over the next 10 years: 1) the coastline from Point Conception to Carpinteria (lower bound coastline estimate), 2) the coastline from Point

---

addition to precluding sea urchin and abalone fisheries) in the areas they reoccupy. However, we do not know the level of harvest at which a commercial fishery would become non-viable. In our analysis, we employ zero landings as a non-viable fishery, with the understanding that in reality the commercial fishery could collapse earlier.

TABLE 6-2 COMMERCIAL SEA URCHIN HARVEST: LANDINGS AND EX-VESSEL REVENUE BY AREA.								
Year	Commercial Landings (pounds)				Ex Vessel Revenue (thousands of 2009 dollars)			
	SCB*	Point Conception to Carpinteria	Point Conception to Oxnard	San Nicolas Island	SCB	Point Conception to Carpinteria	Point Conception to Oxnard	San Nicolas Island
1986	12,155,209	375,010	375,010	2,369,846	$5,315	$124	$124	$1,209
1987	7,193,837	409,559	409,559	3,395,431	$2,747	$211	$211	$1,326
1988	6,006,438	286,154	288,184	2,335,082	$2,740	$233	$235	$703
1989	5,309,415	543,572	543,572	356,974	$3,061	$488	$488	$286
1990	10,402,343	602,291	605,485	2,184,513	$8,486	$475	$477	$1,548
1991	16,340,679	427,320	443,762	2,323,093	$10,323	$76	$92	$1,282
1992	13,628,097	766,282	780,487	1,504,035	$12,485	$538	$554	$1,319
1993	14,897,618	454,678	470,330	1,372,737	$14,370	$315	$340	$1,026
1994	16,196,547	454,596	473,228	1,715,937	$26,365	$800	$832	$2,505
1995	16,714,982	532,960	551,327	2,971,561	$24,222	$839	$868	$3,876
1996	15,776,375	400,291	406,186	1,291,148	$21,007	$613	$622	$1,572
1997	13,199,317	485,052	502,332	1,359,738	$15,146	$601	$621	$1,495
1998	7,001,081	199,738	201,741	942,818	$7,511	$213	$215	$915
1999	10,378,689	62,164	73,626	1,675,293	$13,552	$75	$84	$2,115
2000	9,947,301	40,288	56,493	546,048	$12,945	$52	$69	$628
2001	8,271,694	34,270	34,870	293,539	$10,068	$40	$40	$325
2002	8,286,564	16,294	17,974	337,618	$8,676	$17	$18	$314
2003	8,660,645	72,445	72,935	389,698	$8,470	$66	$66	$379
2004	10,755,600	83,017	94,637	192,331	$8,133	$65	$76	$167
2005	9,945,705	81,619	81,619	309,575	$6,389	$47	$47	$228
2006	9,528,115	116,653	116,663	503,377	$4,953	$54	$54	$233
2007	9,528,019	72,956	76,464	708,353	$4,619	$32	$34	$330
2008	7,581,618	30,527	40,015	171,936	$4,619	$14	$21	$90
2009	8,193,962	15,531	18,487	60,853	$5,030	$8	$11	$31

Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a)
*All references to the southern California fishery as a whole include landings for coastal areas and islands but exclude landings for offshore banks.

Conception to Oxnard (upper bound coastline estimate) and 3) San Nicolas Island. These areas are discussed in greater detail below.

Southern California Bight

Figure 6-5 shows commercial sea urchin landings and numbers of sea urchin diving permits for the southern California fishery. The annual sea urchin harvest in southern California peaked at 16.7 million pounds in 1995 but declined to a low of about 7.0 million pounds in 1998. In the late 1990s, a strong El Niño event (1997/1998) affected the quality of sea urchins available for harvest, and a weak Japanese economy (the primary market for harvested sea urchins) reduced demand and forced downward pressure on prices (Kalvass and Rogers-Bennett 2001).

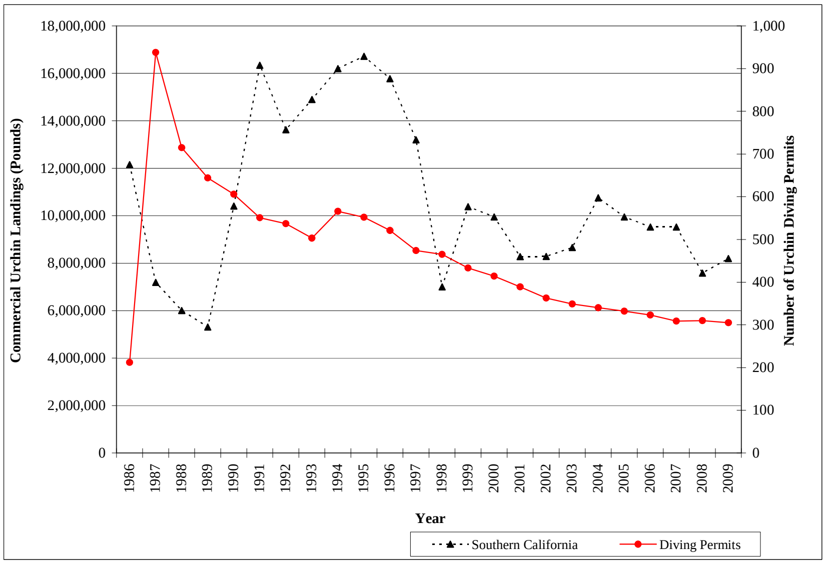

Figure 6-5 Commercial sea urchin landings and sea urchin diving permits for the Southern California Bight, 1986-2009
Data source: California Department of Fish and Game (2002a, 2005b, 2006a, 2008a, 2010a)

Coastline, Point Conception to Carpinteria and Point Conception to Oxnard

Sea urchin landings along the coastline from Point Conception to Carpinteria and Point Conception to Oxnard are depicted in Figure 6-6. Sea urchin landings along these two segments of coastline followed the same patterns over the last 20 years. Sea urchin landings in both areas peaked in 1992 but have since declined dramatically. During the 1997-1998 El Niño event, landings dropped between 285,000 and 300,000 pounds from 1997 to 1998. Landings along the Point Conception to Carpinteria coastline continued to decline after the 1997-1998 El Niño event and averaged 38,000 pounds annually from 1999 through 2002. However, landings increased in 2006 to over 116,000 pounds but have declined to 15,000 pounds in 2009. Landings along the Point Conception to Oxnard coastline also declined after the 1997-1998 El Niño event and have further declined to 18,000 pounds in 2009.

San Nicolas Island

Sea urchin landings at San Nicolas Island peaked at over 3 million pounds in 1987 but have since declined by 90 percent. During the 1997-1998 El Niño event, landings dropped from 1.4 million pounds in 1997 to about 943,000 pounds in 1998. In 1999, landings at the island increased to pre-El Niño levels, but subsequently (in 2001) they dropped again to 294,000 pounds. Landings were about 61,000 pounds in 2009.

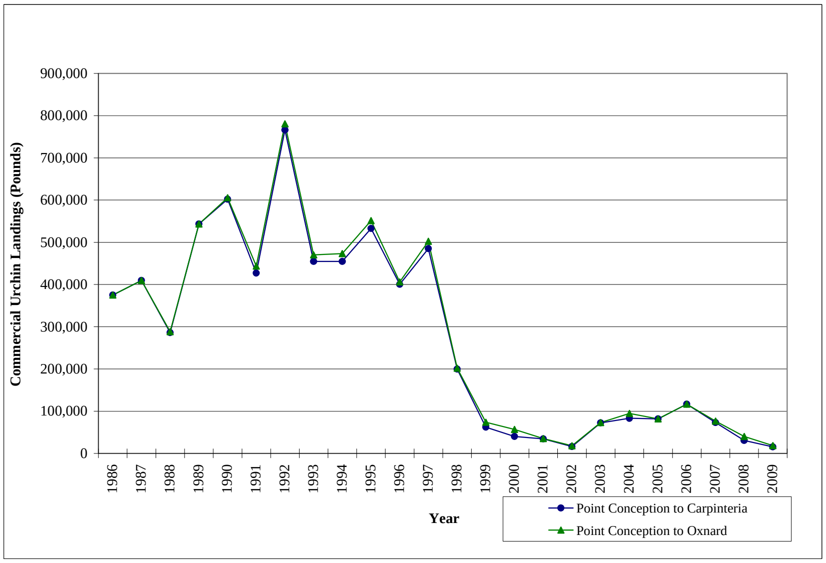

Figure 6-6 Annual sea urchin landings: Point Conception to Carpinteria and Point Conception to Oxnard, 1986-2009
Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a)

Northern Channel Islands
Sea urchin landings surrounding the northern Channel Islands reached 10.1 million pounds in 1991 but declined to 6.1 million pounds in 2009. In 2009, sea urchin landings from this area had an ex-vessel value of $3.5 million (2009 dollars). From 2000 to 2009, commercial sea urchin landings averaged 5.6 million pounds annually, with an average annual ex-vessel value of $4.1 million (2009 dollars).

TABLE 6-3 AVERAGE ANNUAL SEA URCHIN LANDINGS, 2000-2009.

	Average Annual Landings (pounds)	Percentage of Southern California Bight Landings
Impact Range:		
Point Conception to Carpinteria (coastline)	56,360	1%
Point Conception to Oxnard (coastline)	61,016	1%
San Nicolas Island	351,333	4%
SCB (excluding landings from the above areas)	8,657,574	95%
Total Annual Landings	9,069,922	100%

Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a)

Percentages of Fishery
From 2000 to 2009, annual commercial sea urchin landings along the coastline from Point Conception to Carpinteria accounted for one percent of southern California sea urchin landings, and landings along the coastline from Point Conception to Oxnard also accounted for one percent of southern California sea urchin landings. During the same period, annual commercial sea urchin landings at San Nicolas Island accounted for 4 percent of southern California sea urchin landings (Table 6-3).

SEA OTTER RANGE EXPANSION AND EFFECT ON THE SOUTHERN CALIFORNIA SEA URCHIN FISHERY

Under the baseline (no attempt to remove sea otters), changes in the southern California sea urchin fishery would likely occur over time. The southern sea otter's range is expected to expand along the mainland coastline towards Carpinteria (lower bound) or Oxnard (upper bound) over the next 10 years (see section 6.1.4.1). For the purposes of our analysis, we assume that sea otter predation would eliminate all commercial sea urchin harvest within the sea otter's range by the year 2021.

Whether sea otters would reoccupy other areas of the Southern California Bight in subsequent years would be a function of sea otter demographic rates, food supply, and other variables. Those areas reoccupied by sea otters would likely cease to support commercial sea urchin diving, but the magnitude and timing of this potential change is unknown.

The colony of sea otters at San Nicolas Island is predicted to increase from approximately 11 percent of carrying capacity at present to 21 percent of carrying capacity in 10 years. Assuming a perfect inverse relationship between the percentage of carrying capacity attained by sea otters and the commercial sea urchin catch, sea urchin landings would decrease approximately 10 percent by the year 2021.

ESTABLISHING THE BASELINE FOR THE SOUTHERN CALIFORNIA SEA URCHIN FISHERY

To establish a landings baseline, we employ a 10-year average (2000-2009) for each area to mitigate the effects of cyclic variations in populations, adverse weather, market demand, and other factors that influence catch from one year to the next. From the 10-year average, we project sea urchin harvest impacts as a direct function of sea otter occupation in each area.

Along the affected coastline (Point Conception to Carpinteria or Point Conception to Oxnard), the 10-year landings average is 56,360 pounds and 61,016 pounds, respectively. We assume that once an area is permanently occupied by sea otters, the commercial sea urchin fishery would no longer be viable in that area. Thus, we assume that sea urchin landings along the affected coastline would decrease 10 percent each year (5,636 pounds under the lower bound scenario or 6,102 pounds under the upper bound scenario), to zero landings in 2021. Around San Nicolas Island, the 10-year landings average is 351,333 pounds. We assume that commercial sea urchin landings in this area would decrease by approximately 10 percent over 10 years. Thus, we assume that sea urchin landings from San Nicolas Island would decrease by approximately 1 percent (2,705 pounds) each year, from 351,333 pounds to 348,628 pounds in 2012 to 345,922 pounds in 2013, and so forth to 324,280 pounds in 2021.

Table 6-4 depicts the baseline for sea urchin landings (lower and upper bounds) that will be employed in this analysis. Note that commercial landings across areas are not additive. Rather, the Point Conception to Carpinteria coastline, Point Conception to Oxnard coastline, and San Nicolas Island represent portions of the entire southern California sea urchin fishery. While this baseline represents a reasonable estimation of potential trends over time, there are several problems inherent in the approach used here. Because we employ a 10-year average as our starting point, the projected landings for almost all years of the series are extremely high compared to current actual landings (in 2009, sea urchin harvest along the coastline from Point Conception to Carpinteria was less than 16,000 pounds, and sea urchin harvest at San Nicolas Island was 61,000 pounds). When compared to current landings, the baseline appears to predict an immediate recovery of sea urchin landings to a level equivalent to the 10-year average. Because of our use of the 10-year average, our projected decreases in landings due to anticipated sea otter predation are correspondingly high. Therefore, our analysis likely overestimates the baseline effects of sea otters on the sea urchin fishery.

TABLE 6-4 PROJECTED BASELINE FOR COMMERCIAL SEA URCHIN LANDINGS

Year	Commercial Landings (pounds)*				
	SCB** (Lower Bound)	SCB** (Upper Bound)	Point Conception to Carpinteria	Point Conception to Oxnard	San Nicolas Island
10-year average (2000-2009)	9,069,922	9,069,922	56,360	61,016	351,333
2012	9,061,581	9,061,115	50,724	54,914	348,628
2013	9,053,240	9,052,308	45,088	48,812	345,922
2014	9,044,898	9,043,502	39,452	42,711	343,217
2015	9,036,557	9,034,695	33,816	36,609	340,512
2016	9,028,216	9,025,888	28,180	30,508	337,806
2017	9,019,875	9,017,081	22,544	24,406	335,101
2018	9,011,533	9,008,274	16,908	18,305	332,396
2019	9,003,192	8,999,468	11,272	12,203	329,691
2020	8,994,851	8,990,661	5,636	6,102	326,985
2021	8,986,510	8,981,854	0	0	324,280

*Landings are rounded to the nearest pound.
**Note that commercial landings across areas are not additive.

6.2.4.3 Spiny Lobster Fishery

For a description of the commercial lobster fishery, see section 4.4.2.3. Unlike sea urchin and crab fisheries, the California lobster fishery is confined to the waters of southern California because the range of the spiny lobster does not normally extend north of Point Conception. Lobsters are an important component of the recreational fishery as well as the commercial fishery and are discussed further under “Recreational Fishery” below.

CALIFORNIA LOBSTER FISHING EFFORT (COMMERCIAL)

Since 1997, CDFG has restricted access to the fishery by limiting the number of permits issued. All lobster fishers must have an operator permit, and all deckhands must have a lobster crewmember permit. From 2000 to 2009, an annual average of 169 vessels participated in the commercial lobster fishery (Leos pers. comm. 2010).

PAST LANDINGS AND EX-VESSEL REVENUES

Table 6-5 summarizes landings and ex-vessel revenues for the southern California lobster fishery from 1986-2009. This table also includes specific information for the areas that would likely be affected by sea otter predation over the next 10 years: 1) the coastline from Point Conception to Carpinteria (lower bound coastline estimate), 2) the coastline from Point Conception to Oxnard (upper bound coastline estimate), and 3) San Nicolas Island. These areas are discussed in greater detail below.

Southern California Bight

Commercial landings of spiny lobsters in the state of California have been marked by fluctuations that reflect a number of factors, including market influences, weather patterns, population health, and harvest regulations (Barsky 2001). Figure 6-7 shows commercial lobster landings and the annual number of operator permits for the southern California fishery. Lobster landings for southern California steadily increased from 251,000 pounds in 1986 to 860,000 pounds in 1997. Landings decreased by almost 50 percent in 1999 but have since increased to about 675,000 pounds in 2009.

Coastline, Point Conception to Carpinteria and Point Conception to Oxnard

Lobster landings along the coastline from Point Conception to Carpinteria and from Point Conception to Oxnard are depicted in Figure 6-8. Lobster landings along these two segments of coastline followed the same patterns over the last 20 years. From 1986 to 1997, lobster landings along this stretch of coastline increased five-fold, from 13,612 pounds to 82,628 pounds. Landings decreased after 1997, steadying at 39,396 pounds in 2000. As of 2009, lobster landings are again at about 40,000 pounds. Landings along the Point Conception to Oxnard coastline also declined after the 1997-1998 El Niño event but have since steadied to 62,000 pounds in 2009.

San Nicolas Island

Lobster landings at San Nicolas Island varied from 2000 to 2009, ranging from about 30,000 pounds to approximately 50,000 pounds.

TABLE 6-5 COMMERCIAL LOBSTER HARVEST: LANDINGS AND EX-VESSEL REVENUE BY AREA

	Commercial Landings (pounds)				Ex-Vessel Revenue (thousands of 2009 dollars)			
Year	Southern California	Point Conception to Carpinteria	Point Conception to Oxnard	San Nicolas Island	SCB	Point Conception to Carpinteria	Point Conception to Oxnard	San Nicolas Island
1986	250,553	13,612	13,966	16,113	$2,213	$122	$125	$141
1987	199,852	9,978	10,044	19,783	$1,637	$84	$84	$166
1988	193,813	3,698	3,698	22,076	$1,580	$25	$25	$194
1989	256,900	7,654	7,962	26,369	$2,344	$77	$81	$254
1990	226,089	19,813	20,510	25,166	$2,089	$187	$194	$245
1991	324,244	30,946	32,100	36,393	$3,400	$334	$346	$387
1992	329,660	41,808	44,123	31,640	$3,333	$449	$473	$341
1993	350,318	33,039	35,045	24,350	$3,568	$343	$366	$286
1994	416,533	42,879	48,538	27,317	$4,743	$503	$576	$352
1995	567,727	51,533	61,926	30,276	$6,511	$618	$746	$386
1996	631,728	44,655	51,664	29,934	$7,397	$528	$614	$382
1997	859,118	82,628	98,170	44,143	$8,942	$881	$1,056	$542
1998	665,966	57,241	67,862	56,411	$5,724	$505	$597	$506
1999	452,651	31,851	42,007	33,129	$4,302	$315	$417	$326
2000	679,440	39,396	56,749	36,524	$5,702	$332	$485	$335
2001	681,767	52,942	71,437	29,506	$5,721	$440	$595	$255
2002	669,486	48,575	63,246	39,577	$5,953	$423	$556	$356
2003	672,210	52,476	69,001	50,408	$6,177	$464	$619	$464
2004	830,082	76,919	100,644	50,988	$7,189	$670	$884	$474
2005	741,019	78,820	101,841	50,340	$6,574	$730	$942	$484
2006	868,230	66,613	96,534	38,346	$8,341	$667	$947	$389
2007	649,009	45,991	61,317	40,375	$6,956	$521	$694	$448
2008	727,351	45,229	73,294	39,531	$7,681	$483	$776	$422
2009	674,676	39,783	62,421	40,627	$7,549	$439	$695	$476

Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a).
*All references to the southern California fishery as a whole include landings for coastal areas and islands but exclude landings for offshore banks.

Northern Channel Islands

Lobster landings surrounding the northern Channel Islands steadily increased from 84,000 pounds in 1996 to 128,000 pounds in 2009. In 2009, lobster landings from this area had an ex-vessel value of $1.5 million (2009 dollars). From 2000 to 2009, commercial lobster landings averaged about 139,000 pounds annually, with an average annual ex-vessel value of $1.3 million (2009 dollars).

Percentages of Fishery

From 2000 to 2009, annual commercial lobster landings on the coastline from Point Conception to Carpinteria represented 8 percent of southern California lobster landings, while annual commercial lobster landings from Point Conception to Oxnard represented 11 percent of southern California landings. San Nicolas Island and the Northern Channel Islands accounted for 6 percent and 19 percent of southern California lobster landings, respectively (Table 6-6).

SEA OTTER RANGE EXPANSION AND EFFECT ON THE CALIFORNIA LOBSTER FISHERY

Under the baseline (no attempt to remove sea otters), changes in the California lobster fishery would likely occur over time. The southern sea otter's range is expected to expand along the mainland coastline towards Carpinteria (lower bound) or Oxnard (upper bound) over the next 10 years (see section 6.1.4.1). Although there is little or no evidence of sea otters adversely affecting lobster fisheries (sea otters have only recently recolonized range inhabited by California spiny lobsters), sea otters have been observed consuming lobsters in captivity and in the wild. To be conservative (*i.e.*, to make sure we fully capture potential effects on the lobster fishery), we assume that sea otter predation would eliminate all commercial lobster harvest along the coastline by the year 2021.

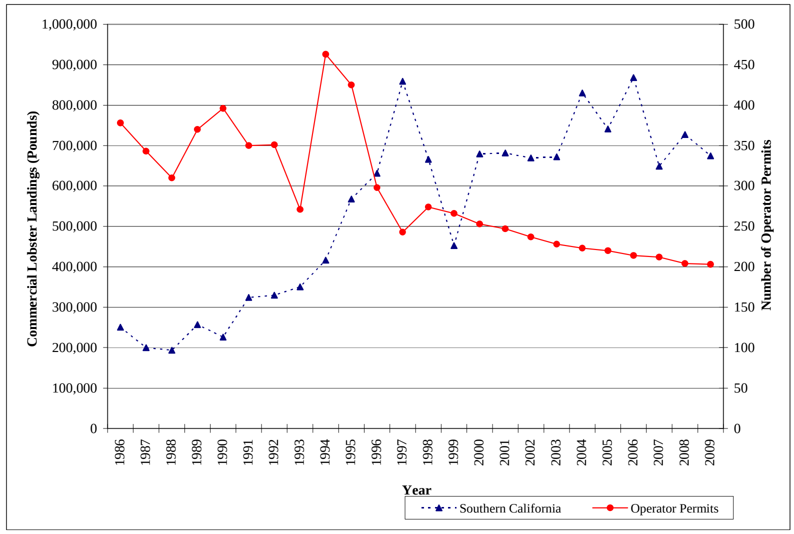

Figure 6-7 Commercial lobster landings and number of operator permits for the Southern California Bight, 1986-2009
Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a).

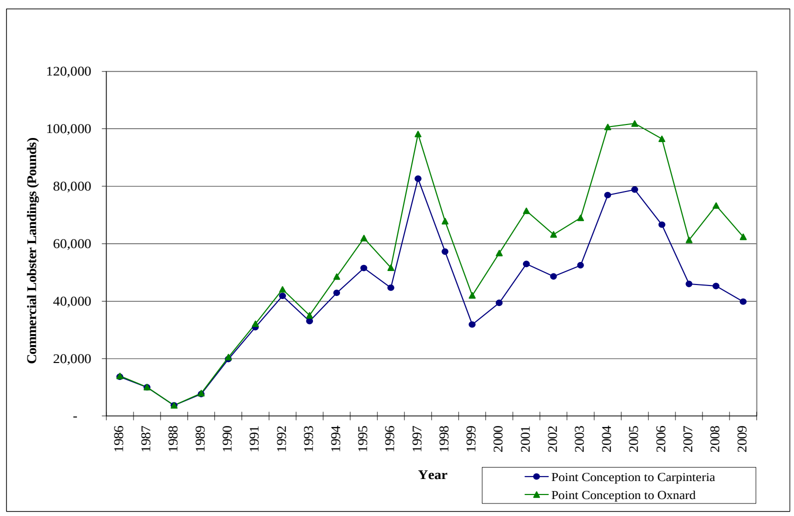

Figure 6-8 Annual lobster landings: Point Conception to Carpinteria and Point Conception to Oxnard, 1986-2009
Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a).

Whether sea otters would reoccupy other areas of the Southern California Bight in subsequent years would be a function of sea otter demographic rates, food supply, and other variables. Those areas reoccupied by sea otters would likely cease to support commercial lobster fishing, but the magnitude and timing of this potential change is unknown.

The colony of sea otters at San Nicolas Island is predicted to increase from approximately 11 percent of carrying capacity at present to 21 percent of carrying capacity in 10 years. Assuming a perfect inverse relationship between the percentage of carrying capacity attained by sea otters and the commercial lobster catch, lobster landings would decrease approximately 10 percent by the year 2021.

ESTABLISHING THE BASELINE FOR THE CALIFORNIA LOBSTER FISHERY

TABLE 6-6 AVERAGE ANNUAL LOBSTER LANDINGS, 2000-2009.		
	Average Annual Landings (pounds)	**Percentage of Southern California Bight Landings**
Impact Range:		
Point Conception to Carpinteria (coastline)	54,674	8%
Point Conception to Oxnard (coastline)	75,649	11%
San Nicolas Island	41,622	6%
SCB (excluding landings from the above areas)	602,056	84%
Total Average Annual Landings	719,327	100%
Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a).		

To establish a landings baseline, we employ a 10-year average (2000-2009) for each area to mitigate the effects of cyclic variations in populations, adverse weather, market demand, and other factors that influence catch from one year to the next. From the 10-year average, we project lobster harvest impacts as a direct function of sea otter occupation in each area. Along the affected coastline (Point Conception to Carpinteria or Point Conception to Oxnard), the 10-year landings averages are 54,674 pounds and 75,649 pounds, respectively. We assume that once an area is permanently occupied by sea otters, the commercial lobster fishery would no longer be viable in that area. Thus, we assume that lobster landings along the affected coastline would decrease 10 percent each year (5,467 pounds to Carpinteria or 7,565 pounds to Oxnard), to zero landings in 2021. Around San Nicolas Island, the 10-year landings average is 41,622 pounds. We assume that the commercial lobster fishery in this area would decrease by approximately 10 percent over 10 years. Thus, we assume that lobster landings from San Nicolas Island would decrease by about 1 percent (320 pounds) each year, from 41,622 pounds to 41,302 pounds in 2012 to 40,981 pounds in 2013, and so forth to 38,417 pounds in 2021.

Table 6-7 depicts the baseline for lobster landings that will be employed in this analysis. Note that commercial landings across areas are not additive. Rather, the Point Conception to Carpinteria coastline, the Point Conception to Oxnard coastline, and San Nicolas Island represent portions of the entire southern California lobster fishery.

TABLE 6-7 PROJECTED BASELINE FOR COMMERCIAL SPINY LOBSTER LANDINGS

Year	**Commercial Landings (pounds)***				
	SCB (Lower Bound)**	**SCB** (Upper Bound)**	**Point Conception to Carpinteria**	**Point Conception to Oxnard**	**San Nicolas Island**
10-year average (2000-2009)	719,327	719,327	54,674	75,649	41,622
2012	713,539	711,442	49,207	68,084	41,302
2013	707,751	703,556	43,739	60,519	40,981
2014	701,963	695,671	38,272	52,954	40,661
2015	696,175	687,785	32,805	45,389	40,340
2016	690,387	679,900	27,337	37,824	40,020
2017	684,599	672,015	21,870	30,259	39,699
2018	678,811	664,129	16,402	22,695	39,379
2019	673,023	656,244	10,935	15,130	39,058
2020	667,236	648,359	5,467	7,565	38,738
2021	661,448	640,473	0	0	38,417

*Landings are rounded to the nearest pound.
** Note that commercial landings across areas are not additive.

6.2.4.4 Crab Fishery

For a general description of the commercial crab fishery, see section 4.4.2.4.

SOUTHERN CALIFORNIA CRAB FISHING EFFORT

From 2000 to 2009, an annual average of 147 vessels participated in the crab fishery (Leos pers. comm. 2010).

PAST LANDINGS AND EX-VESSEL REVENUES

Table 6-8 summarizes landings and ex-vessel revenues for the southern California crab fishery from 1986-2009. This table also includes specific information for the areas that would likely be affected by sea otter predation over the next 10 years: 1) the coastline from Point Conception to Carpinteria, 2) the coastline from Point Conception to Oxnard, and 3) San Nicolas Island. These areas are discussed in greater detail below.

Southern California Bight

Figure 6-9 shows commercial crab landings for the entire southern California fishery. Crab harvests in southern California more than doubled from 1986 to 2009, from 400,000 pounds to more than 1.3 million pounds. Harvests tend to decline slightly after each El Niño event but recover quickly.

Coastline, Point Conception to Carpinteria and Point Conception to Oxnard

Crab landings along the coastline from Point Conception to Carpinteria and from Point Conception to Oxnard are depicted in Figure 6-10. Commercial annual crab landings along these two segments of coastline followed the same patterns until 2003. In 2003, landings from Point Conception to Carpinteria continued to decline while landings from Point Conception to Oxnard increased.

San Nicolas Island

Commercial crab harvest levels at San Nicolas Island have been relatively low, ranging from 0 to 22,851 pounds. From 1993 to 2002, the average annual crab harvest at San Nicolas Island was 4,609 pounds. The crab harvest doubled in 2003 to 18,468 pounds. The harvest in 2009 declined to 13,769 pounds.

Northern Channel Islands

Crab landings surrounding the northern Channel Islands steadily increased from 109,000 pounds in 1991 to about 387,000 pounds in 2009. In 2009, crab landings from this area had an ex-vessel value of approximately $573,000 (2009 dollars). From 2000 to 2009, commercial crab landings averaged about 408,000 pounds annually, with an average annual ex-vessel value of $619,000 (2009 dollars).

Percentages of Fishery

From 2000 to 2009, average annual commercial crab landings along the coastline from Point Conception to Carpinteria accounted for 23 percent of southern California crab landings and landings along the coastline from Point Conception to Oxnard accounted for 35 percent of total crab landings. During the same period, annual crab landings at San Nicolas Island and the

Northern Channel Islands accounted for 1 percent and 37 percent of southern California's annual crab landings, respectively (Table 6-9).

TABLE 6-8 COMMERCIAL CRAB HARVEST: LANDINGS AND EX-VESSEL REVENUE BY AREA.

Year	Commercial Landings (pounds)				Ex Vessel Revenue (thousands of 2009 dollars)			
	SCB*	Point Conception to Carpinteria	Point Conception to Oxnard	San Nicolas Island	SCB	Point Conception to Carpinteria	Point Conception to Oxnard	San Nicolas Island
1986	398,933	199,894	200,214	1,526	$714	$357	$357	$3
1987	366,168	138,098	143,815	16,550	$559	$221	$229	$26
1988	246,334	127,579	129,028	2,876	$380	$209	$210	$5
1989	161,344	76,430	78,684	0	$275	$140	$141	$0
1990	361,468	236,183	244,841	672	$625	$430	$442	$1
1991	600,046	232,212	254,728	7,507	$977	$395	$430	$12
1992	503,753	187,997	224,880	0	$793	$299	$357	$0
1993	488,108	156,537	163,455	1,053	$764	$238	$248	$2
1994	484,180	130,846	138,106	737	$759	$206	$218	$1
1995	621,210	178,495	203,569	619	$1,059	$315	$356	$1
1996	802,058	292,412	312,795	1,253	$1,384	$486	$523	$10
1997	958,960	357,591	425,535	1,675	$1,541	$578	$687	$2
1998	990,563	345,771	399,046	22,851	$1,551	$529	$618	$38
1999	651,729	238,023	274,199	4,545	$1,060	$385	$448	$8
2000	931,467	216,951	310,339	1,453	$1,489	$350	$508	$2
2001	1,042,774	241,735	302,663	4,852	$1,744	$405	$517	$12
2002	1,082,491	310,642	367,610	7,047	$1,768	$500	$596	$10
2003	954,515	145,256	231,936	18,468	$1,487	$219	$359	$30
2004	1,127,466	218,460	378,010	14,604	$1,650	$312	$528	$20
2005	1,051,092	205,748	346,554	7,267	$1,431	$279	$451	$10
2006	1,143,831	243,690	381,356	1,262	$1,496	$308	$484	$1
2007	1,286,465	310,566	488,567	4,558	$1,648	$382	$608	$7
2008	1,184,564	275,961	458,181	33,064	$1,498	$337	$547	$49
2009	1,303,533	366,707	592,212	13,769	$1,689	$455	$747	$21

Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a).
*All references to the southern California fishery as a whole include landings for coastal areas and islands but exclude landings for offshore banks.

SEA OTTER RANGE EXPANSION AND EFFECT ON THE SOUTHERN CALIFORNIA CRAB FISHERY

Under the baseline (no attempt to move sea otters), changes in the southern California crab fishery may occur over time. The southern sea otter's range is expected to expand along the mainland coastline towards Carpinteria (lower bound) or Oxnard (upper bound) over the next 10 years (see section 6.1.4.1).. For the purposes of our analysis, we assume that sea otter predation would eliminate all commercial crab harvest within the sea otter range by the year 2021.

Whether sea otters would reoccupy other areas of the Southern California Bight in subsequent years would be a function of sea otter demographic rates, food supply, and other variables.

Those areas reoccupied by sea otters would likely cease to support commercial crab fishing, but the magnitude and timing of this potential change is unknown.

The colony of sea otters at San Nicolas Island is predicted to increase from approximately 11 percent of carrying capacity at present to 21 percent of carrying capacity in 10 years. Assuming a perfect inverse relationship between the percentage of carrying capacity attained by sea otters and the commercial crab catch, crab landings would decrease by approximately 10 percent by the year 2021.

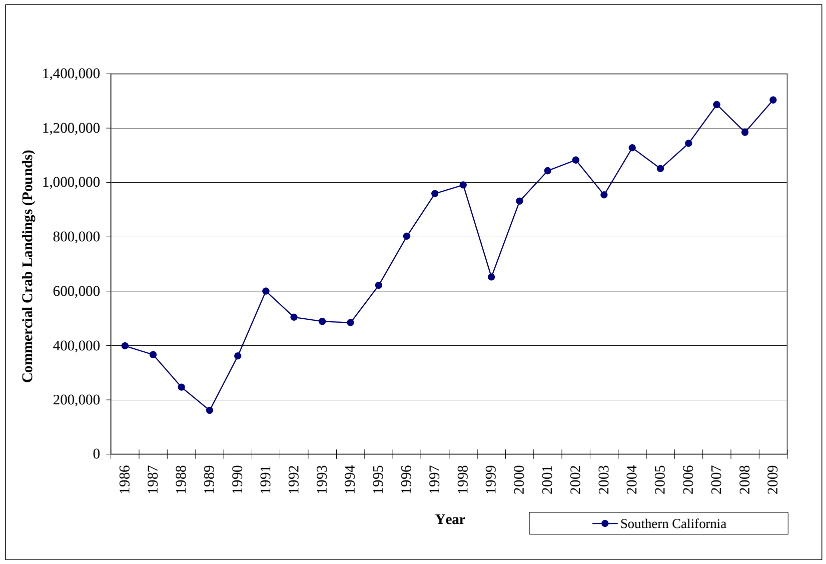

Figure 6-9 Commercial crab landings for southern California, 1986-2009
Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a)

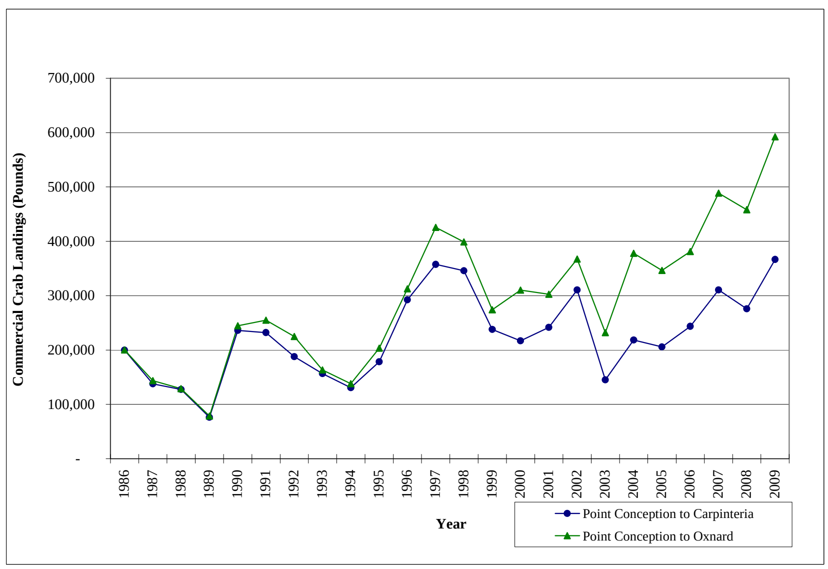

Figure 6-10 Annual crab landings: Point Conception to Carpinteria and point Conception to Oxnard
Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a)

Establishing the Baseline for the Southern California Crab Fishery

To establish a landings baseline, we employ a 10-year average (2000-2009) for each area to mitigate the effects of cyclic variations in populations, adverse weather, market demand, and other factors that influence catch from one year to the next. From the 10-year average, we project crab harvest impacts as a direct function of sea otter occupation in each area. Along the affected coastline (Point Conception to Carpinteria or Point Conception to Oxnard), the 10-year landings average is 253,572 pounds and 385,743 pounds, respectively. We assume that once an area is permanently occupied by sea otters, the commercial crab fishery would no longer be viable in that area. Thus, we assume that crab landings along the coastline would decrease 10 percent each year (25,357 pounds to Carpinteria or 38,574 pounds to Oxnard), to zero landings in 2021. Around San Nicolas Island, the 10-year landings average is 10,634 pounds. We assume that the commercial crab fishery in this area would decrease by approximately 10 percent over 10 years. Thus, we assume that crab landings from San Nicolas Island would decrease by about 1 percent (82 pounds) each year, from 10,634 pounds to 10,553 pounds in 2012 to 10,471 pounds in 2013, and so forth to 9,816 pounds in 2021.

TABLE 6-9 AVERAGE ANNUAL CRAB LANDINGS, 2000-2009

	Average Annual Landings (pounds)	Percentage of Southern California Bight Landings
Impact Range:		
Point Conception to Carpinteria (coastline)	253,572	23%
Point Conception to Oxnard (coastline)	385,743	35%
San Nicolas Island	10,634	1%
SCB (excluding landings from the above areas)	714,443	64%
Total Average Annual Landings	1,110,820	100%

Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a)

Table 6-10 depicts the baseline for crab landings that will be employed in this analysis. Note that commercial landings across areas are not additive. Rather, the Point Conception to Carpinteria coastline, the Point Conception to Oxnard coastline, and San Nicolas Island represent portions of the entire southern California crab fishery.

TABLE 6-10 PROJECTED BASELINE FOR COMMERCIAL CRAB LANDINGS

Year	Commercial Landings (pounds)*				
	SCB** (Lower Bound)	SCB** (Upper Bound)	Point Conception to Carpinteria	Point Conception to Oxnard	San Nicolas Island
10-year average (2000-2009)	1,110,820	1,110,820	253,572	385,743	10,634
2012	1,085,381	1,072,164	228,214	347,169	10,553
2013	1,059,942	1,033,508	202,857	308,594	10,471
2014	1,034,503	994,851	177,500	270,020	10,389
2015	1,009,064	956,195	152,143	231,446	10,307
2016	983,625	917,539	126,786	192,871	10,225
2017	958,186	878,883	101,429	154,297	10,143
2018	932,747	840,227	76,071	115,723	10,061
2019	907,308	801,571	50,714	77,149	9,979
2020	881,868	762,914	25,357	38,574	9,897
2021	856,429	724,258	0	0	9,816

*Landings are rounded to the nearest pound.
** Note that commercial landings across areas are not additive.

6.2.4.5 Sea Cucumber Fishery

For a general description of the commercial sea cucumber fishery, see section 4.4.2.5.

SOUTHERN CALIFORNIA SEA CUCUMBER FISHING EFFORT

Fishing effort and harvest of sea cucumbers in the southern California commercial fishery shifted in 1982 from the Los Angeles area to the Santa Barbara Channel (CDFG 2001). From 2000 to 2009, an annual average of 49 vessels participated in the sea cucumber fishery (Leos pers. comm. 2010).

PAST LANDINGS AND EX-VESSEL REVENUES

Table 6-11 summarizes landings and ex-vessel revenues for the southern California sea cucumber fishery from 1986-2009. This table also includes specific information for the areas that would likely be affected by sea otter predation over the next 10 years: 1) the coastline from Point Conception to Carpinteria (lower bound coastline estimate), 2) the coastline from Point Conception to Oxnard (upper bound coastline estimate), and 3) San Nicolas Island. These areas are discussed in greater detail below.

Southern California Bight

Figure 6-11 shows commercial sea cucumber landings and numbers of sea cucumber diving permits for the southern California fishery. The annual sea cucumber harvest in southern

TABLE 6-11 COMMERCIAL SEA CUCUMBER HARVEST: LANDINGS AND EX-VESSEL REVENUE BY AREA.

Year	Commercial Landings (pounds)				Ex Vessel Revenue (thousands of 2009 dollars)			
	SCB*	Point Conception to Carpinteria	Point Conception to Oxnard	San Nicolas Island	SCB	Point Conception to Carpinteria	Point Conception to Oxnard	San Nicolas Island
1986	27,817	24,950	24,950	0	$6	$3	$3	$0
1987	15,085	10,250	10,250	0	$9	$4	$4	$0
1988	62,211	60,250	60,250	0	$21	$19	$19	$0
1989	38,830	38,500	38,500	0	$14	$14	$14	$0
1990	4,697	2,700	2,700	0	$3	$1	$1	$0
1991	29,232	11,463	12,659	0	$11	$4	$4	$0
1992	115,467	22,186	22,186	0	$62	$13	$13	$0
1993	135,970	93,283	95,283	1,550	$97	$62	$63	$1
1994	405,531	31,972	31,972	1,220	$389	$20	$20	$1
1995	415,954	58,072	60,789	5,926	$428	$48	$50	$19
1996	460,150	15,139	15,609	68,070	$431	$15	$15	$67
1997	398,572	50,580	50,880	13,776	$272	$32	$32	$10
1998	619,225	58,609	65,821	48,258	$470	$36	$42	$47
1999	513,978	60,282	61,522	27,952	$478	$49	$50	$28
2000	607,767	52,636	53,534	123,169	$697	$45	$46	$148
2001	659,038	211,506	218,746	66,523	$711	$181	$188	$79
2002	847,144	202,611	204,531	227,845	$956	$174	$176	$268
2003	648,637	195,297	196,587	74,210	$755	$159	$160	$88
2004	457,975	175,907	178,013	3,719	$509	$172	$174	$3
2005	486,512	173,610	173,610	35	$614	$195	$195	$0
2006	401,560	111,272	112,802	0	$522	$141	$143	$0
2007	417,150	69,458	70,736	3,026	$589	$88	$90	$3
2008	739,720	186,872	194,239	31,080	$1,506	$367	$384	$43
2009	493,202	177,968	183,566	7,223	$952	$355	$365	$15

Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a).
*All references to the southern California fishery as a whole include landings for coastal areas and islands but exclude landings for offshore banks.

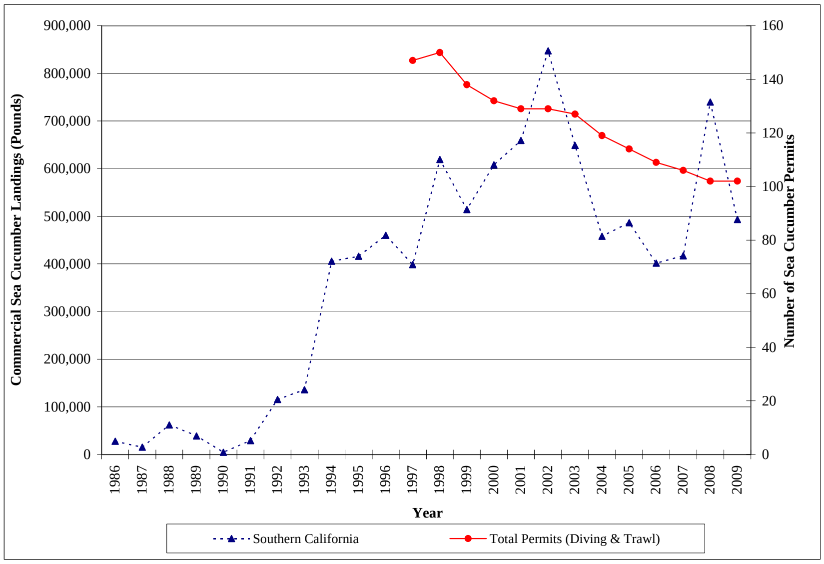

Figure 6-11 Commercial sea cucumber landings and number of operator permits for southern California, 1986-2009
Data source: California Department of Fish and Game (2006a, 2006b, 2008a, 2010a)

California peaked at 847,000 pounds in 2002 but declined to about 493,000 pounds in 2009. In the late 1990s, a number of circumstances led to a higher sea cucumber harvest due to fishers changing their target species. A strong El Niño event (1997/1998) and a weak Japanese economy caused sea cucumber divers to increasingly target sea cucumbers while a moratorium on abalone caused abalone divers to dive for sea cucumbers instead (Kalvass and Rogers-Bennett 2001).

Coastline, Point Conception to Carpinteria and Point Conception to Oxnard

Sea cucumber landings along the coastline from Point Conception to Carpinteria and along the coastline from Point Conception to Oxnard are depicted in Figure 6-12. Landings along these two segments of coastline followed the same patterns over the last 20 years. Sea cucumber landings in both of these areas increased dramatically in 2000 and have maintained these landings with the exception of landings in 2007.

Figure 6-12 Annual sea cucumber landings, Point Conception to Carpinteria and Point Conception to Oxnard
Data source: California Department of Fish and Game (2006a, 2006b, 2008a, 2010a)

San Nicolas Island

Since landings were recorded at San Nicolas Island in 1993, annual sea cucumber landings have been highly variable. During the 1997-1998 El Niño event, landings increased from 14,000 pounds in 1997 to 48,000 pounds in 1998. Sea cucumber landings at San Nicolas Island peaked at 228,000 pounds in 2002 but have since rapidly declined to 7,223 in 2009.

Northern Channel Islands

Sea cucumber harvests surrounding the northern Channel Islands were first recorded in 1991, where landings were about 6,000 pounds. Since then, landings have increased dramatically to 182,185 pounds in 2009. In 2009, sea cucumber landings from this area had an ex-vessel value of about $318,000 (2009 dollars). From 2000 to 2009, commercial sea cucumber landings averaged about 198,000 pounds annually, with an average annual ex-vessel value of about $285,000 (2009 dollars).

TABLE 6-12 AVERAGE ANNUAL SEA CUCUMBER LANDINGS, 2000-2009.

	Average Annual Landings (pounds)	Percentage of Southern California Bight Landings
Impact Range:		
Point Conception to Carpinteria (coastline)	155,714	27%
Point Conception to Oxnard (coastline)	158,636	28%
San Nicolas Island	53,683	9%
SCB (excluding landings from the above areas)	363,551	63%
Total Average Annual Landings	575,871	100%

Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a)

Percentages of Fishery

From 2000 to 2009, annual commercial sea cucumber landings accounted for 27 percent of southern California sea cucumber landings along the coastline from Point Conception to Carpinteria and accounted for 28 percent of southern California sea cucumber landings along the coastline from Point Conception to Oxnard (CDFG 2006a, 2008a, 2010a). During the same period, annual commercial sea cucumber landings at San Nicolas Island and the Northern Channel Islands accounted for 9 percent and 34 percent of southern California sea cucumber landings, respectively (Table 6-12).

Sea Otter Range Expansion and Effect on the Southern California Sea Cucumber Fishery

Under the baseline (no attempt to remove sea otters), changes in the southern California sea cucumber fishery would likely occur over time. The southern sea otter's range is expected to expand along the mainland coastline towards Carpinteria (lower bound) or Oxnard (upper bound) over the next 10 years (see section 6.1.4.1).

Whether sea otters would reoccupy other areas of the Southern California Bight in subsequent years would be a function of sea otter demographic rates, food supply, and other variables. Those areas reoccupied by sea otters would likely cease to support commercial sea cucumber diving, but the magnitude and timing of this potential change is unknown.

The colony of sea otters at San Nicolas Island is predicted to increase from approximately 11 percent of carrying capacity at present to 21 percent of carrying capacity in 10 years. Assuming a perfect inverse relationship between the percentage of carrying capacity attained by sea otters and the commercial sea cucumber catch, sea cucumber landings would decrease approximately 10 percent by the year 2021.

Establishing the Baseline for the Southern California Sea Cucumber Fishery

To establish a landings baseline, we employ a 10-year average (2000-2009) for each area to mitigate the effects of cyclic variations in populations, adverse weather, market demand, and other factors that influence catch from one year to the next. From the 10-year average, we project sea cucumber harvest impacts as a direct function of sea otter occupation in each area.

Along the affected coastline (Point Conception to Carpintera or Point Conception to Oxnard), the 10-year landings average is 155,714 pounds and 158,636 pounds, respectively. We assume that once an area is permanently occupied by sea otters, the commercial sea cucumber fishery would no longer be viable in that area. Thus, we assume that sea cucumber landings along the affected coastline would decrease 10 percent each year (15,571 pounds to Carpinteria or 15,864 pounds to Oxnard), to zero landings in 2021. Around San Nicolas Island, the 10-year landings average is 53,683 pounds. We assume that the commercial sea cucumber fishery in this area would decrease by approximately 10 percent over 10 years. Thus, we assume that sea cucumber landings from San Nicolas Island would decrease by about 1 percent (413 pounds) each year, from 53,683 pounds to 53,270 pounds in 2012 to 52,856 pounds in 2013, and so forth to 49,549 pounds in 2021.

Table 6-13 depicts the baseline for sea cucumber landings that will be employed in this analysis. Note that commercial landings across areas are not additive. Rather, the Point Conception to Carpinteria coastline, the Point Conception to Oxnard coastline, and San Nicolas Island represent portions of the entire southern California sea cucumber fishery.

TABLE 6-13 PROJECTED BASELINE FOR COMMERCIAL SEA CUCUMBER LANDINGS

Year	Commercial Landings (pounds)*				
	SCB** (Lower Bound)	SCB** (Upper Bound)	Point Conception to Carpinteria	Point Conception to Oxnard	San Nicolas Island
10-year average (2000-2009)	575,871	575,871	155,714	158,636	53,683
2012	559,886	559,594	140,142	142,773	53,270
2013	543,901	543,317	124,571	126,909	52,856
2014	527,916	527,040	109,000	111,045	52,443
2015	511,932	510,763	93,428	95,182	52,029
2016	495,947	494,486	77,857	79,318	51,616
2017	479,962	478,209	62,285	63,455	51,203
2018	463,977	461,932	46,714	47,591	50,789
2019	447,993	445,655	31,143	31,727	50,376
2020	432,008	429,378	15,571	15,864	49,963
2021	416,023	413,101	0	0	49,549

*Landings are rounded to the nearest pound.
** Note that commercial landings across areas are not additive.

While this baseline represents a reasonable estimation of potential trends over time, there are several problems inherent in the approach used here. Because we employ a 10-year average as our starting point, the projected landings for almost all years of the series are not consistent compared to current actual landings (in 2009, sea cucumber harvest at San Nicolas Island was 7,223 pounds). When compared to current landings, the baseline appears to predict an immediate recovery of sea cucumber landings to a level equivalent to the 10-year average at San Nicolas Island and an immediate decrease of sea cucumber landings along the coastlines.

6.2.4.6 Gill and Trammel Net Fishery

Gill and trammel nets are known to be lethal to sea otters and other marine species. The set gill net fishery in California is estimated to have killed from 48 to 166 (average of 103) southern sea otters per year from 1973 to 1983 (Herrick and Hanan 1988) and 80 sea otters annually from June 1982 to June 1984 (Wendell *et al.* 1986). A 1991 closure restricted gill and trammel nets to waters deeper than 55 m (30 fathoms) throughout most of the southern sea otter's range (California Senate Bill No. 2563). In 1990, the National Marine Fisheries Service (NMFS) started an observer program using at-sea observers, which provided data on incidental mortality rates relative to the distribution of fishing effort. The observer program was active through 1994, discontinued from 1995 to 1998, and reinstated in the Monterey Bay area in 1999 and 2000 because of concern over increased harbor porpoise mortality. Based on a detailed analysis of fishing effort, sea otter distributions by depth, and regional entanglement patterns during observed years, NMFS estimated southern sea otter mortality in the central California halibut set gill net fishery to have been 64 in 1990, zero from 1991 to 1994, 3 to 13 in 1995, 2 to 29 in 1996, 6 to 47 in 1997, 6 to 36 in 1998, 5 in 1999, and zero in 2000 (Cameron and Forney 2000; Carretta 2001; Forney *et al.* 2001). Forney *et al.* (2001) produced several sets of mortality estimates for 1995-1998 based on historic entanglement rate data, estimates of fishing effort for 1995-1998, and a variety of assumptions. The increase in estimated mortality from 1995 to 1998 was attributed to a shift in set gill net fishing effort into areas where sea otters are found in waters deeper than 55 m (30 fathoms).

Fishing with set gill nets has since been further restricted throughout the range of the southern sea otter. An order prohibiting the use of gill and trammel nets year-round in ocean waters of 110 m (60 fathoms) or less from Point Reyes, Marin County, to Point Arguello, Santa Barbara County was made permanent in September 2002 in response to fishery mortality exceeding potential biological removal (PBR) for the Monterey Bay harbor porpoise stock (http://www.nmfs.noaa.gov/pr/pdfs/fisheries/ca_halibut_whiteseabass_other_set_gillnet.pdf). In the waters south of Point Arguello, the Marine Resources Protection Act of 1990 (California Constitution Article 10B) defined a Marine Resources Protection zone in which the use of gill and trammel nets is banned. This zone includes 1) waters less than 128m (70 fathoms) or within one mile, whichever is less, around the Channel Islands, 2) the area within three nautical miles offshore of the mainland coast, and the area within three nautical miles off any manmade breakwater, between a line extending due west from Point Arguello and a line extending due west from the Mexican border, and 3) waters less than 64 m (35 fathoms) between a line running 180 degrees true from Point Fermin and a line running 270 degrees true from the south jetty of Newport Harbor. This closure generally encompasses the depths (less than 40 m or 131 ft) to which sea otters most commonly dive (Tinker *et al.* 2006a, Chapter 6).

However, some areas within the Southern California Bight are characterized by a relatively shallow shelf that extends beyond the area currently closed to gill net fishing.
Additionally, although the vast majority (more than 99 percent) of southern sea otter dives are to depths of 40 m (131 ft) or less, individuals occasionally dive to depths of approximately 100 m (328 ft) (Tinker pers. comm. 2008). Measures intended to prevent any take of sea otters in gill nets would have to account for the deepest-diving animals. An analysis based on time-depth-recorder data from 20 sea otters in the south half of the mainland range (San Simeon and Point Conception) found that the following depths would include *all dives* of 95 percent and 99 percent

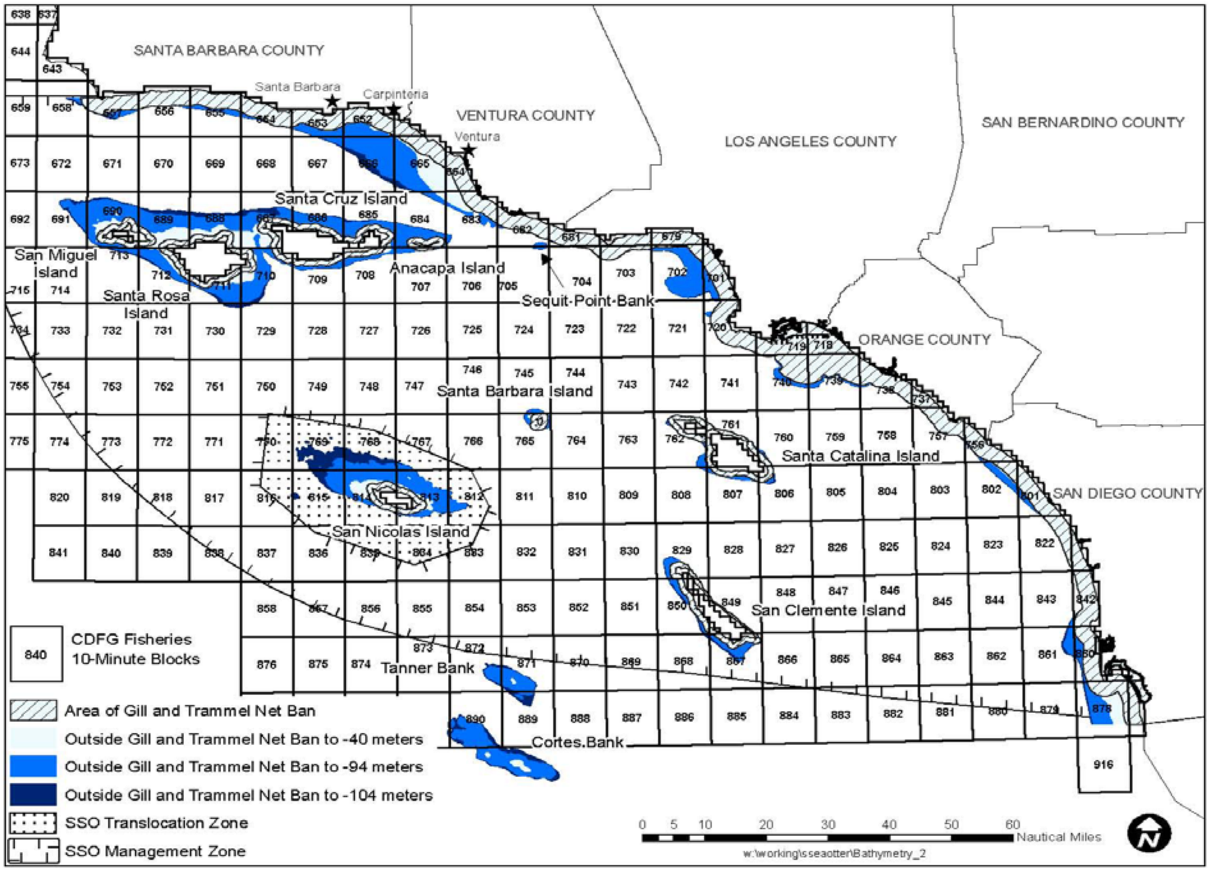

Figure 6-13 Bathymetry in relation to maximum sea otter dive depths and current gill and trammel net closure

of sea otters, respectively: 94 m (308 ft) and 104 m (341 ft) (Tinker pers. comm. 2008). Figure 6-13 shows these depth contours in relation to the existing gill and trammel net closure in the Southern California Bight.

Fishing with gill and trammel net gear in areas not already affected by the existing closure but within the depth ranges used by sea otters could potentially be affected by an additional closure. This closure could be imposed if the regulatory environment changed as a result of selection of one of the alternatives under consideration and the State or NMFS chose to act to protect sea otters from potential incidental take. This change would occur only in areas within the currently designated management zone (the incidental taking of sea otters in commercial fishing nets is already prohibited within the translocation zone, so no change would occur at San Nicolas Island under any of the alternatives). An additional closure would not likely be enacted unless the following conditions were met: 1) the regulatory environment in the Southern California Bight changed so that the incidental taking of sea otters in otherwise legal fisheries were no longer permitted (see section 6.2.12 for a description of the baseline regulatory environment) and 2) sea otters expanded their range into these areas. Although these conditions are likely necessary for the State or NMFS to act, they are not sufficient (*i.e.*, the State or NMFS may choose not to enact an additional closure even if these conditions are met).

The primary fisheries using gill and trammel net gear in these areas target halibut and white seabass. Under the baseline, sea otters may continue to extend their range into the Southern California Bight, but there is no change in the regulations that affect sea otters in the currently designated management zone, and no additional closure is expected. In sections 6.2.4.6.1 and 6.2.4.6.2 we describe the baseline halibut and white seabass landings that could be affected if an additional gill and trammel net closure were enacted by the State or NMFS in response to the alternatives considered in this document.

6.2.4.6.1 Halibut Fishery

For a general description of the commercial halibut fishery, see section 4.4.2.6.1

Southern California Halibut Fishing Effort

Halibut landings have averaged about 900,000 pounds annually in southern California. The primary types of gear used include otter trawl, set and drift gill nets, and hook-and-line. From 2000-2009, an average of 49 vessels participated in the halibut fishery using set and drift gill nets, whereas an average of 138 vessels participated in the halibut fishery using all other gears (trawl, hook-and-line, trap, and other) (Leos pers. comm. 2010).

Past Landings and Ex-Vessel Revenues

Tables 6-14 and 6-15 summarize landings and ex-vessel revenues for the southern California halibut fishery from 1986-2009. While Table 6-14 shows the halibut landings for all gear types, Table 6-15 shows the landings and ex-vessel revenues for halibut caught using only gill or trammel net gear. These tables also include specific information for the area that would likely be affected by a gill and trammel net gear closure (the coastline from Santa Barbara to Port Hueneme) and additional information (for reference) for San Nicolas Island. These areas are discussed in greater detail below.

Southern California Bight

Figure 6-14 shows commercial halibut landings and the number of general gill and trammel net permits in southern California. The annual halibut harvest in southern California peaked at 421,017 pounds in 1999, declined to a low of 159,787 pounds in 2005, and has since rebounded to 237,935 in 2009. The annual halibut harvest using gill or trammel net gear also followed the same pattern, peaking at 295,699 pounds in 1999, declining to 88,212 pounds in 2006, and rebounding to 114,906 in 2009.

Coastline, Santa Barbara to Port Hueneme

Halibut landings along the coastline from Santa Barbara to Port Hueneme are depicted in Figure 6-15. Halibut landings are shown for all gear types and for gill and trammel net gear only. The landings have followed the same patterns since 1994. Both peaked in the late 1990s and have since declined over the past 5 years, with the exception of 2009.

San Nicolas Island

Halibut landings around San Nicolas Island have been minimal over the last 20 years. Over the last two years, there have been zero gill and trammel net halibut landings around the island.

TABLE 6-14 COMMERCIAL HALIBUT HARVEST: LANDINGS AND EX-VESSEL REVENUE BY AREA (ALL GEAR TYPES)						
Year	Commercial Landings (pounds)			Ex-Vessel Revenue (thousands of 2009 dollars)		
	SCB	Santa Barbara to Port Hueneme	San Nicolas Island	SCB	Santa Barbara to Port Hueneme	San Nicolas Island
1986	241,024	35,927	6,021	$994	$150	$24
1987	186,462	12,973	4,922	$714	$52	$18
1988	109,278	11,782	0	$404	$46	$0
1989	108,231	23,214	0	$417	$87	$0
1990	86,691	12,433	0	$327	$48	$0
1991	274,555	90,855	613	$1,107	$363	$3
1992	222,873	88,577	682	$850	$335	$3
1993	216,395	88,268	73	$886	$331	$0
1994	156,055	108,061	437	$796	$574	$2
1995	188,148	103,971	462	$911	$507	$2
1996	270,256	164,813	3,305	$1,275	$777	$14
1997	297,952	137,687	96	$1,327	$609	$0
1998	267,654	141,159	178	$1,009	$533	$1
1999	421,017	218,006	50	$1,542	$791	$0
2000	338,304	142,989	70	$1,292	$550	$0
2001	398,802	241,033	7	$1,690	$1,066	$0
2002	364,453	228,783	207	$1,623	$1,051	$1
2003	240,816	136,518	589	$1,091	$627	$2
2004	243,658	131,118	10	$1,223	$666	$0
2005	159,787	67,275	593	$801	$366	$4
2006	168,333	65,711	0	$916	$365	$0
2007	171,519	67,303	2,056	$967	$378	$11
2008	194,739	82,181	3,069	$986	$400	$17
2009	237,935	125,144	8,739	$1,023	$521	$41

Data source: California Department of Fish and Game (2008a, 2010a)
*Landings are estimated based on ex-vessel revenue

Percentages of Fishery
From 2000-2009, annual commercial halibut landings using gill or trammel net gear along the coastline from Santa Barbara to Port Hueneme accounted for 41 percent of southern California halibut landings using gill and trammel net gear. These landings comprised 21 percent of halibut landings using all gear types in the same area (Table 6-16).

SEA OTTER RANGE EXPANSION AND EFFECT ON THE SOUTHERN CALIFORNIA HALIBUT FISHERY

Under the baseline, (no attempt to remove sea otters), sea otters may continue to extend their range into the Southern California Bight. Sea otters do not prey on halibut, and under the baseline there is no change in the regulations that affect sea otters in the currently designated management zone (see section 6.2.12). Therefore, no additional closure will occur, and there will be no effect on the southern California halibut fishery.

TABLE 6-15 COMMERICAL HALIBUT HARVEST - GILL AND TRAMMEL NET GEAR: LANDINGS AND EX-VESSEL REVENUE BY AREA

	Commercial Landings (Gill & Trammel Net) (pounds)			Ex-Vessel Revenue (Gill & Trammel Net Gear) (thousands of 2009 dollars)		
Year	Southern California	Santa Barbara to Port Hueneme	San Nicolas Island	Southern California	Santa Barbara to Port Hueneme	San Nicolas Island
1986	5,535	132	0	$23	$0.5	0
1987	0	0	0	0	0	0
1988	0	0	0	0	0	0
1989	621	0	0	$2	0	0
1990	0	0	0	0	0	0
1991	0	0	0	0	0	0
1992	0	0	0	0	0	0
1993	6,039	2,943	0	$25	$11	0
1994	69,872	38,044	0	$334	$191	0
1995	125,619	63,489	0	$612	$315	0
1996	168,588	80,850	2,884	$830	$405	$12
1997	225,090	84,061	16	$1,012	$368	$0
1998	180,066	82,659	31	$675	$306	$0
1999	295,699	138,067	0	$1,071	$488	0
2000	262,369	99,302	0	$1,001	$383	0
2001	240,566	109,679	0	$968	$457	0
2002	171,600	70,503	0	$708	$304	0
2003	158,268	76,763	502	$670	$329	$2
2004	146,085	66,943	10	$644	$317	$0
2005	90,444	24,383	0	$385	$114	0
2006	88,212	25,360	0	$411	$128	0
2007	90,706	27,932	0	$451	$144	0
2008	105,751	34,576	0	$469	$148	0
2009	114,906	65,200	0	$464	$267	0

Data source: California Department of Fish and game (2008a, 2010a)

TABLE 6-16 AVERAGE ANNUAL HALIBUT LANDINGS (GILL & TRAMMEL NET), 2000-2009.

	Average Annual Landings (Gill & Trammel Net)	Percentage of SCB Landings (Gill & Trammel Net)	Percentage of SCB Landings (All Gear Types)
Santa Barbara to Port Hueneme (coastline)	60,064	41%	21%
San Nicolas Island	51	0%	0%
SCB (excluding landings from the above area)	86,775	59%	30%
Total Average Annual Landings	146,891	100%	51%

Data source: California Department of Fish and Game (2008a, 2010a)

Establishing the Baseline for the Southern California Halibut Fishery

To establish a landings baseline, we employ a 10-year average (2000-2009) for the affected coastline (Santa Barbara to Port Hueneme) to mitigate the effects of cyclic variations in populations, adverse weather, market demand, and other factors that influence catch from one year to the next. Along the affected coastline (Santa Barbara to Port Hueneme), the 10-year landings average for halibut using gill and trammel net gear is 60,064 pounds. We assume that this level of harvest will continue.

Table 6-17 depicts the baseline for halibut landings that will be used in this analysis.

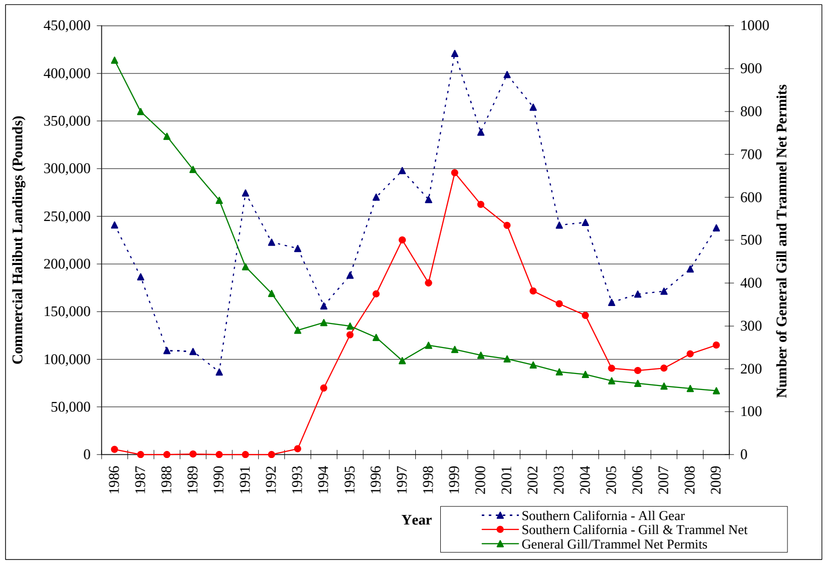

Figure 6-14 Commercial halibut landings and number of general gill/trammel net permits for southern California, 1986-2009
Data source: California Department of Fish and Game (2008a, 2010a)

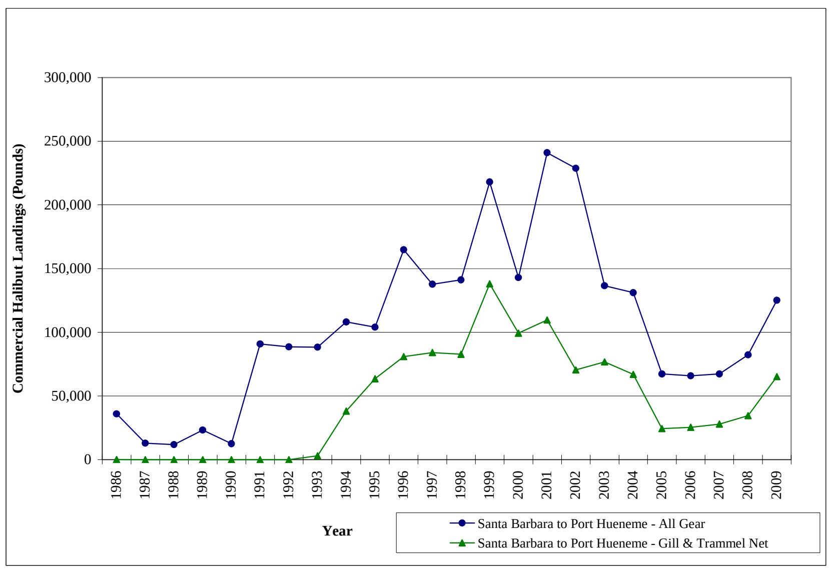

Figure 6-15 Annual halibut landings: Santa Barbara to Port Hueneme
Data source: California Department of Fish and Game (2008a, 2010a**)**

TABLE 6-17 PROJECTED BASELINE FOR COMMERCIAL HALIBUT LANDINGS (GILL & TRAMMEL NET)				
Year	**Commercial Landings (pounds)***			
	SCB (lower estimate – no impact)	**SCB (upper estimate)**	**Santa Barbara to Port Hueneme**	**San Nicolas Island**
10-year average (2000-2009)	251,835	251,835	60,064	51
2012	251,835	191,771	60,064	51
2013	251,835	191,771	60,064	51
2014	251,835	191,771	60,064	51
2015	251,835	191,771	60,064	51
2016	251,835	191,771	60,064	51
2017	251,835	191,771	60,064	51
2018	251,835	191,771	60,064	51
2019	251,835	191,771	60,064	51
2020	251,835	191,771	60,064	51
2021	251,835	191,771	60,064	51
*Landings are rounded to the nearest pound. **Note that commercial landings across areas are not additive				

6.4.2.6.2 WHITE SEABASS FISHERY

For a general description of the commercial white seabass fishery, see section 4.4.2.6.2

SOUTHERN CALIFORNIA WHITE SEABASS FISHING EFFORT

The primary types of gear used to catch white seabass include gill nets, and hook-and-line. Drift gillnets are the predominant gear used. From 2000-2009, an average of 45 vessels participated in the white seabass fishery using set and drift gill nets, whereas an average of 42 vessels participated in the white seabass fishery using all other gears (trawl, hook-and-line, trap, and other) (Leos pers. comm. 2010).

PAST LANDINGS AND EX-VESSEL REVENUES

Tables 6-18 and 6-19 summarize landings and ex-vessel revenues for the southern California white seabass fishery from 1986 to 2009. While Table 6-18 shows the white seabass landings and ex-vessel revenues for all gear types, Table 6-19 shows the landings and ex-vessel revenues for white seabass caught using only gill or trammel net gear. These tables also include specific information for the area that would likely be affected by a gill and trammel net gear closure (the coastline from Santa Barbara to Port Hueneme) and additional information (for reference) for San Nicolas Island. These areas are discussed in greater detail below.

Southern California Bight

Figure 6-16 shows commercial white seabass landings and the number of general gill and trammel net permits in southern California. The annual white seabass harvest in southern California has increased from 30,966 pounds in 1997 to nearly 600,000 pounds in 2008. Landings declined to 305,000 pounds in 2009. The annual white seabass harvest using gill or trammel net gear also followed the increase in landings.

TABLE 6-18 COMMERCIAL WHITE SEABASS HARVEST: LANDINGS AND EX-VESSEL REVENUE BY AREA (ALL GEAR TYPES).

Year	Commercial Landings (pounds)			Ex-Vessel Revenue (thousands of 2009 dollars)		
	SCB	Santa Barbara to Port Hueneme	San Nicolas Island	SCB	Santa Barbara to Port Hueneme	San Nicolas Island
1986	15,225	712	301	$63	$3	$1
1987	21,079	110	4,377	$75	$0	$14
1988	13,802	86	0	$49	$0	$0
1989	33,063	2,000	0	$130	$7	$0
1990	26,337	192	0	$99	$1	$0
1991	56,700	884	2,219	$199	$3	$6
1992	74,090	7,480	1,833	$226	$22	$6
1993	61,824	4,134	1,174	$162	$13	$3
1994	50,750	14,446	2,400	$114	$41	$8
1995	40,731	0	6,587	$107	$10	$3
1996	75,988	7,621	5,225	$218	$25	$15
1997	30,966	9,923	5,983	$86	$33	$5
1998	99,102	4,823	7,931	$255	$14	$16
1999	150,424	16,733	5,032	$346	$44	$10
2000	122,307	22,667	7,696	$327	$69	$18
2001	109,081	28,877	2,525	$264	$77	$6
2002	241,070	74,035	6,301	$601	$203	$17
2003	291,784	95,978	6,903	$674	$215	$18
2004	217,395	112,755	3,777	$553	$290	$12
2005	232,135	41,679	11,747	$682	$125	$35
2006	307,994	67,247	1,242	$683	$177	$4
2007	397,441	170,217	10,394	$1,016	$429	$31
2008	595,304	362,393	9,410	$1,358	$812	$28
2009	305,296	210,494	3,519	$694	$506	$10

Data source: California Department of Fish and Game (2008a, 2010a).

Coastline, Santa Barbara to Port Hueneme

White seabass landings along the coastline from Santa Barbara to Port Hueneme are depicted in Figure 6-17. White seabass landings are shown for both all gear types and for gill and trammel net gear only. The landings have followed the same patterns over the last 20 years. Both increased to 207,000 to 210,000 pounds in 2009.

San Nicolas Island

White seabass landings around San Nicolas Island have been minimal over the last 20 years. In 2009, white seabass landings from around San Nicolas Island were 3,279 pounds.

Percentages of Fishery

From 2000 to 2009, annual commercial white seabass landings using gill or trammel net gear along the coastline from Santa Barbara to Port Hueneme accounted for 44 percent of southern

California white seabass landings using gill and trammel net gear. These landings comprised 42 percent of white seabass landings using all gear types in the same area. During the same period, annual commercial white seabass landings at San Nicolas Island accounted for two percent of southern California white seabass landings (Table 6-20).

TABLE 6-19 COMMERCIAL WHITE SEABASS HARVEST: LANDINGS AND EX-VESSEL REVENUE BY AREA (ONLY GILL OR TRAMMEL NET GEAR).

Year	Commercial Landings (pounds)			Ex-Vessel Revenue (thousands of 2009 dollars)		
	SCB	Santa Barbara to Port Hueneme	San Nicolas Island	SCB	Santa Barbara to Port Hueneme	San Nicolas Island
1986	321	0	0	$1	$0	$0
1987	588	0	0	$2	$0	$0
1988	0	0	0	$0	$0	$0
1989	0	0	0	$0	$0	$0
1990	0	0	0	$0	$0	$0
1991	0	0	0	$0	$0	$0
1992	0	0	0	$0	$0	$0
1993	1,150	26	0	$2	$0	$0
1994	38,834	9,413	1,654	$80	$29	$6
1995	23,722	0	6,505	$41	$7	$3
1996	60,775	7,456	4,119	$159	$24	$11
1997	24,953	9,179	5,689	$64	$30	$3
1998	92,558	4,751	7,908	$235	$14	$16
1999	123,511	16,395	5,032	$266	$43	$10
2000	92,430	20,613	7,696	$236	$62	$18
2001	83,196	27,478	2,525	$182	$73	$6
2002	218,138	71,212	6,301	$533	$194	$17
2003	282,680	94,423	6,800	$646	$210	$18
2004	211,316	111,666	3,749	$537	$288	$12
2005	225,558	41,352	11,737	$663	$124	$35
2006	297,469	67,022	1,187	$662	$176	$3
2007	392,375	169,626	10,142	$1,002	$427	$30
2008	587,138	361,156	9,174	$1,334	$809	$28
2009	296,993	206,746	3,279	$668	$493	$9

Data source: California Department of Fish and Game (2008a, 2010a).

TABLE 6-20 AVERAGE ANNUAL WHITE SEABASS LANDINGS (GILL & TRAMMEL NET), 2000-2009.

	Average Annual Landings (Gill & Trammel Net)	Percentage of SCB Landings (Gill & Trammel Net)	Percentage of SCB Landings (All Gear Types)
Santa Barbara to Port Hueneme (coastline)	117,129	44%	42%
San Nicolas Island	6,259	2%	2%
SCB (excluding landings from the above two areas)	145,341	54%	52%
Total Average Annual Landings	268,729	100%	95%

Data source: California Department of Fish and Game (2008a, 2010a).

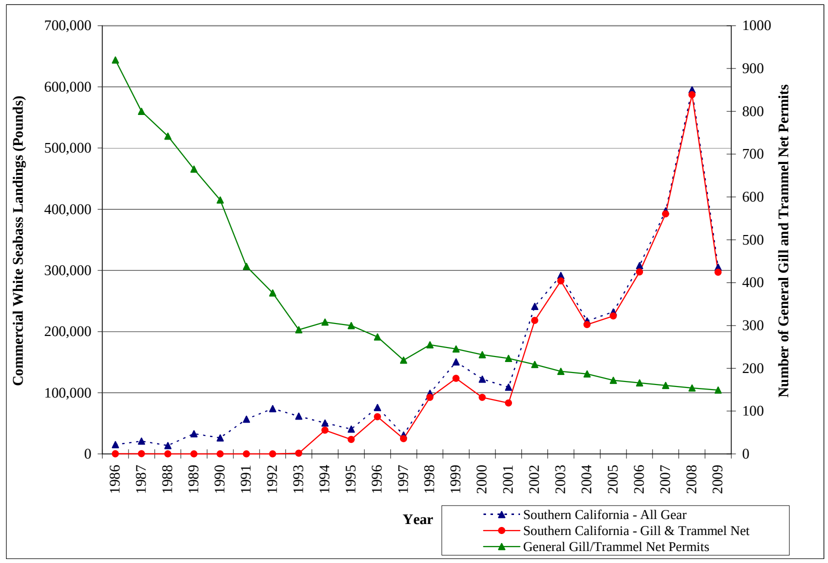

Figure 6-16 Commercial white seabass landings and number of general gill/trammel net permits for southern California, 1986-2009

Data source: California Department of Fish and Game (2008a, 2010a)

Sea Otter Range Expansion and Effect on the Southern California White Seabass Fishery

Under the baseline, (no attempt to remove sea otters), sea otters may continue to extend their range into the Southern California Bight. Sea otters do not prey on white seabass, and under the baseline there is no change in the regulations that affect sea otters in the currently designated management zone (see section 6.2.12). Therefore, no additional closure will occur, and there will be no effect on the southern California halibut fishery.

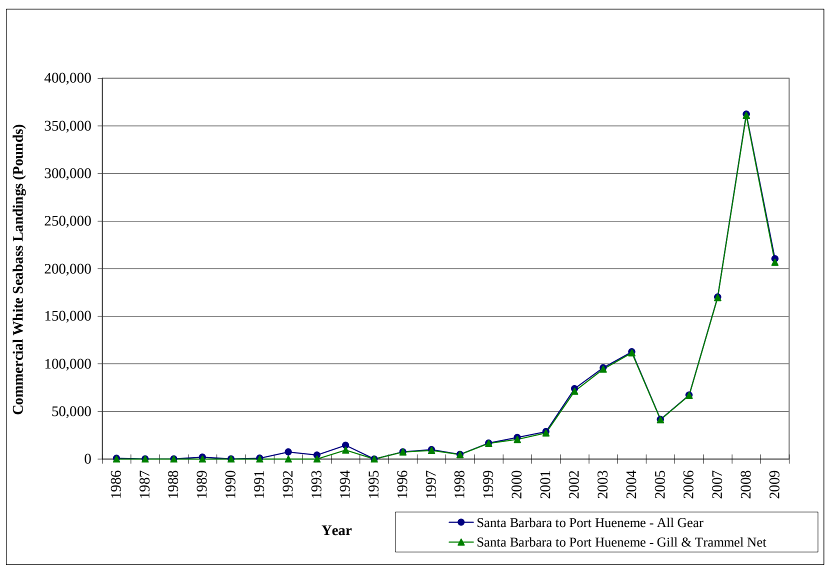

Figure 6-17 Annual white seabass landings: Santa Barbara to Port Hueneme

Data source: California Department of Fish and Game (2008a, 2010a)

Establishing the Baseline for the Southern California White Seabass Fishery

To establish a landings baseline, we employ a 10-year average (2000-2009) for the affected coastline (Santa Barbara to Port Hueneme) to mitigate the effects of cyclic variations in populations, adverse weather, market demand, and other factors that influence catch from one year to the next. Along the affected coastline (Santa Barbara to Port Hueneme), the 10-year landings average for white seabass using gill and trammel net gear is 117,129 pounds. We assume that this level of harvest will continue. Table 6-21 depicts the baseline for white seabass landings that will be used in this analysis.

TABLE 6-21 PROJECTED BASELINE FOR COMMERCIAL WHITE SEABASS LANDINGS (GILL & TRAMMEL NET)

Year	Commercial Landings (pounds)*			
	SCB (lower estimate)	SCB (upper estimate)	Santa Barbara to Port Hueneme	San Nicolas Island
10-year average (2000-2009)	281,981	281,981	117,129	6,259
2012	281,981	158,592	117,129	6,259
2013	281,981	158,592	117,129	6,259
2014	281,981	158,592	117,129	6,259
2015	281,981	158,592	117,129	6,259
2016	281,981	158,592	117,129	6,259
2017	281,981	158,592	117,129	6,259
2018	281,981	158,592	117,129	6,259
2019	281,981	158,592	117,129	6,259
2020	281,981	158,592	117,129	6,259
2021	281,981	158,592	117,129	6,259

*Landings are rounded to the nearest pound.
**Note that commercial landings across areas are not additive

6.2.5 MARINE AQUACULTURE

Most commercial shellfish production in marine aquaculture operations has leveled off or declined slightly in recent years, with oyster production down since 1994, clam production down since 2004, abalone production down since 2004, and mussel production down since 2002 (CDFG 2010c). Because of production methods, only mussel and oyster aquaculture may potentially be affected by sea otter predation.

The harvest of mussels from oil platforms in the Santa Barbara Channel reached a peak in the 1980s but has been discontinued in recent years (CDFG 2010c). In Santa Barbara offshore waters, one producer uses submerged long lines to grow Pacific oysters and Mediterranean mussels. Mussels are also grown on a nearshore open ocean lease near Santa Barbara, but avian predation has limited production (CDFG 2010c). Expanding sustainable marine aquaculture is a priority identified in NOAA's Ten Year Strategic Plan, National Marine Aquaculture Policy, and National Shellfish Initiative.

ESTABLISHING THE BASELINE FOR MARINE AQUACULTURE

Over the next 10 years, sea otters are expected to extend their range along the coastline between Point Conception and Carpinteria or Oxnard and to increase in number at San Nicolas Island. Sea otters reoccupying the mainland coastline could affect mussel and oyster production in the nearshore and offshore waters of the Santa Barbara Channel. The potential effect of sea otters on the limited marine aquaculture operations in this area is unclear. Sea otters are capable of locally reducing mussel densities, but regional depletion of harvestable mussel stocks may not occur (Estes and Van Blaricom 1985). Because the local clearing of patches in mussel beds by sea otter predation is episodic, it is not possible to predict or quantify impacts. At the regional level, it is probable that mussel aquaculture operations could persist within the range of sea otters because the consumption of mussels in California is patchy and sporadic (Estes and Van Blaricom 1985); however, the combination of sea otter predation and other factors that may adversely affect these operations (including other sources of predation) could result in cumulative effects on mussel aquaculture. Depending on the production methods, the presence of sea otters in these areas may affect the shellfish aquaculture that is anticipated under NOAA's Ten Year Strategic Plan, National Marine Aquaculture Policy, and National Shellfish Initiative.

Beyond 10 years, marine aquaculture operations located in other portions of the Southern California Bight may be affected by sea otters. Effects on marine aquaculture operations overall would likely be limited to sporadic losses at open water marine aquaculture leases where the harvested species is unprotected from sea otter foraging.

6.2.6 Seafood Processing Industry (Sea Urchins)

For a description of the seafood processing industry (sea urchins), see section 4.4.4.

Lobster and crabs captured in southern California are usually marketed with little or no processing. Sea urchin processing, however, is highly labor-intensive and mostly accomplished by hand. After the hard shell (test) of the sea urchin is cracked, five pieces of roe are gently extracted and are then cleaned with salt water. The size, style, grade, and color of the roe are important attributes that are directly related to the price of the roe. Therefore, expert care is taken to arrange the roe carefully on trays for optimal presentation. Although some roe is steamed, baked, frozen, or salted, the market caters largely to fresh roe (Price and Tom 1995). Because fresh roe is highly perishable, harvesting and processing of the product is especially dependent upon market demand.

Establishing the Baseline for the Sea Urchin Processing Industry

Under the baseline (no attempt to manage sea otters), changes in the southern California sea urchin processing industry may occur. The southern sea otter's range is expected to expand along the mainland coastline towards Carpinteria (lower bound) or Oxnard (upper bound) over the next 10 years (see section 6.1.4.1). Sea otter predation is projected to reduce the total commercial sea urchin harvest in the Southern California Bight, and thus inputs to southern California sea urchin processing facilities, by 3 percent over the next 10 years due to (1) the elimination of the commercial sea urchin fishery along the coastline from Point Conception to Carpinteria or from Point Conception to Oxnard, and (2) the 10 percent decline of the commercial sea urchin harvest at San Nicolas Island. Whether sea otters would reoccupy other areas of the Southern California Bight in subsequent years would be a function of sea otter demographic rates, food supply, and other variables. Those areas reoccupied by sea otters would cease to be a source of sea urchin inputs to the seafood processing industry, but the magnitude and timing of this potential future change is unknown.

6.2.7 Kelp Harvest

For background on kelp harvesting in the Southern California Bight, see section 4.4.5.

Establishing the Baseline for Kelp Harvest

Harvesting of giant kelp (*Macrocystis pyrifera*), the algal species most important to the kelp industry, occurs throughout a portion of the coastline that sea otters are expected to recolonize over the next 10 years. Sea otter predation on herbivores is generally expected to promote the growth of dense beds of giant kelp (for a more detailed discussion of the relationship between sea otters, sea urchins, and kelp, see section 6.2.2). However, because kelp distribution in areas of suitable substrate is not strictly correlated with grazing pressure (storms, pollution, water temperature, and other factors can also limit kelp), the magnitude of impact to this industry cannot be reasonably predicted.

Within 10 years, sea otters are expected to reduce invertebrate prey populations only along the coastline from Point Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound) and at San Nicolas Island. Sea otters would likely have a greater effect along the coastline, where they are expected to reach the densities required to reduce populations of invertebrate herbivores considerably. However, the reestablishment of kelp canopy in areas where it is limited by grazing pressure may require a decade or more to occur after the reduction of herbivore populations (Dayton and Tegner 1984), and thus no changes in kelp may be noticeable immediately.

The impact around San Nicolas Island is likely to be minimal over the next 10 years because the sea otter population is expected to reach only 21 percent of the estimated carrying capacity for the island. Although some increased predation on invertebrate herbivore populations at the island is expected, San Nicolas Island presently has extensive kelp forests. The predicted increase in sea otter numbers would not likely result in noticeable effects, but the persistence and density of these kelp beds may be enhanced.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. Those areas reoccupied by sea otters would likely exhibit a general increase in the distribution and abundance of kelp where it is limited by invertebrate herbivores.

6.2.8 Recreational Fishing

For a description of recreational fishing, see section 4.4.6. Recreational fishing activities that may be affected by sea otters include lobster fishing, abalone diving, and finfish fishing. Lobster fishing and finfish fishing are addressed below. Abalone diving is included under “Abalone Fishery Restoration” (section 6.2.9).

Southern California is a leading recreational fishing area along the west coast. Recreational fisheries in the Southern California Bight access nearshore and offshore areas, targeting both finfish and shellfish. Recreational fishing may occur from human-made structures, such as jetties and piers, from beaches, from CPFVs, or from private boats. CDFG has collected data on CPFVs since 1995.

Recreational fishing may be affected by the presence of sea otters in two ways: 1) direct competition between recreational divers and sea otters for recreationally targeted species consumed by sea otters, or 2) indirect habitat enhancement that could benefit recreational fishing through increased production of targeted finfish species. Southern sea otters primarily consume shellfish. Sea otter predation may thus reduce the abundance of spiny lobsters available to the recreational lobster fishery. However, sea otter predation would also reduce the abundance of herbivorous invertebrates, which would in turn promote the development, stability, and persistence of the nearshore kelp forest ecosystem in areas where herbivores are limiting kelp production. A healthy kelp forest ecosystem is important for a wide range of finfish species harvested by the recreational fishery (see section 6.2.2).

6.2.8.1 Lobster Fishing

Lobsters are caught by means of dives made from CPFVs, private vessels launched from harbors, and small vessels launched from shore. Lobsters may also be caught by means of dives made directly from shore and by hoop nets deployed from shores, piers, and vessels. The term "recreational lobster fishing" is used in this document to mean the recreational pursuit of lobsters by any of the means described above.

Skippers of CPFVs are required to submit logbooks containing information on target species, number of fish caught, fishing method, and location fished for each fish taken. Additionally, since 2008, every person who goes lobster diving or hoop netting has been required to carry a lobster report card and to record data for each trip, including month, day, location, gear type, and the number of lobsters retained, regardless of the mode of fishing (such as from CPFVs, private boats boats, piers, *etc.*) (CDFG 2011). Lobster report cards are used to monitor recreational spiny lobster catch, fishing effort, and the gear used in the recreational fishery. These report cards are a separate entity from the CPFV logs and provide data that overlap partially with the data collected from CPFV logs (each CPFV passenger, if diving or hoop-netting for lobster, is required to carry a lobster report card, but many lobster divers and hoop-netters do not utilize CPFVs). Approximately 27,500 cards were sold in 2008, 31,000 in 2009, and 29,000 in 2010 (CDFG 2011). The number of lobster report cards sold may be used to estimate recreational fishery effort, but there is additionally an unknown number of poachers retaining lobsters illegally (CDFG 2011). Due to low report card return rates (*e.g.*, 22 percent in 2008, 14 percent in 2009, 13 percent in 2010, and 14 percent in 2011), these data represent only a small portion of the recreational lobster fishing community, and it is not currently possible to produce an unbiased estimate of effort by method, such as sport diving versus hoop netting (Buck pers. comm. 2012). CDFG is investigating ways to increase report card return rates (Buck pers. comm. 2012).

Because only four years of lobster report card data are currently available, and because of low report card return rates, the partial overlap of report card data with CPFV data, and insufficient report card data on which to base an estimate of the proportion of people utilizing CPFVs versus other platforms for recreational lobster fishing, we do not attempt to utilize report card data to establish a quantitative baseline. Although we do not quantify absolute effects on recreational lobster fishing executed by means other than from CPFVs, we present report card data to provide a picture of the relative magnitude of effects under each alternative and for comparison with the CPFV data. In subsequent discussions of recreational lobster fishing throughout the document, it should be noted that the proportion of effort that CPFVs represent varies from year to year and that all CPFVs do not report every year, which leads to an underestimate of fishing effort.

From 1996 to 2005, recreational lobster fishing trips from CPFVs in southern California averaged 8,322 trips annually, ranging from about 11,700 trips in 1996 to about 6,500 trips in 2005 (Table 6-22). The ratio of person-trips to lobster catch in southern California averaged 1.2:1 from 1996 to 2005. This ratio was slightly lower (0.9) for San Nicolas Island. There are too few data points for the stretches of coastlines to estimate a similar ratio. Between 1996 and

2005, the majority of lobster fishing trips was concentrated around the Northern Channel Islands, where 63 percent of trips occurred (Figure 6-18). Although the affected mainland coastline is located near the Northern Channel Islands, virtually no CPFV lobster fishing trips were reported in this region, and are therefore not included in Figure 6-18. Approximately 5 percent of the CPFV fishing trips in the Southern California Bight occurred in the nearshore waters around San Nicolas Island. The coastline from Santa Barbara to the Mexican border also had very few CPFV lobster fishing trips.

Lobster report cards reflect private trips as well as trips made on CPFVs. Information from the limited number of lobster report cards returned from 2008-2011 (Buck pers. comm. 2012) indicates the following relative contributions of different areas to the total number of lobster fishing trips in the Southern California Bight: the coastline from Point Conception to Carpinteria (3 percent), the coastline from Point Conception to Oxnard (7 percent), and San Nicolas Island (0.2 percent). These proportions should be considered provisional because of the low percentage of lobster report cards returned.

ESTABLISHING THE BASELINE FOR LOBSTER FISHING

Under the baseline (no attempt to manage sea otters), changes in recreational lobster fishing may occur. The southern sea otter's range is expected to expand along the coastline towards Carpinteria (lower bound) or Oxnard (upper bound) over the next 10 years (see section 6.1.4.1). For the purposes of our analysis, we assume that sea otter predation would eliminate lobster fishing trips within the sea otter's range by 2021. Recreational lobster fishing trips around San Nicolas Island could also be affected. Over the next 10 years, sea otters at San Nicolas Island are expected to increase from approximately 11 percent of carrying capacity at present to 21 percent of carrying capacity in 10 years. We assume that lobster fishing trips would decrease accordingly, by 10 percent over 10 years at the island.

TABLE 6-22 NUMBER OF RECREATIONAL LOBSTER FISHING TRIPS AND CATCH VIA CPFVS DISTRIBUTED BY AREA

Year	Recreational Lobster Dive Trips				Number of Lobsters Caught		Ratio of Trips to Catch	
	Southern California Bight	Point Conception to Carpinteria	Point Conception to Oxnard	San Nicolas Island	Southern California Bight	San Nicolas Island	Southern California Bight	San Nicolas Island
1996	11,698	0	0	1,398	6,143	1,583	1.9	0.9
1997	11,514	27	38	933	7,148	925	1.6	1.0
1998	7,910	0	0	274	5,446	182	1.5	1.5
1999	9,164	2	2	342	5,782	373	1.6	0.9
2000	9,880	0	0	352	9,098	624	1.1	0.6
2001	7,118	0	0	120	6,830	243	1.0	0.5
2002	6,163	0	0	346	7,270	441	0.8	0.8
2003	7,309	0	32	183	9,032	177	0.8	1.0
2004	5,979	0	0	251	7,429	635	0.8	0.4
2005	6,510	18	18	143	6,510	79	1.0	1.8
10-year average	8,322	5	9	434	7,089	526	1.2	0.9

Data source: California Department of Fish and Game (1995, 1996, 1997, 1998, 1999b, 2000b, 2001, 2002b, 2003, 2006b)

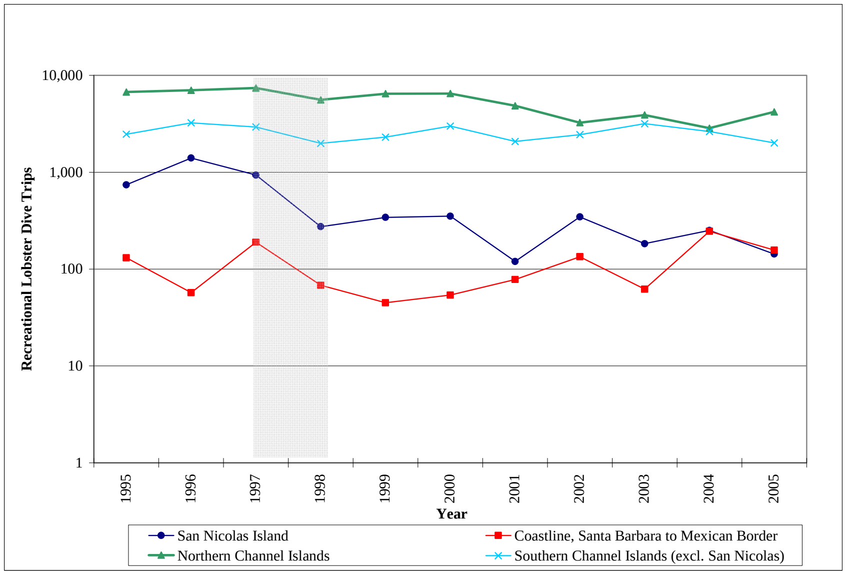

Figure 6-18 Annual distribution of recreational lobster fishing trips via CPFVs by area in southern California
Shaded area indicates El Niño event. Data source: California Department of Fish and Game (2002a, 2005a, 2006b)

Whether sea otters would reoccupy other areas of the Southern California Bight in subsequent years would be a function of sea otter demographic rates, food supply, and other variables. Those areas reoccupied by sea otters would likely exhibit declines in the number of lobsters available to recreational lobster divers, but the magnitude and timing of this potential future change is unknown.

Changes in the southern California recreational lobster fishery would take place gradually, with some localized areas (the coastline from Point Conception to Carpinteria or Oxnard and San Nicolas Island) being affected over the next decade. We assume that the number of trips taken is proportional to the potential catch on a recreational lobster dive trip, and that the potential catch on a recreational dive trip is a perfect inverse function of the area occupied by sea otters. Using this approach, we likely overestimate impacts of sea otters because we do not account for CPFVs that choose to fish in other areas or shift emphasis to carrying passengers involved in non-consumptive activities.

To establish the recreational lobster fishing baseline (Table 6-23), we project that the elimination

TABLE 6-23 PROJECTED BASELINE FOR RECREATIONAL LOBSTER FISHING TRIPS

Year	Recreational Lobster Fishing Trips*			
	SCB	San Nicolas Island	Point Conception to Carpinteria	Point Conception to Oxnard
10-year avg (1996-2005)	8,322	434	5	9
2012	8,317	431	4	8
2013	8,313	428	4	7
2014	8,309	424	3	6
2015	8,304	421	3	5
2016	8,300	417	2	5
2017	8,295	414	2	4
2018	8,291	411	1	3
2019	8,287	407	1	2
2020	8,282	404	0	1
2021	8,278	401	0	0

*Rounded to the nearest trip.

of lobster fishing trips along the coastline would be distributed evenly across 10 years so that lobster fishing trips would decrease 10 percent (less than 1 trip) each year to zero trips in 2021. Around San Nicolas Island, the average number of annual trips is 434. Using this approach, trips around San Nicolas Island are predicted to decrease about 1 percent per year over 10 years from 434 trips (10-year average) to 431 trips in 2012 to 428 trips in 2013, and so forth to 401 trips in 2021. Because the data represent only CPFVs (no private fishing trips are included), the number of fishing trips may be underestimated.

Information from the limited number of lobster report cards returned from 2008-2011 indicates that under the baseline, if all lobster trips (both private and CPFV) are eliminated as a result of sea otter recolonization of the coastline to Carpinteria (lower bound) or Oxnard (upper bound) within the next 10 years, then the total number of trips in the Southern California Bight will be reduced by 3-7 percent. Because the proportion of trips to San Nicolas Island is already so small, the projected increase in the number of sea otters there would not be expected to have a detectable effect on the total number of trips in the Southern California Bight. These proportion al reductions should be considered provisional because they are based on limited data.

6.2.8.2 Finfish Fishing

The presence of sea otters may improve habitat for recreationally important finfish and thus have a positive effect on the abundance of finfish available for harvest. Such changes would likely require more than 10 years to become noticeable (because the reestablishment of giant kelp canopies in areas where sea urchin grazing is limiting kelp is expected to take at least 10 years) and could occur gradually over several decades. A discussion of the long-term effects of sea otter predation on the kelp forest community, including finfish production, is given in section 6.2.2. A healthy kelp forest ecosystem is important for a wide range of finfish species harvested by the recreational fishery; however, it is not possible to reasonably quantify positive short-term effects sea otters may have on recreational finfish fishing because of the number of factors involved.

6.2.9 Abalone Fishery Restoration

For general information on the commercial and recreational abalone fishery, see section 4.4.7. From 1995 to 1997, recreational abalone trips in southern California decreased by 83 percent, while trips at San Nicolas Island decreased by 50 percent (Table 6-24). The California abalone fishery was closed in 1997 (with the exception of a sport-only fishery for red abalone north of San Francisco County) due to the depletion of multiple species of abalone caused by commercial and recreational harvest. Advances in diving equipment and boats increased the efficiency of commercial abalone exploitation, contributing to the depletion of stocks and the continual expansion of fishing grounds. During this same period, sea otter reoccupation of historic range along the central coast of California resulted in the displacement and concentration of fishing pressure to other areas of California (CDFG 2005c).

In December 2005, CDFG published a final Abalone Recovery and Management Plan (ARMP) for all seven species of abalone (red, black, green, pink, white, pinto, and flat) in California (CDFG 2005c). If abalone populations recover to sufficient levels, the ARMP specifies that the management portion of the plan “will apply to any fully recovered species in central and southern California, *outside of the Central California Sea Otter Range*” (CDFG 2005c, emphasis added). As indicated here and elsewhere in the ARMP, areas of southern California that are reoccupied by sea otters would not be considered for the development of commercial or recreational abalone fisheries.

The ARMP projects recovery times and key recovery areas for each species of abalone considered in the plan (Table 6-25). According to these projections, abalone populations will require 6 to 20 (or more) years to meet Criterion 1, which will be achieved when abalone reach a broad size distribution over their former range. Only when abalone have met Criterion 3 (an average density of 6,600 abalone per hectare) would they be considered for recreational or commercial harvest. The ARMP does not estimate the time required to meet Criteria 2 or 3 because such estimates would be purely "speculative," but the plan does state that achievement of these criteria may take decades. However, the plan does allow for consideration by the Fish and Game Commission of limited abalone fisheries at selected areas at reduced density and prior to reaching full recovery in all areas (CDFG 2005c, section 6.3.1). Such a fishery is being considered for red abalone at San Miguel Island (McCreary *et al.* 2010).

Establishing the Baseline for Abalone Fishery Restoration

The southern sea otter's range is expected to expand along the mainland coastline towards Carpinteria (lower bound) or Oxnard (upper bound) over the next 10 years (see section 6.1.4.1). Based on the projected times to reach Criterion 1 (Table 6-25), it does not appear that there is any potential for reopening the abalone fishery for any species during this 10-year time frame, regardless of the presence or absence of sea otters, except possibly at San Miguel Island under the provisions of section 6.3.1 of the ARMP. We assume that extension of the southern sea otter's range from Point Conception to Carpinteria or Oxnard would preclude reestablishment of abalone fishing along this stretch of coastline because the ARMP states that areas within the sea otter range will not be considered for the development of commercial or recreational abalone

TABLE 6-24 NUMBER OF RECREATIONAL ABALONE FISHING TRIPS AND CATCH VIA CPFVS DISTRIBUTED BY AREA

Year	Recreational Abalone Dive Trips			Number of Abalone Harvested		Ratio of Trips to Catch	
	Southern CA	Point Conception to Santa Barbara	San Nicolas Island	Southern CA	San Nicolas Island	Southern CA	San Nicolas Island
1995	8,972	0	207	4,135	171	2.2	1.2
1996	4,934	0	507	3,746	271	1.3	1.9
1997	1,592	0	110	1,111	50	1.4	2.2
1998	n/a	n/a	n/a	n/a	n/a	n/a	n/a
1999	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2000	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2001	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2002	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2003	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2004	n/a	n/a	n/a	n/a	n/a	n/a	n/a
2005	n/a	n/a	n/a	n/a	n/a	n/a	n/a
10-year average	--	--	--	--	--	--	--

Data source: California Department of Fish and Game (1995, 1996, 1997, 1998, 1999b, 2000b, 2001, 2002, 2003, 2006).

fisheries. Because sea otters are not expected to extend their range to the northern Channel Islands within 10 years (see section 6.1.4.1), sea otters would likely have no effect on the potential for reopening a limited fishery at San Miguel Island in the short term.

The colony of sea otters at San Nicolas Island is expected to increase from approximately 11 percent of carrying capacity at present to 21 percent of carrying capacity in 10 years. Abalone populations at San Nicolas Island are expected to persist as sea otter predation increases. However, densities of large individual abalone would likely eventually be reduced to a point that would preclude reestablishment of an abalone fishery at the island. If the colony at San Nicolas Island persisted as projected, the area surrounding the island would likely be disqualified from abalone fishery consideration on the grounds that it is not outside of the sea otter range (CDFG 2005c). Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. Whether or when an abalone fishery could be reestablished in the absence of sea otters is also uncertain, but it is clear that sea otter range expansion would preclude the possibility of recreational or commercial abalone fishing in reoccupied areas. At San Miguel Island, red abalone populations are apparently stable (Karpov *et al.* 2000). Eventual colonization of San Miguel Island by sea otters would reduce the densities of red abalone present there (Hines and Pearse 1982) and thus reduce but not eliminate the potential for these populations to contribute reproductively to other areas in the Southern California Bight. This reduced reproductive potential could have a detrimental effect on the eventual re-opening of the red abalone fishery in other areas of the Southern California Bight, if such a re-opening were proposed, even if sea otters were not present in these other areas.

TABLE 6-25 PROJECTED ABALONE RECOVERY TIMES AND KEY RECOVERY AREAS.

Species	Minimum Recovery Time*	Key Areas
Red	6-11 years	San Miguel Island Santa Rosa Island Santa Cruz Island San Diego area
Pink	14-16 years	Anacapa Island Santa Cruz Island Santa Barbara Island Santa Catalina Island San Clemente Island Cortez Bank Palos Verdes Peninsula Dana Point San Diego area
Green	14-20 years	Anacapa Island Santa Cruz Island Santa Barbara Island Santa Catalina Island San Clemente Island Palos Verdes Peninsula Dana Point San Diego area
Black	20+ years	San Miguel Island Santa Rosa Island Anacapa Island Santa Barbara Island San Nicolas Island Santa Catalina Island San Clemente Island Palos Verdes Peninsula Dana Point San Diego area
White	9+ years	Santa Barbara Island Santa Catalina Island San Clemente Island Tanner Bank Cortes Bank

Source: Final Abalone Recovery and Management Plan (CDFG 2005c).
*Recovery times are minimum times for the achievement of Criterion 1, which requires a broad size distribution of abalone over their former range. Achievement of Criterion 2 requires that minimum viable population (MVP) levels be reached at all key locations in all recovery areas. Achievement of Criterion 3 requires an average density of 6,600 abalone per hectare, at which point a population would enter the "fishery consideration" phase. Expected times for the attainment of Criteria 2 and 3 are not given.

6.2.10 ECOTOURISM AND NON-MARKET VALUE

HISTORY AND PAST TRENDS

Domestic and international travelers spent $95.1 billion in California in 2010, supporting 873,000 jobs and accounting for combined earnings of $29.9 billion (Dean Runyan Associates 2011). Travel spending generated $2.1 billion in local taxes and $4 billion in state taxes (Dean Runyan Associates 2011). Ocean-dependent tourism and recreation constituted 54.3 percent of California's ocean economy, more than transportation, construction, living resources, minerals, and ship and boat building combined (Kildow *et al.* 2009). Expenditures for wildlife-watching activities in the state of California are the highest of any state and totaled about $4.2 billion in 2006 (U.S. Department of the Interior *et al.* 2006). The number of people participating in wildlife watching in 2006 was more than three times the number of people participating in recreational fishing and hunting in California (U.S. Department of the Interior *et al.* 2006).

The attractiveness of boats and harbors, and particularly the presence of wildlife, contribute significantly to coastal tourism. Ecotourism in the nearshore waters of the Southern California Bight is based primarily on the gray whale migration and on tours of ecologically significant areas. Some operators also conduct trips during the blue whale and humpback whale season in the summer and early fall (Hoyt 2001). Whale watching in CINMS accounted for 25,984 person days of recreation activity in 1999 and generated more than $1.5 million in total revenue (Leeworthy and Wiley 2002). More generally, non-consumptive recreation in CINMS (which includes whale watching, non-consumptive diving, sailing, and kayaking/island sightseeing) yielded a total revenue of about $2.6 million in 1999 (Leeworthy and Wiley 2002).

Like whales, sea otters can be a considerable draw for tourists. Sea otters in Monterey Bay and Morro Bay attract visitors who contribute to the local economies through spending on accommodations, meals at restaurants, recreation, and retail purchases. However, it is difficult to estimate the economic importance of sea otters relative to other tourist attractions. There are only two studies that directly estimate the economic value of California sea otters. Hageman (1985) conducted a mail survey to California households to determine a non-market value for various sea otter population levels. The Hageman study determined that a population of 1500 otters results in a $0.007 value per otter per California household. Aldrich *et al.* (2001) attempted to quantify the impact of sea otters on tourism. This study conducted a regression analysis to calculate a yearly added-value destination spending (in California) per sea otter of $69,700 +/- $39,300, which includes accommodation, eating-drinking, recreation, and retail spending. Hageman (1985) determined that only 19 percent of tourism expenditures were related to sea otters, which would decrease the Aldrich *et al.* estimate. Sea otters have occurred only in very low numbers in the Southern California Bight in the recent past. At San Nicolas Island, the only area of the Southern California Bight where sea otters have been consistently present, the numbers of sea otters have also remained low. Trips directed toward ecotourism in the Southern California Bight would increase in quality if sea otters were observed.

ESTABLISHING THE BASELINE FOR ECOTOURISM AND NON-MARKET VALUE

Over the next 10 years, southern sea otters are expected to recolonize the stretch of coastline from Point Conception to Carpinteria or to Oxnard, with a median number of 73 to 299 sea otters residing year-round south of Point Conception by the end of the 10-year period. Tourism, based on sea otter watching, would be enhanced with sea otters residing along a coastline accessible by a well-traveled highway and near busy areas like the Santa Barbara harbor. Overall economic value of this tourism is difficult to quantify and would not necessarily result in increased economic activity because the tourism market in Santa Barbara is likely saturated and tourist vessels are limited by available space in Santa Barbara harbor. Rather, it would likely manifest itself as an added value to other tourist draws in the area.

TABLE 6-26 PROJECTED BASELINE FOR SEA OTTER NON-MARKET VALUE.

	Value per otter per household	CA households	Sea otter population after 10 years	Total non-market value
Coastline, Pt. Conception to Carpinteria or Oxnard	$0.007	12.2 million	73 to 299	$6.2 million to $25.5 million
San Nicolas Island	$0.007	12.2 million	103	$8.8 million
Total			176 to 402 sea otters	$15.0 million to $34.3 million
Data Source: U.S. Census Bureau (2008), Hageman (1985)				

While additional tourism may not be generated within the next 10 years along the affected stretch of coastline, a non-market value can be estimated for the increasing population of sea otters. Applying Hageman's estimate for the non-market value of sea otters would result in $15.0 million to $34.3 million (Table 6-26). This analysis assumes that today's California households have the same non-market value for sea otters as those households in 1985.

The sea otter colony at San Nicolas Island is expected to increase by an average of 7 percent annually over the next 10 years, resulting in an estimated population size of 103 in 2021. This change represents an increase of 50 sea otters from the 53 sea otters estimated for 2012. San Nicolas Island is not currently an important destination for ecotourism (U.S. Department of Defense 2002) relative to the other Channel Islands because of its isolation from other islands, its distance from the mainland, and the periodic closure of its surrounding waters for military operations. We do not expect ecotourism in this area to grow considerably (in terms of number of trips) due to the increased abundance of sea otters. Rather, the quality of recreational trips that do occur at San Nicolas Island would likely be enhanced due to increased opportunities to see sea otters. However, applying Hageman's estimate for the non-market value of sea otters would result in $8.8 million over 10 years for the sea otters at San Nicolas Island (Table 6-26).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized other areas of the Southern California Bight, ecotourism would likely be enhanced in those areas.

6.2.11 Federal and State Agency Programs

For general background on the activities of CINP, CINMS, CDFG, BOEM, and the U.S. Navy/DOD, see section 4.4.9. For a discussion of the regulatory environment, see section 6.2.12.

6.2.11.1 U.S. Fish and Wildlife Service

Baseline effects on southern sea otter recovery are also addressed in section 6.2.3.3 ("Southern Sea Otter"). Here we address our ability to meet our mandates under the ESA and the MMPA and give the implementation costs associated with the baseline.

The mission of USFWS is "working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people." In the case of endangered or threatened species like the southern sea otter, we are required to promote the recovery of the species as defined by the ESA. Generally, the goal of the ESA is to ensure the recovery of listed species so that they are no longer in danger of extinction or likely to become in danger of extinction in the foreseeable future. In addition, under the MMPA, federal agencies are charged with managing marine mammals to their Optimum Sustainable Population level. The Optimum Sustainable Population level is defined by the MMPA as the number of animals, with respect to any population stock, that "will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element" (16 *U.S.C.* 1362). For the southern sea otter, the Optimum Sustainable Population level is believed to be greater than the population level needed to achieve recovery under the ESA. The final revised recovery plan for the southern sea otter identifies a population size of 3,090 as necessary to consider delisting of the species under the ESA and gives the lower bound of the Optimum Sustainable Population level as approximately 8,400 animals for the California coast (USFWS 2003).

This estimated lower bound of the Optimum Sustainable Population level, also known as the maximum net productivity level (MNPL), is roughly 50 percent of the estimated carrying capacity of California (Laidre *et al.* 2001). Carrying capacity in this context is defined as the maximum number of sea otters that can be supported by the nearshore marine environment of California. Laidre *et al.* (2001) estimated carrying capacity as a product of the densities of sea otters in rocky, sandy, and mixed habitats in portions of their range believed to be at equilibrium, and the total amount of rocky, sandy, and mixed habitat to the 40 meter isobath in California. Habitat availability was determined using a Geographic Information Systems (GIS) program (Laidre *et al.* 2001). Whereas the MNPL is generally defined as approximately 60 percent of the carrying capacity (Gerrodette and DeMaster 1990), the MNPL can range from 50 to 80 percent of carrying capacity, depending on density-dependent age-specific birth and death rates (Taylor and DeMaster 1993).

Establishing the Baseline for Fish and Wildlife Service Programs

Under baseline conditions, sea otters may expand their range naturally into the Southern California Bight, maximizing the area available at the southern end of the range for southern sea otter recovery and the potential for the eventual increase of southern sea otters to their Optimum Sustainable Population level. The carrying capacity of the Southern California Bight has been estimated as 6,441 sea otters, which accounts for about 40 percent of the carrying capacity of California as a whole (Laidre *et al*. 2001). According to Doak (2011), the probability that southern sea otters will meet the recovery criterion of 3,090 animals within 10 years if natural range expansion continues unimpeded is 89 percent (77 percent if inter-year correlations in growth rates are considered). For a discussion of the regulatory provisions that apply to sea otters under the baseline, see section 6.2.12.

Implementation Costs (10-year period)

Currently, no sea otters are being moved to San Nicolas Island or out of the designated management zone. Monitoring of the colony and ecological changes at the island are conducted by the U.S. Geological Survey and are not included here as costs to USFWS. Without the movement of sea otters, no other implementation costs are associated with the program. Under the baseline, the absence of implementation costs would remain constant over the next 10 years.

6.2.11.2 Channel Islands National Park

Establishing the Baseline for Channel Island National Park Programs

The southern sea otter's range is expected to expand along the mainland coastline towards Carpinteria (lower bound) or Oxnard (upper bound) over the next 10 years (see section 6.1.4.1). At San Nicolas Island, the sea otter population is expected to grow by an average of about seven percent annually. Because both of these areas are outside the boundaries of the CINP, sea otters are not expected to have any effect on this agency within ten years.

However, at some point in the future, it is possible that sea otters would recolonize other areas of the Southern California Bight, which would likely include areas within the CINP. If sea otters recolonized areas within Park boundaries, the National Park Service would be required to conference under the ESA for actions that would be likely to jeopardize the continued existence of the species. For further discussion of the regulatory environment, see section 6.2.12.

According to the *Strategic Plan for Channel Islands National Park*, the Park's mission is to "protect and interpret the natural ecosystems and cultural values of the Channel Islands and adjacent marine waters (…)." The "Park Mission Goals" specify that natural, scenic, and cultural resources should be "protected, restored, understood, and maintained and managed within their broader ecosystem and cultural context" (CINP n.d.). Because of the important role of sea otters as keystone predators in nearshore marine ecosystems of the North Pacific (see section 6.2.2) and the historic presence of sea otters in the Southern California Bight, the renewed presence of sea otters would be consistent with efforts of the CINP to fulfill its mission and related goals.

6.2.11.3 Channel Islands National Marine Sanctuary

Establishing the Baseline for Channel Islands National Marine Sanctuary Programs

The southern sea otter's range is expected to expand along the mainland coastline towards Carpinteria (lower bound) or Oxnard (upper bound) over the next 10 years (see section 6.1.4.1). At San Nicolas Island, the sea otter population is expected to grow by an average of about seven percent annually. Because both of these areas are outside the boundaries of the CINMS, sea otters are not expected to have any effect on this agency within ten years.

However, at some point in the future, it is possible that sea otters would recolonize other areas of the Southern California Bight, which would likely include nearshore waters within the CINMS. If sea otters recolonized areas within the Sanctuary, the National Oceanic and Atmospheric Administration would be required to conference under the ESA for actions that would be likely to jeopardize the continued existence of the species. For further discussion of the regulatory environment, see section 6.2.12.

The mission of the National Marine Sanctuary Program is "to conserve and enhance biodiversity, ecological integrity and cultural legacy of areas of special national significance through comprehensive long term management and outreach" (CINMS 2002a). Because of the important role of sea otters as keystone predators in nearshore marine ecosystems of the North Pacific (see section 6.2.2) and the historic presence of sea otters in the Southern California Bight, the renewed presence of sea otters would be consistent with efforts of CINMS to fulfill its mission. Possible effects on the recently designated Channel Islands Marine Protected Areas are discussed in section 6.2.11.4 ("California Department of Fish and Game").

6.2.11.4 California Department of Fish and Game

Note: CDFG activities that may be affected by sea otters are diverse, and baseline effects on these activities are discussed separately. CDFG activities include general fisheries management or restoration, efforts to protect rare species (such as abalone and southern sea otters), and the implementation of MPAs. Effects on the recovery of white and black abalone and sea otters are discussed under "Candidate, Threatened, and Endangered Species" (section 6.2.3). Effects on existing commercial fisheries are discussed under "Commercial Fisheries" (section 6.2.4). Effects on attempts to restore an abalone fishery are discussed under "Abalone Fishery Restoration" (section 6.2.9). Effects on MPAs and the restoration of depleted abalone species that are not federally listed are discussed here.

ESTABLISHING THE BASELINE FOR CALIFORNIA DEPARTMENT OF FISH AND GAME PROGRAMS

MARINE PROTECTED AREAS

Twelve MPAs at the northern Channel Islands were designated by the California Fish and Game Commission in 2002. NOAA expanded the MPA network into deeper waters in 2006 and 2007, resulting in 13 MPAs. Of the 13 MPAs at the Channel Islands, 11 are "marine reserves," where no fishing or kelp harvesting is allowed, and 2 are "conservation areas," in which limited recreational fishing and lobster trapping are allowed. The establishment of additional MPAs throughout California is proceeding in compliance with the Marine Life Protection Act, which directs the state to redesign California's system of MPAs to function as a network. On December 15, 2010, the California Fish and Game Commission adopted regulations to create 49 MPAs and 3 special closures in southern California (from Point Conception to the Mexican border). This 917-square km (354-square mi) network includes the 13 MPAs and 3 special closures previously established at the northern Channel Islands and represents approximately 15 percent of the region. These new MPAs are effective as of October 1, 2011.

According to the Marine Life Protection Act (MLPA) of 1999, the purpose of the redesigned MPA network is to "increase its coherence and its effectiveness at protecting the state's marine life, habitat, and ecosystems" (Fish and Game Code Section 2853(b)). Guiding the design and management of the network are six goals:

> (1) To protect the natural diversity and abundance of marine life, and the structure, function, and integrity of marine ecosystems.

(2) To help sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted.

(3) To improve recreational, educational, and study opportunities provided by marine ecosystems that are subject to minimal human disturbance, and to manage these uses in a manner consistent with protecting biodiversity.

(4) To protect marine natural heritage, including protection of representative and unique marine life habitats in California waters for their intrinsic value.

(5) To ensure that California's MPAs have clearly defined objectives, effective management measures, and adequate enforcement, and are based on sound scientific guidelines.

(6) To ensure that the state's MPAs are designed and managed, to the extent possible, as a network.

Under baseline conditions, sea otters are expected to recolonize the mainland coastline to Carpinteria (lower bound) or Oxnard (upper bound) within the next 10 years. Five of the MPAs designated in 2010 fall within this area of coastline: Point Conception State Marine Reserve (SMR), Kashtayit State Marine Conservation Area (SMCA), Naples SMCA, Campus Point SMCA, and Goleta Slough SMCA. All take is prohibited in these five MPAs, except that 1) the recreational take of finfish and invertebrates (except scallops and mussels) and the recreational take of giant kelp is allowed in Kashtayit SMCA, and 2) the recreational take of pelagic finfish by spearfishing and the commercial take of giant kelp (with certain restrictions) is allowed in Naples SMCA. The presence of sea otters may enhance opportunities related to finfish and giant kelp in Kashtayit SMCA and Naples SMCA but may decrease the availability of invertebrates for recreational take in Kashtayit SMCA. The presence of sea otters would generally be expected to affect all five MPAs as described in the paragraphs below. The remaining MPAs are outside the area that sea otters are expected to colonize in the short term (except Begg Rock SMR near San Nicolas Island), but in the longer term, sea otters may continue to expand their range throughout the Southern California Bight and to encounter other MPAs, including those at the Channel Islands.

The presence of sea otters in MPAs is consistent with the goals set out for these areas relating to: the maintenance of ecosystem biodiversity; the protection of the structure, function, and integrity of marine ecosystems; the protection of marine natural heritage; and the provision of recreational, scientific, and educational opportunities. The presence of sea otters would also be compatible with state legislative mandates to practice ecosystem management. Specifically, the presence of sea otters is compatible with the objectives of state policy to conserve entire systems, to allow only sustainable uses of the marine environment, to recognize the importance of non-consumptive uses, and to encourage commercial fishing and aquaculture where it is consistent with marine living resource conservation policies. These objectives are expressed in Division 6, Part 1.7 of the Marine Life Management Act (7050(b)):

1) Conserve the health and diversity of marine ecosystems and marine living resources.[16]

2) Allow and encourage only those activities and uses of marine living resources that are sustainable.

3) Recognize the importance of the aesthetic, educational, scientific, and recreational uses that do not involve the taking of California's marine living resources.

4) Recognize the importance to the economy and the culture of California of sustainable sport and commercial fisheries and the development of commercial aquaculture consistent with the marine living resource conservation policies of this part.

An assessment of the possible effects of sea otters on sustainable fisheries goals for the MPAs is somewhat more complicated. Generally, sea otters can be expected to have a beneficial effect on the nearshore marine ecosystem, and thus to enhance the potential productivity of MPAs overall (see section 6.2.2). Most of the fishery benefits of MPAs are expected to accrue outside of their boundaries. These benefits may occur as a result of "spillover effects": the increased reproductive output and recruitment of fished species and the migration of legal-sized individuals out of Marine Protected Area boundaries (Ugoretz 2002). If sea otters reoccupied areas designated as MPAs, the reproductive output of benthic invertebrate populations in these areas would likely diminish as a result of sea otter predation. Nevertheless, some mature individuals would remain in cryptic and inaccessible habitat, and dispersal of their highly mobile pelagic larvae could still occur. The potential for dispersal of larger individuals outside the boundaries of reserves depends on the mobility of the species in question (Ugoretz 2002). For example, mature sea urchins and abalone are not highly mobile and are unlikely to migrate out of MPAs. Therefore, sea otter predation would have no impact on this form of "spillover effect" for sea urchins and abalone. However, sea otters would be expected to reduce the number of legal-sized lobsters and crabs that could potentially move out of MPAs.

To the extent that MPAs are intended to enhance the prospect of a possible eventual reopening of the abalone fishery in southern California, the presence of sea otters in these areas would adversely affect such efforts (see section 6.2.9 for additional discussion). Sea otter predation can be expected to remove the larger, exposed individuals (which are more vulnerable to predation) from the abalone population and to restrict the remaining individuals to cryptic and inaccessible habitat. Abalone populations would likely be maintained at the densities typical for the area prior to the extirpation of sea otters, in whose absence the commercial abalone and sea urchin fisheries developed (Estes and Van Blaricom 1985). For abalone populations reduced to very low densities by overexploitation or other factors, reductions in density could result in reduced fecundity due to the spatial separation of adults. The presence of sea otters in MPAs would not eliminate the potential for persistent (cryptic) abalone populations but would rather diminish the fishery benefit anticipated from the exported reproductive output of protected large adults. Fanshawe *et al.* (2003) conclude from a study of red abalone in California "no take" areas with

[16] The Marine Life Management Act defines "Marine Living Resources" as including "all wild mammals, birds, reptiles, fish, and plants that normally occur in or are associated with salt water, and the marine habitats on which these animals and plants depend for their continued viability."

and without sea otters that sea otters restrict abalone to a subset of microhabitats adequate for population persistence but likely insufficient to contribute to regional fishery sustainability.

The *Final Environmental Document for Marine Protected Areas* (for the Channel Islands) states that the potential reduction of prey species by top predators (such as sea otters) is not to be regarded as a negative effect from the perspective of ecosystem management:

> Empirical studies suggest that trophic cascades may occur when areas are protected from fishing, particularly when top predators have been reduced in numbers (*e.g.* sea otters and California sheephead), allowing the exceptional growth of prey populations (*e.g.*, sea urchins). One consequence of reserve establishment may be to offset the exceptional growth of prey populations with increased numbers of top predators. In this circumstance, declines are expected and desired from the perspective of ecosystem management. (Ugoretz 2002)

RESTORATION OF DEPLETED ABALONE SPECIES (NOT FEDERALLY LISTED)

In December 2005, CDFG published a final Abalone Recovery and Management Plan (ARMP) for all seven species of abalone (red, black, green, pink, white, pinto, and flat) in California (CDFG 2005c). White and black abalone have been federally listed as endangered and are discussed separately under "Candidate, Threatened, and Endangered Species." State recovery efforts for red, green, pink, pinto, and flat abalone are discussed here. The ARMP projects recovery times and key recovery areas for each species of abalone considered in the plan (see Table 6-25 in section 6.2.9). According to these projections, abalone populations will require 6 to 20 (or more) years to meet Criterion 1, which will be achieved when abalone reach a broad size distribution over their former range. As the ARMP notes, the first step towards the recovery of abalone populations was the closure of the fishery, and a continuation of the closure until a species has recovered is an "underlying tenet" of the plan (CDFG 2005c). Enhancement activities include translocation or aggregation of adult stocks, larval outplanting, captive breeding to obtain large individuals for outplanting, and the establishment of MPAs.

Under baseline conditions, sea otters are expected to recolonize the mainland coastline to Carpinteria (lower bound) or Oxnard (upper bound) within the next 10 years and to recolonize other areas of the Southern California Bight gradually in the longer term. Natural sea otter range expansion could negatively affect State efforts to enhance abalone populations by means of larval outplanting if outplanting efforts were planned for habitats lacking sufficient cryptic habitat to shield abalone from sea otter predation. Negative effects would be lessened to the extent that outplanting efforts were conducted in cryptic habitat that is inaccessible to sea otters or in areas outside the range into which sea otters naturally expanded. The translocation or aggregation of adult stocks would likely be unaffected by sea otters, as one purpose of translocation is to protect adults from predation or other threats, and it would seem likely that abalone would be translocated into, or aggregated in, sufficiently protective crevice habitat. Natural range expansion of sea otters into the Southern California Bight would not affect other enhancement activities, such as captive breeding or the establishment of MPAs.

6.2.11.5 U.S. Navy/Department of Defense

ESTABLISHING THE BASELINE FOR U.S. NAVY/DEPARTMENT OF DEFENSE PROGRAMS

The U.S Navy allowed sea otters to be translocated to San Nicolas Island in 1987 provided it was given certain exemptions under the ESA at San Nicolas Island and under the ESA and MMPA in the management zone. Section 7 of the ESA directs all federal agencies to consult with USFWS when their actions may affect listed species or critical habitats. However, Public Law 99-625 and federal implementing regulations modified the regulatory provisions that apply to sea otters in the translocation zone and management zone. For a discussion of the regulatory environment, see section 6.2.12.

6.2.11.6 Bureau of Ocean Energy Management

ESTABLISHING THE BASELINE FOR BUREAU OF OCEAN ENERGY MANAGEMENT PROGRAMS

Section 7 of the ESA directs all federal agencies to consult with USFWS when their actions may affect listed species or critical habitats. However, Public Law 99-625 and federal implementing regulations modified the regulatory provisions that apply to sea otters in the translocation zone and management zone. For a discussion of the regulatory environment, see section 6.2.12.

6.2.11.7 National Marine Fisheries Service

National Marine Fisheries Service activities that occur within or overlap with the nearshore areas of the Southern California Bight are diverse. These activities include implementing recovery actions for federally listed threatened and endangered species and managing federal fisheries. Information on endangered white and black abalone and NMFS-led recovery efforts for these species is given under “Candidate, Threatened, and Endangered Species.” Federally managed fisheries are discussed here.

ESTABLISHING THE BASELINE FOR NATIONAL MARINE FISHERIES SERVICE PROGRAMS

Section 7 of the ESA directs all federal agencies to consult with USFWS when their actions may affect listed species or critical habitats. Federally managed fisheries that may overlap with nearshore areas of the Southern California Bight are described in the Fishery Management Plans (FMPs) for Highly Migratory Species, Coastal Pelagic Species, Pacific Groundfish, and Salmon. We describe these fisheries in more detail in section 4.4.9.7 of the FSEIS. These federally managed fisheries are pursued over large geographic areas. These geographic areas may overlap partially with the southern sea otter range along the central coast. Requests for consultation under section 7 of the ESA due to potential effects on sea otters have been limited due to the gear types used and/or the depths in which these fisheries are pursued. Public Law 99-625 and federal implementing regulations modified the regulatory provisions that apply to sea otters in the translocation zone and management zone. For a discussion of the regulatory environment, see section 6.2.12.

6.2.12 REGULATORY ENVIRONMENT

The southern sea otter is federally listed as a threatened species under the ESA, and is therefore considered a depleted species under the MMPA. The state of California additionally recognizes the southern sea otter as a fully protected mammal in Fish and Game Code section 4700 and as a protected marine mammal in Fish and Game Code section 4500. Among other restrictions, "take" of southern sea otters is prohibited under each of these laws.

Under the ESA and the MMPA, there are provisions that allow certain types of take (*e.g.,* for scientific research or enhancement purposes, or incidental to specific legal activities) upon authorization of USFWS. However, state law appears to be more restrictive. While California Fish and Game Code Section 4500 makes it unlawful to take a sea otter except in accordance with the MMPA of 1972, Fish and Game Code Section 4700 goes further and provides that "no provision of this code or any other law shall be construed to authorize the issuance of permits or licenses to take a fully protected mammal." Section 4700 contains a limited exception for scientific research and recovery efforts. In 2012, California enacted legislation that creates an exception to the prohibition against take of fully protected species, including the sea otter, if the species is covered under a Natural Community Conservation Plan that has been approved by the Department of Fish and Game pursuant to the state's Natural Community Conservation Planning Act. (Cal. Fish and Game Code §§ 2800 – 2835, 2835)_

ESTABLISHING THE BASELINE FOR THE REGULATORY ENVIRONMENT

As a free-standing act of Congress, Public Law 99-625 changed the protections under the ESA and the MMPA for sea otters residing in the translocation zone and management zone.

Under Public Law 99-625, sea otters within the translocation zone receive the standard protections of the ESA for threatened species, except with respect to defense-related activities. Proposed actions other than defense-related activities that are carried out, authorized, or funded by a federal agency within the translocation zone and that may affect the southern sea otter are subject to the consultation requirements of Section 7 of the ESA. Under Section 7 and its implementing regulations, a federal agency must consult with USFWS if a proposed action in the translocation zone, other than a defense-related activity, may affect the southern sea otter, and the agency may not proceed with the action if it is likely to jeopardize the continued existence of the southern sea otter. The standard prohibitions and authorizations (exceptions to the prohibitions) of the MMPA and state law apply to southern sea otters within the translocation zone.

With respect to defense-related activities, sea otters within the translocation zone are treated as members of a species that is proposed to be listed (50 CFR §17.84(d)(4)(iv)) under the ESA. Consultation requirements under Section 7 of the ESA do not apply to proposed species, and therefore a federal agency carrying out a defense-related activity is not required to avoid jeopardy to, or incidental take of, southern sea otters within the translocation zone. However, pursuant to Section 7(a)(4) of the ESA and Public Law 99-625, when a federal agency in a military department proposes to carry out a defense-related activity in the translocation zone that is likely to jeopardize the continued existence of the southern sea otter, a conference between the federal agency and USFWS, resulting in the issuance by USFWS of a non-binding conference opinion, is required.

Under Public Law 99-625, sea otters within the management zone are treated as members of a species that is proposed to be listed for the purposes of Section 7 of the ESA. Accordingly, federal agencies are not required to consult with USFWS under Section 7 of the ESA but only to conference with USFWS if a proposed action is likely to jeopardize the continued existence of the species. In addition, any taking of sea otters within the management zone that is incidental to an otherwise legal activity (including commercial fishing) is not subject to the take authorization procedures of, and may not be considered a violation of, either the ESA or the MMPA. To accommodate Public Law 99-625 and to support the southern sea otter translocation program, the State enacted section 8664.2 of the California Fish and Game Code. Among other provisions, section 8664.2 allows for incidental take of sea otters in the management zone by means of specific exemptions from section 4700 of the Fish and Game Code.

6.3 Alternative 1—Resume Implementation of 1987 Translocation Plan

6.3.1 Introduction

Under Alternative 1, USFWS would continue monitoring the sea otter colony at San Nicolas Island and the local marine environment and resume containment activities associated with the southern sea otter translocation program, as defined by Public Law 99-625 and 50 CFR §17.84(d). The primary activities would include (1) observing and protecting sea otters around San Nicolas Island, (2) conducting sea-otter-related research (3) maintaining a management (or no-sea-otter) zone from Point Conception to the Mexican border, and (4) moving small numbers of sea otters to San Nicolas Island, as necessary, to improve genetic diversity in the colony. Alternative 1 entails resumption of sea otter translocation and relocation activities and hence differs considerably from the baseline in this respect.

Alternative 1 would require removing all sea otters that enter the management zone. In light of the past seasonal movement of large numbers of sea otters into and out of the management zone, the substantial difficulty in capturing such numbers of sea otters, and the tendency of moved sea otters to return, it is unlikely that maintenance of the management zone can be performed with absolute or even a reasonably high rate of success. The degree of success depends largely on the movements of sea otters themselves. In light of this uncertainty, we evaluate the effects of Alternative 1 as if the management zone could be maintained absolutely, with the understanding that the effects projected for this alternative (both positive and negative) would be diminished to some unknown extent relative to the baseline if sea otters cannot be captured and removed effectively.

The assumptions that apply to the analysis for Alternative 1 are the same as those described for the baseline. For a detailed description of the baseline, to which each activity is compared, refer to section 6.2, "Baseline (Status Quo)—The No Action Alternative."

6.3.2 Nearshore Marine Ecosystem

Alternative 1 would require the exclusion of sea otters from all areas of the Southern California Bight except the translocation zone surrounding San Nicolas Island. Any community changes that have occurred as a result of seasonal sea otter predation in the management zone during the last several years would likely be reversed, and none of the ecosystem changes predicted under baseline conditions would occur (see section 6.2.2). Conditions at San Nicolas Island would be the same as those projected for the baseline. We do not assign a level of significance to effects on the nearshore marine ecosystem because of the extent of uncertainty involved.

In the long term, Alternative 1 would prevent any of the changes described in section 6.2.2 from occurring in all areas of the Southern California Bight except the immediate area surrounding San Nicolas Island.

6.3.3 Candidate, Threatened, and Endangered Species

6.3.3.1 White Abalone

Resuming maintenance of the currently designated management zone, as required under Alternative 1, would ultimately minimize sea otter predation on white abalone populations in the Southern California Bight except in the translocation zone surrounding San Nicolas Island. Within 10 years, the exclusion of sea otters from the coastline between Point Conception and Carpinteria (lower bound) or Point Conception and Oxnard (upper bound) would prevent the changes described for the baseline from occurring. During this period, Alternative 1 would likely benefit shallow-living individual white abalone and may have benefits at the local population level. Restriction of the naturally expanding southern sea otter population could positively affect NMFS-led recovery efforts under Recovery Action 3.3 (protect white abalone populations and habitat as they are discovered or established through enhancement) through the prevention of sea otter predation if white abalone populations recover naturally or are established within the depth range utilized by sea otters and within the geographic area that would have been reclaimed by natural sea otter range expansion.

Because Alternative 1 calls for only minor changes to the colony at San Nicolas Island relative to the baseline (including the possibility of continued translocation of small numbers of sea otters for the purposes of genetic enhancement), effects on white abalone in the vicinity of San Nicolas Island are essentially the same as for the baseline. As discussed under the baseline, sea otter and white abalone depth ranges overlap only marginally. Additionally, fishery data collected from 1955-1997 indicate that less than one half of one percent of all white abalone landings came from these areas (the coastline between Point Conception and Oxnard and at San Nicolas Island) combined (Hobday *et al.* 2001). Therefore, relative to the baseline, the effect of Alternative 1 on white abalone within 10 years is expected to be positive but of low significance.

In the longer term, maintenance of the management zone under Alternative 1 would afford white abalone protection from sea otter predation in the depth ranges where the two species overlap. However, because historic and current white abalone population centers are in the southern portion of the Southern California Bight and at offshore banks, which may provide refuge from sea otter predation, and because sea otter range expansion into the southern portions of the Southern California Bight would be expected to require many decades, the timing and magnitude of the long-term benefit to white abalone recovery from preventing sea otter range expansion is uncertain.

Because the effects of this alternative on white abalone would be expected to be beneficial, insignificant, or discountable relative to the baseline, we would seek concurrence from NMFS on a “not likely to adversely affect” determination under Section 7 of the ESA before selecting this alternative.

6.3.3.2 Black Abalone

Maintenance of the currently designated management zone, as required under Alternative 1, would ultimately minimize sea otter predation on black abalone populations in the Southern California Bight except in the translocation zone surrounding San Nicolas Island. Within 10 years, the exclusion of sea otters from the coastline between Point Conception and Carpinteria (lower bound) or Point Conception and Oxnard (upper bound) would prevent the changes described for the baseline from occurring. During this period, removal of the threat of sea otter predation from this stretch of the coastline could have benefits at the local population level (to the extent that suitable habitat exists and that other factors, such as withering syndrome, have not reduced local populations and the possibility of successful local recruitment to zero), especially if local recovery of black abalone populations occurred within this stretch of coastline in areas lacking sufficient cryptic habitat, whether naturally or as a result of outplanting efforts. However, if future recovery actions for black abalone included relocating or aggregating exposed individuals in crevice habitat sufficiently deep to afford protection from sea otter predation, then there would be more limited benefits to black abalone from maintenance of the management zone.

San Nicolas Island has also been identified by CDFG as 1 of 10 key locations for the recovery of black abalone (CDFG 2005c). Because Alternative 1 calls for only minor changes to the colony at San Nicolas Island relative to the baseline (including the possibility of continued translocation of small numbers of sea otters for the purposes of genetic enhancement), effects on black abalone in the vicinity of San Nicolas Island are essentially the same as for the baseline. Relative to the baseline, the effect of Alternative 1 on black abalone within 10 years is expected to be positive and of moderate significance.

In the longer term, maintenance of the management zone under Alternative 1 would afford black abalone protection from sea otter predation in key recovery areas, including the Channel Islands. However, because black abalone can maintain reproductively viable populations where sufficient cryptic and inaccessible habitat exists, and because sea otter range expansion into the Southern California Bight would be expected to require many decades, the timing and magnitude of the long-term benefit to black abalone recovery from preventing sea otter range expansion are uncertain.

Critical Habitat

Critical habitat for black abalone includes a number of areas both within the current sea otter range and outside the current sea otter range (in southern California waters) (76 FR 66806). If sea otters were prevented from recolonizing the Southern California Bight gradually over the course of several decades, then their range would not overlap any black abalone critical habitat in southern California. The primary constituent elements of critical habitat essential for the conservation of black abalone are: rocky substrate; food resources; juvenile settlement habitat; suitable water quality; and suitable nearshore circulation patterns (76 FR 66806). Of these five elements, only one, food resources, may potentially be affected by sea otters. Under Alternative 1, sea otters would be prevented from improving food resources for adult black abalone through predation on sea urchins in the management zone. However, ecological relationships are complex, and it is likely that numerous positive and negative interactions would occur simultaneously.

Because the effects of this alternative on black abalone and black abalone critical habitat would be expected to be beneficial, insignificant, or discountable relative to the baseline, we would seek concurrence from NMFS on a “not likely to adversely affect” determination under Section 7 of the ESA before selecting this alternative.

6.3.3.3 Southern Sea Otter

EFFECTS ON PARENT POPULATION

Alternative 1 would require the resumption of zonal management (containment) of sea otters and the maintenance of the currently designated management zone in perpetuity. Under this alternative, sea otters found in the management zone (Point Conception to the Mexican border) would be captured and relocated to other portions of the southern sea otter's range. Within 10 years, implementation of Alternative 1 would prevent sea otters from reoccupying the mainland coastline to Carpinteria (lower bound) or Oxnard (upper bound). Relocating sea otters from the management zone to the northern or central portion of the existing range would increase competition among sea otters, especially in areas of the central coast now thought to be food-limited (see Tinker *et al.* 2008b), disrupt natural behaviors, and likely result in the deaths of otherwise healthy animals. The incidental injury or death of sea otters removed from the management zone would likely be unavoidable. The relocation of sea otters may result in increased risk of mortality due in part to the stress associated with capture, handling, and time out of water, and in part to the general lack of familiarity of the animals with their new environments (Estes *et al.* n.d.). For males, there may be an added risk of death or injury from encountering territorial males in foreign habitats (Estes *et al.* n.d.). Some sea otters would likely attempt to return to their location of capture, depleting their energy reserves and increasing their risk of mortality.

It has been suggested that restricting range expansion could protect sea otters from hazards present in southern California waters. Because under Alternative 1, there would be no sea otters south of Point Conception (except at San Nicolas Island), they would not be subject to the benefits and risks that sea otters recolonizing southern California habitat would be subject to under baseline conditions (see section 6.2.3.3). We note, however, that without range expansion and access to additional prey resources, any significant growth of the southern sea otter population as a whole, now and increasingly in the future, is probably precluded. Thus, spatially based risks to sea otters resulting from southward range expansion should realistically also be evaluated against the risk of these sea otters not existing at all. From the perspective of population growth and recovery, any additional risks encountered by sea otters in southern California waters would be minimal compared to the much larger risk imposed on the species by preventing southward range expansion.

According to a simulation model by Doak (2011), preventing natural range expansion into the Southern California Bight would reduce the probability of reaching the delisting criterion in 10 years by as much as 14 percent. It would also require the removal of approximately 400 sea otters from the management zone over the next 10 years (approximately 1800 sea otters over the next 40 years). If a 17 percent mortality rate is assumed (based on the fact that, of 24 sea otters removed from the management zone, 4 were known or suspected to have died as a result of capture and removal activities; see Appendix C to this document), enforcement of the management zone may result in the deaths of approximately 67 sea otters over the next 10 years (306 sea otters over the next 40 years). It is important to note that these simulations are based on individual movement rates and area-specific demographic rates. Thus, they account for effects arising from density-dependence (food limitation), but they do not account for other negative effects of zonal management, such as the potential mortality of moved sea otters and the behavioral disruption of the receiving population (Doak 2011). They also do not account for the increased risk to the species from catastrophic events that would result from limiting the distribution of the population (Doak 2011). Negative effects on recovery of the species would thus be greater than those quantified by Doak (2011).

EFFECTS ON SAN NICOLAS ISLAND COLONY

Alternative 1 would have little or no effect on the sea otter colony at San Nicolas Island compared to baseline conditions. Monitoring of the colony would continue, and protective measures currently in place would remain unchanged. Alternative 1 allows for the limited translocation of sea otters to San Nicolas Island for the purposes of maintaining genetic diversity; however, past experience indicates that dispersal of translocated sea otters would be high, possibly negating the intended effect of supplementing genetic diversity. Because of the effects on key segments and behaviors of the southern sea otter, within 10 years Alternative 1 is expected to have an adverse effect of high significance on the southern sea otter.

In the longer term, continuation of zonal management of sea otters would limit natural range expansion and would eliminate about 37 percent of the carrying capacity (for sea otters) of California (see section 6.3.11.1, “U.S. Fish and Wildlife Service”). Restriction of the southern sea otter’s range would increase the vulnerability of the species to oil spills, disease, and stochastic events relative to the baseline. In combination, these effects would slow or prevent the recovery of the species. In the revised southern sea otter recovery plan (USFWS 2003), the recovery team recommends that we discontinue zonal management and allow natural range expansion of sea otters to occur.

In 2000, USFWS completed a biological opinion (USFWS 2000, included as Appendix B) on the southern sea otter containment program as described in our original southern sea otter translocation plan (USFWS 1987). In this opinion, we concluded that continuing the containment program and restricting the southern sea otter to the area north of Point Conception (with the exception of the translocation zone at San Nicolas Island) would likely jeopardize the continued existence of the species. We based this conclusion, in part, on the assumption that reversal of southern sea otter population declines and expansion of the southern sea otter’s range is essential to the survival and recovery of the species. Resumption of sea otter containment under Alternative 1 could result in increased mortality of sea otters and disrupt behavior throughout the range of the species. Therefore, before selecting Alternative 1, we would reinitiate consultation under the ESA to consider any new information that is available. If the resulting opinion concluded that continuation of the program would not jeopardize the southern sea otter, containment under Alternative 1 would be considered a viable option.

6.3.4 COMMERCIAL FISHERIES

For a discussion of the regulatory environment (including as it pertains to commercial fisheries) see section 6.3.12.

6.3.4.1 Sea Urchin Fishery

Under Alternative 1, impacts to the commercial sea urchin fishery are expected to be limited to the coastline from Point Conception to just southeast of Gaviota (CDFG statistical blocks 655, 656, and 657). This area is henceforth referred to as Cojo Anchorage. Maintenance of the management zone would theoretically eliminate sea otter predation on sea urchins that has been occurring in this area over the past several years, which could lead to a larger sea urchin population for commercial harvest. We determine benefits to the fishery by estimating the reduction in landings already caused by sea otter predation (*i.e.*, we account for a potentially reduced baseline) and estimating avoided future reductions in landings (landings would not decrease the anticipated 310,000 to 336,000 pounds over 10 years from 2012 to 2021 as a result of continued sea otter range expansion to Carpinteria (lower bound) or Oxnard (upper bound)). Thus, the analysis for the sea urchin fishery is divided into two sections: (1) increased harvests from the elimination of past predation, and (2) increased harvests due to elimination of the anticipated future decrease. Benefits are represented as increased landings and increased ex-vessel revenue.

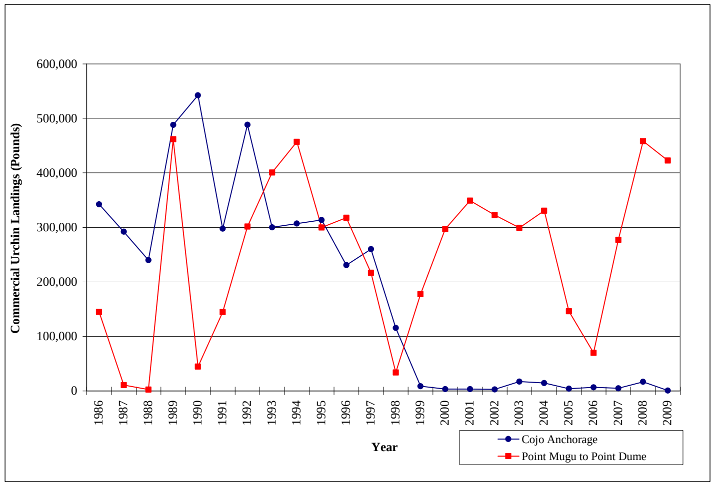

Figure 6-19 Commercial sea urchin landings for Cojo Anchorage area (statistical blocks 655, 656, and 657) and Point Mugu-Point Dume (statistical blocks 680, 681, 682, and 703)
Data source: California Department of Fish and Game (2002a,

REMOVAL OF PAST SEA OTTER PREDATION EFFECTS

Sea urchin landings from the Cojo Anchorage area peaked in the early 1990s (540,000 pounds in 1990), and steadied at about 300,000 pounds in the mid-1990s. Unlike other areas of southern California, Cojo Anchorage landings have not rebounded. In 1998, landings dropped to just over 100,000 pounds, and declined further in subsequent years, averaging 7,139 pounds between 1999 and 2003. In 2009, landings declined to 640 pounds. The drop in landings is more severe than the average decrease for southern California and coincides with the seasonal movement of sea otters into the management zone.

To estimate the effects of sea otter predation in relation to other factors that have influenced sea urchin landings, we compare sea urchin landings from the Cojo Anchorage area with a similar (in terms of habitat and landings history) section of coast, Point Mugu to Point Dume (CDFG statistical blocks 680, 681, 682, and 703) (Figure 6-19). Prior to 1998, this section of the coastline exhibited peaks and troughs similar to those at Cojo Anchorage. However, beginning in 1998, Cojo Anchorage landings decreased, while landings along the coast from Point Mugu to Point Dume increased.

Figure 6-20 shows annual sea urchin landings on a logarithmic scale for five areas: southern California, the Northern Channel Islands, San Nicolas Island, Cojo Anchorage, and the coastline from Point Mugu to Point Dume. As shown in the figure, southern California and the Northern Channel Islands follow similar trends over time. After the 1997/98 El Niño event, southern California and northern Channel Islands landings dropped an average of 32 and 11 percent, respectively, compared to the peak year of harvest in 1997. Landings from Cojo Anchorage, however, exhibited a 94 percent decline after the 1997/98 El Niño event. Landings along the coastline from Point Mugu to Point Dume recovered to a pre- El Niño level (see Table 6-27).

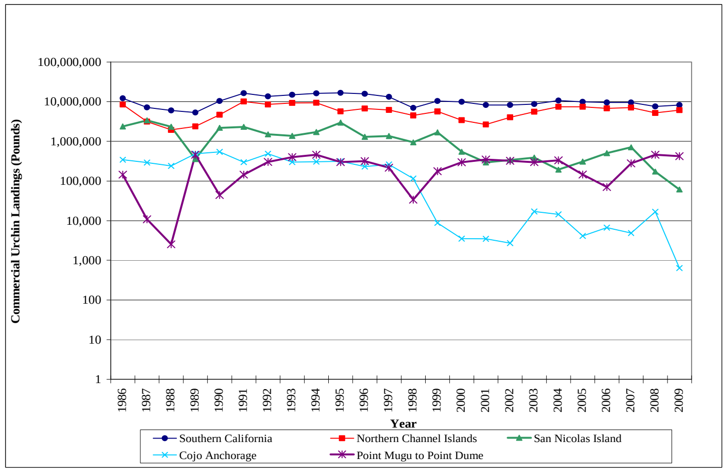

Figure 6-20 Commercial annual sea urchin landings by area, on a logarithmic scale
Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a)

Sea urchin landings in southern California are a function of a variety of factors, including (but not limited to) population variation, weather fluctuations, and market demand. Determining the exact composition of these factors for sea urchin landings is difficult. As a conservative approach, we assume that sea urchin landings are solely and equally dependent upon weather fluctuations (El Niño events) and sea otter predation. We further assume that southern California's average annual sea urchin landings are not representative of landings along the northern coastline of the management zone because landings in these areas have not followed similar historical trends. Rather, we assert that landings throughout the coastline from Point Conception to Point Dume should respond similarly to weather fluctuations and sea otter predation. Thus, we establish sea urchin landings fluctuations along the coastline from Point Mugu to Point Dume as a baseline for Cojo Anchorage landings fluctuations. Because little or no sea otter predation occurred southeast of Gaviota, we attribute the total percentage decrease from Point Mugu to Point Dume to the El Niño event (Table 6-28). Any Cojo Anchorage decrease above the baseline is, thus, attributed to sea otter predation. Since the El Niño event, landings have actually increased in the Point Mugu to Point Dume area. We therefore attribute a loss of 100 percent (243,619 pounds) of the Cojo Anchorage landings to sea otter predation.

If sea otters are removed from the management zone and the zone is successfully maintained, it is assumed that sea urchin populations would fully rebound from sea otter predation in five years.[17] We further assume that the landings increase would be equally distributed across the

TABLE 6-27 CHANGE IN ANNUAL SEA URCHIN LANDINGS AFTER THE 1997/1998 EL NIÑO EVENT.

	Southern California	Northern Channel Islands	San Nicolas Island	Cojo Anchorage	Point Mugu to Point Dume
1997 Peak Landings	13,199,317	6,178,144	1,359,738	260,176	216,962
Average Landings (1998-2009)	9,006,583	5,495,541	510,953	16,557	265,329
Percentage Change after El Niño	-32%	-11%	-62%	-94%	+22%

Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a).

[17] Red sea urchins can reach a commercially harvestable size (3.5 inches) in 6 to 8 years (Kalvass and Rogers-Bennett, 2001). We assume that landings would rebound prior to six years because sea otters are unable to reach urchins located in sufficiently deep crevices. Therefore, some urchins will have survived and will reach a harvestable size in fewer than 6 years.

five years. Thus, sea urchin landings would increase by 20 percent (48,724 pounds) each year to a stable increase in landings of 243,619 pounds in 2016.

TABLE 6-28 AVERAGE ANNUAL SEA URCHIN LANDINGS IN COJO ANCHORAGE AREA AND RELATIVE CHANGE ATTRIBUTABLE TO EL NIÑO AND SEA OTTER PREDATION.

Year	Average Annual Landings (pounds)
1997 peak (pre-sea otter)	260,176
1998-2009	16,557
Decrease attributable to El Niño	0
Decrease attributable to sea otter predation	243,619
Total decrease	243,619

Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a).

AVOIDED FUTURE LOSS

Sea urchin landings would not be eliminated along the coastline from Point Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound), as under the baseline, because maintenance would remove the sea otter population from this section of the coastline. Therefore, landings would not decrease an anticipated 310,000 to 336,000 pounds over 10 years from 2012 to 2021.

SUMMARY OF IMPACTS

Tables 6-29 and 6-30 show the expected change in commercial landings and ex-vessel revenue in the Cojo Anchorage area if sea otters are removed from CDFG statistical blocks 655, 656, and 657. Over 10 years, landings would increase by about 2.3 million pounds. Thus, the total non-discounted benefit to sea urchin fishing vessels for Alternative 1 would total about $1.8 million, and the total discounted 10-year benefit for this Alternative would be about $1.5 million (discounted at 3 percent) or about $1.1 million (discounted at 7 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-4.

The expected increase in sea urchin landings resulting from implementation of Alternative 1 would be approximately 3 percent over 10 years (Table 6-31). An average of 131 vessels

TABLE 6-29 SEA URCHIN LANDINGS: BENEFITS OF ALTERNATIVE 1 – LOWER ESTIMATE (POINT CONCEPTION TO CARPINTERIA)

2012	5,636	48,724	54,360	$44,291	$40,533	$36,155
2013	11,272	97,448	108,720	$88,583	$78,705	$67,579
2014	16,908	146,172	163,080	$132,874	$114,618	$94,737
2015	22,544	194,895	217,439	$177,165	$148,373	$118,053
2016	28,180	243,619	271,799	$221,457	$180,065	$137,912
2017	33,816	243,619	277,435	$226,049	$178,445	$131,563
2018	39,452	243,619	283,071	$230,641	$176,767	$125,453
2019	45,088	243,619	288,707	$235,233	$175,036	$119,581
2020	50,724	243,619	294,343	$239,825	$173,255	$113,939
2021	56,360	243,619	299,979	$244,417	$171,429	$108,524
Total Benefits	309,980	1,948,955	2,258,935	$1,840,536	$1,437,226 (PV@3%)	$1,053,497 (PV@7%)

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price divers received for sea urchins (in shell) from 2000 to 2009, which is $0.81 per pound in 2009 dollars.

TABLE 6-30 SEA URCHIN LANDINGS: BENEFITS OF ALTERNATIVE 1 – UPPER ESTIMATE (POINT CONCEPTION TO OXNARD)

Year	Commercial Landings (avoided future loss)	Commercial Landings (increase from removal of past predation effects)	Total Increase in Commercial Landings (pounds)	Ex-Vessel Revenue*	Ex-Vessel Discounted Revenue (3%)*	Ex-Vessel Discounted Revenue (7%)*
2012	6,102	48,724	54,825	$44,671	$40,880	$36,465
2013	12,203	97,448	109,651	$89,341	$79,379	$68,158
2014	18,305	146,172	164,476	$134,012	$115,600	$95,549
2015	24,406	194,895	219,302	$178,683	$149,644	$119,064
2016	30,508	243,619	274,127	$223,353	$181,607	$139,093
2017	36,609	243,619	280,229	$228,325	$180,242	$132,887
2018	42,711	243,619	286,330	$233,296	$178,802	$126,898
2019	48,812	243,619	292,432	$238,268	$177,294	$121,123
2020	54,914	243,619	298,533	$243,239	$175,721	$115,561
2021	61,016	243,619	304,635	$248,211	$174,090	$110,209
Total Benefits	335,586	1,948,955	2,284,541	1,861,399	1,453,258 (PV@3%)	1,065,007 (PV@7%)

Note: Benefits are rounded to the nearest dollar.
* Ex-vessel revenue is based upon the average price divers received for sea urchins (in shell) from 2000 to 2009, which is $0.81 per pound in 2009 dollars.

participated annually in the southern California sea urchin fishery from 2000-2009 (Leos pers. comm. 2010). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels and no new vessels entered the fishery, then each vessel would have increased landings of approximately 17,200 pounds and increased revenue between $8,000 (PV at 7 percent) and $11,100 (PV at 3 percent) per vessel total over 10 years.

To determine the regional impact of increased sea urchin revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 1 would result in an increase of $2.0 million to $2.8 million in total output over 10 years discounted at 7 percent and 3 percent, respectively. These impacts assume fishers would have the capacity to increase their landings.

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 1 is expected to result in a 3 percent increase in sea urchin ex-vessel revenues within the Southern California Bight over the next 10 years compared to the baseline, it qualifies as a beneficial effect of low significance (see Table 5-1 for definitions of levels of significance).

TABLE 6-31 SEA URCHIN LANDINGS BENEFITS OF ALTERNATIVE 1 COMPARED TO THE SOUTHERN CALIFORNIA BASELINE

Year	Southern California Baseline Landings (lower estimate)	Southern California Baseline Landings (upper estimate)	Expected Percentage Increase from Alternative 1 (lower estimate)	Expected Percentage Increase from Alternative 1 (upper estimate)
2012	9,061,757	9,069,922	1%	1%
2013	9,053,591	9,061,291	1%	1%
2014	9,045,425	9,052,660	2%	2%
2015	9,037,260	9,044,029	2%	2%
2016	9,029,094	9,035,398	3%	3%
2017	9,020,929	9,026,766	3%	3%
2018	9,012,763	9,018,135	3%	3%
2019	9,004,597	9,009,504	3%	3%
2020	8,996,432	9,000,873	3%	3%
2021	8,988,266	8,992,242	3%	3%
TOTAL	90,250,114	90,310,819	3%	3%

Beyond 10 years, maintenance of the management zone would continue to prevent sea otters from expanding their range into southern California. As a result, the long-term impacts that would have occurred under the baseline (the elimination of commercial sea urchin harvests via competition with sea otters in recolonized areas) would not occur. The timing and magnitude of this potential benefit is uncertain, but it would likely accrue gradually over many decades.

6.3.4.2 Spiny Lobster Fishery

Under Alternative 1, impacts to the commercial lobster fishery are expected to be limited to the coastline from Point Conception to just southeast of Gaviota (CDFG statistical blocks 655, 656, and 657). This area is henceforth referred to as Cojo Anchorage. Maintenance of the management zone would theoretically eliminate sea otter predation on lobsters in this area, which could lead to a larger lobster population for commercial harvest. We determine benefits to the fishery by estimating the reduction in landings already caused by sea otter predation (*i.e.*, we account for a potentially reduced baseline) and estimating avoided future reductions in landings (landings would not decrease the anticipated 301,000 to 416,000 pounds over 10 years from 2012 to 2021 as a result of continued sea otter range expansion to Carpinteria (lower bound) or Oxnard (upper bound)). Thus, the analysis for the lobster fishery is divided into two sections: (1) increased harvests from the elimination of past predation, and (2) increased harvests due to elimination of the anticipated future decrease. Benefits are represented as increased landings and increased ex-vessel revenue.

Removal of Past Sea Otter Predation Effects

Lobster landings within the Cojo Anchorage area peaked in 1997 (about 37,000 pounds). In 1999, landings dropped by two-thirds to 11,826 pounds and have since averaged approximately 16,600 pounds between 2000 and 2009. This drop in landings is more severe than the decrease for southern California and coincides both with when sea otters were first sighted in the management zone and the 1997/98 El Niño event. The decline in landings is similar to that along the coastline from Point Mugu to Point Dume, an area in which sea otters have not been sighted. Landings for these two sections of coastline are shown in Figure 6-21. Figure 6-22 shows annual lobster landings on a logarithmic scale for five areas: southern California, the

Northern Channel Islands, San Nicolas Island, Cojo Anchorage, and the coastline from Point Mugu to Point Dume. As shown in the figure, southern California and the Northern Channel Islands follow similar trends over time. After the 1997/98 El Niño event, southern California landings dropped 19 percent, while landings around Point Mugu to Point Dume and the Northern Channel Islands both increased. Landings at Cojo Anchorage declined by 55 percent, and those at San Nicolas Island decreased by 5 percent compared to landings made in 1997. Table 6-32 depicts this difference in landings between the areas.

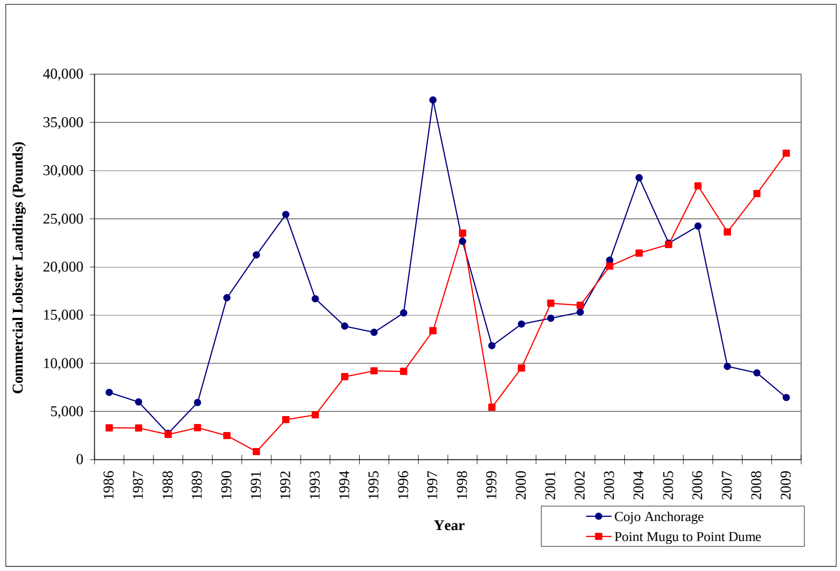

Figure 6-21 Commercial lobster landings for the Cojo Anchorage area (statistical blocks 655, 656, 657) and Point Mugu-Point Dume (statistical blocks 680, 681, 682, and 703)
Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a).

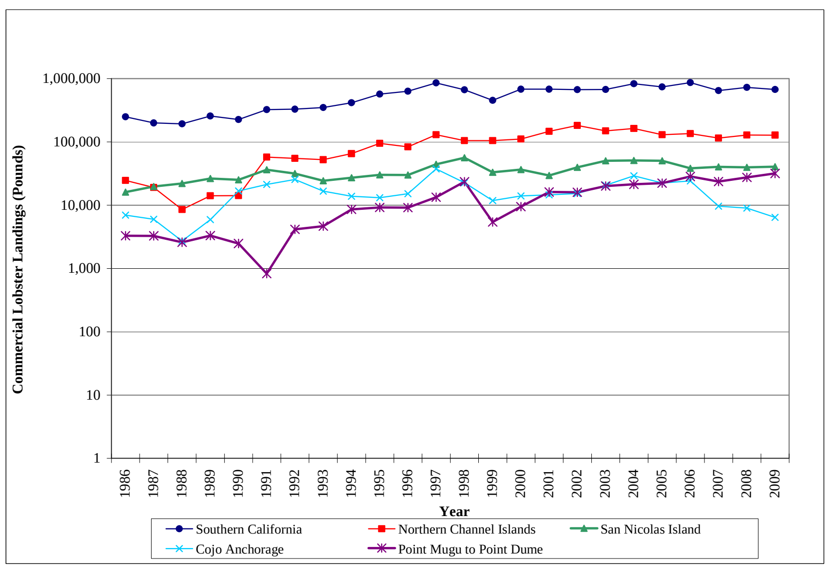

Figure 6-22 Annual lobster landings by area, on a logarithmic scale
Data source: California Department of Fish and Game (2002a, 2005a, 2008a, 2010a)

Lobster landings in southern California are a function of a variety of factors, including (but not limited to) population variation, weather fluctuations, and market demand. Determining the exact composition of these factors for lobster landings is difficult. As a conservative approach, we assume that lobster landings are solely and equally dependent upon weather fluctuations (El Niño events) and sea otter predation. We further assume that southern California's average annual lobster landings are not representative of landings along the northern coastline of the management zone because landings in these areas have not followed similar historical trends. Rather, we assert that landings throughout the coastline from Point Mugu to Point Dume should respond similarly to weather fluctuations and sea otter predation. Thus, we establish lobster

TABLE 6-32 CHANGE IN ANNUAL LOBSTER LANDINGS AFTER THE 1997/1998 EL NIÑO EVENT					
	Southern California	**Northern Channel Islands**	**San Nicolas Island**	**Cojo Anchorage Coastline**	**Point Mugu to Point Dume**
1997 Peak Landings	859,118	130,321	44,143	37,316	13,378
Average Landings (1998-2009)	692,657	133,456	42,147	16,686	20,494
Percentage Change after El Niño	-19%	+2%	-5%	-55%	+53%

landings fluctuations along the coastline from Point Mugu to Point Dume as a baseline for Cojo Anchorage landings fluctuations. Because little or no sea otter predation occurred southeast of Gaviota, we attribute the total percentage decrease from Point Mugu to Point Dume to the El Niño event. Any Cojo Anchorage decrease above the baseline is, therefore, attributed to sea otter predation. In Table 6-33, we attribute 100 percent of the recent lobster landings decrease at Cojo Anchorage to sea otter predation (16,686 pounds).

TABLE 6-33 AVERAGE ANNUAL LOBSTER LANDINGS IN COJO ANCHORAGE AND THE CHANGE ATTRIBUTABLE TO THE EL NIÑO EVENT AND SEA OTTER PREDATION	
Year	**Average Annual Landings (pounds)**
1997 Peak (pre-sea otter)	37,316
1998-2009	16,686
Decrease Attributable to El Niño	0
Decrease Attributable to Sea Otter Predation	20,630
Total Decrease	20,630

If sea otters are removed from the management zone and the zone is successfully maintained, we assume that lobster populations would fully rebound from sea otter predation in seven years.[18] We further assume that the landings increase would be equally distributed across the seven years. Thus, lobster landings would increase by about 14 percent (2,947 pounds) each year to an annual increase of 20,630 pounds in 2018.

AVOIDED FUTURE LOSS

Lobster landings would not be eliminated along the coastline from Point Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound), as under the baseline, because maintenance of the management zone would remove sea otters from this area. Therefore, landings would not decrease an anticipated 301,000 to 416,000 pounds over 10 years from 2012 to 2021.

SUMMARY OF IMPACTS

Tables 6-34 and 6-35 show the expected change in commercial landings and ex-vessel revenue in the Cojo Anchorage area if sea otters are removed from CDFG statistical blocks 655, 656, and 657. Over 10 years, landings would increase by 445,000 to 560,000 pounds. Thus, the maximum non-discounted benefit to lobster fishing vessels for Alternative 1 would total between $4.2 million to $5.3 million, and the maximum discounted 10-year benefit for this Alternative would range from $3.2 million to $4.1 million (discounted at 3 percent) and from $2.3 million to $2.9 million (discounted at 7 percent). For the regional economic context, which can help to put

[18] Spiny lobsters can reach a commercially harvestable size (3.5 inches carapace length) in 7 to 11 years (Barsky 2001). We assume that landings would rebound prior to seven years because sea otters are unable to consume lobsters located in inaccessible habitat (deep crevices). Thus, the harvest may resume in a minimum time interval.

this number in perspective, see Tables 4-3 and 4-4. The expected increase in lobster landings resulting from implementation of Alternative 1 would be about 6 to 7 percent of southern California lobster landings over 10 years (Table 6-36).

TABLE 6-34 LOBSTER LANDINGS: BENEFITS OF ALTERNATIVE 1 – LOWER ESTIMATE (POINT CONCEPTION TO CARPINTERIA)

Year	Commercial Landings (avoided future loss)	Commercial Landings (increase from removal of past predation effects)	Total Increase in Commercial Landings (pounds)	Ex-Vessel Revenue*	Ex-Vessel Discounted Revenue (3%)*	Ex-Vessel Discounted Revenue (7%)*
2012	5,467	2,947	8,415	$79,362	$72,627	$64,783
2013	10,935	5,894	16,829	$158,723	$141,024	$121,089
2014	16,402	8,841	25,244	$238,085	$205,374	$169,751
2015	21,870	11,788	33,658	$317,447	$265,856	$211,528
2016	27,337	14,736	42,073	$396,808	$322,641	$247,112
2017	32,805	17,683	50,487	$476,170	$375,893	$277,135
2018	38,272	20,630	58,902	$555,531	$425,769	$302,172
2019	43,739	20,630	64,369	$607,097	$451,738	$308,618
2020	49,207	20,630	69,837	$658,663	$475,832	$312,926
2021	54,674	20,630	75,304	$710,229	$498,141	$315,350
Total Benefits	300,709	144,408	445,117	$4,198,116	$3,234,895 (PV@3%)	$2,330,465 (PV@7%)

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price divers received for lobster from 2000 to 2009, which is $9.43 per pound in 2009 dollars.

TABLE 6-35 LOBSTER LANDINGS: BENEFITS OF ALTERNATIVE 1 – UPPER ESTIMATE (POINT CONCEPTION TO OXNARD)

Year	Commercial Landings (avoided future loss)	Commercial Landings (increase from removal of past predation effects)	Total Increase in Commercial Landings (pounds)	Ex-Vessel Revenue*	Ex-Vessel Discounted Revenue (3%)*	Ex-Vessel Discounted Revenue (7%)*
2012	7,565	2,947	10,512	$99,143	$90,730	$80,931
2013	15,130	5,894	21,024	$198,287	$176,175	$151,272
2014	22,695	8,841	31,536	$297,430	$256,566	$212,064
2015	30,259	11,788	42,048	$396,574	$332,124	$264,254
2016	37,824	14,736	52,560	$495,717	$403,063	$308,708
2017	45,389	17,683	63,072	$594,860	$469,588	$346,214
2018	52,954	20,630	73,584	$694,004	$531,896	$377,492
2019	60,519	20,630	81,149	$765,351	$569,493	$389,066
2020	68,084	20,630	88,713	$836,699	$604,449	$397,510
2021	75,649	20,630	96,278	$908,047	$636,886	$403,184
Total Benefits	416,067	144,408	560,475	$5,286,113	$4,070,972 (PV@3%)	$2,930,693 (PV@7%)

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price divers received for lobster from 2000 to 2009, which is $9.43 per pound in 2009 dollars.

TABLE 6-36 LOBSTER LANDINGS BENEFITS OF ALTERNATIVE 1 COMPARED TO THE SOUTHERN CALIFORNIA BASELINE

Year	Southern California Baseline Landings (lower estimate)	Southern California Baseline Landings (upper estimate)	Expected Percentage Increase from Alternative 1 (lower estimate)	Expected Percentage Increase from Alternative 1 (upper estimate)
2012	713,560	711,462	1%	1%
2013	707,793	703,598	2%	2%
2014	702,026	695,733	4%	4%
2015	696,258	687,869	5%	5%
2016	690,491	680,004	6%	6%
2017	684,724	672,140	7%	8%
2018	678,957	664,275	9%	9%
2019	673,190	656,411	10%	10%
2020	667,423	648,546	10%	11%
2021	661,656	640,682	11%	12%
TOTAL	6,876,077	6,760,719	6%	7%

An average of 169 vessels participated annually in the southern California lobster fishery from 2000-2009 (Leos pers. comm. 2010). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be affected disproportionately. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels and no additional vessels entered the fishery, then each vessel would have increased landings of about 2,600 to 3,300 pounds and increased revenue between $13,800 (PV at 7 percent) and $24,100 (PV at 3 percent) per vessel total over 10 years.

To determine the regional impact of increased lobster revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 1 would result in an increase of $4.4 million to $7.7 million in total output over 10 years discounted at 7 percent and 3 percent, respectively. These impacts assume fishers would have the capacity to increase their landings.

As described in Chapter 5, we define levels of significance by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 1 is expected to result in an increase in lobster ex-vessel revenues within the Southern California Bight over the next 10 years of 6 to 7 percent compared to the baseline, it qualifies as a beneficial effect of low significance (see Table 5-1 for definitions of levels of significance).

Beyond 10 years, maintenance of the management zone would continue to prevent sea otters from expanding their range into southern California. As a result of this management, the long-term impacts that would have occurred under the baseline (the elimination of commercial lobster harvests via competition with sea otters in recolonized areas) would not occur. The timing and magnitude of this potential benefit is uncertain, but it would likely accrue gradually over the course of many decades.

6.3.4.3 Crab Fishery

Under Alternative 1, impacts to the commercial crab fishery are expected to be limited to the coastline from Point Conception to just southeast of Gaviota (CDFG statistical blocks 655, 656, and 657). This area is henceforth referred to as Cojo Anchorage.

Maintenance of the management zone would theoretically eliminate sea otter predation on crabs that has been occurring in this area for several years, which could lead to a larger crab population for commercial harvest. We determine benefits to the fishery by estimating the reduction in landings already caused by sea otter predation (*i.e.*, we account for a potentially reduced baseline) and estimating avoided future reductions in landings (landings would not decrease the anticipated 1.4 million to 2.1 million pounds over 10 years from 2012 to 2021 as a result of continued sea otter range expansion to Carpinteria (lower bound) or Oxnard (upper bound)). Thus, the analysis for the crab fishery is divided into two sections: (1) increased harvests from the elimination of past predation along Cojo Anchorage, and (2) increased harvests due to elimination of the anticipated future decrease. Benefits are represented as increased landings and increased ex-vessel revenue.

Removal of Past Sea Otter Predation Effects

Crab landings within the Cojo Anchorage area are cyclical and peak and trough roughly coincident with El Niño events (Figures 6-23 and 6-24). Crab landings peaked at about 220,000 pounds in both 1990 and 1998. However, after each peak, landings declined by about 50 percent. The drop in landings after 1998 is more severe than the average decrease for southern California and coincides with the movement of sea otters into the management zone. However, past landings trends are similar to the neighboring coastline southeast from Point Mugu to Point Dume, along which sea otters have not been sighted (Figure 6-23).

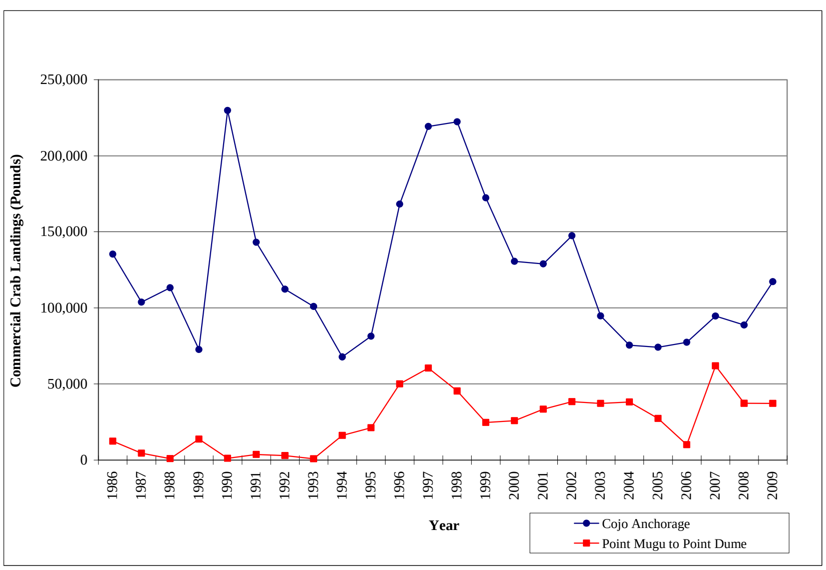

Figure 6-23 Commercial crab landings for Cojo Anchorage area (statistical blocks 655, 656, and 657) and Point Mugu-Point Dume (statistical blocks 680, 681, 682, and 703)
Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a)

Figure 6-24 shows annual crab landings on a logarithmic scale for five areas: southern California, the northern Channel Islands, San Nicolas Island, Cojo Anchorage, and the coastline from Point Mugu to Point Dume. As shown in the figure, southern California and the northern Channel Islands follow similar trends over time. After the 1997/98 El Niño event, southern California landings increased by 11 percent. Cojo Anchorage and the Point Mugu to Point Dume area declined by 46 percent and 43 percent, respectively (see Table 6-37).

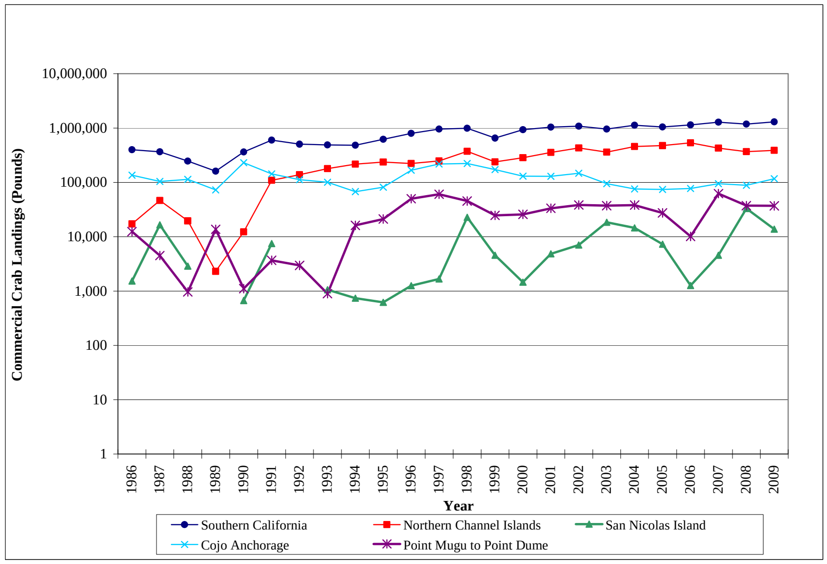

Figure 6-24 Commercial annual crab landings by area, on a logarithmic scale

Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a)

Crab landings in southern California are a function of a variety of factors, including (but not limited to) population variation, weather fluctuations, and market demand. Determining the composition of these factors for crab landings is difficult. As a conservative approach, we assume that crab landings are solely and equally dependent upon weather fluctuations (El Niño events) and sea otter predation. We further assume that southern California's average annual crab landings are not representative of landings along the northern coastline of the management zone. Rather, we assert that landings throughout the coastline from Point Conception to Point Dume should respond similarly to weather fluctuations and sea otter predation. Thus, we establish crab landings fluctuations along the coastline from Point Mugu to Point Dume as a baseline for Cojo Anchorage landings fluctuations. Because little or no sea otter predation occurred southeast of Gaviota, we attribute the total percentage decrease from Point Mugu to Point Dume (see Figure 6-24) to the El Niño event. Any Cojo Anchorage decrease above the baseline is thus attributed to sea otter predation. In Table 6-38, we attribute 93 percent of the recent Cojo Anchorage landings decrease to El Niño (94,103 pounds). The remaining 6,565 pound decrease is attributed to sea otter predation.

Avoided Future Loss

Crab landings would not be eliminated along the coastline from Point Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound), as under the baseline, because

TABLE 6-37 CHANGE IN ANNUAL CRAB LANDINGS AFTER THE 1997/1998 EL NIÑO EVENT.

	Southern California	Northern Channel Islands	San Nicolas Island	Cojo Anchorage Coastline	Point Mugu to Point Dume Coastline
1997 Peak Landings	958,960	248,117	1,675	219,333	60,442
Average Landings (1998-2009)	1,062,541	390,954	11,145	118,664	34,743
Percentage Change after El Niño	+11%	+58%	+565%	-46%	-43%

Data source: California Department of Fish and Game (2002a, 2005a, 2006a, 2008a, 2010a).

TABLE 6-38 AVERAGE ANNUAL CRAB LANDINGS IN COJO ANCHORAGE AND CHANGE ATTRIBUTABLE TO EL NIÑO AND SEA OTTER PREDATION	
Year	**Average Annual Landings (pounds)**
1997 Peak (pre-sea otter)	219,333
1998-2009	118,664
Decrease Attributable to El Niño	94,103
Decrease Attributable to Sea Otter Predation	6,565
Total Decrease	100,668

maintenance of a management zone would remove sea otters from this section of the coastline. Therefore, landings would not decrease an anticipated 1.4 million to 2.1 million pounds over 10 years from 2012 to 2021.

Summary of Impacts

Tables 6-39 and 6-40 show the expected change in commercial landings and ex-vessel revenue in the Cojo Anchorage area if sea otters are removed from CDFG statistical blocks 655, 656, and 657. Over 10 years, landings would increase by 1.4 million to 2,2 million pounds. The maximum non-discounted benefit to crabbing vessels for Alternative 1 would total about $2.1 million to $3.1 million, and the maximum discounted 10-year benefit for this Alternative would be between $1.1 million to $1.7 million (PV at 7 percent) and $1.6 million to $2.4 million (PV at 3 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-4.

The expected increase in crab landings resulting from implementation of Alternative 1 would be approximately 8 to 9 percent of southern California crab landings over 10 years (Table 6-41). An average of 147 vessels participated annually in the southern California crab fishery from 2000-2009 (Leos pers. comm. 2010). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels and no additional vessels entered the fishery, then each vessel would have

TABLE 6-39 CRAB LANDINGS: BENEFITS OF ALTERNATIVE 1 – LOWER ESTIMATE (POINT CONCEPTION TO CARPINTERIA)						
Year	**Commercial Landings (avoided future loss)**	**Commercial Landings (increase from removal of past predation effects)**	**Total Increase in Commercial Landings (Pounds)**	**Ex-Vessel Revenue***	**Ex-Vessel Discounted Revenue (3%)***	**Ex-Vessel Discounted Revenue (7%)***
2012	25,357	1,641	26,998	$38,643	$35,363	$31,544
2013	50,714	3,283	53,997	$77,285	$68,667	$58,960
2014	76,071	4,924	80,995	$115,928	$100,000	$82,655
2015	101,429	6,565	107,994	$154,570	$129,450	$102,997
2016	126,786	6,565	133,351	$190,864	$155,190	$118,860
2017	152,143	6,565	158,708	$227,157	$179,320	$132,207
2018	177,500	6,565	184,065	$263,450	$201,913	$143,300
2019	202,857	6,565	209,423	$299,744	$223,038	$152,375
2020	228,214	6,565	234,780	$336,037	$242,760	$159,649
2021	253,572	6,565	260,137	$372,331	$261,145	$165,319
Total Benefits	1,394,644	55,805	1,450,449	$2,076,009	$1,596,846 (PV@3%)	$1,147,866 (PV@7%)

Note: Benefits are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price divers received for crabs from 2000 to 2009, which is $1.43 per pound in 2009 dollars.

TABLE 6-40 CRAB LANDINGS: BENEFITS OF ALTERNATIVE 1 – UPPER ESTIMATE (POINT CONCEPTION TO OXNARD)

Year	Commercial Landings (avoided future loss)	Commercial Landings (increase from removal of past predation)	Total Increase in Commercial Landings (Pounds)	Ex-Vessel Revenue*	Ex-Vessel Discounted Revenue (3%)*	Ex-Vessel Discounted Revenue (7%)*
2012	38,574	1,641	40,216	$57,560	$52,676	$46,986
2013	77,149	3,283	80,431	$115,120	$102,283	$87,825
2014	115,723	4,924	120,647	$172,680	$148,955	$123,119
2015	154,297	6,565	160,862	$230,240	$192,823	$153,419
2016	192,871	6,565	199,437	$285,451	$232,098	$177,765
2017	231,446	6,565	238,011	$340,662	$268,922	$198,268
2018	270,020	6,565	276,585	$395,873	$303,404	$215,329
2019	308,594	6,565	315,160	$451,084	$335,649	$229,308
2020	347,169	6,565	353,734	$506,295	$365,758	$240,537
2021	385,743	6,565	392,308	$561,505	$393,829	$249,315
Total Benefits	2,121,585	55,805	2,177,391	$3,116,471	$2,396,395 (PV@3%)	$1,721,870 (PV@7%)

Note: Benefits are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price divers received for crabs from 2000 to 2009, which is $1.43 per pound in 2009 dollars.

increased landings of about 9,870 to 14,800 pounds and increased revenue between $7,810 (PV at 7 percent) and $16,300 (PV at 3 percent) total over 10 years.

To determine the regional impact of increased crab revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 1 would result in an increase of $2.2 million to $4.5 million in total output over 10 years discounted at 7 percent and

TABLE 6-41 CRAB LANDINGS BENEFITS OF ALTERNATIVE 1 COMPARED TO THE SOUTHERN CALIFORNIA BASELINE

Year	Southern California Baseline Landings (lower estimate)	Southern California Baseline Landings (upper estimate)	Expected Percentage Increase from Alternative 1 (lower estimate)	Expected Percentage Increase from Alternative 1 (upper estimate)
2012	1,085,386	1,072,169	2%	3%
2013	1,059,952	1,033,518	5%	5%
2014	1,034,519	994,867	8%	8%
2015	1,009,085	956,216	11%	11%
2016	983,651	917,566	14%	15%
2017	958,218	878,915	17%	18%
2018	932,784	840,264	20%	22%
2019	907,350	801,613	23%	26%
2020	881,916	762,962	27%	31%
2021	856,483	724,311	30%	36%
TOTAL	9,709,344	8,982,402	15%	16%

3 percent, respectively. These impacts assume fishers would have the capacity to increase their landings.

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 1 is expected to result in an increase in crab ex-vessel revenues within the Southern California Bight over the next 10 years of 15 to 16 percent compared to the baseline, it qualifiesas a beneficial effect of moderate significance (see Table 5-1 for definitions of levels of significance).

Beyond 10 years, maintenance of the management zone would continue to prevent sea otters from expanding their range into southern California. As a result of this management, the long-term impacts that would have occurred under the baseline (the elimination of commercial crab harvests via competition with sea otters in recolonized areas) would not occur. The timing and magnitude of this potential benefit is uncertain, but it would likely accrue gradually over the course of many decades.

6.3.4.4 Sea Cucumber Fishery

Under Alternative 1, impacts to the commercial sea cucumber fishery are expected to be limited to the coastline from Point Conception to just southeast of Gaviota (CDFG statistical blocks 655, 656, and 657). This area is henceforth referred to as Cojo Anchorage. Maintenance of the management zone would theoretically eliminate sea otter predation on sea cucumbers that has been occurring in this area over the past several years, which could lead to a larger sea cucumber population for commercial harvest. We determine benefits to the fishery by estimating the reduction in landings already caused by sea otter predation (*i.e.*, we account for a potentially reduced baseline) and estimating avoided future reductions in landings (landings would not decrease the anticipated 856,000 to 873,000 pounds over 10 years from 2012 to 2021 as a result of continued sea otter range expansion to Carpinteria (lower bound) or Oxnard (upper bound)). Thus, the analysis for the sea cucumber fishery is divided into two sections: (1) increased harvests from the elimination of past predation along Cojo Anchorage, and (2) increased harvests due to elimination of the anticipated future decrease. Benefits are represented as increased landings and increased ex-vessel revenue.

Removal of Past Sea Otter Predation Effects

Sea cucumber landings from the Cojo Anchorage area peaked in 2001 (121,608 pounds), which were double the harvest of any other year. Annual landings averaged about 37,000 pounds from 1998 to 2009.

To estimate the effects of sea otter predation in relation to other factors that have influenced sea cucumber landings, we compare sea cucumber landings from the Cojo Anchorage area with a similar (in terms of habitat and landings history) section of coast, Point Mugu to Point Dume (CDFG statistical blocks 680, 681, 682, and 703) (Figure 6-25). With the exception of 1995, this section of the coastline exhibited peaks and troughs similar to those at Cojo Anchorage.

Figure 6-26 shows annual sea cucumber landings on a logarithmic scale for five areas: southern California, the Northern Channel Islands, San Nicolas Island, Cojo Anchorage, and the coastline

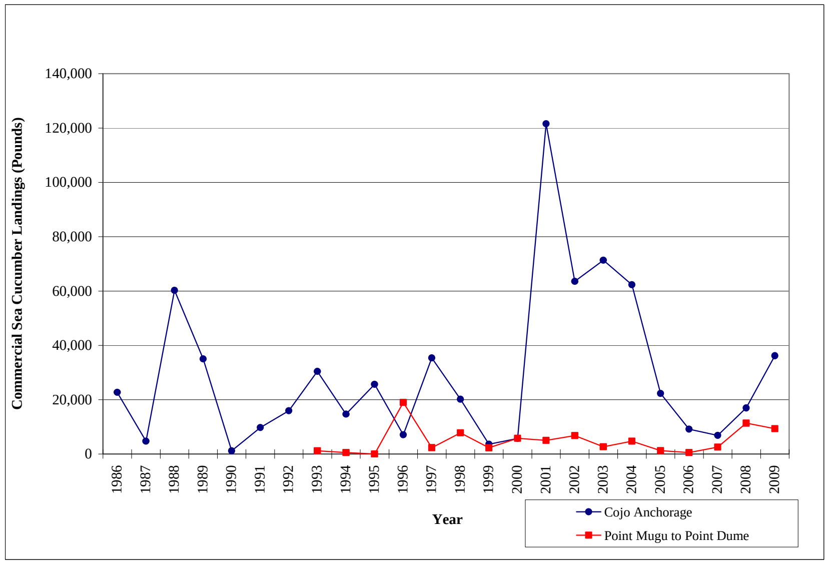

Figure 6-25 Commercial sea cucumber landings for Cojo Anchorage area (statistical blocks 655, 656, and 657) and Point Mugu-Point Dume (statistical blocks 680, 681, 682, and 703)
Data source: California Department of Fish and Game (2006a, 2008a, 2010a).

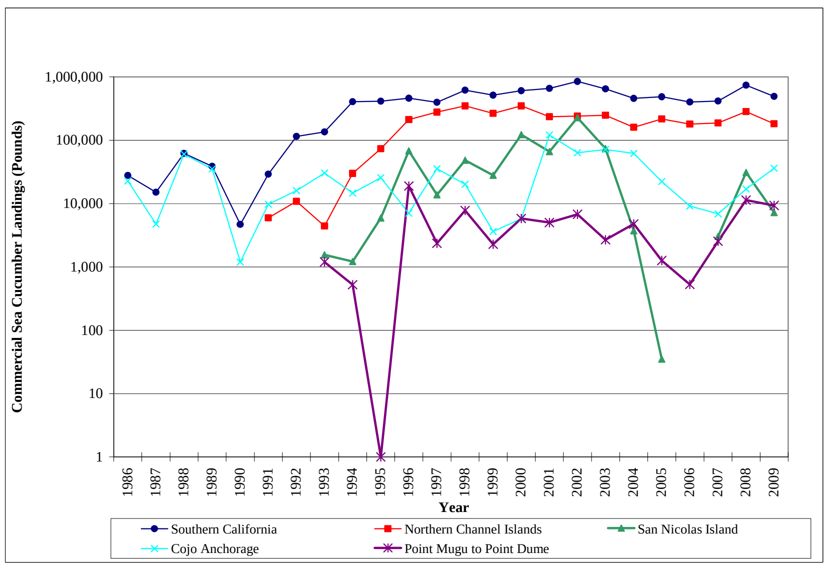

Figure 6-26 Commercial annual sea cucumber landings by area, on a logarithmic scale
Data source: California Department of Fish and Game (2006a, 2008a, 2010a)

from Point Mugu to Point Dume. As shown in the figure, southern California and the Northern Channel Islands f ollow similar trends over time. However, after the 1997/98 El Niño event, southern California landings increased 44 percent and Northern Channel Islands landings dropped about 13 percent, compared to the peak year of harvest in 1997. Landings from Cojo Anchorage exhibited a 4 percent increase after the 1997/98 El Niño event. Landings along the coastline from Point Mugu to Point Dume increased 112 percent, compared to the harvest in 1997 (see Table 6-42).

Sea cucumber landings in southern California are a function of a variety of factors, including (but not limited to) population variation, weather fluctuations, and market demand. Determining the exact composition of these factors for sea cucumber landings is difficult. As a conservative approach, we assume that sea cucumber landings are solely and equally dependent upon weather fluctuations (El Niño events) and sea otter predation. We further assume that southern California's average annual sea cucumber landings are not representative of landings along the northern coastline of the management zone because landings in these areas have not followed similar historical trends. Rather, we assert that landings throughout the coastline from Point Conception to Point Dume should respond similarly to weather fluctuations and sea otter predation. Thus, we establish sea cucumber landings

TABLE 6-42 CHANGE IN ANNUAL SEA CUCUMBER LANDINGS AFTER THE 1997/1998 EL NIÑO EVENT.					
	Southern California	**Northern Channel Islands**	**San Nicolas Island**	**Cojo Anchorage Coastline**	**Point Mugu to Point Dume Coastline**
1997 Peak Landings	398,572	278,127	13,776	35,390	2,371
Average Landings (1998-2009)	574,326	241,765	51,087	36,670	5,017
Percentage Change after El Niño	+44%	-13%	+271%	+4%	+112%
Data source: California Department of Fish and Game (2006a, 2008a, 2010a).					

TABLE 6-43 AVERAGE ANNUAL SEA CUCUMBER LANDINGS IN COJO ANCHORAGE AND CHANGE ATTRIBUTABLE TO EL NIÑO AND SEA OTTER PREDATION

Year	Average Annual Landings (pounds)
1997 Peak (pre-sea otter)	35,390
1998-2009	36,670
Decrease Attributable to El Niño	0
Decrease Attributable to Sea Otter Predation	0
Total Decrease	0

fluctuations along the coastline from Point Mugu to Point Dume as a baseline for Cojo Anchorage landings fluctuations. Because there was no decrease in harvest on either areas of coastline, there were no losses along the Cojo Anchorage coastline attributable to sea otter predation (Table 6-43).

AVOIDED FUTURE LOSS

Sea cucumber landings would not be eliminated along the coastline from Point Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound), as under the baseline, because maintenance would remove the sea otter population from this section of the coastline. Therefore, landings would not decrease an anticipated 856,000 to 873,000 pounds over 10 years from 2012 to 2021.

SUMMARY OF IMPACTS

Tables 6-44 and 6-45 show the expected change in commercial landings and ex-vessel revenue in the Cojo Anchorage area if sea otters are removed from CDFG statistical blocks 655, 656, and 657. Over 10 years, landings would increase by 856,000 to 873,000 pounds. Thus, the total non-discounted benefit to sea cucumber fishing vessels for Alternative 1 would total about $1.2 million, and the total discounted 10-year benefit for this Alternative would be from $893,000 to $909,000 (discounted at 3 percent) or $641,000 to $653,000 (discounted at 7 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-6.

The expected increase in sea cucumber landings resulting from implementation of Alternative 1 would average approximately 18 percent over 10 years (Table 6-46). On average in the southern California sea cucumber fishery, 49 vessels participate (Leos pers. comm. 2010). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels and no new vessels entered the fishery, then each vessel would have increased landings of approximately 17,469 to 17,816 pounds and increased revenue between $13,100-$13,300 (PV at 7 percent) and $18,224-$18,551 (PV at 3 percent) per vessel total over 10 years.

To determine the regional impact of increased sea cucumber revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the

TABLE 6-44 SEA CUCUMBER LANDINGS: BENEFITS OF ALTERNATIVE 1 - LOWER ESTIMATE (POINT CONCEPTION TO CARPINTERIA)

Year	Commercial Landings (avoided future loss)	Commercial Landings (increase from removal of past predation)	Total Increase in Commercial Landings (Pounds)	Ex-Vessel Revenue*	Ex-Vessel Discounted Revenue (3%)*	Ex-Vessel Discounted Revenue (7%)*
2012	15,571	0	15,571	$21,120	$19,327	$17,240
2013	31,143	0	31,143	$42,239	$37,529	$32,224
2014	46,714	0	46,714	$63,359	$54,654	$45,174
2015	62,285	0	62,285	$84,478	$70,749	$56,291
2016	77,857	0	77,857	$105,598	$85,861	$65,761
2017	93,428	0	93,428	$126,717	$100,032	$73,751
2018	109,000	0	109,000	$147,837	$113,305	$80,413
2019	124,571	0	124,571	$168,956	$125,719	$85,889
2020	140,142	0	140,142	$190,076	$137,315	$90,304
2021	155,714	0	155,714	$211,195	$148,128	$93,773
Total Benefits	856,425	0	856,425	$1,161,574	$892,618 (PV@3%)	$640,820 (PV@7%)

Note: Benefits are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price received for sea cucumbers from 2000 to 2009, which is $1.36 per pound in 2009 dollars.

TABLE 6-45 SEA CUCUMBER LANDINGS: BENEFITS OF ALTERNATIVE 1 - UPPER ESTIMATE (POINT CONCEPTION TO OXNARD)

Year	Commercial Landings (avoided future loss)	Commercial Landings (increase from removal of past predation)	Total Increase in Commercial Landings (Pounds)	Ex-Vessel Revenue*	Ex-Vessel Discounted Revenue (3%)*	Ex-Vessel Discounted Revenue (7%)*
2012	15,864	0	15,864	$21,516	$19,690	$17,563
2013	31,727	0	31,727	$43,032	$38,233	$32,829
2014	47,591	0	47,591	$64,548	$55,679	$46,022
2015	63,455	0	63,455	$86,064	$72,077	$57,348
2016	79,318	0	79,318	$107,580	$87,472	$66,995
2017	95,182	0	95,182	$129,096	$101,909	$75,135
2018	111,045	0	111,045	$150,612	$115,431	$81,923
2019	126,909	0	126,909	$172,127	$128,079	$87,501
2020	142,773	0	142,773	$193,643	$139,892	$91,999
2021	158,636	0	158,636	$215,159	$150,908	$95,533
Total Benefits	872,500	0	872,500	$1,183,376	$909,372 (PV@3%)	$652,847 (PV@7%)

Note: Benefits are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price received for sea cucumbers from 2000 to 2009, which is $1.36 per pound in 2009 dollars.

counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 1 would result in an increase of $1.2 million to $1.7 million in total output over 10 years discounted at 7 percent and 3 percent, respectively. These impacts assume fishers would have the capacity to increase their landings.

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 1 is expected to result in an 18 percent increase in sea cucumber ex-vessel revenues within the Southern California Bight over the next 10 years compared to the baseline, it qualifies as a beneficial effect of moderate significance (see Table 5-1 for definitions of levels of significance).

Beyond 10 years, maintenance of the management zone would continue to prevent sea otters from expanding their range into southern California. As a result of this management, the long-term impacts that would have occurred under the baseline (the elimination of commercial sea cucumber harvests via competition with sea otters in recolonized areas) would not occur. The timing and magnitude of this potential benefit is uncertain, but it would likely accrue gradually over the course of many decades.

6.3.4.5 Gill and Trammel Net Fishery

6.3.4.5.1 Halibut Fishery

Under Alternative 1, the regulatory environment would remain unchanged relative to the baseline (see section 6.3.12). Because any potential effects on the portion of the halibut fishery using gill and trammel net gear would stem from regulatory changes, there is no effect.

6.3.4.5.2 White Seabass Fishery

Under Alternative 1, the regulatory environment would remain unchanged relative to the baseline (see section 6.3.12). Because any potential effects on the portion of the white seabass fishery using gill and trammel net gear would stem from regulatory changes, there is no effect.

6.3.5 Marine Aquaculture

Alternative 1 would require a resumption of zonal management (containment) of sea otters, which may result in the exclusion of sea otters from all areas of the Southern California Bight except the translocation zone surrounding San Nicolas Island. Over the next 10 years, open-water marine aquaculture operations in the Santa Barbara Channel may benefit from zonal management of sea otters through a reduction in episodic predation on mussel beds or a reduction in predation on other unprotected shellfish aquaculture operations anticipated under NOAA's Ten Year Strategic Plan, National Marine Aquaculture Policy, and National Shellfish Initiative. There are no effects at San Nicolas Island because 1) there are currently no aquaculture operations at the island, and 2) there is no difference in management of the colony under Alternative 1 and the baseline. We do not assign a level of significance to marine aquaculture because of the extent of uncertainty involved.

Beyond 10 years, marine aquaculture facilities located in other portions of the Southern California Bight may benefit from the exclusion of sea otters, but these benefits are expected to be relatively unimportant because 1) there are few registered open-water aquaculture operations in the remainder of the Southern California Bight (*i.e.*, not in Santa Barbara Channel); 2) under baseline conditions, sea otter range expansion (if it continues to occur) is expected to occur gradually over the course of many decades; and 3) sea otters are not likely to affect abalone or finfish aquaculture operations and would likely affect mussel operations only locally and episodically. The exclusion of sea otters from the Southern California Bight may benefit shellfish aquaculture operations anticipated under NOAA's Ten Year Strategic Plan, National Marine Aquaculture Policy, and National Shellfish Initiative.

6.3.6 SEAFOOD PROCESSING INDUSTRY (SEA URCHINS)

Under Alternative 1, impacts to the sea urchin processing industry would be a positive function of the change in sea urchin landings. If sea urchin landings increase according to the projections discussed above, then southern California landings would increase by approximately 3 percent over 10 years. Impacts to the sea urchin processing industry would be dependent upon whether individual companies are operating at capacity and whether they are capable of processing different seafood products. If companies are operating at capacity, then there may be room for growth in the industry for an additional company. If companies are not operating at capacity, then revenues may increase in relation to any increase in raw product. Companies receiving sea urchins harvested along the affected coastline would be disproportionately affected.

Because of the expected 3 percent increase in sea urchin inputs from the Southern California Bight, Alternative 1 is expected to have a beneficial effect of low significance on the seafood processing industry (see Table 5-1 for definitions of levels of significance).

6.3.7 KELP HARVEST

Alternative 1 would require the exclusion of sea otters from all areas of the Southern California Bight except the translocation zone surrounding San Nicolas Island. If kelp abundance or density has begun to be enhanced as a result of seasonal sea otter predation on invertebrate herbivores in the Cojo Anchorage area during the last several years, this effect would be eliminated (for a description of the relationship between sea otters and kelp abundance, see section 6.2.2). As a result of maintenance of the currently designated management zone, the potential increases in kelp (where kelp is limited by invertebrate herbivory) along the coastline from Point Conception to Carpinteria (lower bound) or Oxnard (upper bound) within 10 years would not occur, representing a possible loss to the kelp industry. Conditions at San Nicolas Island would be the same as those projected for the baseline. We do not assign a level of significance to kelp harvesting because of the extent of uncertainty involved.

In the longer term, Alternative 1 would prevent the enhancement of kelp beds that would have resulted from sea otter predation on invertebrate herbivores if sea otters gradually expanded their range, over many decades, into the Southern California Bight.

6.3.8 Recreational Fishing

Recreational fishing activities that may be affected by sea otters include lobster fishing, abalone diving, and finfish fishing. Lobster fishing and finfish fishing are addressed below. Abalone diving is included under “Abalone Fishery Restoration” (section 6.3.9).

6.3.8.1 Lobster Fishing

Under Alternative 1, impacts to recreational lobster fishing are expected to be limited to the coastline from Point Conception to just southeast of Gaviota (CDFG statistical blocks 655, 656, and 657). Resumption of zonal management would require the removal of sea otters from this area. From 1996 to 2005, recreational lobster dives via CPFV near the affected coastline were less than one percent of all trips taken annually in southern California. For the coastline, there were only two observations to calculate an average of five trips from Point Conception to Carpinteria and an average of nine trips from Point Conception to Oxnard.

If Alternative 1 is selected, the removal of sea otters from the northern edge of the management zone may result in an increase in the lobster population. Continued prevention of sea otter range expansion would mean that recreational lobster fishing trips via CPFV would not be eliminated along the coastline from Point Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound), as projected under the baseline. Thus, recreational lobster fishing trips in 10 years may increase along the coastline. These benefits are minimal (five to nine trips) and represent less than one percent of the total number of lobster fishing trips via CPFVs in the Southern California Bight. Effects at San Nicolas Island are the same as for the baseline. Therefore, overall, Alternative 1 is expected to have a beneficial effect of very low significance on recreational lobster fishing (see Table 5-1 for definitions of levels of significance).

Information from the limited number of lobster report cards returned from 2008-2011 suggests that 3-7 percent of the total number of lobster fishing trips (including CPFV trips) in the Southern California Bight occur along the portion of mainland coastline that is expected to be affected by natural range expansion under baseline conditions during the next 10 years. Alternative 1 would prevent the reduction in trips expected under baseline conditions from occurring. Effects at San Nicolas Island are the same as under the baseline. We do not use report card data as the basis for assigning a level of significance because these data are limited, and the estimates based on them are necessarily provisional.

Beyond 10 years, maintenance of the management zone would continue to prevent sea otters from expanding their range into southern California. As a result of this management, the long-term impacts that would have occurred under the baseline (the elimination of recreational lobster fishing trips via competition with sea otters in recolonized areas) would not occur. The timing and magnitude of this potential benefit is uncertain, but it would likely accrue gradually over the course of many decades.

6.3.8.2 Finfish Fishing

Alternative 1 would require the removal of any sea otters currently in the management zone and would prevent the expansion of the southern sea otter’s range (along the coastline towards the city of Carpinteria or Oxnard) that is expected to occur under baseline conditions within 10 years. It would also preclude the possibility of any further sea otter range expansion into the Southern California Bight in the more distant future.

As a consequence, Alternative 1 may have adverse effects, relative to the baseline, on the recreational finfish fishery in all nearshore areas of the Southern California Bight except in the translocation zone surrounding San Nicolas Island, where effects would be the same as for the baseline. A healthy kelp forest ecosystem is important for a wide range of finfish species harvested by the recreational fishery (a discussion of the long-term effects of sea otter predation on the kelp forest community, including finfish production, is given in section 6.2.2). However, any beneficial effects that would occur under the baseline (and would be prevented under Alternative 1) would likely require more than 10 years to become noticeable (because the reestablishment of giant kelp canopies in areas where sea urchin grazing is limiting kelp is expected to take at least 10 years) and could occur gradually over several decades. Therefore, it is not possible to reasonably quantify the effects of Alternative 1 on recreational finfish fishing. We do not assign a level of significance to recreational finfish fishing because of the extent of uncertainty involved.

6.3.9 Abalone Fishery Restoration

The commercial and recreational abalone fishery in southern California was placed under a fishing moratorium in 1997 due to the depletion of stocks. The moratorium is expected to be removed once the population reaches a level where sustainable harvesting can occur. It does not appear that there is any potential for reopening the abalone fishery (for any species) during the next 10 years, regardless of the presence or absence of sea otters, except possibly a limited fishery for red abalone at San Miguel Island (see section 6.2.9). Because sea otters are not expected to extend their range to the Channel Islands within 10 years, the exclusion of sea otters under Alternative 1 would not benefit efforts to reopen this limited fishery or other abalone fisheries in the short term.

It is conceivable, however, that an abalone fishery could be restored in the Southern California Bight at some point in the future. Abalone will be considered for recreational or commercial harvest when they have met Criterion 3 as defined in the Abalone Recovery and Management Plan (ARMP): an average density of 6,600 abalone per hectare (CDFG 2005c). The ARMP does not estimate the time needed to achieve Criterion 3, beyond stating that it would likely require several decades, because such an estimate would be “speculative.” As stated in the ARMP, areas within the range of southern sea otters would not be considered for restoration of an abalone fishery (CDFG 2005c). Therefore, sea otter range expansion would preclude the reestablishment of an abalone fishery in the areas that are reoccupied.

Alternative 1 would require the removal of any sea otters currently in the management zone and would prevent the expansion of the southern sea otter’s range (along the coastline towards Carpinteria (lower bound) or Oxnard (upper bound)) that is expected to occur under baseline conditions within 10 years. It would also preclude the possibility of any further sea otter range expansion into the Southern California Bight in the more distant future. As a consequence, Alternative 1 may benefit abalone fishery restoration. Although the coastline area northwest of Carpinteria or Oxnard is not identified as a key location for abalone recovery (CDFG 2005c), if sea otters are consuming abalone in the Cojo Anchorage area, then the removal of this source of predation would enhance efforts to foster increases in abalone densities there. Additionally, the long-term removal of sea otters from the management zone would prevent areas within the zone from being eliminated from abalone fishery consideration due to the extension of the southern sea otter's range and would release emergent reproductive abalone from the risk of sea otter predation, presumably maximizing their ability to repopulate depleted areas of the Southern California Bight.

Impacts at San Nicolas Island are the same as for the baseline. Over the next 10 years, sea otters at San Nicolas Island (CDFG statistical blocks 813 and 814) are expected to increase from 11 percent of carrying capacity to 21 percent of carrying capacity. Abalone populations at San Nicolas Island are expected to persist as sea otter predation increases. However, densities of large individual abalone would likely eventually be reduced to a point that would preclude reestablishment of an abalone fishery at the island. Because San Nicolas Island would continue to be occupied by sea otters, it would likely be disqualified from abalone fishery consideration on the grounds that it is not "outside of the sea otter range of sea otters" (CDFG 2005c).

The magnitude of benefit provided by Alternative 1 to the restoration of an abalone fishery is difficult to determine for two reasons: 1) it is unknown whether or when an abalone fishery could be reopened even in the absence of sea otters; and 2) sea otter range expansion that would occur beyond 10 years if not prevented under Alternative 1 is uncertain (it would be a function of demographic rates, food supply, and other variables). Still, it is clear that sea otter range expansion would preclude the possibility of recreational or commercial abalone fishing in reoccupied areas. Therefore, the prevention of range expansion under Alternative 1 can be expected to provide a benefit of unknown magnitude to efforts to restore an abalone fishery. We do not assign a level of significance to abalone fishery restoration because of the extent of uncertainty involved.

6.3.10 Ecotourism and Non-Market Value

Under Alternative 1, ecotourism based on observing sea otters would decrease relative to the baseline because no sea otters would be allowed to remain in the management zone. Although ecotourism activity directed specifically at sea otter watching is now rare in the management zone, under the baseline, tourism is expected to be enhanced over the next 10 years as sea otters progressively reoccupy and begin to reside year-round along the stretch of mainland coastline between Point Conception and Carpinteria or between Point Conception and Oxnard. Alternative 1 would prevent this enhancement from occurring. Overall impacts are difficult to quantify, and implementation of Alternative 1 would not necessarily result in decreased economic activity. However, the quality of tourist trips may decrease relative to the baseline because sea otters would not be observed.

Non-market values for sea otters would not increase if otters do not colonize the coastline from Point Conception to Carpinteria or to Oxnard, as under the baseline. Therefore, the $13.2 million to $32.5 million in non-market benefits for California households would not be realized over 10 years from 2012 to 2021.

Beyond 10 years, Alternative 1 would prevent, in perpetuity, the development of any tourism based on sea otter watching in the area currently designated as the management zone. Effects on ecotourism at San Nicolas Island are the same as for the baseline.

We do not assign a level of significance to ecotourism/non-market value because of the extent of uncertainty involved.

6.3.11 Federal and State Agency Programs

We do not assign a level of significance to effects on agency programs because these effects and programs are various and cannot be meaningfully compared with a single set of criteria. For a discussion of the regulatory environment, see section 6.3.12.

6.3.11.1 U.S. Fish and Wildlife Service

The effects of Alternative 1 on southern sea otter recovery are also addressed in section 6.3.3.3 ("Southern Sea Otter"). Here we address our ability to meet our mandates under the ESA and MMPA and give the implementation costs of Alternative 1.

Ability to Meet Mandate

Alternative 1 would require the exclusion of sea otters from all areas of the Southern California Bight except the translocation zone surrounding San Nicolas Island. According to a simulation model by Doak (2011), preventing natural range expansion into the Southern California Bight would reduce the probability of reaching the delisting criterion in 10 years by as much as 14 percent. It is important to note that the simulations by Doak (2011) are based on individual movement rates and area-specific demographic rates. Thus, they account for effects arising from density-dependence (food limitation), but they do not account for other negative effects of zonal management, such as the potential mortality of moved sea otters and the behavioral disruption of the receiving population (Doak 2011). They also do not account for the increased risk to the species from catastrophic events that would result from limiting the distribution of the population (Doak 2011). Negative effects on recovery of the species would thus be greater than those quantified by Doak (2011).

If the colony at San Nicolas Island persisted, it could conceivably reach the estimated carrying capacity of the island, which is about 500 animals (see section 6.1.4.2). Measured against the estimated carrying capacities given in Laidre *et al.* (2001) for areas of southern California and for California overall, San Nicolas Island accounts for about eight percent of the carrying capacity of the Southern California Bight and about three percent of the carrying capacity of California as a whole. The carrying capacity of the currently designated management zone (*i.e.*, the Southern California Bight minus San Nicolas Island) represents about 37 percent of the carrying capacity of California as a whole and about 92 percent of the carrying capacity of the Southern California Bight.

An estimate of the Optimum Sustainable Population level has not been formally determined for sea otters, but if it were based on the 50-80 percent range of values proposed by Taylor and DeMaster (1993), and on the most recent estimate of carrying capacity for California of 15,941 sea otters (Laidre *et al.* 2001), the Optimum Sustainable Population level in California would be between 7,971 and 12,753 sea otters. The final revised recovery plan for the southern sea otter estimates the lower bound of the Optimum Sustainable Population level as approximately 8,400 animals for the California coast (USFWS 2003). Alternative 1 would make it difficult, if not impossible, to reach the Optimum Sustainable Population level for sea otters in California, even under the most optimistic scenario (assuming that all remaining habitat could be successfully reoccupied).[19]

If sea otters were prevented from recolonizing the management zone as specified under Alternative 1, the remaining sea otter habitat in California would need to be sufficient to achieve the Optimum Sustainable Population level. Excluding the management zone, California could theoretically support about 10,000 sea otters (this number includes about 500 at San Nicolas Island). Therefore, Alternative 1 may or may not allow for the achievement of the Optimum Sustainable Population level. Failure to achieve the Optimum Sustainable Population level would ensure that southern sea otters remained "depleted" and would effectively prevent USFWS from fulfilling our mandate under the MMPA to manage sea otters to their Optimum Sustainable Population level.

Maintenance of the existing management zone, as required by Alternative 1, restricts the habitat available to the subspecies and subjects the entire population to a risky management scenario (see additional discussion in section 6.3.3.3, "Southern Sea Otter"). Alternative 1 would require the removal, in perpetuity, of all sea otters that enter the management zone. The potential effects of the continual introduction of sea otters into the mainland population on the subspecies as a whole have been previously evaluated by USFWS in a biological opinion pursuant to Section 7 of the ESA (USFWS 2000, included as Appendix B). At that time we determined that the continuation of the program would likely jeopardize the survival and recovery of the southern sea otter. If Alternative 1 were chosen, its effects on sea otter recovery would have to be reevaluated through a reinitiation of consultation using the most current information available before it could be implemented. Because the management scenario under Alternative 1 is the same as that evaluated in the 2000 biological opinion, it is possible that Alternative 1 would preclude the survival and recovery of the species. Alternative 1 would not result in any changes in the regulatory provisions that apply to sea otters. For a discussion of these provisions, see section 6.3.12.

Implementation Costs (10-year period)

Under Alternative 1, funding would be necessary to resume maintenance of the management zone. Associated costs result from expenditures for personnel, transportation, and equipment (Table 6-46).

Table 6-47 represents the estimated expenditures for the entire program over 10 years. Personnel costs to maintain the management zone comprise approximately 75 percent of the annual implementation costs listed here. Within the personnel costs, the capture teams represent the largest expense, at $300,000 per year. The capture teams would patrol the management zone to ensure that no sea otters become established in the area. Most likely, effort would be

[19] For example, the remaining habitat includes the San Francisco Bay, which could theoretically sustain 1098 sea otters. However, given the intensity of the Bay's surrounding urbanization, its heavy human use, and its correspondingly poor water quality, it seems highly unlikely that the bay in its current condition could support such numbers of sea otters.

TABLE 6-46 PERSONNEL AND EQUIPMENT NEEDED TO IMPLEMENT ALTERNATIVE 1		
Personnel	**Transportation**	**Equipment**
Program Manager	2 Vans	Boat Maintenance
Capture Teams	1 Tow Vehicle	Dive Gear and Maintenance
Transport Team	2 Monitor Vehicles	Tracking Equipment
Monitoring Team	Air Charters	Training
Veterinary Services	Boat Charters	
	Travel Costs	

concentrated at the northern border of the management zone boundary near Point Conception. Based upon past and projected efforts, the annual implementation costs would stabilize at $709,000 and would sum to about $7.0 million over 10 years. The 10-year discounted implementation costs would sum to about $5.6 million (discounted at 3 percent) or $4.3 million (discounted at 7 percent). Annual expenditures would continue in perpetuity.

TABLE 6-47 IMPLEMENTATION COSTS FOR MAINTENANCE OF THE MANAGEMENT ZONE AND MONITORING AT THE TRANSLOCATION ZONE OVER 10 YEARS

Year	Annual Cost			Discounted Cost (3% discount rate)	Discounted Cost (7% discount rate)
	Personnel	Transportation	Equipment		
2012	$535,000	$75,000	$75,000	$626,872	$559,164
2013	$535,000	$85,000	$66,000	$609,502	$523,346
2014	$535,000	$95,000	$68,000	$602,101	$497,664
2015	$535,000	$104,000	$70,000	$593,776	$472,437
2016	$535,000	$104,000	$70,000	$576,482	$441,530
2017	$535,000	$104,000	$70,000	$559,691	$412,644
2018	$535,000	$104,000	$70,000	$543,389	$385,649
2019	$535,000	$104,000	$70,000	$527,563	$360,420
2020	$535,000	$104,000	$70,000	$512,197	$336,841
2021	$535,000	$104,000	$70,000	$497,278	$314,804
Total	*$7,032,000*			*$5,648,852 (PV@3%)*	*$4,304,499 (PV@7%)*

6.3.11.2 Channel Islands National Park

Under Alternative 1, sea otters would be removed from the existing management zone in perpetuity. Therefore, they would be permanently prevented from establishing range within the boundaries of CINP. Because sea otters are expected to recolonize only the mainland coastline to Carpinteria (lower bound) or Oxnard (upper bound) within the next 10 years (and therefore would not be expected within Park boundaries during this period), the effects of Alternative 1 are effectively the same as under the baseline scenario within this 10-year period. However, in the long term, it is possible that sea otters would attempt to recolonize nearshore areas within CINP. Alternative 1 would prevent this recolonization, which appears to be inconsistent with the Park's mission and mission-related goals to protect and restore natural ecosystems and to practice ecosystem management.

Alternative 1 would not result in any changes in the regulatory provisions that apply to sea otters. For a discussion of these provisions, see section 6.3.12.

6.3.11.3 Channel Islands National Marine Sanctuary

Under Alternative 1, sea otters would be removed from the existing management zone in perpetuity. Therefore, they would be permanently prevented from establishing range within the boundaries of CINMS. Because sea otters are expected to recolonize only the mainland coastline to Carpinteria (lower bound) or Oxnard (upper bound) within the next 10 years (and therefore would not be expected within Sanctuary boundaries during this period), the effects of Alternative 1 are effectively the same as under the baseline scenario within this 10-year period. However, in the long term, it is possible that sea otters would attempt to recolonize nearshore areas that are within the boundaries of CINMS. Alternative 1 would prevent this recolonization, which appears to be inconsistent with the Sanctuary's mission to conserve and enhance the biodiversity, ecological integrity, and cultural legacy of areas of special national significance.

Alternative 1 would not result in any changes in the regulatory provisions that apply to sea otters. For a discussion of these provisions, see section 6.3.12.

6.3.11.4 California Department of Fish and Game

Note: Effects on the recovery of white and black abalone and sea otters are discussed under "Candidate, Threatened, and Endangered Species" (section 6.3.3). Effects on existing commercial fisheries and the restoration of the abalone fishery are discussed under "Commercial Fisheries" (section 6.3.4) and "Abalone Fishery Restoration" (section 6.3.9). Effects on MPAs and the restoration of depleted abalone species that are not federally listed are discussed here.

Marine Protected Areas

Under Alternative 1, sea otters would be removed from the existing management zone in perpetuity. Therefore, they would be permanently prevented from establishing range within any of the 49 MPAs and 3 special closures in southern California except where Begg Rock SMR and the translocation zone surrounding San Nicolas Island coincide. Under the baseline, sea otters are expected to recolonize the mainland coastline to Carpinteria (lower bound) or Oxnard (upper bound) within the next 10 years. This area includes five MPAs, which sea otters would thus be prevented from recolonizing. The permanent exclusion of sea otters from these MPAs would likely enhance fishery restoration goals pertaining to benthic invertebrates (due mostly to "spillover effects," since the take of invertebrates is allowed only in Kashtayit SMCA, and is restricted to recreational take) but would negatively affect the achievement of the remaining goals for MPAs relating to: the maintenance of ecosystem biodiversity; the protection of the structure, function, and integrity of marine ecosystems; the protection of marine natural heritage; and the provision of recreational, scientific, and educational opportunities. With respect to the non-consumptive socio-economic goals set for MPAs, preventing sea otters from recolonizing these areas would eliminate any potential increase in the quality of non-consumptive recreation that would occur as a result of the presence of sea otters.

In the long term, under baseline conditions, it is possible that sea otters would attempt to recolonize other areas that are now designated as MPAs. Alternative 1 would prevent this recolonization, affecting the goals established for the MPA network as described above.

Alternative 1 would not result in any changes in the regulatory provisions that apply to sea otters. For a discussion of these provisions, see section 6.3.12.

RESTORATION OF DEPLETED ABALONE SPECIES (NOT FEDERALLY LISTED)

Enhancement activities for depleted abalone species include the translocation or aggregation of adult stocks, larval outplanting, captive breeding to obtain large individuals for outplanting, and the establishment of MPAs (CDFG 2005c). Under Alternative 1, sea otters would be prevented from recolonizing the mainland coastline to Carpinteria (lower bound) or Oxnard (upper bound) within the next 10 years, and in the long term, sea otters would be prevented from recolonizing any areas of the Southern California Bight except San Nicolas Island. Preventing sea otters from recolonizing the management zone could positively affect State efforts to enhance abalone populations by means of larval outplanting, if outplanting efforts were planned for habitats lacking sufficient cryptic habitat to shield abalone from sea otter predation. The benefits would be lessened to the extent that outplanting efforts were conducted in cryptic habitat that is inaccessible to sea otters or in areas outside the range into which sea otters would have naturally expanded. The translocation or aggregation of adult stocks would likely be unaffected by sea otters, as one purpose of translocation is to protect adults from predation or other threats, and it would seem likely that abalone would be translocated into, or aggregated in, sufficiently protective crevice habitat. The exclusion of sea otters from the management zone would not affect other enhancement activities, such as captive breeding or the establishment of MPAs.

6.3.11.5 U.S. Navy

No regulatory changes are associated with Alternative 1. Under Alternative 1, ESA consultation and permitting requirements for the U.S. Navy/DOD under the ESA, the MMPA, and state law would remain the same as those described for the baseline. For a discussion of these provisions, see section 6.3.12.

6.3.11.6 Bureau of Ocean Energy Management

No regulatory changes are associated with Alternative 1. Under Alternative 1, ESA consultation and permitting requirements for BOEM under the ESA, the MMPA, and state law would remain the same as those described for the baseline. For a discussion of these provisions, see section 6.3.12.

6.3.11.7 National Marine Fisheries Service

National Marine Fisheries Service activities that occur within or overlap with the nearshore areas of the Southern California Bight are diverse. These activities include implementing recovery actions for federally listed threatened and endangered species and managing federal fisheries. Information on endangered white and black abalone and NMFS-led recovery efforts for these species is given under “Candidate, Threatened, and Endangered Species.” Federally managed fisheries are discussed here.

No regulatory changes are associated with Alternative 1. Under Alternative 1, consultation and permitting requirements under the ESA, the MMPA, and state law would remain the same as those described for the baseline. For a discussion of these provisions, see section 6.3.12.

6.3.12 REGULATORY ENVIRONMENT

Under Alternative 1, the regulatory environment in the Southern California Bight would remain unchanged.

In the translocation zone, with the exception of defense-related activities by a military department, the consultation requirements of Section 7 of the ESA would continue to apply to proposed federal actions, and take of sea otters would continue to be subject to the standard take authorization procedures for threatened species under the ESA, depleted species under the MMPA, and fully protected species under Fish and Game Code section 4700 and 4500. With respect to defense-related activities, sea otters would continue to be treated (for the purposes of consultation and incidental take authorization) as a species that is proposed to be listed (50 CFR §17.84(d)(4)(iv)) under the ESA.

In the management zone, the conference and not the consultation requirements of Section 7 of the ESA would apply to actions that may affect southern sea otters, and incidental take of southern sea otters resulting from otherwise legal activities would not be subject to take authorization procedures under the ESA or MMPA or be considered a violation of either Act. As under the baseline, Section 8664.2 of the California Fish and Game Code would allow for incidental take of sea otters in the management zone by means of specific exemptions from section 4700.

Our biological opinion on sea otter containment, released in 2000, concluded that continued zonal management of the sea otter population would likely jeopardize the species' continued existence. Because of the potential effects of sea otter containment on sea otters found in the parent population, consultation under the ESA would need to be reinitiated and a finding of no-jeopardy reached before we could proceed with implementation of Alternative 1.

6.4 Alternative 2—Implement Modified Translocation Program with Smaller Management Zone

6.4.1 INTRODUCTION

Alternative 2 modifies the southern sea otter translocation program from its original design, defined in 50 CFR §17.84(d). The size of the management zone would decrease, with its boundaries redrawn to exclude San Miguel Island, Santa Rosa Island, and the nearshore area between Point Conception and Santa Barbara from the zone. The new delineation would remove CDFG statistical blocks 654, 655, 656, 657, 688, 689, 690, 711, 712, 713, and the western half of block 710 from the management zone. This action would decrease projected sea otter range expansion compared to the baseline within 10 years. Under baseline conditions, sea otters are expected to reoccupy the coastline from Point Conception to Carpinteria (lower bound: CDFG statistical blocks 651, 652, 653, 654, 655, 656, and 657) or from Point Conception to Oxnard (upper bound: CDFG statistical blocks 651, 652, 653, 654, 655, 656, 657, 664, 665, and 683) within 10 years. They are not expected to recolonize San Miguel and Santa Rosa Islands within this period (see section 6.1.4.1). Therefore, impacts within the 10-year period of analysis result from the projected range expansion of sea otters along the coastline towards Santa Barbara and from maintenance of the management zone southeast of Santa Barbara. Regulatory changes would also occur in the area excluded from the management zone under the new designation.

Under Alternative 2, translocations of sea otters to San Nicolas Island would not be reinitiated, beyond moving small numbers of sea otters to San Nicolas Island as necessary to improve genetic diversity in the colony. Instead, sea otters would be allowed to remain at San Nicolas Island, and the existing colony would be observed, protected, and contained. Because this action would not detectably increase or decrease the San Nicolas Island colony compared to the baseline, there would be no impacts except in terms of increased implementation costs.

The assumptions that apply to the analysis for Alternative 2 are the same as those described for the baseline. For a more detailed description of the baseline, to which each activity is compared, refer to section 6.2, "Baseline (Status Quo)—The No Action Alternative."

6.4.2 NEARSHORE MARINE ECOSYSTEM

Alternative 2 would exclude sea otters from a smaller management zone than under Alternative 1, allowing sea otters to recolonize the coastline to Santa Barbara and eventually the islands of San Miguel and Santa Rosa but preventing any further range expansion. The projected expansion of sea otter range would bring about the community changes described in section 6.2.2 along the coastline to Santa Barbara, but maintenance of the management zone southeast of Santa Barbara would prevent the changes that would have occurred within 10 years to Carpinteria (lower bound) or Oxnard (upper bound). Community changes at San Nicolas Island would be the same as those projected for the island under baseline conditions because possible translocations of small numbers of animals for the purposes of maintaining genetic diversity are not expected to have a detectable effect. We do not assign a level of significance to effects on the nearshore marine ecosystem because of the extent of uncertainty involved.

Beyond 10 years, sea otters may attempt to recolonize other areas of the Southern California Bight. The redefined management zone would exclude sea otters from most of the Southern

California Bight but allow them to recolonize the islands of San Miguel and Santa Rosa. If sea otters became re-established in these areas, the nearshore marine environment surrounding these islands would be subject to the kinds of changes described in section 6.2.2. However, maintenance of the modified management zone would prevent such ecosystem changes from occurring in the nearshore areas of the remainder of the Southern California Bight.

6.4.3 CANDIDATE, THREATENED, AND ENDANGERED SPECIES

6.4.3.1 White Abalone

Alternative 2 would require maintenance of a modified management zone. Sea otters would be captured and removed from all areas of the Southern California Bight except the coastline from Point Conception to the city of Santa Barbara and the waters surrounding San Nicolas, San Miguel, and Santa Rosa Islands. The projected expansion of sea otter range would bring about the changes described for the baseline along the coastline to Santa Barbara, but maintenance of the management zone southeast of Santa Barbara would prevent any effects on white abalone that would have occurred within 10 years along the coastline from Santa Barbara to Carpinteria (lower bound) or Oxnard (upper bound). Restriction of the naturally expanding southern sea otter population east of Santa Barbara along the mainland coastline could positively affect NMFS-led recovery efforts under Recovery Action 3.3 (protect white abalone populations and habitat as they are discovered or established through enhancement) through the prevention of sea otter predation if white abalone populations recover naturally or are established within the depth range utilized by sea otters and within the geographic area that would have been reclaimed by natural sea otter range expansion. Effects on white abalone at San Nicolas Island would be the same as those projected for the island under baseline conditions. As discussed under the baseline, sea otter and white abalone depth ranges overlap only marginally. Additionally, fishery data collected from 1955-1997 indicate that less than one half of one percent of all white abalone landings came from these areas (the coastline between Point Conception and Oxnard and at San Nicolas Island) combined (Hobday *et al.* 2001). Relative to the baseline, the effect of Alternative 2 on white abalone within 10 years is expected to be positive but of very low significance.

In the longer term, maintenance of the modified management zone under Alternative 2 would afford white abalone more protection from sea otter predation than the baseline but slightly less than Alternative 1 in the depth ranges where the two species overlap. Specifically, sea otters would be prevented from recolonizing any of the Channel Islands except San Nicolas, San Miguel, and Santa Rosa Islands, providing white abalone with a long-term refuge from sea otter predation. However, because historic and current white abalone population centers are in the southern portion of the Southern California Bight and at offshore banks, which may provide refuge from sea otter predation, and because sea otter range expansion into the southern portions of the Southern California Bight would be expected to require many decades, the timing and magnitude of the long-term benefit to white abalone recovery from preventing sea otter range expansion is uncertain.

Because the effects of this alternative on white abalone would be expected to be beneficial, insignificant, or discountable relative to the baseline, we would seek concurrence from NMFS on a “not likely to adversely affect” determination under Section 7 of the ESA before selecting this alternative.

6.4.3.2 Black Abalone

Alternative 2 would require maintenance of a modified management zone. Sea otters would be captured and removed from all areas of the Southern California Bight except the coastline from Point Conception to the city of Santa Barbara and the waters surrounding San Nicolas, San Miguel, and Santa Rosa Islands. The projected expansion of sea otter range would bring about the changes described for the baseline along the coastline to Santa Barbara, but maintenance of the modified management zone southeast of Santa Barbara would prevent any effects on black abalone that would have occurred within 10 years along the coastline from Santa Barbara to Carpinteria (lower bound) or Oxnard (upper bound). During this period, removal of the threat of sea otter predation from this truncated stretch of coastline could have benefits at the local population level (to the extent that suitable habitat exists and that other factors, such as withering syndrome, have not reduced local populations and the possibility of successful local recruitment to zero), especially if local recovery of black abalone populations occurred within this stretch of coastline in areas lacking sufficient cryptic habitat, whether naturally or as a result of outplanting efforts. However, if future recovery actions for black abalone included relocating or aggregating exposed individuals in crevice habitat sufficiently deep to afford protection from sea otter predation, then there would be more limited benefits to black abalone from maintenance of the management zone. San Nicolas Island has been identified by CDFG as 1 of 10 key locations for the recovery of black abalone (CDFG 2005c). Effects on black abalone at San Nicolas Island would be the same as those projected for the island under baseline conditions. Relative to the baseline, the effect of Alternative 2 on black abalone within 10 years is expected to be positive but of very low significance.

Over the longer term, the exclusion of sea otters from the modified management zone would afford black abalone more protection from sea otter predation than under the baseline but less protection than Alternative 1 in key recovery areas, including the Channel Islands. However, because black abalone can maintain reproductively viable populations where sufficient cryptic and inaccessible habitat exists, and because sea otter range expansion into the Southern California Bight would be expected to require many decades, the timing and magnitude of the long-term benefit to black abalone recovery from preventing sea otter range expansion into the modified management zone is uncertain.

CRITICAL HABITAT

Critical habitat for black abalone includes a number of areas both within the current sea otter range and outside the current sea otter range (in southern California waters) (76 FR 66806). If sea otters were prevented from recolonizing the portions of the Southern California Bight contained within the modified management zone that they would have gradually reoccupied over the course of several decades, then their range would never overlap with a substantial portion of black abalone critical habitat in southern California. The primary constituent elements of critical habitat essential for the conservation of black abalone are: rocky substrate; food resources; juvenile settlement habitat; suitable water quality; and suitable nearshore circulation patterns (76 FR 66806). Of these five elements, only one, food resources, may potentially be affected by sea otters. Under Alternative 2, sea otters would be prevented from improving food resources for adult black abalone through predation on sea urchins in the modified management zone. However, ecological relationships are complex, and it is likely that numerous positive and negative interactions would occur simultaneously.

Because the effects of this alternative on black abalone and black abalone critical habitat would be expected to be beneficial, insignificant, or discountable relative to the baseline, we would seek concurrence from NMFS on a "not likely to adversely affect" determination under Section 7 of the ESA before selecting this alternative.

6.4.3.3 Southern Sea Otter

EFFECTS ON PARENT POPULATION

Alternative 2 would require the resumption of zonal management (containment) of sea otters and the maintenance, in perpetuity, of a modified management zone. Sea otters found in the modified management zone would be captured and moved to other portions of the existing range. Within 10 years, sea otters would be allowed to expand their range to Santa Barbara, but maintenance of the modified management zone would prevent any further range expansion along the mainland coastline. The range expansion projected under the baseline along the coastline southeast of Santa Barbara to Carpinteria (lower bound) or Oxnard (upper bound) would not occur. Relocation activities would be expected to begin within 10 years.

Relocating sea otters from the management zone to the northern or central portion of the existing range would increase competition among sea otters, especially in areas of the central coast now thought to be food-limited (see Tinker *et al.* 2008b), disrupt natural behaviors, and likely result in the deaths of otherwise healthy animals. The incidental injury or death of sea otters removed from the management zone would likely be unavoidable. The relocation of sea otters may result in increased risk of mortality due in part to the stress associated with capture, handling, and time out of water, and in part to the general lack of familiarity of the animals with their new environments (Estes *et al.* n.d.). For males, there may be an added risk of death or injury from encountering territorial males in foreign habitats (Estes *et al.* n.d.). Some sea otters would likely attempt to return to their location of capture, depleting their energy reserves and increasing their risk of mortality.

It has been suggested that restricting range expansion could protect sea otters from hazards present in southern California waters. Because under Alternative 2, there would be no sea otters in the modified management zone, they would not be subject, in those areas, to the benefits and risks that sea otters recolonizing southern California habitat would be subject to under baseline conditions (see section 6.2.3.3). However, outside the modified management zone, the benefits and risks would be the same as those described for the baseline.

According to a simulation model by Doak (2011), preventing *any* natural range expansion into the Southern California Bight would reduce the probability of reaching the delisting criterion in 10 years by as much as 14 percent. It would also require the removal of approximately 400 sea otters from the management zone over the next 10 years (approximately 1800 sea otters over the next 40 years). If a 17 percent mortality rate is assumed (based on the fact that, of 24 sea otters removed from the management zone, 4 were known or suspected to have died as a result of capture and removal activities; see Appendix C to this document), enforcement of a management zone from Point Conception to the Mexican border would result in the deaths of approximately 67 sea otters over the next 10 years (306 sea otters over the next 40 years). Doak (2011) does not simulate the effects of a modified management zone as described under Alternative 2. Alternative 2 would allow range expansion along the coastline to Santa Barbara (and ultimately to San Miguel Island and Santa Rosa Island); negative effects on recovery within 10 years and in the longer term would thus be diminished somewhat relative to those described by Doak (2011). However, it is important to note that the simulations reported in Doak (2011) are based only on individual movement rates and area-specific demographic rates. Thus, they account for effects arising from density-dependence (food limitation), but they do not account for other negative effects of zonal management, such as the potential mortality of moved sea otters, the behavioral disruption of the receiving population, or the increased risk to the species from catastrophic events that would result from limiting the distribution of the population (Doak 2011). These negative effects on recovery would occur under Alternative 2 as well as under Alternative 1.

EFFECTS ON SAN NICOLAS ISLAND COLONY

Alternative 2 would have little or no effect on the sea otter colony at San Nicolas Island compared to baseline conditions. Monitoring of the colony would continue, and protective measures currently in place would remain unchanged. Alternative 2 allows for the limited translocation of sea otters to San Nicolas Island for the purposes of maintaining genetic diversity; however, past experience indicates that dispersal of translocated sea otters would be high, possibly negating the intended effect of supplementing genetic diversity.

Because of the effects on key segments and behaviors of the southern sea otter, within 10 years Alternative 2 is expected to have an adverse effect of high significance on the southern sea otter.

In the longer term, continuation of zonal management of sea otters would limit natural range expansion and would eliminate about 27 percent of the carrying capacity (for sea otters) of California (see section 6.4.11.1). Restriction of the southern sea otter's range would increase the vulnerability of the species to oil spills, disease, and stochastic events relative to the baseline. In combination, these effects would slow or prevent the recovery of the species. In the revised southern sea otter recovery plan (USFWS 2003), the recovery team recommends that we discontinue zonal management and allow natural range expansion of sea otters to occur.

In 2000, USFWS completed a biological opinion (USFWS 2000) on the southern sea otter containment program as described in our original southern sea otter translocation plan (USFWS 1987). In this opinion, we concluded that continuing the containment program and restricting the southern sea otter to the area north of Point Conception (with the exception of the translocation zone at San Nicolas Island) would likely jeopardize the continued existence of the species. We based this conclusion, in part, on the assumption that reversal of southern sea otter population declines and expansion of the southern sea otter's range is essential to the survival and recovery of the species. Resumption of sea otter containment under Alternative 2 could result in increased mortality of sea otters and disrupt behavior throughout the range of the species. Therefore, before selecting Alternative 2, we would reinitiate consultation under the ESA to consider any new information that is available. If the resulting opinion concluded that continuation of the program would not likely jeopardize the southern sea otter, containment under Alternative 2 could be considered a viable option.

6.4.4 Commercial Fisheries

For a discussion of the regulatory environment (including as it pertains to commercial fisheries) see section 6.4.12.

6.4.4.1 Sea Urchin Fishery

Under Alternative 2, commercial sea urchin landings within 10 years would be (1) eliminated along the coastline from Point Conception to Santa Barbara (2) unaffected from Santa Barbara to Carpinteria, (3) unaffected from Santa Barbara to Oxnard and (4) unaffected at San Miguel and Santa Rosa Islands. The sea urchin fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Carpinteria (lower bound estimate including CDFG statistical blocks 651, 652, 653, 654, 655, 656, and 657) or along the coastline from Point Conception to Oxnard (upper bound estimate including CDFG statistical blocks 683, 664, 665, 651, 652, 653, 654, 655, 656, and 657.

Under Alternative 2, sea otters would not be able to fully expand their range from Point Conception to Carpinteria, as projected in the lower bound baseline estimate, and would not be able to fully expand their range to Oxnard, as projected in the upper bound estimate. Instead, sea otter range would be restricted to northwest of Santa Barbara. Therefore, benefits to the fishery would accrue because sea urchin landings would not be eliminated along the coastline from Santa Barbara to Carpinteria (CDFG statistical blocks 651, 652, and 653) compared to the lower bound baseline, and landings would not be eliminated along the coastline from Santa Barbara to Oxnard (CDFG statistical blocks 683, 664, 665, 651, 652, and 653) compared to the upper bound baseline (see section 6.2.4.2 for the commercial sea urchin fishery baseline).

Avoided Future Loss

To establish landings baselines for Santa Barbara to Carpinteria (lower bound) and Santa Barbara to Oxnard (upper bound), we employ 10-year averages (2000 to 2009) to mitigate the effects of cyclic variations in populations, adverse weather, market demand, and other factors than influence catch from one year to the next. Along the affected coastlines, the 10-year landings averages are 19,991 pounds for the lower bound and 24,646 pounds for the upper bound.

We assume that sea urchin landings along this section of coastline would no longer decrease 10 percent (1,999 to 2,465 pounds) each year to zero landings in 2021 because maintenance would remove the sea otter population south of Santa Barbara.

Summary of Impacts

Tables 6-48 and 6-49 show the expected change in commercial landings and ex-vessel revenue if sea otters are not able to recolonize the coastline south of Santa Barbara. Over 10 years, landings would increase by 110,000 to 136,000 pounds. The total non-discounted benefit to sea urchin fishing vessels for Alternative 2 would range from $90,000 to $110,000, and the total discounted 10-year benefit for this Alternative would total between $69,000 and $85,000 (discounted at 3 percent) or from $49,000 to $61,000 (discounted at 7 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-4.

TABLE 6-48 SEA URCHIN LANDINGS: BENEFITS OF ALTERNATIVE 2 – LOWER ESTIMATE (POINT CONCEPTION TO CARPINTERIA)					
Year	**Increase in Commercial Landings – Avoided Future Loss (Pounds)**	**Ex-Vessel Revenue***	**Ex-Vessel Discounted Revenue (3%)***	**Ex-Vessel Discounted Revenue (7%)***	**Expected Percentage Increase from Alternative 1**
2012	1,999	$1,629	$1,491	$1,330	0.0%
2013	3,998	$3,258	$2,894	$2,485	0.0%
2014	5,997	$4,886	$4,215	$3,484	0.1%
2015	7,996	$6,515	$5,456	$4,341	0.1%
2016	9,995	$8,144	$6,622	$5,072	0.1%
2017	11,994	$9,773	$7,715	$5,688	0.1%
2018	13,993	$11,402	$8,738	$6,202	0.2%
2019	15,993	$13,030	$9,696	$6,624	0.2%
2020	17,992	$14,659	$10,590	$6,964	0.2%
2021	19,991	$16,288	$11,424	$7,232	0.2%
TOTAL BENEFITS	109,949	$89,584	$68,841 (PV@3%)	$49,422 (PV@7%)	0.1%

Note: Benefits are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price received for sea urchin from 2000 to 2009, which is $0.81 per pound in 2009 dollars.

TABLE 6-49 SEA URCHIN LANDINGS: BENEFITS OF ALTERNATIVE 2 – UPPER ESTIMATE (POINT CONCEPTION TO OXNARD)					
Year	**Increase in Commercial Landings – Avoided Future Loss (Pounds)**	**Ex-Vessel Revenue***	**Ex-Vessel Discounted Revenue (3%)***	**Ex-Vessel Discounted Revenue (7%)***	**Expected Percentage Increase from Alternative 1**
2012	2,465	$2,008	$1,838	$1,639	0.0%
2013	4,929	$4,016	$3,568	$3,064	0.1%
2014	7,394	$6,024	$5,197	$4,295	0.1%
2015	9,859	$8,033	$6,727	$5,352	0.1%
2016	12,323	$10,041	$8,164	$6,253	0.1%
2017	14,788	$12,049	$9,511	$7,013	0.2%
2018	17,252	$14,057	$10,773	$7,646	0.2%
2019	19,717	$16,065	$11,954	$8,167	0.2%
2020	22,182	$18,073	$13,056	$8,586	0.2%
2021	24,646	$20,081	$14,085	$8,916	0.3%
Total Benefits	135,555	$110,448	$84,874 (PV@3%)	$60,932 (PV@7%)	0.2%

Note: Benefits are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price received for sea urchin from 2000 to 2009, which is $0.81 per pound in 2009 dollars.

To determine the regional impact of increased sea urchin revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 2 would result in a maximum increase of $93,000 to $160,000 in total output over 10 years discounted at 7 percent and 3 percent, respectively. These impacts assume fishers would have the capacity to increase their landings.

As described in Chapter 5, we define levels of significance by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 2 is expected to result in an increase in sea urchin ex-vessel revenues within the Southern California Bight over the next 10 years of 0.1 percent compared to the baseline, it qualifies as a beneficial effect of very low significance (see Table 5-1 for definitions of levels of significance).

Whether sea otters would recolonize the nearshore areas around San Miguel and Santa Rosa Islands after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, the commercial sea urchin fishery in these areas would likely no longer be viable, and landings would approach zero because sea urchin divers would fish other areas where their catch per unit effort would be greater. However, there would be no additional impact from this expansion, compared to the baseline, because sea otters are equally likely to colonize these areas under baseline conditions.

Maintenance of the management zone southeast of Santa Barbara would prevent sea otters from further expanding their range. As a result of this management, the long-term impacts that would have occurred under the baseline (the elimination of commercial sea urchin harvests via competition with sea otters in recolonized areas) would not occur. This benefit is likely to accrue gradually over the course of many decades.

6.4.4.2 Spiny Lobster Fishery

Under Alternative 2, commercial spiny lobster landings within 10 years would be (1) eliminated along the coastline from Point Conception to Santa Barbara, (2) unaffected from Santa Barbara to Carpinteria, (3) unaffected from Santa Barbara to Oxnard, and (4) unaffected at San Miguel and Santa Rosa Islands. The lobster fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Carpinteria (lower bound estimate including CDFG statistical blocks 651, 652, 653, 654, 655, 656, and 657) or along the coastline from Point Conception to Oxnard (upper bound estimate including CDFG statistical blocks 683, 664, 665, 651, 652, 653, 654, 655, 656, and 657).

Under Alternative 2, sea otters would not be able to fully expand their range from Point Conception to Carpinteria, as projected in the lower bound baseline estimate, and would not be able to fully expand their range to Oxnard, as projected in the upper bound estimate. Instead, sea otter range would be restricted to northwest of Santa Barbara. Therefore, benefits to the fishery would accrue because sea urchin landings would not be eliminated along the coastline from Santa Barbara to Carpinteria (CDFG statistical blocks 651, 652, and 653) compared to the lower bound baseline, and landings would not be eliminated along the coastline from Santa Barbara to Oxnard (CDFG statistical blocks 683, 664, 665, 651, 652, and 653) compared to the upper bound baseline (see section 6.2.4.3 for the commercial lobster fishery baseline).

AVOIDED FUTURE LOSS

To establish landings baselines for Santa Barbara to Carpinteria (lower bound) and Santa Barbara to Oxnard (upper bound), we employ 10-year averages (2000 to 2009) to mitigate the effects of cyclic variations in populations, adverse weather, market demand, and other factors that influence catch from one year to the next. Along the affected coastlines, the 10-year landings averages are 25,631 pounds for the lower bound and 46,605 pounds for the upper bound. We assume that lobster landings along this section of coastline would no longer decrease 10 percent (2,563 to 4,661 pounds) each year to zero landings in 2021 because maintenance of the management zone would remove the sea otter population southeast of Santa Barbara.

SUMMARY OF IMPACTS

Tables 6-50 and 6-51 show the expected change in commercial landings and ex-vessel revenue if sea otters are not able to recolonize the coastline south of Santa Barbara. Over 10 years, landings would increase by 141,000 to 256,00 pounds. The total non-discounted upper bound benefit to lobster fishing vessels for Alternative 2 would range from $1.3 million to about $2.4 million, and the total discounted 10-year benefit for this Alternative would range from $1.0 million to $1.9 million (discounted at 3 percent) or from $733,000 to $1.3 million (discounted at 7 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-4.

TABLE 6-50 LOBSTER LANDINGS: BENEFITS OF ALTERNATIVE 2 – LOWER ESTIMATE (POINT CONCEPTION TO CARPINTERIA)

Year	Increase in Commercial Landings – Avoided Future Loss (Pounds)	Ex-Vessel Revenue*	Ex-Vessel Discounted Revenue (3%)*	Ex-Vessel Discounted Revenue (7%)*	Expected Percentage Increase from Alternative 1
2012	2,563	$24,174	$22,122	$19,733	0%
2013	5,126	$48,347	$42,956	$36,884	1%
2014	7,689	$72,521	$62,557	$51,706	1%
2015	10,252	$96,695	$80,980	$64,432	1%
2016	12,815	$120,868	$98,277	$75,271	2%
2017	15,378	$145,042	$114,497	$84,416	2%
2018	17,942	$169,216	$129,690	$92,042	3%
2019	20,505	$193,389	$143,900	$98,309	3%
2020	23,068	$217,563	$157,172	$103,363	3%
2021	25,631	$241,737	$169,549	$107,334	4%
Total Benefits	140,970	$1,329,551	$1,021,701 (PV@3%)	$733,489 (PV@7%)	2%

Note: Benefits are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price received for lobster from 2000 to 2009, which is $9.43 per pound in 2009 dollars.

TABLE 6-51 LOBSTER LANDINGS: BENEFITS OF ALTERNATIVE 2 – UPPER ESTIMATE (POINT CONCEPTION TO OXNARD)					
Year	**Increase in Commercial Landings – Avoided Future Loss (Pounds)**	**Ex-Vessel Revenue***	**Ex-Vessel Discounted Revenue (3%)***	**Ex-Vessel Discounted Revenue (7%)***	**Expected Percentage Increase from Alternative 1**
2012	4,661	$43,955	$40,225	$35,881	1%
2013	9,321	$87,911	$78,108	$67,067	1%
2014	13,982	$131,866	$113,749	$94,019	2%
2015	18,642	$175,822	$147,248	$117,157	3%
2016	23,303	$219,777	$178,699	$136,866	3%
2017	27,963	$263,732	$208,193	$153,495	4%
2018	32,624	$307,688	$235,817	$167,362	5%
2019	37,284	$351,643	$261,656	$178,758	6%
2020	41,945	$395,599	$285,789	$187,946	6%
2021	46,605	$439,554	$308,294	$195,167	7%
Total Benefits	256,328	$2,417,548	$1,857,778 (PV@3%)	$1,333,717 (PV@7%)	4%

Note: Benefits are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price received for lobster from 2000 to 2009, which is $9.43 per pound in 2009 dollars.

To determine the regional impact of increased lobster revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 2 would result in a maximum increase of $1.4 million to $3.6 million in total output over 10 years discounted at 7 percent and 3 percent, respectively. These impacts assume fishers would have the capacity to increase their landings.

As described in Chapter 5, we define levels of significance by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 2 is expected to result in an increase in lobster ex-vessel revenues within the Southern California Bight over the next 10 years of 2 percent compared to the baseline, it qualifies as a beneficial effect of low significance (see Table 5-1 for definitions of levels of significance).

Whether sea otters would recolonize the nearshore areas around San Miguel and Santa Rosa Islands after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, the commercial lobster fishery in these areas would likely no longer be viable, and landings would approach zero because lobster fishers would fish other areas where their catch per unit effort would be greater. However, there would be no additional impact from this expansion, compared to the baseline, because sea otters are equally likely to colonize these areas under baseline conditions.

Maintenance of the management zone southeast of Santa Barbara would prevent sea otters from further expanding their range. As a result of this management, the long-term impacts that would have occurred under the baseline (the elimination of commercial lobster harvests via competition with sea otters in recolonized areas) would not occur. This benefit is likely to accrue gradually over the course of many decades.

6.4.4.3 Crab Fishery

Under Alternative 2, sea otters are predicted to recolonize the northern fringe of the previously established management zone. Thus, commercial crab landings within one decade would be (1) eliminated along the coastline from Point Conception to Santa Barbara, (2) unaffected from Santa Barbara to Carpinteria, (3) unaffected from Santa Barbara to Oxnard, and (4) unaffected at San Miguel and Santa Rosa Islands. The crab fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Carpinteria (lower bound estimate including CDFG statistical blocks 651, 652, 653, 654, 655, 656, and 657) or along the coastline from Point Conception to Oxnard (upper bound estimate including CDFG statistical blocks 683, 664, 665, 651, 652, 653, 654, 655, 656, and 657).

Under Alternative 2, sea otters would not be able to fully expand their range beyond Santa Barbara, as projected in the baseline estimates. Instead, sea otter range would be restricted to northwest of Santa Barbara. Therefore, benefits to the fishery would accrue because crab landings would not be eliminated along the coastline from Santa Barbara to Carpinteria (CDFG statistical blocks 651, 652, and 653) compared to the lower bound baseline, and landings would not be eliminated along the coastline from Santa Barbara to Oxnard (CDFG statistical blocks 683, 664, 665, 651, 652, and 653) compared to the upper bound baseline (see section 6.2.4.4 for the commercial crab fishery baseline).

Avoided Future Loss

To establish landings baselines for Santa Barbara to Carpinteria (lower bound) and Santa Barbara to Oxnard (upper bound)), we employ 10-year averages (2000 to 2009) to mitigate the effects of cyclic variations in populations, adverse weather, market demand, and other factors that influence catch from one year to the next. Along the affected coastlines, the 10-year landings averages are 135,951 pounds for the lower bound and 268,122 pounds for the upper bound.

We assume that crab landings along these sections of coastline would no longer decrease 10 percent (13,595 to 26,812 pounds) each year to zero landings in 2021 because maintenance would remove the sea otter population south of Santa Barbara.

Summary of Impacts

Tables 6-52 and 6-53 show the expected change in commercial landings and ex-vessel revenue if sea otters are not able to recolonize the coastline south of Santa Barbara. Over 10 years, landings would increase by 748,000 to 1.5 million pounds. The total non-discounted upper bound benefit to crab fishing vessels for Alternative 2 would range from $1.1 million to $2.1 million, and the total discounted 10-year benefit for this Alternative would range from $822,000 to $1.6 million (discounted at 3 percent) or $590,000 to $1.2 million (discounted at 7 percent).

For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-4.

TABLE 6-52 CRAB LANDINGS: BENEFITS OF ALTERNATIVE 2 – LOWER ESTIMATE (POINT CONCEPTION TO CARPINTERIA)

Year	Increase in Commercial Landings – Avoided Future Loss (Pounds)	Ex-Vessel Revenue*	Ex-Vessel Discounted Revenue (3%)*	Ex-Vessel Discounted Revenue (7%)*	Expected Percentage Increase from Alternative 1
2012	13,595	$19,459	$17,807	$15,884	1%
2013	27,190	$38,917	$34,577	$29,690	3%
2014	40,785	$58,376	$50,355	$41,621	4%
2015	54,380	$77,834	$65,185	$51,864	5%
2016	67,976	$97,293	$79,108	$60,589	7%
2017	81,571	$116,751	$92,164	$67,950	9%
2018	95,166	$136,210	$104,393	$74,089	10%
2019	108,761	$155,668	$115,832	$79,134	12%
2020	122,356	$175,127	$126,515	$83,201	14%
2021	135,951	$194,585	$136,478	$86,398	16%
Total Benefits	747,732	$1,070,219	$822,415 (PV@3%)	$590,420 (PV@7%)	8%

Note: Benefits are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price received for crab from 2000 to 2009, which is $1.43 per pound in 2009 dollars.

TABLE 6-53 CRAB LANDINGS: BENEFITS OF ALTERNATIVE 2 – UPPER ESTIMATE (POINT CONCEPTION TO OXNARD)

Year	Increase in Commercial Landings – Avoided Future Loss (Pounds)	Ex-Vessel Revenue*	Ex-Vessel Discounted Revenue (3%)*	Ex-Vessel Discounted Revenue (7%)*	Expected Percentage Increase from Alternative 1
2012	26,812	$38,376	$35,119	$31,326	3%
2013	53,624	$76,752	$68,193	$58,554	5%
2014	80,437	$115,128	$99,310	$82,085	8%
2015	107,249	$153,504	$128,557	$102,286	11%
2016	134,061	$191,880	$156,016	$119,493	15%
2017	160,873	$230,256	$181,766	$134,011	18%
2018	187,686	$268,632	$205,884	$146,118	22%
2019	214,498	$307,008	$228,443	$156,067	27%
2020	241,310	$345,384	$249,513	$164,089	32%
2021	268,122	$383,760	$269,162	$170,394	37%
Total Benefits	1,474,673	$2,110,680	$1,621,964 (PV@3%)	$1,164,424 (PV@7%)	16%

Note: Benefits are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price received for crab from 2000 to 2009, which is $1.43 per pound in 2009 dollars.

To determine the regional impact of increased crab revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 2 would result in a maximum increase of $1.1 million to $3.0 million in total output over 10 years discounted at 7 percent and 3 percent, respectively. These impacts assume fishers would have the capacity to increase their landings.

As described in Chapter 5, we define levels of significance by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 2 is expected to result in an increase in crab ex-vessel revenues within the Southern California Bight over the next 10 years of 8 to 16 percent compared to the baseline, it qualifies as a beneficial effect of low to moderate significance (see Table 5-1 for definitions of levels of significance).

Whether sea otters would recolonize the nearshore areas around San Miguel and Santa Rosa Islands after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, the commercial crab fishery in these areas would likely no longer be viable, and landings would approach zero because crab fishers would fish other areas where their catch per unit effort would be greater. However, there would be no additional impact from this expansion, compared to the baseline, because sea otters are equally likely to colonize these areas under baseline conditions.

Maintenance of the management zone southeast of Santa Barbara would prevent sea otters from further expanding their range. As a result of this management, the long-term impacts that would have occurred under the baseline (the elimination of commercial crab harvests via competition with sea otters in recolonized areas) would not occur. This benefit is likely to accrue gradually over the course of many decades.

6.4.4.4 Sea Cucumber Fishery

Under Alternative 2, commercial sea cucumber landings within 10 years would be (1) eliminated along the coastline from Point Conception to Santa Barbara, (2) unaffected from Santa Barbara to Carpinteria, (3) unaffected from Santa Barbara to Oxnard, and (4) unaffected at San Miguel and Santa Rosa Islands. The sea cucumber fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Carpinteria (lower estimate including CDFG statistical blocks 651, 652, 653, 654, 655, 656, and 657) or along the coastline from Point Conception to Oxnard (upper bound estimate including CDFG statistical blocks 683, 664, 665, 651, 652, 653, 654, 655, 656, and 657).

Under Alternative 2, sea otters would not be able to fully expand their range from Point Conception to Carpinteria, as projected in the lower bound baseline estimate, and would not be able to fully expand their range to Oxnard, as projected in the upper bound estimate.. Instead, sea otter range would be restricted to northwest of Santa Barbara. Therefore, benefits to the fishery would accrue because sea cucumber landings would not be eliminated along the coastline from Santa Barbara to Carpinteria (CDFG statistical blocks 651, 652, and 653) compared to the lower bound baseline, and landings would not be eliminated along the coastline from Santa Barbara to Oxnard (CDFG statistical blocks 683, 664, 665, 651, 652, and 653) compared to the upper bound baseline (see section 6.2.4.5 for the commercial sea cucumber fishery baseline).

Avoided Future Loss

To establish landings baselines for Santa Barbara to Carpinteria (lower bound) and Santa Barbara to Oxnard (upper bound), we employ 10-year averages (2000 to 2009) to mitigate the effects of cyclic variations in populations, adverse weather, market demand, and other factors than influence catch from one year to the next. Along the affected coastlines, the 10-year landings averages are 68,192 pounds for the lower bound and 71,115 pounds for the upper bound. We assume that crab landings along these sections of coastline would no longer decrease 10 percent (6,819 to 7,112 pounds) each year to zero landings in 2021 because maintenance of the management zone would remove the sea otter population southeast of Santa Barbara.

Summary of Impacts

Tables 6-54 and 6-55 shows the expected change in commercial landings and ex-vessel revenue if sea otters are not able to recolonize the coastline south of Santa Barbara. Over 10 years, landings would increase by 375,000 to 391,000 pounds. The total non-discounted upper bound benefit to sea cucumber fishing vessels for Alternative 2 would range from $509,000 to $530,000, and the total discounted 10-year benefit for this Alternative would range from $391,000 to $408,000 (discounted at 3 percent) or from $281,000 to $293,000(discounted at 7 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-4.

TABLE 6-54 SEA CUCUMBER LANDINGS: BENEFITS OF ALTERNATIVE 2 – LOWER ESTIMATE (POINT CONCEPTION TO CARPINTERIA)

Year	Increase in Commercial Landings – Avoided Future Loss (Pounds)	Ex-Vessel Revenue*	Ex-Vessel Discounted Revenue (3%)*	Ex-Vessel Discounted Revenue (7%)*	Expected Percentage Increase from Alternative 1
2012	6,819	$9,249	$8,464	$7,550	1%
2013	13,638	$18,498	$16,435	$14,112	3%
2014	20,458	$27,747	$23,935	$19,783	4%
2015	27,277	$36,996	$30,983	$24,652	5%
2016	34,096	$46,245	$37,601	$28,799	7%
2017	40,915	$55,494	$43,807	$32,298	9%
2018	47,735	$64,743	$49,620	$35,216	10%
2019	54,554	$73,992	$55,057	$37,614	12%
2020	61,373	$83,240	$60,135	$39,547	14%
2021	68,192	$92,489	$64,870	$41,066	16%
Total Benefits	375,057	$508,692	$390,907 (PV@3%)	$280,636 (PV@7%)	8%

Note: Benefits are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price received for sea cucumber from 2000 to 2009, which is $1.36 per pound in 2009 dollars.

TABLE 6-55 SEA CUCUMBER LANDINGS: BENEFITS OF ALTERNATIVE 2 – UPPER ESTIMATE (POINT CONCEPTION TO OXNARD)					
Year	**Increase in Commercial Landings – Avoided Future Loss (Pounds)**	**Ex-Vessel Revenue***	**Ex-Vessel Discounted Revenue (3%)***	**Ex-Vessel Discounted Revenue (7%)***	**Expected Percentage Increase from Alternative 1**
2012	7,111	$9,645	$8,827	$7,873	1%
2013	14,223	$19,291	$17,140	$14,717	3%
2014	21,334	$28,936	$24,960	$20,631	4%
2015	28,446	$38,581	$32,311	$25,708	6%
2016	35,557	$48,227	$39,213	$30,033	7%
2017	42,669	$57,872	$45,685	$33,682	9%
2018	49,780	$67,517	$51,746	$36,725	11%
2019	56,892	$77,163	$57,416	$39,226	13%
2020	64,003	$86,808	$62,712	$41,242	15%
2021	71,115	$96,453	$67,650	$42,826	17%
Total Benefits	391,131	$530,494	$407,661 (PV@3%)	$292,664 (PV@7%)	8%

Note: Benefits are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price received for sea cucumber from 2000 to 2009, which is $1.36 per pound in 2009 dollars.

To determine the regional impact of increased sea cucumber revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 2 would result in a maximum increase of $529,000 to $769,000 in total output over 10 years discounted at 7 percent and 3 percent, respectively. These impacts assume fishers would have the capacity to increase their landings.

As described in Chapter 5, we define levels of significance by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 2 is expected to result in an increase in sea cucumber ex-vessel revenues within the Southern California Bight over the next 10 years of 8 percent compared to the baseline, it qualifies as a beneficial effect of low significance (see Table 5-1 for definitions of levels of significance).

Whether sea otters would recolonize the nearshore areas around San Miguel and Santa Rosa Islands after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, the commercial sea cucumber fishery in these areas would likely no longer be viable, and landings would approach zero because sea cucumber divers would fish other areas where their catch per unit effort would be greater. However, there would be no additional impact from this expansion, compared to the baseline, because sea otters are equally likely to colonize these areas under baseline conditions.

Maintenance of the management zone southeast of Santa Barbara would prevent sea otters from expanding their range into southern California. As a result of this management, the long-term impacts that would have occurred under the baseline (the elimination of commercial sea cucumber harvests via competition with sea otters in recolonized areas) would not occur. This benefit is likely to accrue gradually over the course of many decades.

6.4.4.5 Gill and Trammel Net Fishery

6.4.4.5.1 Halibut Fishery

Under Alternative 2, the regulatory environment would remain unchanged relative to the baseline within the modified management zone and translocation zone. Areas excluded from the modified management zone relative to the existing management zone (the mainland coastline to Santa Barbara, San Miguel Island, and Santa Rosa Island) would be subject to the regulations currently in effect throughout the remainder of the southern sea otter's range (see section 6.1.4.2), representing a change from the baseline. However, because the existing gill and trammel net closure is believed to be fully protective of sea otters from Point Conception to Santa Barbara, the exclusion of this portion of the coastline from the modified management zone would not result in any additional regulatory changes. Therefore, there would be no effect on the portion of the halibut fishery using gill and trammel net gear within 10 years.

Whether sea otters would recolonize the nearshore areas around San Miguel and Santa Rosa Islands after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas, it is possible that the State or NMFS would extend the existing closure at these islands to depths (104 m or 341 ft) that include all dives of 99 percent of sea otters. However, the likelihood, timing, and magnitude of this potential impact are unknown.

6.4.4.5.2 White Seabass Fishery

Under Alternative 2, the regulatory environment would remain unchanged relative to the baseline within the modified management zone and translocation zone. Areas excluded from the modified management zone relative to the existing management zone (the mainland coastline to Santa Barbara, San Miguel Island, and Santa Rosa Island) would be subject to the regulations currently in effect throughout the remainder of the southern sea otter's range (see section 6.1.4.2), representing a change from the baseline. However, because the existing gill and trammel net closure is believed to be fully protective of sea otters from Point Conception to Santa Barbara, the exclusion of this portion of the coastline from the modified management zone would not result in any additional regulatory changes. Therefore, there would be no effect on the portion of the white seabass fishery using gill and trammel net gear within 10 years.

Whether sea otters would recolonize the nearshore areas around San Miguel and Santa Rosa Islands after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas, it is possible that the State or NMFS would extend the existing closure at these islands to depths (104 m or 341 ft) that include all dives of 99 percent of sea otters. However, the likelihood, timing, and magnitude of this potential impact are unknown.

6.4.5 Marine Aquaculture

Alternative 2 would require a resumption of zonal management (containment) of sea otters, which would result in the exclusion of sea otters from all areas of the Southern California Bight except the coastline from Point Conception to Santa Barbara and the waters surrounding San Nicolas, San Miguel, and Santa Rosa Islands.

Within 10 years, there may be a beneficial effect on marine aquaculture facilities in the Santa Barbara Channel (see section 6.2.5) because sea otters would be restricted to the mainland coastline northwest of Santa Barbara. Thus, relative to the baseline, benefits may accrue to marine aquaculture operations along the coastline from Santa Barbara to Carpinteria or Oxnard from a reduction in episodic predation on mussel beds or a reduction in predation on other unprotected shellfish aquaculture operations anticipated under NOAA's Ten Year Strategic Plan, National Marine Aquaculture Policy, and National Shellfish Initiative. There are no effects at San Nicolas Island because 1) there are currently no aquaculture operations there, and 2) there is no difference in management of the colony under Alternative 2 and the baseline. We do not assign a level of significance to marine aquaculture because of the extent of uncertainty involved.

Beyond 10 years, marine aquaculture facilities located in other portions of the Southern California Bight may benefit from the exclusion of sea otters, but these benefits are expected to be relatively unimportant because 1) there are few registered open-water aquaculture operations in the remainder of the Southern California Bight (*i.e.,* not in Santa Barbara Channel); 2) under baseline conditions, sea otter range expansion (if it continues to occur) is expected to occur gradually over the course of many decades; and 3) sea otters are not likely to affect abalone or finfish aquaculture operations and would likely affect mussel operations only locally and episodically. The exclusion of sea otters the modified management zone may benefit shellfish aquaculture operations anticipated under NOAA's Ten Year Strategic Plan, National Marine Aquaculture Policy, and National Shellfish Initiative.

6.4.6 Seafood Processing Industry (Sea Urchins)

Under Alternative 2, impacts to the sea urchin processing industry are a function of the change in sea urchin landings. Alternative 2 would require a resumption of zonal management (containment) of sea otters, which would result in the exclusion of sea otters from all areas of the Southern California Bight except the coastline from Point Conception to Santa Barbara and the waters surrounding San Nicolas, San Miguel, and Santa Rosa Islands.

Within 10 years, sea otters would not be able to fully expand their range from Point Conception to Carpinteria or Oxnard, as projected under the baseline. Instead, sea otter range would be restricted to northwest of Santa Barbara. Therefore, benefits to the industry would accrue because sea urchin landings would not be eliminated along the coastline from Santa Barbara to Carpinteria (CDFG statistical blocks 651, 652, and 653) compared to the lower bound baseline, and landings would not be eliminated along the coastline from Santa Barbara to Oxnard (CDFG statistical blocks 683, 664, 665, 651, 652, and 653) compared to the upper bound baseline (see section 6.2.6 for the seafood processing industry baseline).

Impacts to the sea urchin processing industry would be dependent upon whether individual companies are operating at capacity and whether they are capable of processing different seafood products. If companies are operating at capacity, then there may be room for growth in the industry for an additional company. If companies are not operating at capacity, then revenues may increase in relation to any increase in raw product. Companies receiving sea urchins harvested along the affected coastline would be disproportionately affected.

Because of the expected 0.1 to 0.2 percent increase in sea urchin inputs from the Southern California Bight, Alternative 2 is expected to have a beneficial effect of very low significance on the seafood processing industry (see Table 5-1 for definitions of levels of significance).

As a result of this management, the long-term impacts that would have occurred under the baseline (the elimination of sea urchin processing inputs via competition with sea otters in recolonized areas southeast of Santa Barbara) would not occur. This benefit is likely to accrue gradually over the course of many decades.

6.4.7 KELP HARVEST

Alternative 2 would require a resumption of zonal management (containment) of sea otters, which would result in the exclusion of sea otters from all areas of the Southern California Bight except the coastline from Point Conception to Santa Barbara and the waters surrounding San Nicolas, San Miguel, and Santa Rosa Islands.

Within 10 years, sea otters would not be able to fully expand their range from Point Conception to Carpinteria or Oxnard, as projected under the baseline. Instead, sea otter range would be restricted to the mainland coastline northwest of Santa Barbara. Therefore, any potential enhancement of kelp along the coastline from Santa Barbara to Carpinteria or Oxnard resulting from the range expansion predicted under baseline conditions would not occur (for a description of the relationship between sea otters and kelp abundance, see section 6.2.2). However, because any increases in kelp would require suitable substrate and would likely require 10 or more years to occur, short-term effects on kelp harvest are essentially the same as under the baseline. Conditions at San Nicolas Island would also be the same as those projected for the baseline. We do not assign a level of significance to kelp harvesting because of the extent of uncertainty involved.

In the long term, sea otters may attempt to recolonize other areas of the Southern California Bight. The redefined management zone would exclude sea otters from most of the Southern California Bight but allow them to recolonize the islands of San Miguel and Santa Rosa. If sea otters established their range in these areas, the distribution and abundance of kelp would likely increase in the vicinity of these islands where invertebrate herbivores are limiting kelp. However, as a result of maintenance of the modified management zone, the long-term benefits that may have accrued under the baseline (possible increase in kelp available for harvest) would not occur throughout the remainder of the Southern California Bight.

6.4.8 RECREATIONAL FISHING

Recreational fishing activities that may be affected by sea otters include lobster fishing, abalone fishing, and finfish fishing. Lobster fishing and finfish fishing are addressed below. Abalone diving is included under “Abalone Fishery Restoration” (section 6.4.9).

6.4.8.1 Lobster Fishing

Under Alternative 2, recreational lobster fishing trips within 10 years would be (1) eliminated along the coastline from Point Conception to Santa Barbara, as under the baseline (2) not be eliminated along the coastline from Santa Barbara to Carpinteria (lower bound) or Oxnard (upper bound), and (3) be reduced or eliminated, in the long term, at San Miguel and Santa Rosa Islands, as under the baseline. Because the mainland coastline is not an important area for lobster fishing via CPFVs, the potential benefit from increased lobster dives from Santa Barbara to Carpinteria or Oxnard would be negligible.

As described in Chapter 5, we define levels of significance by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 2 is expected to result in an increase in lobster fishing trips via CPFVs within the Southern California Bight over the next 10 years of less than 1 percent, it qualifies as a beneficial effect of very low significance (see Table 5-1 for definitions of levels of significance).

Information from the limited number of lobster report cards returned from 2008-2011 suggests that 1 percent of the total number of lobster fishing trips (including CPFV trips) in the Southern California Bight occurs along the portion of mainland coastline between Santa Barbara and Carpinteria and that 5 percent occur along the portion of mainland coastline between Santa Barbara and and Oxnard. Alternative 2 would sea otters from recolonizing these areas during the next 10 years. Effects at San Nicolas Island are the same as under the baseline. We do not use report card data as the basis for assigning a level of significance because these data are limited, and the estimates based on them are necessarily provisional.

Whether sea otters would recolonize the nearshore areas around San Miguel and Santa Rosa Islands after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, recreational lobster fishing trips in these areas would likely no longer be viable, and trips to these areas would likely approach zero. Based on information from the limited number of lobster report cards returned from 2008-2011, these areas represent 2 percent of the total number of lobster fishing trips (including CPFV trips) in the Southern California Bight. However, there would be no additional impact from this expansion, compared to the baseline, because sea otters are equally likely to colonize these areas under baseline conditions.

Maintenance of the management zone southeast of Santa Barbara would prevent sea otters from further expanding their range. As a result of this management, the long-term impacts that would have occurred under the baseline (the elimination of recreational lobster fishing in other areas of the Southern California Bight recolonized by sea otters) would not occur. This benefit is likely to accrue gradually over the course of many decades.

6.4.8.2 Finfish Fishing

Alternative 2 would require a resumption of zonal management (containment) of sea otters, which would result in the exclusion of sea otters from all areas of the Southern California Bight except the coastline from Point Conception to Santa Barbara and the waters surrounding San Nicolas, San Miguel, and Santa Rosa Islands.

Within 10 years, sea otters would not be able to fully expand their range from Point Conception to Carpinteria or Oxnard, as projected under the baseline. Instead, sea otter range would be restricted to the mainland coastline northwest of Santa Barbara. Therefore, any potential enhancement of kelp (and finfish habitat) along the coastline from Santa Barbara to Carpinteria or Oxnard resulting from the range expansion predicted under baseline conditions would not occur (for a description of the relationship between sea otters, kelp abundance, and finfish, see section 6.2.2). However, because any increases in kelp would require suitable substrate and would likely require 10 or more years to occur, short-term effects on recreational finfish fishing are essentially the same as under the baseline. Conditions at San Nicolas Island would also be the same as those projected for the baseline. We do not assign a level of significance to effects on recreational finfish fishing because of the extent of uncertainty involved.

Whether sea otters would attempt to recolonize other areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters became established at San Miguel and Santa Rosa Islands, recreational finfish fishing may be enhanced, as it would under the baseline. However, maintenance of the management zone southeast of Santa Barbara would prevent sea otters from recolonizing the mainland coastline southeast of Santa Barbara or any additional islands. As a consequence, Alternative 2 would prevent the possible enhancement of the recreational finfish fishery in these areas. Effects on recreational finfish fishing at San Nicolas Island in both the short term and long term are the same as for the baseline.

6.4.9 ABALONE FISHERY RESTORATION

Alternative 2 would require a resumption of zonal management (containment) of sea otters, which would result in the exclusion of sea otters from all areas of the Southern California Bight except the coastline from Point Conception to Santa Barbara and the waters surrounding San Nicolas, San Miguel, and Santa Rosa Islands.

Within 10 years, sea otters would not be able to fully expand their range from Point Conception to Carpinteria or Oxnard, as projected under the baseline. Instead, sea otter range would be restricted to the mainland coastline northwest of Santa Barbara. Sea otter range expansion along the coastline towards Santa Barbara would preclude the reestablishment of abalone fishing in this area. However, it does not appear that there is any potential for reopening the abalone fishery (for any species) during the next 10 years, except possibly a limited fishery for red abalone at San Miguel Island (see section 6.2.9). Because sea otters are not expected to extend their range to the islands within 10 years, the effects of Alternative 2 are the same as for the baseline.

The effects of Alternative 2 on abalone fishery restoration at San Nicolas Island are also the same as for the baseline. At San Nicolas Island (CDFG statistical blocks 813 and 814) sea otters are expected to increase from 11 percent of carrying capacity in 2012 to 21 percent of carrying capacity in 2021. Abalone populations at San Nicolas Island are expected to persist as sea otter predation increases. However, densities of large individual abalone would likely eventually be reduced to a point that would preclude reestablishment of an abalone fishery at the island. Because San Nicolas Island would continue to be occupied by sea otters, it would likely be disqualified from abalone fishery consideration on the grounds that it is not "outside of the sea otter range" (CDFG 2005c). We do not assign a level of significance to abalone fishery restoration because of the extent of uncertainty involved.

Whether sea otters would recolonize the nearshore areas around San Miguel and Santa Rosa Islands after 10 years would be a function of their demographic rates, food supply, and other variables. San Miguel and Santa Rosa Islands are identified as key recovery areas for red and black abalone in the draft Abalone Management and Recovery Plan, and a limited fishery for red abalone at San Miguel Island prior to full recovery is being considered (CDFG 2005c). If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, their presence would likely preclude the restoration of an abalone fishery there. However, there would be no additional impact from this expansion, compared to the baseline, because sea otters are equally likely to colonize these areas under baseline conditions.

Maintenance of the management zone southeast of Santa Barbara would prevent sea otters from further expanding their range. As a result of this management, the long-term impacts that would have occurred under the baseline (elimination of the possibility that an abalone fishery might be reopened in areas that are reoccupied by sea otters) would not occur. Thus, restoration of an abalone fishery may occur in the future.

The magnitude of benefit provided by Alternative 2 to the restoration of an abalone fishery is difficult to determine for two reasons: 1) it is unknown whether or when an abalone fishery could be reopened even in the absence of sea otters; and 2) sea otter range expansion that would occur beyond 10 years if not prevented under Alternative 2 is uncertain. Still, it is clear that sea otter range expansion would preclude the possibility of recreational or commercial abalone fishing in reoccupied areas and would expose emergent reproductive abalone to the risk of sea otter predation, presumably diminishing their ability to repopulate depleted areas of the Southern California Bight. Therefore, the prevention of range expansion under Alternative 2 can be expected to provide a benefit of unknown magnitude (within the modified management zone) to efforts to restore an abalone fishery.

6.4.10 ECOTOURISM AND NON-MARKET VALUE

Alternative 2 would require a resumption of zonal management (containment) of sea otters, which would result in the exclusion of sea otters from all areas of the Southern California Bight except the coastline from Point Conception to Santa Barbara and the waters surrounding San Nicolas, San Miguel, and Santa Rosa Islands.

Within 10 years, sea otters would not be able to fully expand their range from Point Conception to Carpinteria or Oxnard, as projected under the baseline. Instead, sea otter range would be restricted to the mainland coastline northwest of Santa Barbara. Tourism is expected to be enhanced and non-market benefits are expected to accrue where sea otters reoccupy coastline. However, because it is unknown how sea otters would be distributed along the coastline under the lower and upper bound estimates of range expansion, it is not possible to quantify the loss of non-market value that would result from preventing range expansion beyond Santa Barbara within the next 10 years. Nevertheless, some loss or non-market value relative to the baseline would likely occur. Effects on ecotourism and non-market value at San Nicolas Island are the same as for the baseline (see section 6.2.10). We do not assign a level of significance to ecotourism and non-market value because of the extent of uncertainty involved.

Whether sea otters would attempt to recolonize other areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters established range at San Miguel and Santa Rosa Islands, ecotourism and non-market value would be enhanced, as it would under the baseline. However, maintenance of the management zone southeast of Santa Barbara would prevent sea otters from recolonizing the mainland coastline southeast of Santa Barbara or any additional islands. Overall impacts are difficult to quantify and would not necessarily result in decreased economic activity in the modified management zone. However, the quality of tourist trips within the modified management zone may decrease because sea otters would not be observed. Non-market value would decrease, relative to the baseline, because sea otter population growth resulting from the recolonization of historic habitat would be prevented.

6.4.11 Federal and State Agency Programs

We do not assign a level of significance to effects on agency programs because these effects and programs are various and cannot be meaningfully compared with a single set of criteria. For a discussion of the regulatory environment, see section 6.4.12.

6.4.11.1 U.S. Fish and Wildlife Service

The effects of Alternative 2 on southern sea otter recovery are also addressed in section 6.4.3.3 (“Southern Sea Otter”). Here we address our ability to meet our mandates under the ESA and MMPA and give the implementation costs of the alternative.

Ability to Meet Mandate

Under Alternative 2, sea otters would be removed from a modified management zone in perpetuity. The modified zone does not include the mainland coastline from Point Conception to Santa Barbara or the islands of San Miguel or Santa Rosa. Therefore, the habitat available to sea otters under Alternative 2 would include these areas and the translocation zone surrounding San Nicolas Island. Within 10 years, sea otters would be allowed to expand their range to Santa Barbara, but maintenance of the modified management zone would prevent any further range expansion along the mainland coastline. The range expansion projected under the baseline along the coastline southeast of Santa Barbara to Carpinteria (lower bound) or Oxnard (upper bound) would not occur. Sea otters are expected to increase in number by an average of about 7 percent annually at San Nicolas Island. The effects of Alternative 2 on the ability of USFWS to meet our mandates under the ESA and the MMPA arise from the need to resume relocating sea otters during this time period and the detrimental effects that relocations are expected to have on relocated animals and members of the receiving population.

Whether sea otters would attempt to recolonize other areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters established range at San Miguel and Santa Rosa Islands, their chances of attaining recovery and reaching their Optimum Sustainable Population level would be improved relative to today, but the same trend would be expected under the baseline. However, maintenance of the modified management zone southeast of Santa Barbara would prevent sea otters from recolonizing the mainland coastline southeast of Santa Barbara or any additional islands in the Southern California Bight.

San Miguel and Santa Rosa Islands have a large area of high quality habitat within the 40m bathymetric contour. Alternative 2 would provide additional habitat (relative to Alternative 1) to allow for the achievement of recovery and to allow sea otters to reach their Optimum Sustainable Population level in California, but it would still prevent sea otters from reoccupying most of the suitable habitat in the Southern California Bight. Specifically, the modified management zone would eliminate about 27 percent of the carrying capacity (for sea otters) of California. If the estimate of the Optimum Sustainable Population level is based on the total nearshore habitat of California, and if areas that theoretically could support large numbers of sea otters in northern California (such as the San Francisco Bay) were found to be unsuitable for recolonization by sea otters, Alternative 2 could hinder or prevent sea otters from reaching their Optimum Sustainable Population level in California because of insufficient habitat.

The potential effects of the continual introduction of sea otters into the mainland population on the subspecies as a whole have been previously evaluated by USFWS in a biological opinion (USFWS 2000, included as Appendix B), in which we determined that the continuation of the program (which forms the basis of Alternative 1) would likely jeopardize the survival and recovery of the southern sea otter. Although Alternative 2 proposes a modified management zone that would delay the restriction of range expansion and would presumably result in fewer removals, at least in the short term (relative to Alternative 1), the management requirement is essentially the same as that evaluated in the 2000 biological opinion. It is unknown what the population status will be and whether large numbers of sea otters will be seasonally entering the modified management zone 10 years from now, as they were when the biological opinion was written, so the specific effects on the southern sea otter cannot be predicted. However, it is likely that Alternative 2 would make it more difficult to achieve our mandate to bring southern sea otters to their Optimum Sustainable Population level under the MMPA. Before Alternative 2 could be implemented, we would need to reinitiate consultation under Section 7 of the ESA and reach a non-jeopardy opinion.

The modified management zone under Alternative 2 would be smaller than the one currently designated. Any sea otters found in the areas newly excluded from the management zone would be subject to the same regulatory provisions that currently apply to the mainland population along the central California coast under the ESA, MMPA, and applicable state laws. For a discussion of the regulatory provisions that would apply to sea otters under Alternative 2, see section 6.4.12.

Implementation Costs (10-year period)

The change in the regulatory provisions that apply to sea otters in the area excluded from the management zone under Alternative 2 may result, in the long term, in increased coordination and consultation between USFWS and other parties regarding activities that may affect the southern sea otter. Costs resulting from an increased consultation workload are not included here because few or no activities requiring consultation presently occur or are expected to occur in the area that sea otters would likely reoccupy within the next 10 years.

TABLE 6-56 PERSONNEL AND EQUIPMENT NEEDED TO IMPLEMENT ALTERNATIVE 2

Personnel	Transportation	Equipment
Program Manager	2 Vans	Boat Maintenance
Capture Teams	1 Tow Vehicle	Dive Gear and Maintenance
Transport Team	2 Monitor Vehicles	Tracking Equipment
Monitoring Team	Air Charters	Training
Veterinary Services	Boat Charters	
	Travel Costs	

Under Alternative 2, new implementation costs would result from a resumption of activities to support the southern sea otter translocation program. Associated costs result from expenditures for personnel, transportation, and equipment (Table 6-56). Based upon past and projected efforts, the annual implementation costs would stabilize at $635,000 by 2014 and would sum to about $6.4 million over 10 years. The 10-year discounted costs for implementation would sum to $5.1 million (discounted at 3 percent) or $3.9 million (discounted at 7 percent). Annual expenditures would continue for at least 15 years.

Table 6-57 shows the estimated expenditures for the entire program costs over 10 years. Personnel costs to maintain the management zone comprise approximately 83 percent of annual implementation costs. Within the personnel costs, the capture teams represent the largest expense at about $300,000 per year. The capture teams would patrol areas of the modified management zone where sea otters are likely to be found to ensure that sea otters that migrate into the area are removed. Most likely, effort would be concentrated around San Nicolas Island and the northern fringe of the management boundary near Santa Barbara.

TABLE 6-57 IMPLEMENTATION COSTS FOR MAINTENANCE OF MANAGEMENT ZONE AND TRANSLOCATION ZONE OVER 10 YEARS

Year	Annual Cost			Discounted Cost (3% discount rate)	Discounted Cost (7% discount rate)
	Personnel	Transportation	Equipment		
2012	$535,000	$49,000	$61,000	$590,266	$526,512
2013	$535,000	$49,000	$56,000	$568,632	$488,253
2014	$535,000	$49,000	$51,000	$547,757	$452,746
2015	$535,000	$49,000	$51,000	$531,803	$423,127
2016	$535,000	$49,000	$51,000	$516,313	$395,446
2017	$535,000	$49,000	$51,000	$501,275	$369,576
2018	$535,000	$49,000	$51,000	$486,675	$345,398
2019	$535,000	$49,000	$51,000	$472,500	$322,802
2020	$535,000	$49,000	$51,000	$458,738	$301,684
2021	$535,000	$49,000	$51,000	$445,376	$281,948
Total	$6,365,000			$5,119,333 (PV@3%)	$3,907,492 (PV@7%)

6.4.11.2 Channel Islands National Park

Under Alternative 2, sea otters would be removed from a modified management zone in perpetuity. The modified management zone would exclude the islands of San Miguel and Santa Rosa, allowing their eventual colonization by sea otters, but would require the permanent exclusion of sea otters from the Park's three remaining islands. Because sea otters are expected to recolonize only the mainland coastline to Carpinteria (lower bound) or Oxnard (upper bound) within the next 10 years (and therefore would not be expected within Park boundaries during this period), the effects of Alternative 2 are the same as under the baseline scenario within this 10-year period.

However, in the long term, it is possible that sea otters would attempt to recolonize island coastlines that are part of CINP but are also within the modified management zone. Alternative 2 would prevent recolonization of three of the five islands of CINP (Santa Cruz, Anacapa, and Santa Barbara Islands), which appears to be inconsistent with the Park's mission and mission-related goals to protect and restore natural ecosystems and to practice ecosystem management.

Under Alternative 2, a change in the regulatory provisions that apply to sea otters in the area excluded from the management zone under Alternative 2 would occur (see section 6.4.12). This regulatory change could result, in the long term, in increased coordination and consultation between USFWS and Channel Islands National Park. The change would apply only to activities that may affect the southern sea otter at San Miguel and Santa Rosa Islands if sea otters eventually colonized these areas.

6.4.11.3 Channel Islands National Marine Sanctuary

Under Alternative 2, sea otters would be removed from a modified management zone in perpetuity. The modified management zone would exclude the islands of San Miguel and Santa Rosa, allowing their eventual colonization by sea otters, but would require the permanent exclusion of sea otters from the Sanctuary's three remaining islands. Because sea otters are expected to recolonize only the mainland coastline to Carpinteria (lower bound) or Oxnard (upper bound) within the next 10 years (and therefore would not be expected within Sanctuary boundaries during this period), the effects of Alternative 2 are the same as under the baseline scenario within this 10-year period.

However, in the long term, it is possible that sea otters would attempt to recolonize nearshore areas that are part of CINMS but are also within the modified management zone. Alternative 2 would prevent recolonization of three of the five islands of CINMS (Santa Cruz, Anacapa, and Santa Barbara Islands), which appears to be inconsistent with the Sanctuary's mission to conserve and enhance the biodiversity, ecological integrity, and cultural legacy of areas of special national significance.

Under Alternative 2, a change in the regulatory provisions that apply to sea otters in the area excluded from the management zone under Alternative 2 would occur. This regulatory change could result, in the long term, in increased coordination and consultation between USFWS and Channel Islands National Marine Sanctuary. The change would apply only to activities that may affect the southern sea otter at San Miguel and Santa Rosa Islands if sea otters eventually colonized these areas.

6.4.11.4 California Department of Fish and Game

Effects on the recovery of white and black abalone and sea otters are discussed under "Candidate, Threatened, and Endangered Species" (section 6.4.3). Effects on existing commercial fisheries and the restoration of the abalone fishery are discussed under "Commercial Fisheries" (section 6.4.4) and "Abalone Fishery Restoration" (section 6.4.9). Effects on MPAs and the restoration of depleted abalone species that are not federally listed are discussed here.

Marine Protected Areas

Under Alternative 2, sea otters would be removed from a modified management zone in perpetuity. The modified management zone would prevent sea otters from recolonizing the mainland coastline east of Santa Barbara and any islands other than San Miguel and Santa Rosa Islands. Under the baseline, sea otters are expected to recolonize the mainland coastline to Carpinteria (lower bound) or Oxnard (upper bound) within the next 10 years. However, because all five MPAs that are located within this stretch of coastline are west of Santa Barbara, the effects of Alternative 2 on MPAs are the same as for the baseline within the 10-year time horizon.

Whether sea otters would attempt to recolonize other areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. Sea otters could potentially establish range in the 6 MPAs and one Special Closure at San Miguel and Santa Rosa Islands (in addition to the 5 MPAs along the mainland coastline west of Santa Barbara), but maintenance of the modified management zone southeast of Santa Barbara would permanently prevent sea otters from establishing range within the remaining 38 MPAs and 2 special closures in the Southern California Bight, except where Begg Rock SMR and the translocation zone surrounding San Nicolas Island coincide. Preventing sea otters from recolonizing the majority of southern California MPAs would be consistent with the goal to generate fishery benefits (in this case, through increased reproduction and dispersal of shellfish larvae and the emigration of large-size individuals). However, it would eliminate possible benefits to finfish fisheries that could result from the presence of sea otters and would negatively affect the achievement of the remaining goals set for the Channel Islands Marine Protected Areas relating to: the maintenance of ecosystem biodiversity; the protection of the structure, function, and integrity of marine ecosystems; the protection of marine natural heritage; and the provision of recreational, scientific, and educational opportunities. With respect to the non-consumptive socio-economic goals set for the MPAs from which sea otters would be excluded, preventing sea otters from recolonizing these areas would eliminate any potential increase in the quality of non-consumptive recreation that would occur as a result of the presence of sea otters.

Restoration of Depleted Abalone Species (Not Federally Listed)

Enhancement activities for depleted abalone species include the translocation or aggregation of adult stocks, larval outplanting, captive breeding to obtain large individuals for outplanting, and the establishment of MPAs (CDFG 2005c). Under Alternative 2, sea otters would be prevented from recolonizing the mainland coastline east of Santa Barbara to Carpinteria (lower bound) or Oxnard (upper bound) within the next 10 years, and in the longer term, sea otters would be prevented from recolonizing any other areas of the Southern California Bight except San Nicolas Island, San Miguel Island, and Santa Rosa Island. Preventing sea otters from recolonizing the modified management zone could positively affect State efforts to enhance abalone populations by means of larval outplanting if outplanting efforts were planned for habitats lacking sufficient cryptic habitat to shield abalone from sea otter predation. The benefits would be lessened to the extent that outplanting efforts were conducted in cryptic habitat that is inaccessible to sea otters or in areas outside the range into which sea otters would have naturally expanded. The translocation or aggregation of adult stocks would likely be unaffected by sea otters, as one purpose of translocation is to protect adults from predation or other threats, and it would seem likely that abalone would be translocated into, or aggregated in, sufficiently protective crevice habitat. The exclusion of sea otters from the management zone would not affect other enhancement activities, such as captive breeding or the establishment of MPAs.

6.4.11.5 U.S. Navy/Department of Defense

Effects on the U.S. Navy/DOD are regulatory. Under Alternative 2, consultation requirements for the U.S. Navy/DOD for actions that may affect southern sea otters would be the same as those described for the baseline, except that the management zone would be reduced in size. The U.S. Navy/DOD would continue to have no requirement to consult on actions that may affect sea otters found in either the management zone or the translocation zone, but actions that may affect sea otters found outside the newly defined management zone (*i.e.*, along the coastline to Santa Barbara or at San Miguel or Santa Rosa Islands) would be subject to consultation and permitting requirements under the ESA, MMPA, and applicable state laws (see section 6.4.12). Because Point Mugu Sea Range does not include the Santa Barbara Channel, the only areas that would potentially be affected are those immediately surrounding San Miguel and Santa Rosa Islands. Past levels of interaction with sea otters in areas outside the current management zone (*i.e.*, north of Point Conception), indicate that the additional regulatory burden would be minimal.

6.4.11.6 Bureau of Ocean Energy Management

Effects on BOEM are regulatory. Under Alternative 2, consultation requirements for BOEM for actions that may affect southern sea otters would be the same as those described for the baseline, except that the management zone would be reduced in size. BOEM would continue to be required to consult under Section 7 of the ESA and to comply with other applicable laws on actions that may affect sea otters in the translocation zone. BOEM would continue to have no requirement to consult on actions that may affect sea otters found in the management zone, but actions that may affect sea otters found outside the newly defined management zone (*i.e.*, along the coastline to Santa Barbara or at San Miguel or Santa Rosa Islands) would be subject to consultation and permitting requirements under the ESA, MMPA, and applicable state laws. The additional regulatory burden would be negligible because 1) it would apply only to the area excluded from the management zone under the modified management zone designation; 2) the physical presence of the oil industry is expected to diminish offshore of California over the next several decades (BOEM pers. comm. 2010); 3) all proposed actions that may affect *other* threatened or endangered species or marine mammals are already subject to consultation and permitting requirements under the ESA and MMPA in this area; and 4) the regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of this alternative, and requirements for consultations or permits related to the southern sea otter have been minimal.

6.4.11.7 National Marine Fisheries Service

National Marine Fisheries Service activities that occur within or overlap with the nearshore areas of the Southern California Bight are diverse. These activities include implementing recovery actions for federally listed threatened and endangered species and managing federal fisheries. Information on endangered white and black abalone and NMFS-led recovery efforts for these species is given under "Candidate, Threatened, and Endangered Species." Federally managed fisheries are discussed here.

Under Alternative 2, consultation requirements for NMFS for actions that may affect southern sea otters would be the same as those described for the baseline, except that the management zone would be reduced in size. NMFS would continue to be required to consult under Section 7 of the ESA and to comply with other applicable laws on actions that may affect sea otters in the translocation zone. NMFS would continue to have no requirement to consult on actions that may affect sea otters found in the management zone, but actions that may affect sea otters found outside the newly defined management zone (*i.e.*, along the coastline to Santa Barbara or at San Miguel or Santa Rosa Islands) would be subject to consultation and permitting requirements under the ESA, MMPA, and applicable state laws. Take of southern sea otters caused by commercial fisheries cannot be authorized under section 118 of the MMPA. However, any resulting changes would likely be minor. The current regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of this alternative, and requirements for consultations or permits related to the southern sea otter have been minimal. We expect that effects on federally managed fisheries in the Southern California Bight would also be minimal due to the gear types used and/or the depths in which these fisheries are pursued.

6.4.12 REGULATORY ENVIRONMENT

Under Alternative 2, the regulatory environment in the Southern California Bight would remain relatively unchanged.

In the translocation zone, with the exception of defense-related activities by a military department, the consultation requirements of Section 7 of the ESA would continue to apply to proposed federal actions, and take of sea otters would continue to be subject to the standard take authorization procedures for threatened species under the ESA, depleted species under the MMPA, and fully protected species under Fish and Game Code section 4700 and 4500. With respect to defense-related activities, sea otters would continue to be treated (for the purposes of consultation and incidental take authorization) as a species that is proposed to be listed (50 CFR §17.84(d)(4)(iv)) under the ESA.

In the newly defined management zone (the city of Santa Barbara to the Mexican border, excluding San Miguel and Santa Rosa Islands), the conference and not the consultation requirements of Section 7 of the ESA would apply to actions that may affect southern sea otters, and incidental take of southern sea otters resulting from otherwise legal activities would not be subject to take authorization procedures under the ESA or MMPA or be considered a violation of either Act. As under the baseline, Section 8664.2 of the California Fish and Game Code would allow for incidental take of sea otters in the new management zone by means of specific exemptions from section 4700.

In that portion of the former management zone excluded from the newly designated management zone (Point Conception to the city of Santa Barbara, including San Miguel and Santa Rosa Islands), sea otters would come under the standard protections of the ESA (for threatened species), and the MMPA (for depleted species). Because California Fish and Game Code section 8664.2 specifically defines the management zone to include all areas seaward of mean high tide subject to the jurisdiction of the United States that are located south of Point Conception, the take exemption provided under section 8664.2 from section 4700, the state’s fully protected mammal statute, would continue to apply to the former management zone until and unless section 8664.2 is amended. With the exception of California Fish and Game Code sections 8664.2 and 4700, the federal and state law provisions that would apply in the area outside the new management zone would be identical to those that currently apply in the remainder of the southern sea otter range (north of Point Conception). Incidental take of sea otters would be prohibited unless authorized under the ESA, MMPA, and applicable state laws. Incidental take of southern sea otters by commercial fisheries could not be authorized under the MMPA because of specific provisions applicable to southern sea otters.

Our biological opinion on sea otter containment, released in 2000, concluded that continued zonal management of the sea otter population would likely jeopardize the species’ continued existence. Because of the potential effects of sea otter containment on sea otters found in the parent population, consultation under the ESA would need to be reinitiated and a finding of no-jeopardy reached before we could proceed with implementation of Alternative 2.

6.5 Alternative 3A—Terminate Translocation Program; Remove All Sea Otters Residing within the Translocation and Management Zones at the Time the Decision to Terminate is Made

6.5.1 INTRODUCTION

Alternative 3 entails declaring the southern sea otter translocation program a failure and terminating the program, thereby eliminating the management zone and translocation zone established through Public Law 99-625 and 50 CFR §17(d). Sub-alternative 3A would require the removal of sea otters from both San Nicolas Island and the management zone as stipulated in the current regulations at 50 CFR §17(d)(8). All sea otters remaining within the translocation zone at San Nicolas Island would be captured and placed with the parent population. Reasonable efforts would also be made to remove sea otters from the management zone. However, no effort would be made to enforce a management zone once these two tasks are completed, effectively allowing sea otters from the parent population to recolonize historic range throughout the Southern California Bight.

We assume that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight. Nevertheless, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

The removal of sea otters found in the management zone would have little effect on natural range expansion into the Southern California Bight. Sea otter densities north of Point Conception would likely be sufficient to maintain expansion of the population, and sea otters moved out of the management zone would be capable of rapidly returning. Therefore, this removal would likely result in few discernible effects relative to the baseline.

This action would not increase or decrease the projected sea otter range, compared to the baseline, because sea otters are already expected to reach carrying capacity along the coastline from Point Conception to Carpinteria in the next 10 years (CDFG statistical blocks 651, 652, 653, 654, 655, 656, and 657) or from Point Conception to Oxnard (CDFG statistical blocks 683, 664, 665, 651, 652, 653, 654, 655, 656, and 657) (see section 6.1.4.1). However, the removal of sea otters from San Nicolas Island would impact the sea otter population compared to the baseline, and would, therefore, impact some socioeconomic activities around this island. The majority of the quantitative impacts, relative to the baseline, result from implementation costs.

The assumptions that apply to the analysis for Alternative 3A are the same as those described for the baseline. For a more detailed description of the baseline, to which each activity is compared, refer to section 6.2, "Baseline (Status Quo)—The No Action Alternative."

6.5.2 Nearshore Marine Ecosystem

Alternative 3A entails declaring the translocation program a failure (thereby abolishing the management zone and translocation zone) and removing sea otters present in these zones at the time of the final decision. Effects on the nearshore marine environment are the same as those described for the baseline, except for possible effects associated with the removal of sea otters from the management zone and translocation zone.

The removal of sea otters from the management zone would not have any discernible ecosystem effects compared to the baseline because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which fluctuates in sea otter numbers on a seasonal basis, 2) sea otters are capable of returning rapidly to areas from which they have been removed, and 3) ecosystem effects occur gradually over extended periods of time, in which context a temporary fluctuation in sea otter predation would likely be undetectable.

The removal of animals from San Nicolas Island would eliminate or greatly reduce the colony, probably resulting in minor increases in invertebrate prey populations within a few years. Any changes to the nearshore marine ecosystem (see section 6.2.2) that would have been afforded by a colony persisting at San Nicolas Island as projected under the baseline would not occur. Elimination of the sea otter colony at San Nicolas Island would likely slow sea otter recolonization of the Southern California Bight and thus would also delay associated ecosystem changes throughout the area.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

We do not assign a level of significance to effects on the nearshore marine ecosystem because of the extent of uncertainty involved.

6.5.3 Effects on Candidate, Threatened, and Endangered Species

The removal of sea otters from San Nicolas Island at the time of program termination, as required under this alternative, may result in their absence from the island for a period of one or more decades. The absence of sea otters from the island would likely slow eventual range expansion into other areas (particularly the southern portions) of the Southern California Bight. However, their removal could have other effects. Some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the complete removal of sea otters from the island would be diminished by some unknown amount. Additionally, it is possible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight relative to the baseline. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount or even reversed.

6.5.3.1 White Abalone

Effects on white abalone resulting from the implementation of Alternative 3A are essentially the same as for the baseline (see section 6.2.3.1, “Establishing the Baseline for White Abalone”) except for possible short-term benefits to white abalone that may result from the removal of sea otters from San Nicolas Island and the management zone at the time of program termination. Within 10 years, this removal may prevent some predation on shallow-living white abalone that may be present along the mainland coastline (from Point Conception to Carpinteria or Oxnard) or at San Nicolas Island, but this benefit would be very localized and minor because 1) some sea otters would return immediately, especially to the mainland coastline, and 2) these areas are not key recovery areas for white abalone. Effects along the mainland coastline are expected to be very localized and minor because sea otter densities north of Point Conception would likely be sufficient to maintain expansion of the population into this area, and sea otters moved out of the management zone would be capable of rapidly returning. Relative to the baseline, the effect of Alternative 3A on white abalone within 10 years is expected to be positive but of very low significance.

In the longer term, the benefit to white abalone under Alternative 3A relates to the potential for the removal of sea otters from the mainland coastline and San Nicolas Island to slow sea otter range expansion into the Southern California Bight. However, relative to baseline conditions (unrestricted movement of sea otters without removal) this potential benefit is probably minor given the tendency of relocated sea otters to return to their place of capture and the time scale over which sea otter range expansion into the Southern California Bight is expected to occur (many decades).

Because the effects of this alternative on white abalone would be expected to be beneficial, insignificant, or discountable relative to the baseline, we would seek concurrence from NMFS on a “not likely to adversely affect” determination under Section 7 of the ESA before selecting this alternative.

6.5.3.2 Black Abalone

Effects on black abalone resulting from the implementation of Alternative 3A are essentially the same as for the baseline (see section 6.2.3.2, “Establishing the Baseline for Black Abalone”) except for possible short-term benefits to black abalone that may result from the removal of sea otters from San Nicolas Island and the management zone at the time of program termination. Within 10 years, this removal may prevent some predation on black abalone that may be present along the mainland coastline from Point Conception to Carpinteria or Oxnard or at San Nicolas Island. Effects along the mainland coastline are expected to be very localized and minor because sea otter densities north of Point Conception would likely be sufficient to maintain expansion of the population into this area, and sea otters moved out of the management zone would be capable of rapidly returning. However, San Nicolas Island is a key area for black abalone recovery. Removal of sea otters from the island (if they did not immediately return) would reduce predation pressure on black abalone at the island and possibly enhance the survivorship of black abalone with apparent resistance to withering syndrome. Relative to the baseline, the effect of Alternative 3A on black abalone within 10 years is expected to be positive and of moderate significance.

In the longer term, the benefit to black abalone under Alternative 3A relates to the potential for the removal of sea otters from the mainland coastline and San Nicolas Island to slow sea otter range expansion into the Southern California Bight. However, relative to baseline conditions (unrestricted movement of sea otters without removal) this potential benefit is probably minor given the tendency of relocated sea otters to return to their place of capture and the time scale over which sea otter range expansion into the Southern California Bight is expected to occur (many decades).

CRITICAL HABITAT

Critical habitat for black abalone includes a number of areas both within the current sea otter range and outside the current sea otter range (in southern California waters) (76 FR 66806). If sea otters do recolonize the Southern California Bight gradually over the course of several decades, then their range will overlap with black abalone critical habitat in southern California, just as it currently overlaps with black abalone critical habitat in central California. The primary constituent elements of critical habitat essential for the conservation of black abalone are: rocky substrate; food resources; juvenile settlement habitat; suitable water quality; and suitable nearshore circulation patterns (76 FR 66806). Of these five elements, only one, food resources, may potentially be affected by sea otters. Under Alternative 3A, as under the baseline, sea otters would generally be expected to improve food resources for adult black abalone through predation on sea urchins. However, ecological relationships are complex, and it is likely that numerous positive and negative interactions would occur simultaneously.

Because the effects of this alternative on black abalone and black abalone critical habitat would be expected to be beneficial, insignificant, or discountable relative to the baseline, we would seek concurrence from NMFS on a "not likely to adversely affect" determination under Section 7 of the ESA before selecting this alternative.

6.5.3.3 Southern Sea Otter

Effects on southern sea otters resulting from the implementation of Alternative 3A are essentially the same as those identified for the baseline with the exception of 1) negative effects on individual sea otters removed from San Nicolas Island and the management zone, 2) possible negative effects on the mainland southern sea otter population resulting from this short-term action, and 3) potential benefits resulting from regulatory changes if incidental take is affecting sea otters (see section 6.5.12).

At the time of program termination, sea otters would be subject to removal from the mainland coastline southeast of Point Conception and from San Nicolas Island. Relocating sea otters from the management zone and San Nicolas Island to the northern or central portion of the existing range would increase competition among sea otters, especially in areas of the central coast now thought to be food-limited (see Tinker *et al.* 2008b), disrupt natural behaviors, and likely result in the deaths of otherwise healthy animals. The incidental injury or death of sea otters removed from San Nicolas Island or the management zone would likely be unavoidable. The relocation of sea otters may result in increased risk of mortality due in part to the stress associated with capture, handling, and time out of water, and in part to the general lack of familiarity of the animals with their new environments (Estes *et al.* n.d.). Sea otters that have learned to forage in prey-rich environments (such as San Nicolas Island) may experience additional stress or even starvation resulting from their inability to find adequate food in prey-limited areas of the mainland range. For males, there may be an added risk of death or injury from encountering territorial males in foreign habitats (Estes *et al.* n.d.). Some sea otters would likely attempt to return to their location of capture, depleting their energy reserves and increasing their risk of mortality. Overall, relocating sea otters from San Nicolas Island and the management zone to the mainland range would be disruptive, harmful, or possibly lethal, both to the relocated animals and to those in the receiving population. Relative to the baseline, the effect of Alternative 3A on sea otters within 10 years is expected to be negative and of moderate significance.

In the longer term, the removal of sea otters from San Nicolas Island at the time of program termination may result in their absence from the island for a period of one or more decades. The absence of sea otters from the island would likely slow eventual range expansion into other areas (particularly the southern portions) of the Southern California Bight. However, their removal could have other effects. Some sea otters may return to San Nicolas Island immediately. Additionally, it is possible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight relative to the baseline.

Under Alternative 3A, sea otters would ultimately be allowed to expand their range naturally into the Southern California Bight. This long-term scenario enhances the opportunity for southern sea otter recovery by allowing sea otters to recolonize historic habitat. Although the marine habitat in many areas of the Southern California Bight has been degraded by a multitude of human activities, the southern sea otter range has begun to expand into this region. Sea otters in southern California waters would be subject to the benefits and risks associated with this habitat, as described under baseline conditions (see section 6.2.3.3). Allowing natural range expansion over the long term maximizes the habitat available for southern sea otter recovery, avoids the potential threat to the species caused by capturing and releasing sea otters throughout the range, and avoids the potential for injuring or killing individual sea otters removed from the management zone.

Alternative 3A partially reflects recommendations made in the Revised Recovery Plan for the Southern Sea Otter (USFWS 2003). The revised plan continues to focus on efforts to increase the size of the southern sea otter's population. However, it no longer recommends translocating sea otters as a means to achieve this goal and in fact advises against additional translocations (USFWS 2003). The revised plan also registers the recovery team's recommendation to declare the translocation program a failure, allow natural range expansion to occur, and allow the colony at San Nicolas Island to remain at the island rather than capturing these sea otters and releasing them in the mainland range (USFWS 2003). Alternative 3A generally implements these recommendations, with two exceptions: 1) range expansion into the Southern California Bight would be temporarily disrupted by removal of sea otters from the management zone at the time the program was declared a failure, and 2) the colony would be removed from San Nicolas Island.

The potential benefit of the reversion to "threatened" status for southern sea otters is difficult to estimate because its value can be realized only in reference to future actions that may affect members of the species found in the Southern California Bight. Because there are presently relatively few sea otters in the areas designated as a management zone, and incidental takes are not currently known to be occurring there, any benefit to sea otters would be speculative. Even if incidental take were to occur in the future, the benefit of increased regulatory protections would be realized by sea otters only if the incidental take were 1) detected and 2) prevented or minimized by means of measures included in incidental take authorizations.

To evaluate potential effects on sea otters, we would complete formal intra-Service consultation under Section 7 of the ESA before selecting this alternative.

6.5.4 Commercial Fisheries

For a discussion of the regulatory environment (including as it pertains to commercial fisheries) see section 6.5.12.

In the following discussions of the commercial sea urchin, lobster, crab, sea cucumber, halibut, and white seabass fisheries, we assume that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight. Nevertheless, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

The removal of sea otters found in the management zone would have little effect on natural range expansion into the Southern California Bight. Sea otter densities north of Point Conception would likely be sufficient to maintain expansion of the population, and sea otters moved out of the management zone would be capable of rapidly returning. Therefore, this removal would result in little or no benefit to fisheries.

6.5.4.1 Sea Urchin Fishery

Under Alternative 3A, commercial sea urchin landings within 10 years (1) would be eliminated along the coastline from Point Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound) and (2) may increase around San Nicolas Island. If sea otters are removed from the managed coastline that they currently occupy, we do not anticipate the commercial sea urchin catch to increase before sea otters move back into the area. The sea urchin fishery under the baseline is projected to be eliminated (the lower bound including Point

Conception to Carpinteria or the upper bound including Point Conception to Oxnard). Therefore, there is no impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island may result in a sea urchin harvest increase, compared to the baseline, for two reasons. First, sea urchin landings would not decrease the projected 10 percent as projected under the baseline because there would be no sea otter population at the island. Therefore, landings would not decrease the anticipated 149,000 pounds from 2012 to 2021. Second, newly recruited sea urchins and those sea urchins that escaped sea otter predation in the past would now potentially be available for commercial harvest. This potential increase follows the assumption that fishery impacts correspond directly to the sea otter's carrying capacity percentage. Sea otters are projected to be at about 11 percent of their estimated carrying capacity at the island in 2012. Thus, sea urchin landings would increase by approximately 11 percent from the 10-year average of 351,333 pounds. We assume that the sea urchin population would rebound from sea otter predation in five years.[20] We further assume that the associated increase in landings would be equally distributed across five years, so that landings would rise by about 2 percent (7,448 pounds) annually between 2012 and 2015, stabilizing to an annual benefit of approximately 37,241 pounds after 2016 (Table 6-58). This landings increase is dependent upon the assumption that the catch per unit of effort (CPUE) at San Nicolas Island is not already at a maximum, so that the existing sea urchin vessels have the ability to increase their catch.

TABLE 6-58 SEA URCHIN LANDINGS: BENEFITS OF ALTERNATIVE 3A

Year	Commercial Landings (no 10% decrease at San Nicolas Island)	Commercial Landings (increase of 11% at San Nicolas Island)	Total Increase in Commercial Landings (pounds)	Ex-Vessel Revenue	Ex-Vessel Discounted revenue (3%)	Ex-Vessel Discounted revenue (7%)
2012	2,705	7,448	10,154	$8,273	$7,571	$6,753
2013	5,411	14,897	20,307	$16,546	$14,701	$12,623
2014	8,116	22,345	30,461	$24,819	$21,409	$17,695
2015	10,821	29,793	40,614	$33,092	$27,714	$22,050
2016	13,526	37,241	50,768	$41,364	$33,633	$25,760
2017	16,232	37,241	53,473	$43,569	$34,393	$25,357
2018	18,937	37,241	56,178	$45,773	$35,081	$24,897
2019	21,642	37,241	58,883	$47,977	$35,699	$24,389
2020	24,347	37,241	61,589	$50,181	$36,252	$23,841
2021	27,053	37,241	64,294	$52,385	$36,742	$23,260
Total Benefits	148,789	297,930	446,720	$363,979	$283,195	$206,626

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price divers received for sea urchins (in shell) from 2000 to 2009, which is $0.81 per pound in 2009 dollars.
SNI=San Nicolas Island
PV=present value

[20] Red sea urchins can reach a commercially harvestable size (3.5 inches) in 6 to 8 years (Kalvass and Rogers-Bennett, 2001). We assume that landings would rebound prior to six years because sea otters are unable to reach urchins located in sufficiently deep crevices. Therefore, some urchins will have survived and will reach a harvestable size in fewer than 6 years.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial sea urchin fishing in these areas would likely no longer be viable, and landings in these areas would likely approach zero. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight. Therefore, there may be a slight benefit to the sea urchin fishery, compared to the baseline, as a result of some delay in sea otter predation.

The maximum non-discounted benefit to sea urchin fishing vessels for Alternative 3A would total $364,000. The discounted 10-year benefit for this alternative would be about $283,000 (discounted at 3 percent) or $207,000 (discounted at 7 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-4.

On average in the southern California sea urchin fishery, 131 vessels participate annually (Leos pers. comm. 2010). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels, then each vessel would have increased landings of approximately 3,410 pounds and increased revenue between $1,600 (discounted at 7 percent) and $2,200 (discounted at 3 percent) totaled over 10 years.

To determine the regional impact of increased sea urchin revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 3A would result in an increase of $388,000 to $532,000 in total output over 10 years discounted at 7 percent and 3 percent, respectively. These impacts assume fishers would have the capacity to increase their landings.

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 3A is expected to result in an increase in sea urchin ex-vessel revenues within the Southern California Bight of 0.5 percent compared to the baseline (a total benefit of 447,000 pounds over 10 years compared to the projected total for southern California of 90.3 million pounds), the benefit is of very low significance (see Table 5-1 for definitions of levels of significance).

6.5.4.2 Spiny Lobster Fishery

Under Alternative 3A, commercial lobster landings within 10 years would (1) be eliminated along the coastline from Point Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound) and (2) increase at San Nicolas Island. If sea otters are removed from the managed coastline that they currently occupy, we would not expect the commercial lobster catch to increase before sea otters move back into the area. The lobster fishery under the baseline is projected to be eliminated along the coastline from Point

Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound). Therefore, there is no impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island may result in an increase in the lobster catch, compared to the baseline, for two reasons. First, lobster landings would not decrease the projected 10 percent as under the baseline because there would be no sea otter population at the island. Therefore, landings would not decrease the anticipated 18,000 pounds from 2012 to 2021. Second, newly recruited lobsters or lobsters that escaped predation in the past would now potentially be available for commercial harvest. This potential increase follows the assumption that fishery impacts correspond directly to the sea otter's carrying capacity percentage. Sea otters are projected to be at about 11 percent of their estimated carrying capacity at San Nicolas Island in 2012. Thus, lobster landings would increase by approximately 11 percent from the 10-year average of 41,622 pounds. We assume that the lobster population would rebound from sea otter predation in seven years.[21] We further assume that the associated increase in landings would be equally distributed across seven years, so that landings would rise by about 2 percent (630 pounds) annually between 2012 and 2017, stabilizing to an annual benefit of approximately 4,400 pounds after 2018 (Table 6-59).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial lobster fishing in these areas would likely no longer be viable, and landings in these

TABLE 6-59 LOBSTER LANDINGS: BENEFITS OF ALTERNATIVE 3A

Year	Commercial Landings (no 10% decrease at San Nicolas Island)	Commercial Landings (increase of 11% at San Nicolas Island)	Total Increase in Commercial Landings (pounds)	Ex-Vessel Revenue	Ex-Vessel Discounted revenue (3%)	Ex-Vessel Discounted revenue (7%)
2012	320	630	951	$8,967	$8,206	$7,320
2013	641	1,261	1,902	$17,934	$15,934	$13,682
2014	961	1,891	2,852	$26,901	$23,205	$19,180
2015	1,282	2,521	3,803	$35,868	$30,039	$23,901
2016	1,602	3,151	4,754	$44,836	$36,455	$27,921
2017	1,923	3,782	5,705	$53,803	$42,472	$31,314
2018	2,243	4,412	6,655	$62,770	$48,108	$34,143
2019	2,564	4,412	6,976	$65,793	$48,956	$33,446
2020	2,884	4,412	7,296	$68,815	$49,714	$32,694
2021	3,205	4,412	7,617	$71,838	$50,386	$31,897
Total Benefits	17,627	30,884	48,510	$457,525	$353,476	$255,497

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price fishers received for lobsters from 2000 to 2009, which is $9.43 per pound in 2009 dollars.
SNI=San Nicolas Island
PV= present value

[21] Spiny lobsters can reach a commercially harvestable size (3.5 inches carapace length) in 7 to 11 years (Barsky 2001). We assume that landings would rebound prior to seven years because sea otters are unable to consume lobsters located in inaccessible habitat (deep crevices). Thus, the harvest may resume in a minimum time interval.

areas would likely approach zero. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight. Therefore, there may be a slight benefit to the lobster fishery, compared to the baseline, as a result of some delay in sea otter predation.

Thus, the maximum non-discounted benefit to lobster vessels for Alternative 3A would total about $458,000. The discounted 10-year benefit for Alternative 3A would range between about $256,000 (discounted at 7 percent) and $353,000 (discounted at 3 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-4.

On average in the southern California lobster fishery, 169 vessels participate annually (Leos pers. comm. 2010). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels, then each vessel would have increased landings of approximately 287 pounds and increased revenue of between $1,500 (discounted at 7 percent) and $2,100 (discounted at 3 percent) totaled over 10 years.

To determine the regional impact of increased lobster revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 3A would result in an increase of $480,000 to $665,000 in total output over 10 years discounted at 7 percent and 3 percent, respectively. These impacts assume fishers would have the capacity to increase their landings.

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 3A is expected to result in an increase in lobster landings within the Southern California Bight of 0.7 percent compared to the baseline (a total benefit of 49,000 pounds over 10 years compared to the projected total for southern California of 6.9 million pounds), the benefit is very low (see Table 5-1 for definitions of levels of significance).

6.5.4.3 Crab Fishery

Under Alternative 3A, commercial crab landings within 10 years would (1) be eliminated along the coastline from Point Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound) and (2) increase at San Nicolas Island. If sea otters are removed from the managed coastline that they currently occupy, we would not expect the commercial crab catch to increase before sea otters move back into the area. The crab fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound). Therefore, there is no impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island may result in a crab harvest increase, compared to the baseline, for two reasons. First, crab landings would not decrease the projected 10 percent as under the baseline because there would be no sea otter population at the island. Therefore, landings would not decrease the anticipated 4,500 pounds from 2012 to 2021. Second, newly recruited crabs or crabs that escaped predation in the past would now potentially be available for commercial harvest. This potential increase follows the assumption that fishery impacts correspond directly to the sea otter's carrying capacity percentage. Sea otters are projected to be at about 11 percent of their estimated carrying capacity at the island in 2012. Thus, crab landings would increase by approximately 11 percent from the 10-year average of 10,634 pounds. We assume that the crab population would rebound from sea otter predation in four years.[22] We further assume that the associated increase in landings would be equally distributed across four years, so that landings would rise by approximately 3 percent (282 pounds) annually between 2012 and 2014, stabilizing to an annual benefit of approximately 1,127 pounds after 2015 (Table 6-60).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial crab fishing in these areas would likely no longer be viable, and landings in these areas would likely approach zero. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight. Therefore, there may be a slight benefit to the crab fishery, compared to the baseline, as a result of some delay in sea otter predation.

Thus, the maximum non-discounted benefit to crab vessels for Alternative 3A would total $20,000. The discounted 10-year benefit for this Alternative would be between $12,000 (discounted at 7 percent) and $16,000 (discounted at 3 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-6.

On average in the southern California crab fishery, 147 vessels participate annually (Leos pers. comm. 2010). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels, then each vessel would have increased landings of approximately 96 pounds and increased revenue between $79 and $107 totaled over 10 years (discounted at 7 percent and 3 percent, respectively).

To determine the regional impact of increased crab revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 3A would result in an increase of $22,000 to $30,000 in total output over 10 years discounted at 7 percent and 3 percent, respectively. These impacts assume fishers would have the capacity to increase their landings.

[22] Crabs can reach a commercially harvestable size (4.25 inch carapace width) in 4 to 5 years (Parker, 2001). We assume that crab landings would rebound prior to six years because otters are unable to consume crabs inhabiting deep crevices. Thus, crabs may be harvested in less than 4 years.

TABLE 6-60 CRAB LANDINGS: BENEFITS OF ALTERNATIVE 3A						
Year	Commercial Landings (no 10% decrease at San Nicolas Island)	Commercial Landings (increase of 11% at San Nicolas Island)	Total Increase in Commercial Landings (pounds)	Ex-Vessel Revenue	Ex-Vessel Discounted revenue (3%)	Ex-Vessel Discounted revenue (7%)
2012	82	282	364	$521	$476	$425
2013	164	564	727	$1,041	$925	$794
2014	246	845	1,091	$1,562	$1,347	$1,113
2015	328	1,127	1,455	$2,082	$1,744	$1,387
2016	409	1,127	1,537	$2,199	$1,788	$1,370
2017	491	1,127	1,619	$2,317	$1,829	$1,348
2018	573	1,127	1,700	$2,434	$1,865	$1,324
2019	655	1,127	1,782	$2,551	$1,898	$1,297
2020	737	1,127	1,864	$2,668	$1,928	$1,268
2021	819	1,127	1,946	$2,785	$1,954	$1,237
Total Benefits	4,504	9,582	14,085	$20,160	$15,754	$11,563

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price fishers received for crabs from 2000 to 2009, which is $1.43 per pound in 2009 dollars.
SNI=San Nicolas Island
PV=present value

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 3A is expected to result in an increase in crab ex-vessel revenues within the Southern California Bight of 0.1 percent compared to the baseline (a total benefit of 14,000 pounds over 10 years compared to the projected total for southern California of 9.7 million pounds), the benefit is very low (see Table 5-1 for definitions of levels of significance).

6.5.4.4 Sea Cucumber Fishery

Under Alternative 3A, commercial sea cucumber landings within 10 years (1) would be eliminated along the coastline from Point Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound) and (2) may increase around San Nicolas Island. If sea otters are removed from the managed coastline that they currently occupy, we do not anticipate the commercial sea cucumber catch to increase before sea otters move back into the area. The sea cucumber fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound). Therefore, there is no impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island may result in a sea cucumber harvest increase, compared to the baseline, for two reasons. First, sea cucumber landings would not decrease the projected 10 percent as projected under the baseline because there would be no sea otter population at the island. Therefore, landings would not decrease the anticipated 22,735 pounds from 2012 to 2021. Second, newly recruited sea cucumbers and those sea cucumbers that escaped sea otter predation in the past would now potentially be available for commercial harvest. This potential increase follows the assumption that fishery impacts correspond directly to the sea otter’s carrying capacity percentage. Sea otters are projected to be at about 11 percent of their estimated carrying capacity at the island in 2012. Thus, sea cucumber landings would increase by approximately 11 percent from the 10-year average of 53,683 pounds. We assume that the sea cucumber population would rebound from sea otter predation in four years.[23] We further assume that the associated increase in landings would be equally distributed across four years, so that landings would rise by about 3 percent (1,423 pounds) annually between 2012 and 2014, stabilizing to an annual benefit of 5,690 pounds after 2015 (Table 6-61). This landings increase is dependent upon the assumption that the catch per unit of effort (CPUE) at San Nicolas Island is not already at a maximum, so that the existing sea cucumber vessels have the ability to increase their catch.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial sea cucumber fishing in these areas would likely no longer be viable, and landings in these areas would likely approach zero. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight. Therefore, there may be a slight benefit to the sea cucumber fishery, compared to the baseline, as a result of some delay in sea otter predation.

The maximum non-discounted benefit to sea cucumber fishing vessels for Alternative 3A would total $74,000. The discounted 10-year benefit for this alternative would be about

TABLE 6-61 SEA CUCUMBER LANDINGS: BENEFITS OF ALTERNATIVE 3A

Year	Commercial Landings (no 10% decrease at San Nicolas Island)	Commercial Landings (increase of 11% at San Nicolas Island)	Total Increase in Commercial Landings (pounds)	Ex-Vessel Revenue	Ex-Vessel Discounted revenue (3%)	Ex-Vessel Discounted revenue (7%)
2012	413	1,423	1,836	$1,898	$1,737	$1,550
2013	827	2,845	3,672	$3,796	$3,373	$2,896
2014	1,240	4,268	5,508	$5,695	$4,912	$4,060
2015	1,653	5,690	7,344	$7,593	$6,359	$5,060
2016	2,067	5,690	7,757	$8,020	$6,521	$4,995
2017	2,480	5,690	8,171	$8,448	$6,669	$4,917
2018	2,894	5,690	8,584	$8,875	$6,802	$4,827
2019	3,307	5,690	8,997	$9,302	$6,922	$4,729
2020	3,720	5,690	9,411	$9,730	$7,029	$4,623
2021	4,134	5,690	9,824	$10,157	$7,124	$4,510
Total Benefits	22,735	48,368	71,103	$73,515	$57,449	$42,166

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price divers received for sea cucumbers from 2000 to 2009, which is $1.36 per pound in 2009 dollars.
SNI=San Nicolas Island
PV=present value

[23] There are no size limits for the commercial sea cucumber fishery. However, a commercially desirable size is most likely reached in about 4 to 5 years (CDFG 2006c). We assume that landings would rebound prior to five years because sea otters are unable to reach cucumbers located in sufficiently deep crevices. Therefore, some cucumbers will have survived and will reach a harvestable size in four years.

$57,000 (discounted at 3 percent) or $42,000 (discounted at 7 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-4.

On average in the southern California sea cucumber fishery, 49 vessels participate annually (Leos pers. comm 2010). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels, then each vessel would have increased landings of approximately 1,500 pounds and increased revenue between $900 (discounted at 7 percent) and $1,200 (discounted at 3 percent) totaled over 10 years.

To determine the regional impact of increased sea cucumber revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 3A would result in an increase of $79,000 to $108,000 in total output over 10 years discounted at 7 percent and 3 percent, respectively. These impacts assume fishers would have the capacity to increase their landings.

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 3A is expected to result in an increase in sea cucumber ex-vessel revenues within the Southern California Bight of 2 percent compared to the baseline (a total benefit of 71,000 pounds over 10 years compared to the projected total for southern California of 4.9 million pounds), the benefit is of low significance (see Table 5-1 for definitions of levels of significance).

6.5.4.5 Gill and Trammel Net Fishery

6.5.4.5.1 Halibut Fishery

Under Alternative 3A, the regulatory environment would change (see section 6.5.12). The area from Point Conception to the Mexican border would become subject to the regulations currently in effect throughout the remainder of the southern sea otter’s range. Commercial halibut landings using gill and trammel net gear along the coastline from Point Conception to Port Hueneme would be affected within 10 years only if the State or NMFS responded to the change in regulatory environment by imposing an additional depth restriction on the use of gill and trammel net gear in this area. The possibility that the State or NMFS would act may be decreased or delayed, relative to the baseline, by the short-term removal of sea otters from the coastline southeast of Point Conception as required under this alternative, but sea otters would be expected to return to the coastline eventually. It is important to note that the State or NMFS could choose not to act even if sea otters did return to the coastline southeast of Point Conception. Therefore, commercial halibut landings using gill and trammel net gear in this area would either be 1) unaffected (low estimate) or 2) eliminated (high estimate).

The incidental taking of southern sea otters in commercial fisheries is currently prohibited within the translocation zone, and it would remain prohibited if this alternative were selected. Therefore, the change in the regulatory environment that would occur under this alternative would not result in any additional impetus for the State or NMFS to impose supplementary depth restrictions on the use of gill and trammel net gear at San Nicolas Island.

SUMMARY OF IMPACTS

In the lower estimate (no additional closure), there would be no impacts. In the upper estimate (immediate closure), losses would accumulate because halibut landings using gill or trammel net gear would be eliminated from Santa Barbara to Port Hueneme. Landings would decrease an anticipated maximum 601,000 pounds over 10 years from 2012 to 2021. Table 6-62 shows that the total non-discounted maximum loss to the halibut fishery over 10 years for Alternative 3A would total about $2.5 million, and the total discounted loss for this alternative would be about $2.2 million (discounted at 3 percent) or $1.7 million (discounted at 7 percent).

To determine the regional impact of decreased halibut revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 3A would result in a decrease of $3.2 million to $4.2 million in total output over 10 years discounted at 7 percent and 3 percent, respectively.

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. In the lower estimate (no additional closure), there would be no impacts. In the upper estimate (immediate closure), the expected decrease in halibut landings resulting from implementation of Alternative 3A would constitute 21 percent of halibut landings in the Southern California Bight (all gear

TABLE 6-62 HALIBUT LANDINGS: EFFECTS OF ALTERNATIVE 3A – UPPER ESTIMATE (ADDITIONAL DEPTH RESTRICTION SANTA BARBARA TO PORT HUENEME)

Year	Decrease in Commercial Landings (Pounds)	Ex-Vessel Revenue*	Ex-Vessel Discounted Revenue (3%)*	Ex-Vessel Discounted Revenue (7%)*
2012	60,064	-$276,953	-$253,451	-$226,076
2013	60,064	-$276,953	-$246,069	-$211,286
2014	60,064	-$276,953	-$238,902	-$197,463
2015	60,064	-$276,953	-$231,943	-$184,545
2016	60,064	-$276,953	-$225,188	-$172,472
2017	60,064	-$276,953	-$218,629	-$161,189
2018	60,064	-$276,953	-$212,261	-$150,644
2019	60,064	-$276,953	-$206,079	-$140,789
2020	60,064	-$276,953	-$200,076	-$131,578
2021	60,064	-$276,953	-$194,249	-$122,970
Total	600,640	-$2,504,669	-$2,226,846 (PV@3%)	-$1,699,012 (PV@7%)

Note: Values are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price received for halibut from 2000 to 2009, which is $4.61 per pound in 2009 dollars.

types) (Table 6-16). Thus Alternative 3A is expected to result in either 1) no effect or 2) a negative effect of high significance (see Table 5-1 for definitions of levels of significance).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas, it is possible that the State or NMFS would close commercial halibut fishing using gill and trammel net gear in additional areas. The removal of sea otters from San Nicolas Island could 1) slow the rate of eventual dispersal of sea otters into the southern areas of the Southern California Bight or 2) increase the rate of dispersal because unsettled sea otters could colonize new areas. Therefore, it is not possible to predict the effects of removal of sea otters from San Nicolas Island on additional depth restrictions on the use of gill and trammel net gear in other areas.

6.5.4.5.2 WHITE SEABASS FISHERY

Under Alternative 3A, the regulatory environment would change (see section 6.5.12). The area from Point Conception to the Mexican border would become subject to the regulations currently in effect throughout the remainder of the southern sea otter's range. Commercial white seabass landings using gill and trammel net gear along the coastline from Point Conception to Port Hueneme would be affected within 10 years only if the State or NMFS responded to the change in regulatory environment by imposing an additional depth restriction on the use of gill and trammel net gear in this area. The possibility that the State or NMFS would act may be decreased or delayed, relative to the baseline, by the short-term removal of sea otters from the coastline southeast of Point Conception as required under this alternative, but sea otters would be expected to return to the coastline eventually. It is important to note that the State or NMFS could choose not to act even if sea otters did return to the coastline southeast of Point Conception. Therefore, commercial white seabass landings using gill and trammel net gear in this area would either be 1) unaffected (low estimate) or 2) eliminated (high estimate).

The incidental taking of southern sea otters in commercial fisheries is currently prohibited within the translocation zone, and it would remain prohibited if this alternative were selected. Therefore, the change in the regulatory environment that would occur under this alternative would not result in any additional impetus for the State or NMFS to impose supplementary depth restrictions on the use of gill and trammel net gear at San Nicolas Island.

SUMMARY OF IMPACTS

In the lower estimate (no additional closure), there would be no impacts. In the upper estimate (immediate closure), losses would accumulate because white seabass landings using gill or trammel net gear would be eliminated from Santa Barbara to Port Hueneme. Landings would decrease an anticipated maximum 1.2 million pounds over 10 years from 2012 to 2021. Table 6-63 shows that the total non-discounted loss to the white seabass fishery over 10 years for Alternative 3A would total about $2.8 million, and the total discounted loss for this Alternative would be about $2.3 million (discounted at 3 percent) or $1.7 (discounted at 7 percent).

To determine the regional impact of decreased white seabass revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further

TABLE 6-63 WHITE SEABASS LANDINGS: EFFECTS OF ALTERNATIVE 3A – UPPER ESTIMATE (ADDITIONAL DEPTH RESTRICTION SANTA BARBARA TO PORT HUENEME)				
Year	**Decrease in Commercial Landings (Pounds)**	**Ex-Vessel Revenue***	**Ex-Vessel Discounted Revenue (3%)***	**Ex-Vessel Discounted Revenue (7%)***
2012	117,129	-$284,638	-$260,484	-$232,350
2013	117,129	-$284,638	-$252,898	-$217,149
2014	117,129	-$284,638	-$245,532	-$202,943
2015	117,129	-$284,638	-$238,380	-$189,667
2016	117,129	-$284,638	-$231,437	-$177,258
2017	117,129	-$284,638	-$224,696	-$165,662
2018	117,129	-$284,638	-$218,152	-$154,824
2019	117,129	-$284,638	-$211,798	-$144,696
2020	117,129	-$284,638	-$205,629	-$135,230
2021	117,129	-$284,638	-$199,640	-$126,383
Total	1,171,294	-$2,846,384	-$2,288,645 (PV@3%)	-$1,746,162 (PV@7%)

Note: Values are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price received for white seabass from 2000 to 2009, which is $2.43 per pound in 2009 dollars.

assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 3A would result in a decrease of $3.2 million to $4.3 million in total output over 10 years discounted at 7 percent and 3 percent, respectively.

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. In the lower estimate (no additional closure), there would be no impacts. In the upper estimate (immediate closure), the expected decrease in white seabass landings resulting from implementation of Alternative 3A would constitute 42 percent of white seabass landings in the Southern California Bight (all gear types) (Table 6-20). Thus Alternative 3A is expected to result in either 1) no effect or 2) a negative effect of very high significance (see Table 5-1 for definitions of levels of significance).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas, it is possible that the State or NMFS would close commercial white seabass fishing using gill and trammel net gear in additional areas. The removal of sea otters from San Nicolas Island could 1) slow the rate of eventual dispersal of sea otters into the southern areas of the Southern California Bight or 2) increase the rate of dispersal because unsettled sea otters could colonize new areas. Therefore, it is not possible to predict the effects of removal of sea otters from San Nicolas Island on additional depth restrictions on the use of gill and trammel net gear in other areas.

6.5.5 Marine Aquaculture

Effects on marine aquaculture resulting from Alternative 3A are essentially the same as for the baseline (local, episodic reduction of mussel densities in the Santa Barbara Channel). Although Alternative 3A would require the removal of sea otters from San Nicolas Island and the management zone, the removal of these animals is not likely to affect marine aquaculture operations compared to the baseline because 1) sea otters are expected to return rapidly to the mainland coastline and 2) because there are currently no aquaculture operations at San Nicolas Island.

We do not assign a level of significance to marine aquaculture because of the extent of uncertainty involved.

Beyond 10 years, the removal of sea otters from San Nicolas Island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, but the benefits of slowed range expansion to marine aquaculture are expected to be relatively minor because 1) there are few registered open-water aquaculture operations in the remainder of the Southern California Bight (*i.e.*, not in Santa Barbara Channel); 2) under baseline conditions, sea otter range expansion (if it continues to occur) is expected to occur gradually over the course of many decades; and 3) sea otters are not likely to affect abalone or finfish aquaculture operations and would likely affect mussel operations only locally and episodically. Depending on the production methods, the presence of sea otters in the Southern California Bight may affect the shellfish aquaculture that is anticipated under NOAA's Ten Year Strategic Plan, National Marine Aquaculture Policy, and National Shellfish Initiative.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

6.5.6 Seafood Processing Industry (Sea Urchins)

Under Alternative 3A, impacts to the sea urchin processing industry would be a function of the change in sea urchin landings. Alternative 3A would have no impact on sea urchin landings along the coastline from Point Conception to Carpinteria or from Point Conception to Oxnard compared to the baseline. However, the removal of sea otters from San Nicolas Island would increase southern California landings by 0.4 percent over 10 years. Thus, impacts to the sea urchin processing industry would likely be very low, representing a slight benefit to the sea urchin processing industry compared to the baseline.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, sea urchin harvesting would no longer be viable in these areas, and the sea urchin processing industry would be required to obtain sea urchins harvested from other areas of the Southern California Bight. The sea urchin processing industry would eventually be eliminated in southern California if sea otters reached carrying capacity where sea urchin harvesting occurs in the Southern California Bight and processors were unable to obtain sea urchins from elsewhere. This long-term projection is equivalent to the baseline.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

Within 10 years, Alternative 3A is expected to have a beneficial effect of very low significance on the on the seafood processing industry (a gain of 0.4 percent in possible inputs from the Southern California Bight).

6.5.7 KELP HARVEST

Effects of Alternative 3A on the amount of kelp available for harvest are the same as those described for the baseline, except for possible effects associated with the removal of sea otters from the management zone and translocation zone (for a description of the relationship between sea otters and kelp abundance, see section 6.2.2). Within 10 years, the removal of sea otters from the management zone would not likely have any discernible effects on kelp abundance compared to the baseline because sea otters are capable of returning rapidly to areas from which they have been removed, and because the return of *Macrocystis* canopy to an area may require a decade or more after the restriction of invertebrate herbivores to cryptic and inaccessible habitat, in which context the effects of a temporary fluctuation in sea otter predation would be undetectable.

The removal of animals from San Nicolas Island would eliminate the colony, probably resulting in minor increases in invertebrate prey populations within a few years. Removing sea otters from San Nicolas Island could impact kelp harvest at San Nicolas Island. Any enhancement of kelp that would have been afforded by a colony persisting at San Nicolas Island (as projected under the baseline) would not occur, representing a possible slight cost to the kelp industry. We do not assign a level of significance to kelp harvesting because of the extent of uncertainty involved.

In the longer term, elimination of the sea otter colony at San Nicolas Island would likely slow sea otter recolonization of the Southern California Bight and thus would also delay possible associated increases in kelp abundance throughout the area. A slight loss to the kelp harvesting industry, compared to the baseline, could additionally result from this delay. Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

6.5.8 Recreational Fishing

Recreational fishing activities that may be affected by sea otters include lobster fishing, abalone fishing, and finfish fishing. Lobster fishing and finfish fishing are addressed below. Abalone diving is included under “Abalone Fishery Restoration” (section 6.5.9).

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

6.5.8.1 Lobster Fishing

Within the next 10 years under Alternative 3A, the recreational lobster fishery would be (1) eliminated along the coastline from Point Conception to Carpinteria or from Point Conception to Oxnard and (2) improved at San Nicolas Island. If sea otters are removed from the coastline that they currently occupy, we would not expect recreational fishing trips to increase before sea otters move back into the area. The recreational fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Carpinteria (CDFG statistical blocks 651, 652, 653, 654, 655, 656, and 657) or from Point Conception to Oxnard (CDFG statistical blocks 683, 664, 665, 651, 652, 653, 654, 655, 656, and 657). Therefore, there is no impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island may result in an increase in recreational lobster fishing trips, compared to the baseline, for two reasons. First, lobster fishing trips would not decrease the projected 10 percent as under the baseline because there would be no sea otter population at the island. Therefore, recreational lobster fishing via CPFVs would not decrease an anticipated 184 trips from 2012 to 2021. Second, recreational lobster fishing via CPFVs may increase because newly recruited lobsters and those lobsters that escaped predation in the past would now potentially be available for recreational harvest. This potential increase follows the assumption that recreational fishery impacts correspond directly to the sea otter's carrying capacity percentage. Sea otters are projected to be at about 11 percent of their estimated carrying capacity at the island in 2012. Thus, recreational lobster fishing trips via CPFVs would increase by approximately 11 percent from the 10-year average of 434 trips. We assume that the lobster population would rebound from sea otter predation in seven years[24] for recreational harvest. We further assume that the associated increase in trips would be equally distributed across seven years, so that trips would rise by about 1 percent (about 5 trips) annually between 2012 and 2018, stabilizing to an annual benefit of approximately 46 trips after 2018 (Table 6-64).

TABLE 6-64 RECREATIONAL LOBSTER FISHING TRIPS: BENEFITS OF ALTERNATIVE 3A

Year	Dive Trips (no 10% decrease at San Nicolas Island)	Dive Trips (increase of 11% at San Nicolas Island)
2012	3	7
2013	7	13
2014	10	20
2015	13	26
2016	17	33
2017	20	39
2018	23	46
2019	27	46
2020	30	46
2021	33	46
Total Benefits	506 trips	

Note: Benefits are rounded to the nearest trip.
SNI=San Nicolas Island

The benefit to recreational lobster fishing trips for Alternative 3A would total 506 trips over 10 years. On average in the southern California recreational fishery, there are 22 CPFVs (CDFG 1995-2003). If the increased trips were distributed equally among these CPFVs, and no other vessels entered the industry, then each commercial passenger fishing vessel would supply 25 additional trips over 10 years, if there is demand for these additional trips. This change would represent a slight benefit to both recreational lobster divers and CPFVs compared to the baseline.

Alternative 3A would provide the recreational lobster fishery (conducted via CPFVs) with an average annual benefit (for the 10-year time frame) of about 50 trips. This benefit is less than 1 percent of the annual average of 8,322 trips for the Southern California Bight (see section 6.2.8.1). Therefore, Alternative 3A is expected to have a very low beneficial effect on recreational lobster fishing.

[24] Spiny lobsters can reach a commercially harvestable size (3.5 inches carapace length) in 7 to 11 years (Barsky 2001). We assume that landings would rebound prior to seven years because sea otters are unable to consume lobsters located in inaccessible habitat (deep crevices). Thus, the harvest may resume in a minimum time interval.

Information from the limited number of lobster report cards returned from 2008-2011 suggests that 0.2 percent of the total number of lobster fishing trips (including CPFV trips) in the Southern California Bight occurs at San Nicolas Island. The removal of sea otters from San Nicolas Island, as required under Alternative 3A, would result in a potential slight increase in the proportion of recreational lobster fishing trips to the island during the next 10 years. We do not use report card data as the basis for assigning a level of significance because these data are limited, and the estimates based on them are necessarily provisional.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, recreational lobster fishing trips in these areas would likely approach zero. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight. Therefore, there may be a slight benefit to the recreational lobster fishery, compared to the baseline, as a result of some delay in sea otter predation.

6.5.8.2 Finfish Fishing

The effects of Alternative 3A are the same as for the baseline except with respect to San Nicolas Island. Although Alternative 3A would require the removal of sea otters that are in the management zone at the time the translocation program is formally declared a failure, this removal is not expected to have any discernible effects because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which fluctuates in sea otter numbers on a seasonal basis and 2) sea otters are capable of returning rapidly to areas from which they have been removed. Therefore, the removal of sea otters from the management zone would have no impact on recreational finfish fishing relative to the baseline.

As described for the baseline, the presence of sea otters may improve habitat for recreationally important finfish and thus have a positive effect on the abundance of finfish available for harvest. Such changes would likely require more than 10 years to become noticeable (because the reestablishment of giant kelp canopies in areas where sea urchin grazing is limiting kelp is expected to take at least 10 years) and could occur gradually over several decades. A discussion of the long-term effects of sea otter predation on the kelp forest community, including finfish production, is given in section 6.2.2.

The removal of sea otters from San Nicolas Island is generally expected to affect recreational finfish fishing negatively relative to the baseline by eliminating the stabilizing and enhancing effects that a persistent sea otter colony may have on the kelp beds surrounding the island.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized areas of the Southern California Bight at the densities seen in the mainland range for comparable habitat, recreational finfish fishing may benefit. This long-term projection differs from the baseline only to the extent that the removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight.

We do not assign a level of significance to recreational finfish fishing because of the extent of uncertainty involved.

6.5.9 ABALONE FISHERY RESTORATION

The effects of Alternative 3A are the same as for the baseline except with respect to San Nicolas Island. Although Alternative 3A would require the removal of sea otters that are in the management zone at the time the translocation program is formally declared a failure, this removal is not expected to have any discernible effects on abalone fishery restoration because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which fluctuates in sea otter numbers on a seasonal basis, 2) sea otters are capable of returning rapidly to areas from which they have been removed, and 3) abalone fishery restoration is generally expected to require decades.

As described for the baseline, within 10 years sea otter range expansion along the coastline towards Carpinteria (lower bound) or Oxnard (upper bound) would preclude the reestablishment of abalone fishing in that area. However, it does not appear that there is any potential for reopening the abalone fishery (for any species) during the next 10 years, regardless of the presence or absence of sea otters, except possibly at San Miguel Island, where a limited fishery for red abalone is currently being considered (see section 6.2.9). Because the abalone fishery is unlikely to be reopened along the mainland coastline within 10 years, and because sea otters are not expected to recolonize the northern Channel Islands within 10 years, sea otters would likely have no effect on the potential for reopening any abalone fishery in the short term.

San Nicolas Island is identified in the Abalone Recovery and Management Plan (CDFG 2005c) as 1 of 10 key recovery areas for black abalone. Compared to the baseline, removing sea otters from San Nicolas Island may increase the probability that black abalone would reach Criterion 1 (and possibly even Criteria 2 and 3, at which point the population could be considered for a reopening of the abalone fishery). However, even if sea otters were successfully removed, it is possible that they would recolonize San Nicolas Island through natural range expansion before abalone populations have reached the fishery consideration phase (Criterion 3), which is expected to require several decades. In this case, a reopening of the abalone fishery would be precluded in this area.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized areas of the Southern California Bight at the densities seen in the mainland range for comparable habitat, the restoration of an abalone fishery in these areas would not be viable. At San Miguel Island, red abalone populations are apparently stable (Karpov *et al.* 2000). Eventual colonization of San Miguel Island by sea otters would reduce the densities of red abalone present there (Hines and Pearse 1982) and thus reduce but not eliminate the potential for these populations to contribute reproductively to other areas in the Southern California Bight. This reduced reproductive potential could have a detrimental effect on the eventual re-opening of the red abalone fishery in other areas of the Southern California Bight, if such a re-opening were proposed, even if sea otters were not present in these other areas.

This long-term projection under Alternative 3A differs from the baseline only to the extent that the removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

We do not assign a level of significance to abalone fishery restoration because of the extent of uncertainty involved.

6.5.10 Ecotourism and Non-Market Value

The effects of Alternative 3A are the same as for the baseline except with respect to San Nicolas Island. Although Alternative 3A would require the removal of sea otters that are in the management zone at the time the translocation program is formally declared a failure, this removal is not expected to have any discernible effects on ecotourism because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which fluctuates in sea otter numbers on a seasonal basis, 2) ecotourism activity directed specifically at sea otter watching is now rare in the management zone, and 3) sea otters are capable of returning rapidly to areas from which they have been removed. Therefore, the removal of sea otters from the management zone would not change ecotourism relative to the baseline. As described for the baseline, tourism based on sea otter watching would be enhanced within 10 years as sea otters progressively reoccupy and begin to reside year-round along the stretch of mainland coastline between Point Conception and Carpinteria or between Point Conception and Oxnard. Overall economic value of this tourism is difficult to quantify and would not necessarily result in increased economic activity. Rather, it would likely manifest itself as an added value to other tourist draws in the area. As under the baseline, non-market benefits of $15.0 million to $34.3 million would accrue due to the increasing sea otter population from 2012 to 2021.

The removal of sea otters from San Nicolas Island is generally expected to affect ecotourism negatively relative to the baseline by reducing or eliminating the possibility of a sea otter sighting at the island. Under the baseline, we do not expect ecotourism in this area to grow considerably (in terms of number of trips) over the next 10 years as a result of the increased abundance of sea otters, but we do expect that the quality of recreational trips to San Nicolas Island would be enhanced due to the better possibility of a sea otter sighting. Removal of sea otters from San Nicolas Island may result in decreased non-market value if the removed sea otters do not survive.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized areas of the Southern California Bight at the densities seen in the mainland range for comparable habitat, ecotourism would benefit, and non-market values would increase. This long-term projection is differs from the baseline only to the extent that the removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

We do not assign a level of significance to ecotourism/non-market value because of the extent of uncertainty involved.

6.5.11 Federal and State Agency Programs

We do not assign a level of significance to effects on agency programs because these effects and programs are various and cannot be meaningfully compared with a single set of criteria. For a discussion of the regulatory environment, see section 6.5.12.

In the following discussions, we assume that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight. Nevertheless, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

6.5.11.1 U.S. Fish and Wildlife Service

The effects of Alternative 3A on southern sea otter recovery are also addressed in section 6.5.3.3 ("Southern Sea Otter"). Here we address our ability to meet our mandates under the ESA and MMPA and give the implementation costs of the alternative.

Ability to Meet Mandate

Our ability to achieve recovery and the Optimum Sustainable Population level for sea otters under Alternative 3A is the same as under the baseline scenario in terms of the area available for sea otters to recolonize. Alternative 3A (like the baseline and Alternatives 3B and 3C) maximizes the habitat available to sea otters for recolonization and would permit the possible eventual expansion of sea otters throughout their historic range in the Southern California Bight. However, the time that would be required for sea otters to reach recovery and their the Optimum Sustainable Population level is unknown. The removal of sea otters from the management zone would not likely have any discernible effects compared to the baseline because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which fluctuates in sea otter numbers on a seasonal basis, and 2) sea otters are capable of returning rapidly to areas from which they have been removed.

One potentially important difference between 3A and the baseline arises from the removal of sea otters from San Nicolas Island, which could have unpredictable effects on the rapidity with which other areas of the Southern California Bight are recolonized and, consequently, on our ability to bring southern sea otters to recovery and their Optimum Sustainable Population level. Removal of sea otters from San Nicolas Island (if sea otters did not immediately return) would likely slow the eventual colonization of the Southern California Bight because dispersing sea otters could come from only the mainland range. Overall, the removal of sea otters from San Nicolas Island and their placement into the mainland range would likely be extremely disruptive, if not harmful, to the animals removed, and disruptive also to the animals in the receiving population. In this situation, both the displaced colony and the receiving population would suffer disturbance to their social structure and encounter increased competition for food. Individuals from San Nicolas Island, where there is abundant prey, may be unable to compete successfully in the mainland range, where food resources are more limited. Moved animals would additionally be subjected to the stress of capture and transport, which could result in the deaths of some individuals. These negative effects are likely to delay, to some unknown extent, the prospect of recovery and achievement of the Optimum Sustainable Population level for sea otters in California.

Alternative 3A differs notably from the baseline with respect to the regulatory provisions that would apply to sea otters in the Southern California Bight because the management and translocation zones would no longer exist. For a discussion of these provisions, see section 6.5.12.

Because of the various effects outlined above, Alternative 3A is not as conducive to our achievement of mandates under the ESA and the MMPA as is Alternative 3C, but it is far more likely to result in achievement of these mandates than are either Alternative 1 or Alternative 2.

Implementation Costs (10-year period)

The change in the regulatory provisions that apply to sea otters in the Southern California Bight under Alternative 3A may result, in the long term, in increased coordination and consultation between USFWS and other parties regarding activities that may affect the southern sea otter. Costs resulting from an increased consultation workload are not included here because few or no activities requiring consultation presently occur or are expected to occur in the area that sea otters would likely reoccupy within the next 10 years. New implementation costs would be incurred under Alternative 3A. These costs derive from the removal sea otters from San Nicolas Island and the management zone and include expenditures for personnel, transportation, and equipment (Table 6-65).

TABLE 6-65 PERSONNEL AND EQUIPMENT NEEDED TO IMPLEMENT ALTERNATIVE 3A

Personnel	Transportation	Equipment
Program Manager	2 Vans	Boat Maintenance
Capture Teams	1 Tow Vehicle	Dive Gear and Maintenance
Transport Team	2 Monitor Vehicles	Tracking Equipment
Monitoring Team	Air Charters	Training
Veterinary Services	Boat Charters	
	Travel Costs	

Activities related to the removal of sea otters from the translocation and management zones are expected to continue for two years. After all reasonable efforts are expended to remove sea otters from the zones, no further maintenance would continue. In the third year, only monitoring efforts would be implemented. Therefore, implementation costs would cease after the third year of effort.

Personnel costs to maintain the management zone comprise about 72 percent of annual implementation costs. Within the personnel costs, capture team represent the largest expense, at $300,000 per year. These capture teams would patrol the management zone and capture and relocate any sea otter found within it. Most likely, effort would be concentrated at the northern border of the management zone boundary near Point Conception.

The estimated expenditures represent the entire program costs over a 10-year period (Table 6-66). Based upon past and projected efforts, the non-discounted annual implementation costs would sum to about $1.6 million over three years.

TABLE 6-66 IMPLEMENTATION COSTS FOR REMOVAL OF SEA OTTERS FROM SAN NICOLAS ISLAND AND THE MANAGEMENT ZONE

Year	Annual Cost			Discounted Cost (3% discount rate)	Discounted Cost (7% discount rate)
	Personnel	Transportation	Equipment		
2012	$535,000	$128,000	$85,000	$684,526	$610,591
2013	$535,000	$128,000	$56,000	$638,822	$548,522
2014	$90,000	$21,000	$1,000	$96,612	$79,854
2015	-	-	-	-	-
2016	-	-	-	-	-
2017	-	-	-	-	-
2018	-	-	-	-	-
2019	-	-	-	-	-
2020	-	-	-	-	-
2021	-	-	-	-	-
Total	$1,579,000			$1,419,960 (PV@3%)	$1,238,967(PV@7%)

Note: A 10-year period allows for comparison of the alternatives.

6.5.11.2 Channel Islands National Park

The effects of Alternative 3A are virtually the same as under the baseline scenario. Alternative 3A would allow sea otters to recolonize the Southern California Bight. While no effects of sea otters would be expected within 10 years, sea otters would likely eventually re-establish their range within Park boundaries. Alternative 3A is consistent with the mission and mission-related goals of CINP to protect and restore natural ecosystems and to practice ecosystem management.

The removal of sea otters from the management zone would not likely have any discernible effects compared to the baseline because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which fluctuates in sea otter numbers on a seasonal basis, and 2) sea otters are capable of returning rapidly to areas from which they have been removed. The potential difference between 3A and the baseline arises from the removal of sea otters from San Nicolas Island, which could have unpredictable effects on the rapidity with which other areas of the Southern California Bight are recolonized. Removal of sea otters from San Nicolas Island (if sea otters did not immediately return) would likely slow the eventual colonization of islands in CINP because dispersing sea otters would come from only one direction (the mainland range). Generally, however, the effect of this alternative would be to allow the eventual return of sea otters to the islands of CINP.

Under Alternative 3A, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.5.12). This change could result, in the long term, in increased coordination and consultation between USFWS and Channel Islands National Park regarding activities that may affect the southern sea otter if sea otters recolonize historic range within Park boundaries.

6.5.11.3 Channel Islands National Marine Sanctuary

The effects of Alternative 3A are virtually the same as under the baseline scenario. Alternative 3A would allow sea otters to recolonize the Southern California Bight. While no effects of sea otters would be expected within 10 years, sea otters would likely eventually re-establish their range within Sanctuary boundaries. Alternative 3A is consistent with the mission of CINMS to conserve and enhance the biodiversity, ecological integrity, and cultural legacy of areas of special national significance.

The removal of sea otters from the management zone would not likely have any discernible effects compared to the baseline because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which fluctuates in sea otter numbers on a seasonal basis, and 2) sea otters are capable of returning rapidly to areas from which they have been removed. The potential difference between 3A and the baseline arises from the removal of sea otters from San Nicolas Island, which could have unpredictable effects on the rapidity with which other areas of the Southern California Bight are recolonized. Generally, removal of sea otters from San Nicolas Island (if sea otters did not immediately return) is likely to slow the eventual colonization of islands in CINMS because dispersing sea otters would come from only one direction (the mainland range). However, the overall effect of this alternative would be to allow the eventual return of sea otters to the islands within CINMS.

Under Alternative 3A, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.5.12). This regulatory change could result, in the long term, in increased coordination and consultation between USFWS and Channel Islands National Marine Sanctuary regarding activities that may affect the southern sea otter if sea otters recolonize historic range within Sanctuary boundaries.

6.5.11.4 California Department of Fish and Game

Effects on the recovery of white and black abalone and sea otters are discussed under “Candidate, Threatened, and Endangered Species” (section 6.5.3). Effects on existing commercial fisheries and the restoration of the abalone fishery are discussed under “Commercial Fisheries” (section 6.5.4) and “Abalone Fishery Restoration” (section 6.5.9). Effects on MPAs and the restoration of depleted abalone species that are not federally listed are discussed here.

Marine Protected Areas

The effects of Alternative 3A are virtually the same as under the baseline scenario. Alternative 3A would allow sea otters to recolonize the Southern California Bight. Under baseline conditions, sea otters are expected to recolonize the mainland coastline to Carpinteria (lower bound) or Oxnard (upper bound) within the next 10 years, and thus to reestablish range within five of the MPAs designated in 2010. In the longer term, sea otters would likely eventually re-establish their range within additional MPAs in southern California. As under the baseline, Alternative 3A would have a positive effect on MPAs in general. For a full discussion of the expected effects of sea otters on MPAs, see section 6.2.11.4.

The short-term removal of sea otters from the management zone would not likely have any discernible effects compared to the baseline because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which fluctuates in sea otter numbers on a seasonal basis, and 2) sea otters are capable of returning rapidly to areas from which they have been removed. The potential difference between 3A and the baseline arises from the removal of sea otters from San Nicolas Island, which could have unpredictable effects on the rapidity with which other areas of the Southern California Bight are recolonized. Removal of sea otters from San Nicolas Island (if sea otters did not immediately return) would likely slow the eventual colonization of areas designated as MPAs in southern California because dispersing sea otters would come from only one direction (the mainland range). Generally, however, the effect of this alternative would be to allow the eventual return of sea otters to areas designated as MPAs.

Restoration of Depleted Abalone Species (Not Federally Listed)

Enhancement activities include the translocation or aggregation of adult stocks, larval outplanting, captive breeding to obtain large individuals for outplanting, and the establishment of MPAs (CDFG 2005c). The effects of Alternative 3A are virtually the same as under the baseline scenario. Under baseline conditions, sea otters are expected to recolonize the mainland coastline to Carpinteria (lower bound) or Oxnard (upper bound) within the next 10 years and to recolonize other areas of the Southern California Bight gradually in the longer term. The short-term removal of sea otters from the management zone would not likely have any discernible effects compared to the baseline because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which fluctuates in sea otter numbers on a seasonal basis, and 2) sea otters are capable of returning rapidly to areas from which they have been removed. The potential difference between 3A and the baseline arises from the removal of sea otters from San Nicolas Island, which could have unpredictable effects on the rapidity with which other areas of the Southern California Bight are recolonized. Removal of sea otters from San Nicolas Island (if sea otters did not immediately return) would likely provide a slight benefit, relative to the baseline, to State efforts to enhance abalone populations by means of larval outplanting if outplanting efforts were planned for habitats lacking sufficient cryptic habitat to shield abalone from sea otter predation. However, the unpredictability of the effects of sea otter removal from San Nicolas Island would likely far outweigh any slight benefit of removal because of the difficulty of planning restoration efforts in the face of uncertainty. In the long term, the effect of this alternative would be to allow the eventual return of sea otters to the Southern California Bight. Any negative effects of natural range expansion would be lessened to the extent that outplanting efforts were conducted in cryptic habitat that is inaccessible to sea otters or in areas outside the range into which sea otters naturally expanded. The translocation or aggregation of adult stocks would likely be unaffected by sea otters, as one purpose of translocation is to protect adults from predation or other threats, and it would seem likely that abalone would be translocated into, or aggregated in, sufficiently protective crevice habitat. Natural range expansion of sea otters into the Southern California Bight would not affect other enhancement activities, such as captive breeding or the establishment of MPAs.

6.5.11.5 U.S. Navy/Department of Defense

Effects on the U.S. Navy are regulatory. Under Alternative 3A, the translocation program would be declared a failure, and the management zone and translocation zone would be abolished. As a consequence, the regulatory environment would change (see section 6.5.12). The change in the regulatory provisions that apply to sea otters in the Southern California Bight under Alternative 3A will result in increased coordination and consultation between USFWS and the U.S. Navy/DOD regarding activities that may affect the southern sea otter if sea otters are present at San Nicolas Island or if sea otters eventually colonize areas within the Pt. Mugu Sea Range or SOCAL Range Complex (see section 4.4.9.5 for maps of these areas).

Under Alternative 3A, sea otters would be removed from San Nicolas Island, but it is possible that some animals would return after removal efforts had ceased. Although there could be some delay before one or more animals returned, our experience translocating sea otters to San Nicolas Island suggests that many sea otters would attempt to return to their home range immediately. While the colony would likely be greatly reduced in number, at least initially, the regulatory requirements would be the same irrespective of the number of sea otters. To date, we have no evidence that defense-related activities have had any adverse effects on sea otters at San Nicolas Island or in the management zone. However, the U.S. Navy anticipates probable future changes in the type and tempo of military testing and training activities in response to evolving international threats and military technologies. Under Alternative 3A, an intensification of military activities in the nearshore waters of the island would likely trigger the need for additional regulatory compliance on the part of the U.S. Navy/DOD if and when sea otters returned to the island. To minimize the impacts of the U.S. Navy/DOD's increased regulatory obligations, we would propose to coordinate with the U.S. Navy/DOD to develop a programmatic consultation for activities that may affect southern sea otters at San Nicolas Island or to seek other potential mutually agreeable solutions. Although Naval program requirements may change, necessitating multiple consultations over time, programmatic consultations can cover anticipated activities until these requirements change, thereby minimizing the regulatory burden on the Navy associated with ESA compliance with respect to sea otters. The U.S. Navy/DOD is currently required to obtain an Incidental Harassment Authorization under the MMPA for the incidental non-lethal "take by harassment" of marine mammals during missile and target launch operations at San Nicolas Island. The requirement to complete Section 7 consultation for sea otters in the areas surrounding San Nicolas Island would constitute an additional regulatory burden on the U.S. Navy/DOD relative to the baseline.

Although the range of the southern sea otter is predicted to extend only to Carpinteria (lower bound) or Oxnard (upper bound) (see section 6.1.4.1) within the 10-year time horizon (this area of the coastline is outside the boundaries of the Point Mugu Sea Range and the SOCAL range complex), individual sea otters have traveled and will likely continue to travel into and out of other areas of the Southern California Bight during this period. Whether sea otter range expansion would extend to other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. Where sea otters were present, the U.S. Navy/DOD would be subject to the full requirements and authorizations of the ESA and MMPA for activities that may affect the species. Currently, the U.S. Navy/DOD is required to consult with USFWS on actions that may affect other listed species under the ESA and to request Incidental Harassment Authorization under the MMPA for activities affecting other marine mammals. We would propose to add southern sea otters to a programmatic Biological Opinion for other species listed under the ESA at San Clemente Island and to address southern sea otter requirements under the MMPA concurrently with the Incidental Harassment Authorization process the Navy already undergoes with NMFS for other marine mammal species. These processes would occur only when sea otters were present in those areas of the Southern California Bight.

The magnitude of the increased regulatory burden on the U.S. Navy/DOD would depend on the eventual abundance of sea otters in naval ranges throughout southern California and the types of naval activities proposed to be conducted there. In the event that USFWS determined in a future Section 7 consultation that proposed Naval operations were likely to result in jeopardy to the sea otter, Section 7(j) of the ESA requires the Endangered Species Committee, and ad hoc committee made of up the heads of several federal agencies, including but not limited to, the Secretaries of Interior, Commerce, Agriculture, and Army, to grant an exemption from the requirements of Section 7(a)(2) "for any agency action if the Secretary of Defense finds that such exemption is necessary for reasons of national security." Similarly, the Navy may seek a National Defense Exemption from requirements of the MMPA. These options may be exercised by the Secretary of Defense if deemed appropriate.

6.5.11.6 Bureau of Ocean Energy Management

Effects on BOEM are regulatory. Under Alternative 3A, the translocation program would be declared a failure, and the management zone and translocation zone would be abolished. As a consequence, the regulatory environment would change (see section 6.5.12).

In the long term, the change in the regulatory provisions that apply to sea otters in the Southern California Bight under Alternative 3A could result in increased coordination and consultation between USFWS and BOEM regarding activities that may affect the southern sea otter. However, the added consultation and permitting requirements for actions that may affect sea otters in the Southern California Bight would likely impose only a minor additional regulatory burden on BOEM for the following reasons: 1) the physical presence of the oil industry is expected to diminish offshore of California over the next several decades (BOEM pers. comm. 2010); 2) all proposed actions that may affect *other* threatened or endangered species or marine mammals are already subject to consultation and permitting requirements under the ESA and MMPA; 3) the regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of this alternative, and requirements for consultations or permits related to the southern sea otter have been minimal; 4) southern sea otters would not be present in most of southern California for decades (if range expansion continues to occur).

6.5.11.7 National Marine Fisheries Service

National Marine Fisheries Service activities that occur within or overlap with the nearshore areas of the Southern California Bight are diverse. These activities include implementing recovery actions for federally listed threatened and endangered species and managing federal fisheries. Information on endangered white and black abalone and NMFS-led recovery efforts for these species is given under "Candidate, Threatened, and Endangered Species." Federally managed fisheries are discussed here.

Under Alternative 3A, the translocation program would be declared a failure, and the management zone and translocation zone would be abolished. As a consequence, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.6.12). This change may result in increased coordination and consultation between USFWS and NMFS regarding activities that may affect the southern sea otter. NMFS would be required to consult under Section 7 of the ESA and to comply with other applicable laws on actions that may affect sea otters in the Southern California Bight. Take of southern sea otters caused by commercial fisheries cannot be authorized under section 118 of the MMPA. However, any changes would likely be minor. The current regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of this alternative, and requirements for consultations or permits related to the southern sea otter have been minimal. We expect that effects on federally managed fisheries in the Southern California Bight would also be minimal due to the gear types used and/or the depths in which these fisheries are pursued.

6.5.12 REGULATORY ENVIRONMENT

The regulatory environment under Alternative 3A would be identical to the regulatory environment under Alternatives 3B and 3C, although the actual effects of regulatory changes relative to the baseline depend on the presence or absence of sea otters in the Southern California Bight (see section 6.5.11 for a discussion of possible scenarios).

Under Alternative 3A, as under Alternatives 3B and 3C, the translocation program would be declared a failure and terminated, the management and translocation zones would be abolished, and the provisions of Public Law 99-625 would become inoperative. California Fish and Game Code section 8664.2 would also become inoperative. As a result, all activities that may affect southern sea otters within the Southern California Bight would be fully subject to the ESA, the MMPA, and California state law, including applicable consultation requirements and take prohibitions under these laws.

All federal agencies planning activities that may affect southern sea otters in the Southern California Bight would be required to consult with USFWS under Section 7 of the ESA and seek authorization for incidental take of sea otters under the ESA and provisions of the MMPA. If otherwise allowable under applicable state law, including California Fish and Game Code section 4700, non-federal activities that would result in take of southern sea otters in California would require incidental take authorization from USFWS under section 10(a)1(B) of the ESA and section 101(a)(5) of the MMPA. Incidental take of southern sea otters in commercial fisheries cannot be authorized under the MMPA. Therefore, incidental take of southern sea otters in commercial fisheries throughout the Southern California Bight would be prohibited, as it is currently prohibited throughout the remainder of the range of the species (north of Point Conception). Intentional take would continue to be prohibited unless authorized, as under the current regulations.

This change in the regulatory environment would not be likely to result in substantial effects on activities now being conducted within the Southern California Bight for several reasons:

1) The current regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of Alternatives 3A, 3B, or 3C in the Southern California Bight. Commercial fishing activities, harbor maintenance, oil and gas exploration, and other human activities are similar in the two sections of coastline. Along the central coast, requirements for consultations and take authorizations under the ESA and MMPA related to the southern sea otter have been minimal, and we would expect the same to be the case for the Southern California Bight. This is because there are few otherwise legal activities that result in take of southern sea otters and because the southern sea otter's historic habitat, although somewhat degraded, is essentially intact.

2) Southern sea otters would not be present in most of southern California for many decades. In fact, we cannot reliably assert that range expansion will occur at all. Critical habitat has not been designated for the southern sea otter and is not proposed or required (the southern sea otter was listed under the ESA prior to passage of the requirement to designate critical habitat). With no sea otters present in most of the Southern California Bight and no designated critical habitat, the likelihood that adverse interactions between sea otters and human activities would occur would be less than the likelihood that currently exists along the central coast, where substantial numbers of sea otters are found, and where the regulatory environment is the same as that proposed under Alternatives 3A, 3B, and 3C.

3) If the translocation program were declared a failure and terminated, California Fish and Game Code section 4700 would prohibit all take, as defined and applied under state law, of southern sea otters, with the exception of take authorized under an approved Natural Community Conservation Plan (NCCP), and the MMPA would prohibit incidental take of

southern sea otters by commercial fisheries. Nevertheless, commercial fisheries in the Southern California Bight are unlikely to be adversely affected by the change in regulatory environment because few fisheries will likely interact with sea otters. Gill-net fisheries, historically a concern for incidental take of sea otters, are currently prohibited in most of the nearshore waters of southern California and the offshore Channel Islands where sea otters would be found (Marine Resources Protection Act, California Constitution Article 10B). Dive fisheries (sea urchin, abalone) are extremely unlikely to result in take of sea otters by virtue of the methods they employ to harvest shellfish. Trap fisheries (lobster, crab, live-fish) could potentially result in the entrapment and drowning of sea otters and thus could be affected by a change in the regulatory environment. However, there are few data to assess the possibility of incidental take of southern sea otters in these fisheries, and therefore we cannot reliably anticipate the impact of this regulatory change on this segment of the commercial fishing community.

4) Because of potential effects on the receiving population of sea otters in the mainland range caused by the relocation of sea otters removed from the translocation zone, we would be required to consult under Section 7 of the ESA before implementation of this alternative.

6.6 Alternative 3B—Terminate Translocation Program; Remove Only Sea Otters Residing within the Translocation Zone at the Time the Decision to Terminate is Made

6.6.1 Introduction

Alternative 3 entails declaring the southern sea otter translocation program a failure and terminating the program, thereby eliminating the management zone and translocation zone established through Public Law 99-625 and 50 CFR §17(d). Sub-alternative 3B would require the removal of sea otters from San Nicolas Island but allows sea otters to remain in the management zone. All sea otters within the translocation zone at San Nicolas Island would be captured and placed within the parent range. No effort would be made to enforce a management zone, effectively allowing sea otters from the parent population to recolonize historic range throughout the Southern California Bight.

This action would not increase or decrease the projected sea otter range, compared to the baseline, because sea otters are already expected to reach carrying capacity along the coastline from Point Conception to Carpinteria in the next 10 years (CDFG statistical blocks 651, 652, 653, 654, 655, 656, and 657) or from Point Conception to Oxnard (CDFG statistical blocks 683, 664, 665, 651, 652, 653, 654, 655, 656, and 657) (see section 6.1.4.1). However, the removal of sea otters from San Nicolas Island would impact the sea otter population compared to the baseline, and would, therefore, impact some socioeconomic activities.

The assumptions that apply to the analysis for Alternative 3B are the same as those described for the baseline. For a more detailed description of the baseline, to which each activity is compared, refer to section 6.2, "Baseline (Status Quo)—The No Action Alternative."

6.6.2 Nearshore Marine Ecosystem

Alternative 3B entails declaring the translocation program a failure (thereby abolishing the management zone and translocation zone) and removing only those sea otters present in the translocation zone at the time of the final decision. The effects of this alternative on the nearshore marine ecosystem are the same as those for Alternative 3A because the removal of sea otters from the management zone (evaluated under Alternative 3A) is not expected to have any discernible community effects.

The removal of animals from San Nicolas Island would eliminate or greatly reduce the colony, probably resulting in minor increases in invertebrate prey populations within a few years. Any changes to the nearshore marine ecosystem (see section 6.2.2) that would have been afforded by a colony persisting at San Nicolas Island as projected under the baseline would not occur. Elimination of the sea otter colony at San Nicolas Island would likely slow sea otter recolonization of the Southern California Bight and thus would also delay associated ecosystem changes throughout the area.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

We do not assign a level of significance to effects on the nearshore marine ecosystem because of the extent of uncertainty involved.

6.6.3 Effects on Candidate, Threatened, and Endangered Species

The removal of sea otters from San Nicolas Island at the time of program termination, as required under this alternative, may result in their absence from the island for a period of one or more decades. The absence of sea otters from the island would likely slow eventual range expansion into other areas (particularly the southern portions) of the Southern California Bight. However, their removal could have other effects. Some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the complete removal of sea otters from the island would be diminished by some unknown amount. Additionally, it is possible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight relative to the baseline. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount or even reversed.

6.6.3.1 White Abalone

Effects on white abalone resulting from the implementation of Alternative 3B are essentially the same as for the baseline (see section 6.2.3.1, "Establishing the Baseline for White Abalone") except for possible benefits that may result from the removal of sea otters from San Nicolas Island at the time of program termination. Within 10 years, this removal may prevent some predation on shallow-living white abalone that may be present at San Nicolas Island, but this benefit would be very localized and minor because 1) some sea otters would return immediately and 2) this area is not a key recovery area for white abalone. Relative to the baseline, the effect of Alternative 3B on white abalone within 10 years is expected to be positive but of very low significance.

In the longer term, the benefit to white abalone under Alternative 3B relates to the potential for the removal of sea otters from San Nicolas Island to slow sea otter range expansion into the Southern California Bight. However, relative to baseline conditions (unrestricted movement of sea otters without removal) this potential benefit is probably minor given the tendency of relocated sea otters to return to their place of capture and the time scale over which sea otter range expansion into the Southern California Bight is expected to occur (many decades).

Because the effects of this alternative on white abalone would be expected to be beneficial, insignificant, or discountable relative to the baseline, we would seek concurrence from NMFS on a “not likely to adversely affect” determination under Section 7 of the ESA before selecting this alternative.

6.6.3.2 Black Abalone

Effects on black abalone resulting from the implementation of Alternative 3B are essentially the same as for the baseline (see section 6.2.3.2, “Establishing the Baseline for Black Abalone”) except for possible short-term benefits that may result from the removal of sea otters from San Nicolas Island at the time of program termination. Within 10 years, this removal may prevent some predation on black abalone at San Nicolas Island. San Nicolas Island is a key area for black abalone recovery. Removal of sea otters from the island (if they did not immediately return) would reduce predation pressure on black abalone at the island and possibly enhance the survivorship of black abalone with apparent resistance to withering syndrome. Relative to the baseline, the effect of Alternative 3B on black abalone within 10 years is expected to be positive and of moderate significance.

In the longer term, the benefit to black abalone under Alternative 3B relates to the potential for the removal of sea otters from San Nicolas Island to slow sea otter range expansion into the Southern California Bight. However, relative to baseline conditions (unrestricted movement of sea otters without removal) this potential benefit is probably minor given the tendency of relocated sea otters to return to their place of capture and the time scale over which sea otter range expansion into the Southern California Bight is expected to occur (many decades).

CRITICAL HABITAT

Critical habitat for black abalone includes a number of areas both within the current sea otter range and outside the current sea otter range (in southern California waters) (76 FR 66806). If sea otters do recolonize the Southern California Bight gradually over the course of several decades, then their range will overlap with black abalone critical habitat in southern California, just as it currently overlaps with black abalone critical habitat in central California. The primary constituent elements of critical habitat essential for the conservation of black abalone are: rocky substrate; food resources; juvenile settlement habitat; suitable water quality; and suitable nearshore circulation patterns (76 FR 66806). Of these five elements, only one, food resources, may potentially be affected by sea otters. Under Alternative 3B, as under the baseline, sea otters would generally be expected to improve food resources for adult black abalone through predation on sea urchins. However, ecological relationships are complex, and it is likely that numerous positive and negative interactions will occur simultaneously.

Because the effects of this alternative on black abalone and black abalone critical habitat would be expected to be beneficial, insignificant, or discountable relative to the baseline, we would seek concurrence from NMFS on a “not likely to adversely affect” determination under Section 7 of the ESA before selecting this alternative.

6.6.3.3 Southern Sea Otter

Effects on southern sea otters resulting from the implementation of Alternative 3B are essentially the same as those identified in our baseline analysis with the exception of 1) negative effects on individual sea otters removed from San Nicolas Island and possible negative effects on the southern sea otter population resulting from this action, and 2) potential effects resulting from regulatory changes if incidental take is affecting sea otters (see section 6.6.12).

At the time of program termination, sea otters would be subject to removal from San Nicolas Island. Relocating sea otters from San Nicolas Island to the northern or central portion of the existing range would increase competition among sea otters, especially in areas of the central coast now thought to be food-limited (see Tinker *et al.* 2008b), disrupt natural behaviors, and likely result in the deaths of otherwise healthy animals. The incidental injury or death of sea otters removed from San Nicolas Island would likely be unavoidable. The relocation of sea otters may result in increased risk of mortality due in part to the stress associated with capture, handling, and time out of water, and in part to the general lack of familiarity of the animals with their new environments (Estes *et al.* n.d.). Sea otters that have learned to forage in prey-rich environments (such as San Nicolas Island) may experience additional stress or even starvation resulting from their inability to find adequate food in prey-limited areas of the mainland range. For males, there may be an added risk of death or injury from encountering territorial males in foreign habitats (Estes *et al.* n.d.). Some sea otters would likely attempt to return to their location of capture, depleting their energy reserves and increasing their risk of mortality. Overall, relocating sea otters from San Nicolas Island to the mainland range would be disruptive, harmful, or possibly lethal, both to the relocated animals and to those in the receiving population. Relative to the baseline, the effect of Alternative 3B on sea otters within 10 years is expected to be negative and of moderate significance.

In the longer term, the removal of sea otters from San Nicolas Island at the time of program termination may result in their absence from the island for a period of one or more decades. The absence of sea otters from the island would likely slow eventual range expansion into other areas (particularly the southern portions) of the Southern California Bight. However, their removal could have other effects. Some sea otters may return to San Nicolas Island immediately. Additionally, it is possible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight relative to the baseline.

Under Alternative 3B, sea otters would ultimately be allowed to expand their range naturally into the Southern California Bight. This long-term scenario enhances the opportunity for southern sea otter recovery by allowing sea otters to recolonize historic habitat. Although the marine habitat in many areas of the Southern California Bight has been degraded by a multitude of human activities, the southern sea otter range has begun to expand into this region. Sea otters in southern California waters would be subject to the benefits and risks associated with this habitat, as described under baseline conditions (see section 6.2.3.3). Allowing natural range expansion over the long term maximizes the habitat available for southern sea otter recovery, avoids the potential threat to the species caused by capturing and releasing sea otters throughout the range, and avoids the potential for injuring or killing individual sea otters removed from the management zone.

Alternative 3B partially reflects recommendations made in the Revised Recovery Plan for the Southern Sea Otter (USFWS 2003). The revised plan continues to focus on efforts to increase the size of the southern sea otter's population. However, it no longer recommends translocating sea otters as a means to achieve this goal and in fact advises against additional translocations (USFWS 2003). The revised plan also registers the recovery team's recommendation to declare the translocation program a failure, allow natural range expansion to occur, and allow the colony at San Nicolas Island to remain at the island rather than capturing these sea otters and releasing them in the mainland range (USFWS 2003). Alternative 3B generally implements these recommendations, with the exception that the colony would be removed from San Nicolas Island.

The potential benefit of the reversion to "threatened" status for southern sea otters is difficult to estimate because its value can be realized only in reference to future actions that may affect members of the species found in the Southern California Bight. Because there are presently relatively few sea otters in the areas designated as a management zone, and incidental takes are not currently known to be occurring there, any benefit to sea otters would be speculative. Even if incidental take were to occur in the future, the benefit of increased regulatory protections would be realized by sea otters only if the incidental take were 1) detected and 2) prevented or minimized by means of measures included in incidental take authorizations.

To evaluate potential effects on sea otters, we would complete formal intra-Service consultation under Section 7 of the ESA before selecting this alternative.

6.6.4 COMMERCIAL FISHERIES

For a discussion of the regulatory environment (including as it pertains to commercial fisheries) see section 6.6.12. In the following discussions, we assume that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight. Nevertheless, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

6.6.4.1 Sea Urchin Fishery

Under Alternative 3B, commercial sea urchin landings within 10 years would (1) be eliminated along the coastline and (2) increase around San Nicolas Island. The sea urchin fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Carpinteria (lower bound estimate including CDFG statistical blocks 651, 652, 653, 654, 655, 656, and 657) or from Point Conception to Oxnard (upper bound estimate including CDFG statistical blocks 683, 664, 665, 651, 652, 653, 654, 655, 656, and 657). Therefore, there is no impact along the coastline compared to the baseline.

TABLE 6-67 SEA URCHIN LANDINGS: BENEFITS OF ALTERNATIVE 3B						
Year	**Commercial Landings (no 10% decrease at San Nicolas Island)**	**Commercial Landings (increase of 11% at San Nicolas Island)**	**Total Increase in Commercial Landings (pounds)**	**Ex-Vessel Revenue**	**Ex-Vessel Discounted revenue (3%)**	**Ex-Vessel Discounted revenue (7%)**
2012	2,705	7,448	10,154	$8,273	$7,571	$6,753
2013	5,411	14,897	20,307	$16,546	$14,701	$12,623
2014	8,116	22,345	30,461	$24,819	$21,409	$17,695
2015	10,821	29,793	40,614	$33,092	$27,714	$22,050
2016	13,526	37,241	50,768	$41,364	$33,633	$25,760
2017	16,232	37,241	53,473	$43,569	$34,393	$25,357
2018	18,937	37,241	56,178	$45,773	$35,081	$24,897
2019	21,642	37,241	58,883	$47,977	$35,699	$24,389
2020	24,347	37,241	61,589	$50,181	$36,252	$23,841
2021	27,053	37,241	64,294	$52,385	$36,742	$23,260
Total Benefits	148,789	297,930	446,720	$363,979	$283,195	$206,626

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price divers received for sea urchins (in shell) from 2000 to 2009, which is $0.81 per pound in 2009 dollars.
SNI=San Nicolas Island
PV=present value

Removing sea otters from San Nicolas Island may result in a sea urchin harvest increase, compared to the baseline, for two reasons. First, sea urchin landings would not decrease the projected 10 percent as projected under the baseline because there would be no sea otter population at the island. Therefore, landings would not decrease the anticipated 149,000 pounds from 2012 to 2021. Second, newly recruited sea urchins and those sea urchins that escaped sea otter predation in the past would now potentially be available for commercial harvest. This potential increase follows the assumption that fishery impacts correspond directly to the sea otter's carrying capacity percentage. Sea otters are projected to be at about 11 percent of their estimated carrying capacity at the island in 2012. Thus, sea urchin landings would increase by approximately 11 percent from the 10-year average of 351,333 pounds. We assume that the sea urchin population would rebound from sea otter predation in five years.[25] We further assume that the associated increase in landings would be equally distributed across five years, so that landings would rise by about 2 percent (7,448 pounds) annually between 2012 and 2015, stabilizing to an annual benefit of approximately 37,241 pounds after 2016 (Table 6-67). This landings increase is dependent upon the assumption that the catch per unit of effort (CPUE) at San Nicolas Island is not already at a maximum, so that the existing sea urchin vessels have the ability to increase their catch.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea

[25] Red sea urchins can reach a commercially harvestable size (3.5 inches) in 6 to 8 years (Kalvass and Rogers-Bennett, 2001). We assume that landings would rebound prior to six years because sea otters are unable to reach urchins located in sufficiently deep crevices. Therefore, some urchins will have survived and will reach a harvestable size in fewer than 6 years.

otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial sea urchin fishing in these areas would likely no longer be viable, and landings in these areas would likely approach zero. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight. Therefore, there may be a slight benefit to the sea urchin fishery, compared to the baseline, as a result of some delay in sea otter predation.

The maximum non-discounted benefit to sea urchin fishing vessels for Alternative 3B would total $364,000. The discounted 10-year benefit for this alternative would be about $283,000 (discounted at 3 percent) or $207,000 (discounted at 7 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-4.

On average in the southern California sea urchin fishery, 131 vessels participate annually (Leos pers. comm. 2010). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels, then each vessel would have increased landings of approximately 3,410 pounds and increased revenue between $1,600 (discounted at 7 percent) and $2,200 (discounted at 3 percent) totaled over 10 years.

To determine the regional impact of increased sea urchin revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 3B would result in an increase of $388,000 to $532,000 in total output over 10 years discounted at 7 percent and 3 percent, respectively. These impacts assume fishers would have the capacity to increase their landings.

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 3B is expected to result in an increase in sea urchin ex-vessel revenues within the Southern California Bight of 0.5 percent compared to the baseline (a total benefit of 447,000 pounds over 10 years compared to the projected total for southern California of 90.3 million pounds), the benefit is of very low significance (see Table 5-1 for definitions of levels of significance).

6.6.4.2 Spiny Lobster Fishery

Under Alternative 3B, commercial lobster landings within 10 years would (1) be eliminated along the coastline and (2) increase at San Nicolas Island. The lobster fishery under the baseline is projected to be eliminated along the coastline either from Point Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound). Therefore, there is no additional impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island may result in an increase in the lobster catch, compared to the baseline, for two reasons. First, lobster landings would not decrease the projected 10 percent as under the baseline because there would be no sea otter population at the island. Therefore, landings would not decrease the anticipated 18,000 pounds from 2012 to 2021. Second, newly recruited lobsters or lobsters that escaped predation in the past would now potentially be available for commercial harvest. This potential increase follows the assumption that fishery impacts correspond directly to the sea otter's carrying capacity percentage. Sea otters are projected to be at about 11 percent of their estimated carrying capacity at San Nicolas Island in 2012. Thus, lobster landings would increase by approximately 11 percent from the 10-year average of 41,622 pounds. We assume that the lobster population would rebound from sea otter predation in seven years.[26] We further assume that the associated increase in landings would be equally distributed across seven years, so that landings would rise by about 2 percent (630 pounds) annually between 2012 and 2017, stabilizing to an annual benefit of approximately 4,400 pounds after 2018 (Table 6-68).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial lobster fishing in these areas would likely no longer be viable, and landings in these areas would likely approach zero. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight. Therefore, there may be a slight benefit to the lobster fishery, compared to the baseline, as a result of some delay in sea otter predation.

Thus, the maximum non-discounted benefit to lobster vessels for Alternative 3B would total about $458,000. The discounted 10-year benefit for Alternative 3B would range between about $256,000 (discounted at 7 percent) and $353,000 (discounted at 3 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-4.

On average in the southern California lobster fishery, 169 vessels participate annually (Leos pers. comm. 2010). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels, then each vessel would have increased landings of approximately 287 pounds and increased revenue of between $1,500 (discounted at 7 percent) and $2,100 (discounted at 3 percent) totaled over 10 years.

To determine the regional impact of increased lobster revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 3B would result in an increase of $480,000 to $665,000 in total output over 10 years discounted at 7 percent and 3

[26] Spiny lobsters can reach a commercially harvestable size (3.5 inches carapace length) in 7 to 11 years (Barsky 2001). We assume that landings would rebound prior to seven years because sea otters are unable to consume lobsters located in inaccessible habitat (deep crevices). Thus, the harvest may resume in a minimum time interval.

TABLE 6-68 LOBSTER LANDINGS: BENEFITS OF ALTERNATIVE 3B

Year	Commercial Landings (no 10% decrease at San Nicolas Island)	Commercial Landings (increase of 11% at San Nicolas Island)	Total Increase in Commercial Landings (pounds)	Ex-Vessel Revenue	Ex-Vessel Discounted revenue (3%)	Ex-Vessel Discounted revenue (7%)
2012	320	630	951	$8,967	$8,206	$7,320
2013	641	1,261	1,902	$17,934	$15,934	$13,682
2014	961	1,891	2,852	$26,901	$23,205	$19,180
2015	1,282	2,521	3,803	$35,868	$30,039	$23,901
2016	1,602	3,151	4,754	$44,836	$36,455	$27,921
2017	1,923	3,782	5,705	$53,803	$42,472	$31,314
2018	2,243	4,412	6,655	$62,770	$48,108	$34,143
2019	2,564	4,412	6,976	$65,793	$48,956	$33,446
2020	2,884	4,412	7,296	$68,815	$49,714	$32,694
2021	3,205	4,412	7,617	$71,838	$50,386	$31,897
Total Benefits	17,627	30,884	48,510	$457,525	$353,476	$255,497

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price fishers received for lobsters from 2000 to 2009, which is $9.43 per pound in 2009 dollars.
SNI=San Nicolas Island
PV= present value

percent, respectively. These impacts assume fishers would have the capacity to increase their landings.

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 3B is expected to result in an increase in lobster landings within the Southern California Bight of 0.7 percent compared to the baseline (a total benefit of 49,000 pounds over 10 years compared to the projected total for southern California of 6.9 million pounds), the benefit is very low (see Table 5-1 for definitions of levels of significance).

6.6.4.3 Crab Fishery

Under Alternative 3B, commercial crab landings within 10 years would (1) be eliminated along the coastline and (2) increase at San Nicolas Island. The crab fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound). Therefore, there is no impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island may result in a crab harvest increase, compared to the baseline, for two reasons. First, crab landings would not decrease the projected 10 percent as under the baseline because there would be no sea otter population at the island. Therefore, landings would not decrease the anticipated 4,500 pounds from 2012 to 2021. Second, newly recruited crabs or crabs that escaped predation in the past would now potentially be available for commercial harvest. This potential increase follows the assumption that fishery impacts correspond directly to the sea otter's carrying capacity percentage. Sea otters are projected to be at about 11 percent of their estimated carrying capacity at the island in 2012. Thus, crab landings would increase by approximately 11 percent from the 10-year average of 10,634 pounds. We assume that the crab population would rebound from sea otter predation in four years.[27] We further assume that the associated increase in landings would be equally distributed across four years, so that landings would rise by approximately 3 percent (282 pounds) annually between 2012 and 2014, stabilizing to an annual benefit of approximately 1,127 pounds after 2015 (Table 6-69).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial crab fishing in these areas would likely no longer be viable, and landings in these areas would likely approach zero. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight. Therefore, there may be a slight benefit to the crab fishery, compared to the baseline, as a result of some delay in sea otter predation.

Thus, the maximum non-discounted benefit to crab vessels for Alternative 3B would total $20,000. The discounted 10-year benefit for this Alternative would be between $12,000 (discounted at 7 percent) and $16,000 (discounted at 3 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-6.

On average in the southern California crab fishery, 147 vessels participate annually (Leos pers. comm. 2010). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels, then each vessel would have increased landings of approximately 96 pounds and increased revenue between $79 and $107 totaled over 10 years (discounted at 7 percent and 3 percent, respectively).

To determine the regional impact of increased crab revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 3B would result in an increase of $22,000 to $30,000 in total output over 10 years discounted at 7 percent and 3 percent, respectively. These impacts assume fishers would have the capacity to increase their landings.

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 3B is expected to result in an increase in crab ex-vessel revenues within the Southern California Bight of 0.1 percent compared to the baseline (a total benefit of 14,000 pounds over 10 years compared to the projected total for southern California of 9.7 million pounds), the benefit is very low (see Table 5-1 for definitions of levels of significance).

---

[27] Crabs can reach a commercially harvestable size (4.25 inch carapace width) in 4 to 5 years (Parker, 2001). We assume that crab landings would rebound prior to six years because otters are unable to consume crabs inhabiting deep crevices. Thus, crabs may be harvested in less than 4 years.

TABLE 6-69 CRAB LANDINGS: BENEFITS OF ALTERNATIVE 3B						
Year	Commercial Landings (no 10% decrease at San Nicolas Island)	Commercial Landings (increase of 11% at San Nicolas Island)	Total Increase in Commercial Landings (pounds)	Ex-Vessel Revenue	Ex-Vessel Discounted revenue (3%)	Ex-Vessel Discounted revenue (7%)
2012	82	282	364	$521	$476	$425
2013	164	564	727	$1,041	$925	$794
2014	246	845	1,091	$1,562	$1,347	$1,113
2015	328	1,127	1,455	$2,082	$1,744	$1,387
2016	409	1,127	1,537	$2,199	$1,788	$1,370
2017	491	1,127	1,619	$2,317	$1,829	$1,348
2018	573	1,127	1,700	$2,434	$1,865	$1,324
2019	655	1,127	1,782	$2,551	$1,898	$1,297
2020	737	1,127	1,864	$2,668	$1,928	$1,268
2021	819	1,127	1,946	$2,785	$1,954	$1,237
Total Benefits	4,504	9,582	14,085	$20,160	$15,754	$11,563

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price fishers received for crabs from 2000 to 2009, which is $1.43 per pound in 2009 dollars.
SNI=San Nicolas Island
PV=present value

6.6.4.4 Sea Cucumber Fishery

Under Alternative 3B, commercial sea cucumber landings within 10 years would (1) be eliminated along the coastline from Point Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound) and (2) increase around San Nicolas Island. The sea cucumber fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Carpinteria (lower bound) or from Point Conception to Oxnard (upper bound). Therefore, there is no impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island may result in a sea cucumber harvest increase, compared to the baseline, for two reasons. First, sea cucumber landings would not decrease the projected 10 percent as projected under the baseline because there would be no sea otter population at the island. Therefore, landings would not decrease the anticipated 22,735 pounds from 2012 to 2021. Second, newly recruited sea cucumbers and those sea cucumbers that escaped sea otter predation in the past would now potentially be available for commercial harvest. This potential increase follows the assumption that fishery impacts correspond directly to the sea otter's carrying capacity percentage. Sea otters are projected to be at about 11 percent of their estimated carrying capacity at the island in 2012. Thus, sea cucumber landings would increase by approximately 11 percent from the 10-year average of 53,683 pounds. We assume that the sea cucumber population would rebound from sea otter predation in four years.[28] We further assume that the associated increase in landings would be equally distributed across four years, so that landings would rise by about 3 percent (1,423 pounds) annually between 2012 and

[28] There are no size limits for the commercial sea cucumber fishery. However, a commercially desirable size is most likely reached in about 4 to 5 years (CDFG 2006c). We assume that landings would rebound prior to five years because sea otters are unable to reach cucumbers located in sufficiently deep crevices. Therefore, some cucumbers will have survived and will reach a harvestable size in four years.

2014, stabilizing to an annual benefit of 5,690 pounds after 2015 (Table 6-70). This landings increase is dependent upon the assumption that the catch per unit of effort (CPUE) at San Nicolas Island is not already at a maximum, so that the existing sea cucumber vessels have the ability to increase their catch.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial sea cucumber fishing in these areas would likely no longer be viable, and landings in these areas would likely approach zero. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight. Therefore, there may be a slight benefit to the sea cucumber fishery, compared to the baseline, as a result of some delay in sea otter predation.

The maximum non-discounted benefit to sea cucumber fishing vessels for Alternative 3B would total $74,000. The discounted 10-year benefit for this alternative would be about $57,000 (discounted at 3 percent) or $42,000 (discounted at 7 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-4.

On average in the southern California sea cucumber fishery, 49 vessels participate annually (Leos pers. comm 2010). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels, then each vessel would have increased landings of approximately 1,500 pounds and increased revenue between $900 (discounted at 7 percent) and $1,200 (discounted at 3 percent) totaled over 10 years.

To determine the regional impact of increased sea cucumber revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 3B would result in an increase of $79,000 to $108,000 in total output over 10 years discounted at 7 percent and 3 percent, respectively. These impacts assume fishers would have the capacity to increase their landings.

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 3B is expected to result in an increase in sea cucumber ex-vessel revenues within the Southern California Bight of 2 percent compared to the baseline (a total benefit of 71,000 pounds over 10 years compared to the projected total for southern California of 4.9 million pounds), the benefit is of low significance (see Table 5-1 for definitions of levels of significance).

TABLE 6-70 SEA CUCUMBER LANDINGS: BENEFITS OF ALTERNATIVE 3B						
Year	**Commercial Landings (no 10% decrease at San Nicolas Island)**	**Commercial Landings (increase of 11% at San Nicolas Island)**	**Total Increase in Commercial Landings (pounds)**	**Ex-Vessel Revenue**	**Ex-Vessel Discounted revenue (3%)**	**Ex-Vessel Discounted revenue (7%)**
2012	413	1,423	1,836	$1,898	$1,737	$1,550
2013	827	2,845	3,672	$3,796	$3,373	$2,896
2014	1,240	4,268	5,508	$5,695	$4,912	$4,060
2015	1,653	5,690	7,344	$7,593	$6,359	$5,060
2016	2,067	5,690	7,757	$8,020	$6,521	$4,995
2017	2,480	5,690	8,171	$8,448	$6,669	$4,917
2018	2,894	5,690	8,584	$8,875	$6,802	$4,827
2019	3,307	5,690	8,997	$9,302	$6,922	$4,729
2020	3,720	5,690	9,411	$9,730	$7,029	$4,623
2021	4,134	5,690	9,824	$10,157	$7,124	$4,510
Total Benefits	22,735	48,368	71,103	$73,515	$57,449	$42,166

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price divers received for sea cucumbers from 2000 to 2009, which is $1.36 per pound in 2009 dollars.
SNI=San Nicolas Island
PV=present value

6.6.4.5 Gill and Trammel Net Fishery

6.6.4.5.1 Halibut Fishery

Under Alternative 3B, the regulatory environment would change (see section 6.6.12). The area from Point Conception to the Mexican border would become subject to the regulations currently in effect throughout the remainder of the southern sea otter's range. Commercial halibut landings using gill and trammel net gear along the coastline from Point Conception to Port Hueneme would be affected within 10 years only if the State or NMFS responded to the change in regulatory environment by imposing an additional depth restriction on the use of gill and trammel net gear in this area. It is important to note that the State or NMFS could choose not to act even if sea otters did return to the coastline southeast of Point Conception. Therefore, commercial halibut landings using gill and trammel net gear in this area would either be 1) unaffected (low estimate) or 2) eliminated (high estimate).

The incidental taking of southern sea otters in commercial fisheries is currently prohibited within the translocation zone, and it would remain prohibited if this alternative were selected. Therefore, the change in the regulatory environment that would occur under this alternative would not result in any additional impetus for the State or NMFS to impose supplementary depth restrictions on the use of gill and trammel net gear at San Nicolas Island.

Summary of Impacts

In the lower estimate (no additional closure), there would be no impacts. In the upper estimate (immediate closure), losses would accumulate because halibut landings using gill or trammel net gear would be eliminated from Santa Barbara to Port Hueneme. Landings would decrease an anticipated maximum 601,000 pounds over 10 years from 2012 to 2021. Table 6-71 shows that the total non-discounted maximum loss to the halibut fishery over 10 years for Alternative 3B would total about $2.5 million, and the total discounted loss for this alternative would be about $2.2 million (discounted at 3 percent) or $1.7 million (discounted at 7 percent).

To determine the regional impact of decreased halibut revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 3B would result in a decrease of $3.2 million to $4.2 million in total output over 10 years discounted at 7 percent and 3 percent, respectively.

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. In the lower estimate (no additional closure), there would be no impacts. In the upper estimate (immediate closure), the expected decrease in halibut landings resulting from implementation of Alternative 3B would constitute 21 percent of halibut landings in the Southern California Bight (all gear types) (Table 6-16). Thus Alternative 3B is expected to result in either 1) no effect or 2) a negative effect of high significance (see Table 5-1 for definitions of levels of significance).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas, it is possible that the State or NMFS would close commercial halibut fishing using gill and trammel net gear in additional areas. The removal of sea otters from San Nicolas Island could 1) slow the rate of eventual dispersal of sea otters into the southern areas of the Southern California Bight or 2) increase the rate of dispersal because unsettled sea otters could colonize new areas. Therefore, it is not possible to predict the effects

TABLE 6-71 HALIBUT LANDINGS: EFFECTS OF ALTERNATIVE 3B – UPPER ESTIMATE (ADDITIONAL DEPTH RESTRICTION SANTA BARBARA TO PORT HUENEME)

Year	Decrease in Commercial Landings (Pounds)	Ex-Vessel Revenue*	Ex-Vessel Discounted Revenue (3%)*	Ex-Vessel Discounted Revenue (7%)*
2012	60,064	-$276,953	-$253,451	-$226,076
2013	60,064	-$276,953	-$246,069	-$211,286
2014	60,064	-$276,953	-$238,902	-$197,463
2015	60,064	-$276,953	-$231,943	-$184,545
2016	60,064	-$276,953	-$225,188	-$172,472
2017	60,064	-$276,953	-$218,629	-$161,189
2018	60,064	-$276,953	-$212,261	-$150,644
2019	60,064	-$276,953	-$206,079	-$140,789
2020	60,064	-$276,953	-$200,076	-$131,578
2021	60,064	-$276,953	-$194,249	-$122,970
Total	600,640	-$2,504,669	-$2,226,846 (PV@3%)	-$1,699,012 (PV@7%)

Note: Values are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price received for halibut from 2000 to 2009, which is $4.61 per pound in 2009 dollars.

of removal of sea otters from San Nicolas Island on additional depth restrictions on the use of gill and trammel net gear in other areas.

6.5.4.5.2 White Seabass Fishery

Under Alternative 3B, the regulatory environment would change (see section 6.5.12). The area from Point Conception to the Mexican border would become subject to the regulations currently in effect throughout the remainder of the southern sea otter's range. Commercial white seabass landings using gill and trammel net gear along the coastline from Point Conception to Port Hueneme would be affected within 10 years only if the State or NMFS responded to the change in regulatory environment by imposing an additional depth restriction on the use of gill and trammel net gear in this area. The possibility that the State or NMFS would act may be decreased or delayed, relative to the baseline, by the short-term removal of sea otters from the coastline southeast of Point Conception as required under this alternative, but sea otters would be expected to return to the coastline eventually. It is important to note that the State or NMFS could choose not to act even if sea otters did return to the coastline southeast of Point Conception. Therefore, commercial white seabass landings using gill and trammel net gear in this area would either be 1) unaffected (low estimate) or 2) eliminated (high estimate).

The incidental taking of southern sea otters in commercial fisheries is currently prohibited within the translocation zone, and it would remain prohibited if this alternative were selected. Therefore, the change in the regulatory environment that would occur under this alternative would not result in any additional impetus for the State or NMFS to impose supplementary depth restrictions on the use of gill and trammel net gear at San Nicolas Island.

Summary of Impacts

In the lower estimate (no additional closure), there would be no impacts. In the upper estimate (immediate closure), losses would accumulate because white seabass landings using gill or trammel net gear would be eliminated from Santa Barbara to Port Hueneme. Landings would decrease an anticipated maximum 1.2 million pounds over 10 years from 2012 to 2021. Table 6-72 shows that the total non-discounted loss to the white seabass fishery over 10 years for Alternative 3B would total about $2.8 million, and the total discounted loss for this Alternative would be about $2.3 million (discounted at 3 percent) or $1.7 (discounted at 7 percent).

To determine the regional impact of decreased white seabass revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 3B would result in a decrease of $3.2 million to $4.3 million in total output over 10 years discounted at 7 percent and 3 percent, respectively.

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. In the lower estimate (no additional closure), there would be no impacts. In the upper estimate (immediate closure), the expected decrease in white seabass landings resulting from implementation of Alternative 3B would constitute 42 percent of white seabass landings in the Southern California

TABLE 6-72 WHITE SEABASS LANDINGS: EFFECTS OF ALTERNATIVE 3B – UPPER ESTIMATE (ADDITIONAL DEPTH RESTRICTION SANTA BARBARA TO PORT HUENEME)				
Year	**Decrease in Commercial Landings (Pounds)**	**Ex-Vessel Revenue***	**Ex-Vessel Discounted Revenue (3%)***	**Ex-Vessel Discounted Revenue (7%)***
2012	117,129	-$284,638	-$260,484	-$232,350
2013	117,129	-$284,638	-$252,898	-$217,149
2014	117,129	-$284,638	-$245,532	-$202,943
2015	117,129	-$284,638	-$238,380	-$189,667
2016	117,129	-$284,638	-$231,437	-$177,258
2017	117,129	-$284,638	-$224,696	-$165,662
2018	117,129	-$284,638	-$218,152	-$154,824
2019	117,129	-$284,638	-$211,798	-$144,696
2020	117,129	-$284,638	-$205,629	-$135,230
2021	117,129	-$284,638	-$199,640	-$126,383
Total	1,171,294	-$2,846,384	-$2,288,645 (PV@3%)	-$1,746,162 (PV@7%)

Note: Values are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price received for white seabass from 2000 to 2009, which is $2.43 per pound in 2009 dollars.

Bight (all gear types) (Table 6-20). Thus Alternative 3B is expected to result in either 1) no effect or 2) a negative effect of very high significance (see Table 5-1 for definitions of levels of significance).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas, it is possible that the State or NMFS would close commercial white seabass fishing using gill and trammel net gear in additional areas. The removal of sea otters from San Nicolas Island could 1) slow the rate of eventual dispersal of sea otters into the southern areas of the Southern California Bight or 2) increase the rate of dispersal because unsettled sea otters could colonize new areas. Therefore, it is not possible to predict the effects of removal of sea otters from San Nicolas Island on additional depth restrictions on the use of gill and trammel net gear in other areas.

6.6.5 Marine Aquaculture

Effects on marine aquaculture resulting from Alternative 3B are essentially the same as for the baseline (local, episodic reduction of mussel densities in the Santa Barbara Channel). Although Alternative 3B would require the removal of sea otters from San Nicolas Island, the removal of these animals is not likely to affect marine aquaculture operations compared to the baseline because there are currently no aquaculture operations at San Nicolas Island. We do not assign a level of significance to marine aquaculture because of the extent of uncertainty involved.

Beyond 10 years, the removal of sea otters from San Nicolas Island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, but the benefits of slowed range expansion to marine aquaculture are expected to be relatively minor because 1) there are few registered open-water aquaculture operations in the remainder of the Southern California Bight (*i.e.*, not in Santa Barbara Channel); 2) under baseline conditions, sea otter range expansion (if it continues to occur) is expected to occur gradually over the course of many decades; and 3) sea otters are not likely to affect abalone or finfish aquaculture operations and would likely affect mussel operations only locally and episodically. Depending on the production methods, the presence of sea otters in the Southern California Bight may affect the shellfish aquaculture that is anticipated under NOAA's Ten Year Strategic Plan, National Marine Aquaculture Policy, and National Shellfish Initiative.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

6.6.6 Seafood Processing Industry (Sea Urchins)

Under Alternative 3B, impacts to the sea urchin processing industry would be a function of the change in sea urchin landings. Alternative 3B would have no additional impact on sea urchin landings along the coastline from Point Conception to Carpinteria (lower estimate) or from Point Conception to Oxnard (upper estimate). However, the removal of sea otters from San Nicolas Island would increase southern California landings by 1 percent over 10 years. Thus, impacts to the sea urchin processing industry are likely to be minor, representing a slight benefit to the sea urchin processing industry compared to the baseline.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, sea urchin harvesting would no longer be viable in these areas, and the sea urchin processing industry would be required to obtain sea urchins harvested from other areas of the Southern California Bight. The sea urchin processing industry would eventually be eliminated in southern California if sea otters reached carrying capacity where sea urchin harvesting occurs in the Southern California Bight and processors were unable to obtain sea urchins from elsewhere. This projection is equivalent to the baseline.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

Within 10 years, Alternative 3B is expected to have a beneficial effect of very low significance on the seafood processing industry (resulting from an increase of 0.4 percent in regional sea urchin inputs).

6.6.7 KELP HARVEST

The effects of Alternative 3B on the amount of kelp available for harvest are the same as those for Alternative 3A and differ from the baseline only with respect to the removal of sea otters from San Nicolas Island (for a description of the relationship between sea otters and kelp abundance, see section 6.2.2). The removal of animals from San Nicolas Island would eliminate the colony, probably resulting in minor increases in invertebrate prey populations within a few years. Removing sea otters from San Nicolas Island could impact kelp harvest at San Nicolas Island. Any enhancement of kelp that would have been afforded by a colony persisting at San Nicolas Island (as projected under the baseline) would not occur, representing a possible slight cost to the kelp industry. We do not assign a level of significance to kelp harvesting because of the extent of uncertainty involved.

In the longer term, elimination of the sea otter colony at San Nicolas Island would likely slow sea otter recolonization of the Southern California Bight and thus would also delay possible associated increases in kelp abundance throughout the area. A slight loss to the kelp harvesting industry, compared to the baseline, could additionally result from this delay. Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

6.6.8 RECREATIONAL FISHING

Recreational fishing activities that may be affected by sea otters include lobster fishing, abalone fishing, and finfish fishing. Lobster fishing and finfish fishing are addressed below. Abalone diving is included under "Abalone Fishery Restoration" (section 6.6.9).

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

6.6.8.1 Lobster Fishing

Within the next 10 years under Alternative 3B, the recreational lobster fishery would be (1) eliminated along the coastline from Point Conception to Carpinteria (lower estimate) or from Point Conception to Oxnard (upper estimate) and (2) improved at San Nicolas Island. The recreational lobster fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Carpinteria (CDFG statistical blocks 651, 652, 653, 654, 655, 656, and 657) or from Point Conception to Oxnard (CDFG statistical blocks 683, 664, 665, 651, 652, 653, 654, 655, 656, and 657). Therefore, there is no impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island may result in an increase in recreational lobster fishing trips, compared to the baseline, for two reasons. First, lobster fishing trips would not decrease the projected 10 percent as under the baseline because there would be no sea otter population at the island. Therefore, recreational lobster fishing via CPFVs would not decrease an anticipated 184 trips from 2012 to 2021. Second, recreational lobster fishing via CPFVs may increase because newly recruited lobsters and those lobsters that escaped predation in the past would now potentially be available for recreational harvest. This potential increase follows the assumption that recreational fishery impacts correspond directly to the sea otter's carrying capacity percentage. Sea otters are projected to be at about 11 percent of their estimated carrying capacity at the island in 2012. Thus, recreational lobster fishing trips via CPFVs would increase by approximately 11 percent from the 10-year average of 434 trips. We assume that the lobster population would rebound from sea otter predation in seven years[29] for recreational harvest. We further assume that the associated increase in trips would be equally distributed across seven years, so that trips would rise by about 1 percent (about 5 trips) annually between 2012 and 2018, stabilizing to an annual benefit of approximately 46 trips after 2018 (Table 6-73).

The benefit to the recreational lobster fishery under Alternative 3B would total 439 trips over 10 years. On average in the southern California recreational fishery, there are 22 CPFVs (CDFG 1995-2001). If the increased trips were distributed equally among these vessels, then each commercial passenger fishing vessel would supply 20 additional trips over 10 years, if there is demand for these additional trips. This change would represent a slight benefit to recreational lobster divers by increasing the potential for catching a lobster or increasing the number of lobster fishing trips taken compared to the baseline.

Alternative 3B would provide the recreational lobster fishery (conducted via CPFVs) with an average annual benefit (for the 10-year time frame) of about 44 trips. This benefit is less than 1

[29] Spiny lobsters can reach a commercially harvestable size (3.5 inches carapace length) in 7 to 11 years (Barsky 2001). We assume that landings would rebound prior to seven years because sea otters are unable to consume lobsters located in inaccessible habitat (deep crevices). Thus, the harvest may resume in a minimum time interval.

TABLE 6-73 RECREATIONAL LOBSTER FISHING TRIPS: BENEFITS OF ALTERNATIVE 3B		
Year	**Dive Trips (no 10% decrease at San Nicolas Island)**	**Dive Trips (increase of 11% at San Nicolas Island)**
2012	3	7
2013	7	13
2014	10	20
2015	13	26
2016	17	33
2017	20	39
2018	23	46
2019	27	46
2020	30	46
2021	33	46
Total Benefits	506 trips	
Note: Benefits are rounded to the nearest trip.		

percent of the annual average of 8,322 trips for the Southern California Bight (see section 6.2.8.1). Therefore, the beneficial effect resulting from Alternative 3B is very low.

Information from the limited number of lobster report cards returned from 2008-2011 suggests that 0.2 percent of the total number of lobster fishing trips (including CPFV trips) in the Southern California Bight occurs at San Nicolas Island. The removal of sea otters from San Nicolas Island, as required under Alternative 3B, would result in a potential slight increase in the proportion of recreational lobster fishing trips to the island during the next 10 years. We do not use report card data as the basis for assigning a level of significance because these data are limited, and the estimates based on them are necessarily provisional.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, recreational lobster fishing trips in these areas would likely approach zero. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight. Therefore, there may be a slight benefit to the recreational lobster fishery, compared to the baseline, as a result of some delay in sea otter predation.

6.6.8.2 Finfish Fishing

The effects of Alternative 3B are the same as for the baseline except with respect to San Nicolas Island. As described for the baseline, the presence of sea otters may improve habitat for recreationally important finfish and thus have a positive effect on the abundance of finfish available for harvest. Such changes would likely require more than 10 years to become noticeable (because the reestablishment of giant kelp canopies in areas where sea urchin grazing is limiting kelp is expected to take at least 10 years) and could occur gradually over several decades. A discussion of the long-term effects of sea otter predation on the kelp forest community, including finfish production, is given in section 6.2.2.

The removal of sea otters from San Nicolas Island is generally expected to affect recreational finfish fishing negatively relative to the baseline by eliminating the stabilizing and enhancing effects that a persistent sea otter colony may have on the kelp beds surrounding the island.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized areas of the Southern California Bight at the densities seen in the mainland range for comparable habitat, recreational finfish fishing may benefit. This long-term projection differs from the baseline only to the extent that the removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight.

We do not assign a level of significance to recreational finfish fishing because of the extent of uncertainty involved.

6.6.9 ABALONE FISHERY RESTORATION

The effects of Alternative 3B are the same as for the baseline except with respect to San Nicolas Island. As described for the baseline, within 10 years sea otter range expansion along the coastline towards Carpinteria and Oxnard would preclude the reestablishment of abalone fishing in that area. However, it does not appear that there is any potential for reopening the abalone fishery (for any species) during the next 10 years, regardless of the presence or absence of sea otters, except possibly at San Miguel Island, where a limited fishery for red abalone is currently being considered (see section 6.2.9). Because the abalone fishery is unlikely to be reopened along the mainland coastline towards Carpinteria and Oxnard within 10 years, and because sea otters are not expected to recolonize the northern Channel Islands within 10 years, sea otters would likely have no effect on the potential for reopening any abalone fishery in the short term.

San Nicolas Island is identified in the Abalone Recovery and Management Plan (CDFG 2005c) as 1 of 10 key recovery areas for black abalone. Compared to the baseline, removing sea otters from San Nicolas Island would increase the probability that black abalone would reach Criterion 1 (and possibly even Criteria 2 and 3, at which point the population could be considered for a reopening of the abalone fishery). However, even if sea otters were successfully removed, it is possible that they would recolonize San Nicolas Island through natural range expansion before abalone populations have reached the fishery consideration phase (Criterion 3), which is expected to require several decades. In this case, a reopening of the abalone fishery would be precluded in this area.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized areas of the Southern California Bight at the densities seen in the mainland range for comparable habitat, the restoration of an abalone fishery in these areas would not be viable. At San Miguel Island, red abalone populations are apparently stable (Karpov *et al.* 2000). Eventual colonization of San Miguel Island by sea otters would reduce the densities of red abalone present there (Hines and Pearse 1982) and thus reduce but not eliminate the potential for these populations to contribute reproductively to other areas in the Southern California Bight. This reduced reproductive potential could have a detrimental effect on the eventual re-opening of the red abalone fishery in other areas of the Southern California Bight, if such a re-opening were proposed, even if sea otters were not present in these other areas. This long-term projection under Alternative 3B differs from the baseline only to the extent that the removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

We do not assign a level of significance to abalone fishery restoration because of the extent of uncertainty involved.

6.6.10 Ecotourism and Non-Market Value

The effects of Alternative 3B are the same as for Alternative 3A. They are also the same as for the baseline, except with respect to San Nicolas Island. As described for the baseline, tourism based on sea otter watching would be enhanced within 10 years as sea otters progressively reoccupy and begin to reside year-round along the stretch of mainland coastline between Point Conception and Carpinteria or between Point Conception and Oxnard. Overall economic value of this tourism is difficult to quantify and would not necessarily result in increased economic activity. Rather, it would likely manifest itself as an added value to other tourist draws in the area. As under the baseline, non-market benefits of $13.2 million to $32.5 million would accrue due to the increasing sea otter population from 2012 to 2021.

The removal of sea otters from San Nicolas Island is generally expected to affect ecotourism negatively relative to the baseline by reducing or eliminating the possibility of a sea otter sighting at the island. Under the baseline, we do not expect ecotourism in this area to grow considerably (in terms of number of trips) over the next 10 years as a result of the increased abundance of sea otters, but we do expect that the quality of recreational trips to San Nicolas Island would be enhanced due to the better possibility of a sea otter sighting. Removal of sea otters from San Nicolas Island may result in decreased non-market values if the removed sea otters do not survive.

The removal of sea otters from San Nicolas Island could have unpredictable effects on the rapidity with which other areas of the Southern California Bight are recolonized, but it would likely slow recolonization because dispersing sea otters would come from only one direction (the mainland range). Generally, however, the long-term effects of Alternative 3B on ecotourism are expected to be the same as for the baseline.

We do not assign a level of significance to ecotourism/non-market value because of the extent of uncertainty involved.

6.6.11 Federal and State Agency Programs

We do not assign a level of significance to effects on agency programs because these effects and programs are various and cannot be meaningfully compared with a single set of criteria. For a discussion of the regulatory environment, see section 6.6.12.

In the following discussions, we assume that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight. Nevertheless, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

6.6.11.1 U.S. Fish and Wildlife Service

The effects of Alternative 3B on southern sea otter recovery are also addressed in section 6.6.3.3 ("Southern Sea Otter"). Here we address our ability to meet our mandates under the ESA and MMPA and give the implementation costs of the alternative.

Ability to Meet Mandate

Our ability to achieve recovery and the Optimum Sustainable Population level for sea otters in California under Alternative 3B is the same as that described for 3A (see section 6.5.11.1). Both alternatives require removal of the sea otters from San Nicolas Island. Alternative 3A additionally requires the removal of sea otters from the management zone at the time the decision to terminate the program is made, but that removal would not likely have any discernible effects compared to the baseline because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which fluctuates in sea otter numbers on a seasonal basis, and 2) sea otters are capable of returning rapidly to areas from which they have been removed.

Alternative 3B, like Alternative 3A, differs notably from the baseline with respect to the regulatory provisions that would apply to sea otters in the Southern California Bight because the management and translocation zones would no longer exist. For a discussion of these provisions, see section 6.6.12.

Implementation Costs (10-year period)

The change in the regulatory provisions that apply to sea otters in the Southern California Bight under Alternative 3B may result, in the long term, in increased coordination and consultation between USFWS and other parties regarding activities that may affect the southern sea otter. Costs resulting from an increased consultation workload are not included here because few or no activities requiring consultation presently occur or are expected to occur in the area that sea otters would likely reoccupy within the next 10 years. New implementation costs would be incurred under Alternative 3B. These costs derive from the removal sea otters from San Nicolas Island and include expenditures for personnel, transportation, and equipment (Table 6-74).

TABLE 6-74 PERSONNEL AND EQUIPMENT NEEDED TO IMPLEMENT ALTERNATIVE 3B

Personnel	Transportation	Equipment
Program Manager	2 Vans	Boat Maintenance
Capture Teams	1 Tow Vehicle	Dive Gear and Maintenance
Transport Team	2 Monitor Vehicles	Tracking Equipment
Monitoring Team	Air Charters	Training
Veterinary Services	Boat Charters	
	Travel Costs	

Estimated expenditures are given in Table 6-75. Activities related to the removal of sea otters from the translocation zone would be necessary for the first year. After all reasonable efforts were expended to remove sea otters from the zone, no further maintenance would continue. In the second year, only monitoring efforts would be implemented. Therefore, implementation costs would cease after the second year.

The estimated expenditures given in Table 6-75 represent the entire program costs for 10 years. Based upon past and projected efforts, the non-discounted annual implementation costs would sum to about $848,000 over two years.

TABLE 6-75 IMPLEMENTATION COSTS FOR REMOVAL OF SEA OTTERS FROM SAN NICOLAS ISLAND

Year	Annual Cost			Discounted Cost (3% discount rate)	Discounted Cost (7% discount rate)
	Personnel	Transportation	Equipment		
2012	$535,000	$116,000	$85,000	$673,544	$600,795
2013	$90,000	$21,000	$1,000	$99,511	$85,444
2014	-	-	-	-	-
2015	-	-	-	-	-
2016	-	-	-	-	-
2017	-	-	-	-	-
2018	-	-	-	-	-
2019	-	-	-	-	-
2020	-	-	-	-	-
2021	-	-	-	-	-
Total	$848,000			$773,055 (PV@3%)	$686,240 (PV@7%)

6.6.11.2 Channel Islands National Park

The effects of Alternative 3B are the same as those for 3A. Alternative 3B would allow sea otters to recolonize the Southern California Bight. While no effects of sea otters would be expected within 10 years, sea otters would likely eventually re-establish their range within Park boundaries. Alternative 3B is consistent with the mission and mission-related goals of CINP to protect and restore natural ecosystems and to practice ecosystem management.

Under Alternative 3B, the regulatory environment would change (see section 6.6.12). The change in the regulatory provisions that apply to sea otters in the Southern California Bight under Alternative 3B could result, in the long term, in increased coordination and consultation between USFWS and Channel Islands National Park regarding activities that may affect the southern sea otter if sea otters recolonize historic range within Park boundaries.

6.6.11.3 Channel Islands National Marine Sanctuary

The effects of Alternative 3B are the same as those for 3A. Alternative 3B would allow sea otters to recolonize the Southern California Bight. While no effects of sea otters would be expected within 10 years, sea otters would likely eventually re-establish their range within Sanctuary boundaries. Alternative 3B is consistent with the mission of CINMS to conserve and enhance the biodiversity, ecological integrity, and cultural legacy of areas of special national significance.

Under Alternative 3B, the regulatory environment would change (see section 6.6.12). The change in the regulatory provisions that apply to sea otters in the Southern California Bight under Alternative 3B could result, in the long term, in increased coordination and consultation between USFWS and Channel Islands National Marine Sanctuary regarding activities that may affect the southern sea otter if sea otters recolonize historic range within Sanctuary boundaries.

6.6.11.4 California Department of Fish and Game

Effects on the recovery of white and black abalone and sea otters are discussed under "Candidate, Threatened, and Endangered Species" (section 6.6.3). Effects on existing commercial fisheries and the restoration of the abalone fishery are discussed under "Commercial Fisheries" (section 6.6.4) and "Abalone Fishery Restoration" (section 6.6.9). Effects on Marine Protected Areas (MPAs) and the restoration of depleted abalone species that are not federally listed are discussed here.

Marine Protected Areas

The effects of Alternative 3B are the same as those for 3A, except that sea otters would not be subject to short-term removal from the management zone. Alternative 3B would allow sea otters to recolonize the Southern California Bight. While the effects of sea otters would be expected to be limited to the five MPAs along the mainland coastline west of Carpinteria/Oxnard within 10 years, sea otters would likely eventually re-establish their range within additional MPAs. In such as case, Alternative 3B would have a positive effect on MPAs overall, as under the baseline. For a full discussion of the expected effects of sea otters on MPAs, see section 6.2.11.4.

The potential difference between Alternative 3B and the baseline arises from the removal of sea otters from San Nicolas Island, which could have unpredictable effects on the rapidity with which other areas of the Southern California Bight are recolonized. Removal of sea otters from San Nicolas Island (if sea otters did not immediately return) would likely slow the eventual colonization of areas designated as MPAs in southern California because dispersing sea otters would come from only one direction (the mainland range). Generally, however, the effect of this alternative would be to allow the eventual return of sea otters to areas designated as MPAs.

Restoration of Depleted Abalone Species (Not Federally Listed)

Enhancement activities include the translocation or aggregation of adult stocks, larval outplanting, captive breeding to obtain large individuals for outplanting, and the establishment of MPAs (CDFG 2005c). The effects of Alternative 3B are virtually the same as under the baseline scenario. Under baseline conditions, sea otters are expected to recolonize the mainland coastline to Carpinteria (lower bound) or Oxnard (upper bound) within the next 10 years and to recolonize other areas of the Southern California Bight gradually in the longer term. The potential difference between 3B and the baseline arises from the removal of sea otters from San Nicolas Island, which could have unpredictable effects on the rapidity with which other areas of the Southern California Bight are recolonized. Removal of sea otters from San Nicolas Island (if sea otters did not immediately return) would likely provide a slight benefit, relative to the baseline, to State efforts to enhance abalone populations by means of larval outplanting if outplanting efforts were planned for habitats lacking sufficient cryptic habitat to shield abalone from sea otter predation. However, the unpredictability of the effects of sea otter removal from San Nicolas Island would likely far outweigh any slight benefit of removal because of the difficulty of planning restoration efforts in the face of uncertainty. In the long term, the effect of this alternative would be to allow the eventual return of sea otters to the Southern California Bight. Any negative effects of natural range expansion would be lessened to the extent that outplanting efforts were conducted in cryptic habitat that is inaccessible to sea otters or in areas outside the range into which sea otters naturally expanded. The translocation or aggregation of adult stocks would likely be unaffected by sea otters, as one purpose of translocation is to protect adults from predation or other threats, and it would seem likely that abalone would be translocated into, or aggregated in, sufficiently protective crevice habitat. Natural range expansion of sea otters into the Southern California Bight would not affect other enhancement activities, such as captive breeding or the establishment of MPAs.

6.6.11.5 U.S. Navy/Department of Defense

Effects on the U.S. Navy/DOD are regulatory. Under Alternative 3B, the translocation program would be declared a failure, and the management zone and translocation zone would be abolished. As a consequence, the regulatory environment would change (see section 6.6.12). The change in the regulatory provisions that apply to sea otters in the Southern California Bight under Alternative 3B will result in increased coordination and consultation between USFWS and the U.S. Navy/DOD regarding activities that may affect the southern sea otter if sea otters are present at San Nicolas Island or if sea otters eventually colonize areas within the Pt. Mugu Sea Range or SOCAL Range Complex.

Under Alternative 3B, sea otters would be removed from San Nicolas Island, but it is possible that some animals would return after removal efforts had ceased. Although there could be some delay before one or more animals returned, our experience translocating sea otters to San Nicolas Island suggests that many sea otters would attempt to return to their home range immediately. While the colony would likely be greatly reduced in number, at least initially, the regulatory requirements would be the same irrespective of the number of sea otters. To date, we have no evidence that defense-related activities have had any adverse effects on sea otters at San Nicolas Island or in the management zone. However, the U.S. Navy/DOD anticipates probable future changes in the type and tempo of military testing and training activities in response to evolving international threats and military technologies. Under Alternative 3B, an intensification of military activities in the nearshore waters of the island would likely trigger the need for additional regulatory compliance on the part of the U.S. Navy/DOD if and when sea otters returned to the island. To minimize the impacts of the U.S. Navy/DOD's increased regulatory obligations, we would propose to coordinate with the U.S. Navy/DOD to develop a programmatic consultation for activities that may affect southern sea otters at San Nicolas Island or to seek other potential mutually agreeable solutions. Although future Naval program requirements may change, necessitating multiple consultations over time, programmatic consultations can cover anticipated activities until these requirements change, thereby minimizing the regulatory burden on the Navy associated with ESA compliance with respect to sea otters. The U.S. Navy/DOD is currently required to obtain an Incidental Harassment Authorization under the MMPA for the incidental non-lethal "take by harassment" of marine mammals during missile and target launch operations at San Nicolas Island. The requirement to complete Section 7 consultation for sea otters in the areas surrounding San Nicolas Island would constitute an additional regulatory burden on the U.S. Navy/DOD relative to the baseline.

Although the range of the southern sea otter is predicted to extend only to Carpinteria (lower bound) or Oxnard (upper bound) (see section 6.1.4.1) within the 10-year time horizon (this area of the coastline is outside the boundaries of the Point Mugu Sea Range and the SOCAL range complex), individual sea otters have traveled and will likely continue to travel into and out of other areas of the Southern California Bight during this period. Whether sea otter range expansion would extend to other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. Where sea otters were present, the U.S. Navy/DOD would be subject to the full requirements and authorizations of the ESA and MMPA for activities that may affect the species. Currently, the U.S. Navy/DOD is required to consult with USFWS on actions that may affect other listed species under the ESA and to request Incidental Harassment Authorization under the MMPA for activities affecting other marine mammals. We would propose to add southern sea otters to a programmatic Biological Opinion for other species listed under the ESA at San Clemente Island and to address southern sea otter requirements under the MMPA concurrently with the Incidental Harassment Authorization process the Navy already undergoes with NMFS for other marine mammal species. These processes would occur only when sea otters were present in those areas of the Southern California Bight.

The magnitude of the increased regulatory burden on the U.S. Navy/DOD would depend on the eventual abundance of sea otters in naval ranges throughout southern California and the types of naval activities proposed to be conducted there. In the event that USFWS determined in a future Section 7 consultation that proposed Naval operations were likely to result in jeopardy to the sea otter, Section 7(j) of the ESA requires the Endangered Species Committee, and ad hoc committee made of up the heads of several federal agencies, including but not limited to, the Secretaries of Interior, Commerce, Agriculture, and Army, to grant an exemption from the requirements of Section 7(a)(2) "for any agency action if the Secretary of Defense finds that such exemption is necessary for reasons of national security." Similarly, the Navy may seek a National Defense Exemption from requirements of the MMPA. These options may be exercised by the Secretary of Defense if deemed appropriate.

6.6.11.6 Bureau of Ocean Energy Management

The effects of 3B are regulatory and are the same as those under 3A. Under Alternative 3B, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.6.12). This change could result in increased coordination and consultation between USFWS and BOEM regarding activities that may affect the southern sea otter. However, the added consultation and permitting requirements for actions that may affect sea otters in the Southern California Bight would likely impose only a minor additional regulatory burden on BOEM for the following reasons: 1) the physical presence of the oil industry is expected to diminish offshore of California over the next several decades (BOEM pers. comm. 2010); 2) all proposed actions that may affect *other* threatened or endangered species or marine mammals are already subject to consultation and permitting requirements under the ESA and MMPA; 3) the regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of this alternative, and requirements for consultations or permits related to the southern sea otter have been minimal; 4) southern sea otters would not be present in most of southern California for decades (if range expansion continues to occur).

6.6.11.7 National Marine Fisheries Service

National Marine Fisheries Service activities that occur within or overlap with the nearshore areas of the Southern California Bight are diverse. These activities include implementing recovery actions for federally listed threatened and endangered species and managing federal fisheries. Information on endangered white and black abalone and NMFS-led recovery efforts for these species is given under "Candidate, Threatened, and Endangered Species." Federally managed fisheries are discussed here.

The effects of 3B are regulatory and are the same as those under 3A. Under Alternative 3B, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.6.12). This change may result in increased coordination and consultation between USFWS and NMFS regarding activities that may affect the southern sea otter. NMFS would be required to consult under Section 7 of the ESA and to comply with other applicable laws on actions that may affect sea otters in the Southern California Bight. Take of southern sea otters caused by commercial fisheries cannot be authorized under section 118 of the MMPA. However, any changes would likely be minor. The current regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of this alternative, and requirements for consultations or permits related to the southern sea otter have been minimal. We expect that effects on federally managed fisheries in the Southern California Bight would also be minimal due to the gear types used and/or the depths in which these fisheries are pursued.

6.6.12 REGULATORY ENVIRONMENT

The regulatory environment under Alternative 3B would be identical to the regulatory environment under Alternatives 3A and 3C, although the actual effects of regulatory changes relative to the baseline depend on the presence or absence of sea otters in the Southern California Bight (see section 6.6.11 for a discussion of possible scenarios).

Under Alternative 3B, as under Alternatives 3A and 3C, the translocation program would be declared a failure and terminated, the management and translocation zones would be abolished, and the provisions of Public Law 99-625 would become inoperative. California Fish and Game Code section 8664.2 would also become inoperative. As a result, all activities that may affect southern sea otters within the Southern California Bight would be fully subject to the ESA, the

MMPA, and California state law, including applicable consultation requirements and take prohibitions under these laws.

All federal agencies planning activities that may affect southern sea otters in the Southern California Bight would be required to consult with USFWS under Section 7 of the ESA and seek authorization for incidental take of sea otters under the ESA and provisions of the MMPA. If otherwise allowable under applicable state law, including California Fish and Game Code section 4700, non-federal activities that would result in take of southern sea otters in California would require incidental take authorization from USFWS under section 10(a)1(B) of the ESA and section 101(a)(5) of the MMPA. Incidental take of southern sea otters in commercial fisheries cannot be authorized under the MMPA. Therefore, incidental take of southern sea otters in commercial fisheries throughout the Southern California Bight would be prohibited, as it is currently prohibited throughout the remainder of the range of the species (north of Point Conception). Intentional take would continue to be prohibited unless authorized, as under the current regulations.

This change in the regulatory environment would not be likely to result in substantial effects on activities now being conducted within the Southern California Bight for several reasons:

1) The current regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of Alternatives 3A, 3B, or 3C in the Southern California Bight. Commercial fishing activities, harbor maintenance, oil and gas exploration, and other human activities are similar in the two sections of coastline. Along the central coast, requirements for consultations and take authorizations under the ESA and MMPA related to the southern sea otter have been minimal, and we would expect the same to be the case for the Southern California Bight. This is because there are few otherwise legal activities that result in take of southern sea otters and because the southern sea otter's historic habitat, although somewhat degraded, is essentially intact.

2) Southern sea otters would not be present in most of southern California for many decades. In fact, we cannot reliably assert that range expansion will occur at all. Critical habitat has not been designated for the southern sea otter and is not proposed or required (the southern sea otter was listed under the ESA prior to passage of the requirement to designate critical habitat). With no sea otters present in most of the Southern California Bight and no designated critical habitat, the likelihood that adverse interactions between sea otters and human activities would occur would be less than the likelihood that currently exists along the central coast, where substantial numbers of sea otters are found, and where the regulatory environment is the same as that proposed under Alternatives 3A, 3B, and 3C.

3) If the translocation program were declared a failure and terminated, California Fish and Game Code section 4700 would prohibit all take, as defined and applied under state law, of southern sea otters, with the exception of take authorized under an approved NCCP, and the MMPA would prohibit incidental take of southern sea otters by commercial fisheries. Nevertheless, commercial fisheries in the Southern California Bight are

unlikely to be adversely affected by the change in regulatory environment because few fisheries will likely interact with sea otters. Gill-net fisheries, historically a concern for incidental take of sea otters, are currently prohibited in most of the nearshore waters of southern California and the offshore Channel Islands where sea otters would be found (Marine Resources Protection Act, California Constitution Article 10B). Dive fisheries (sea urchin, abalone) are extremely unlikely to result in take of sea otters by virtue of the methods they employ to harvest shellfish. Trap fisheries (lobster, crab, live-fish) could potentially result in the entrapment and drowning of sea otters and thus could be affected by a change in the regulatory environment. However, there are few data to assess the possibility of incidental take of southern sea otters in these fisheries, and therefore we cannot reliably anticipate the impact of this regulatory change on this segment of the commercial fishing community.

4) Because of potential effects on the receiving population of sea otters in the mainland range caused by the relocation of sea otters removed from the translocation zone, we would be required to consult under Section 7 of the ESA before implementation of this alternative.

6.7 Alternative 3C (Preferred Alternative)—Terminate Translocation Program; Do Not Remove Sea Otters Residing within the Translocation or Management Zones at the Time the Decision to Terminate is Made

6.7.1 INTRODUCTION

Alternative 3 entails declaring the southern sea otter translocation program a failure and terminating the program, thereby eliminating the management zone and translocation zone established through Public Law 99-625 and 50 CFR §17(d). Sub-alternative 3C allows sea otters to remain at San Nicolas Island and in the management zone. No effort would be made to enforce a management zone, which would allow southern sea otters to recolonize historic range throughout the Southern California Bight.

This action would not increase or decrease the projected sea otter range compared to the baseline. Rather, this action is identical to the baseline in all respects except with respect to regulatory changes. Even where effects do not differ from the baseline, we summarize those effects below. For a fuller discussion, however, please refer to section 6.2, "Baseline (Status Quo)—The No Action Alternative."

6.7.2 NEARSHORE MARINE ECOSYSTEM

The effects of Alternative 3C on the nearshore marine ecosystem are the same as those described for the baseline. If sea otters reoccupied areas of the Southern California Bight as predicted, community level changes in the nearshore marine ecosystem would take place gradually. Over the next 10 years, an expanding mainland sea otter population would affect invertebrate populations from Point Conception to Carpinteria (lower bound) or Oxnard (upper bound), considerably reducing their densities and restricting individuals to cryptic habitat. Changes in giant kelp abundance in this area of the coast would likely take a decade or more to become noticeable and would occur only in areas where invertebrate herbivory is limiting kelp recruitment and survival. Species dependent on kelp canopy would likely benefit from any increases in kelp abundance. Based on predictions of San Nicolas Island sea otter colony growth and assumptions relating the number of sea otters to effects on invertebrate populations, sea otter predation at San Nicolas Island is expected to increase by 10 percent over the next 10 years. This level of predation may not result in measurable changes in the nearshore marine ecosystem over this period. We do not assign a level of significance to effects on the nearshore marine ecosystem within 10 years because of the extent of uncertainty involved and because the effects of this alternative are the same as for the baseline.

Whether sea otters would reoccupy other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. Those areas reoccupied by sea otters would eventually exhibit the kinds of changes described in section 6.2.2.

6.7.3 EFFECTS ON CANDIDATE, THREATENED, AND ENDANGERED SPECIES

6.7.3.1 White Abalone

Effects on white abalone resulting from the implementation of Alternative 3C are the same as for the baseline (see section 6.2.3.1 for a detailed discussion). Within 10 years, sea otters are expected to expand their range along the coastline to Carpinteria (lower bound) or Oxnard (upper bound) and to increase in number at San Nicolas Island, resulting in possible sea otter predation on white abalone. These areas have not been identified as key recovery areas for white abalone (CDFG 2005c).

The white abalone recovery plan identifies six broad recovery actions, one of which, Recovery Action 3 (protect white abalone populations and their habitat), could potentially be affected by sea otters. Specifically, an expanding southern sea otter population could negatively affect efforts under Recovery Action 3.3 (protect white abalone populations and habitat as they are discovered or established through enhancement) through predation if white abalone populations naturally recover or are established within the depth range utilized by sea otters and within the geographic area reclaimed by natural sea otter range expansion. The white abalone recovery plan ranks the severity of the risk to white abalone from all combined non-human predation (*i.e.*, fishes, invertebrates, and sea otters) as “moderate” on a scale ranging from low to very high (see Table 5 in the recovery plan, “Threats assessment table for the wild population of white abalone in California”). It also ranks the geographic scope and level of certainty that white abalone would be affected by combined non-human predation as “moderate.” The overall priority ranking of this threat is 9 (1 being highest priority, 10 being lowest priority) (NMFS 2008). Because natural sea otter range expansion under Alternative 3C would occur in the same manner as under the baseline, any effects of Alternative 3C are the same as those described for the baseline. Consequently, we do not assign a level of significance.

In the long term, sea otters would probably continue to expand their range, but it would likely be many decades before sea otters reoccupied the southern portions of the Southern California Bight where historic and current white abalone population centers exist and where key recovery areas for white abalone have been identified. The overall effects of sea otter predation on white abalone would likely be tempered by the limited overlap of white abalone and sea otter foraging depth ranges and the location of the highest abundances of white abalone at offshore banks (Tanner and Cortes), which may provide refuge from sea otter predation.

Because under Alternative 3C there is no effect on white abalone relative to the baseline, we would not request formal consultation with NMFS under Section 7 of the ESA before selecting this alternative. However, we recognize our affirmative responsibilities under the ESA and fully support recovery efforts for endangered white abalone. To lessen the risk that natural range expansion of sea otters (which would occur both under baseline conditions and under alternatives that terminate the translocation program) could interfere with recovery efforts for white abalone, we are committed to working closely with NMFS to share information that may affect recovery actions for this species. Specifically, we are working with NMFS to convene a working group composed of managers and scientists that have southern sea otter and abalone expertise to benefit the recovery of endangered abalone and sea otter. We are also pursuing a Memorandum of Understanding with NMFS to formalize this and other cooperative efforts to facilitate the recovery of sea otters alongside the recovery of endangered abalone.

6.7.3.2 Black Abalone

Effects on black abalone resulting from the implementation of Alternative 3C are the same as for the baseline (see section 6.2.3.2 for a detailed discussion). Within 10 years, sea otters are expected to expand their range along the coastline between Point Conception and Carpinteria (lower bound) or Oxnard (upper bound) and to increase in number at San Nicolas Island, likely resulting in sea otter predation on black abalone. Intertidal habitat along much of this section of mainland coastline does not support black abalone, and except for a small segment of coastline between Point Conception and just south of Government Point, this area has not been identified as a key area for black abalone recovery. If local recovery of black abalone populations nevertheless occurred within this stretch of coastline in areas lacking sufficient cryptic habitat, whether naturally or as a result of outplanting efforts, sea otters would likely have a detrimental effect on these populations. However, if future recovery actions for black abalone included relocating or aggregating exposed individuals in crevice habitat sufficiently deep to afford protection from sea otter predation, then sea otters would likely have negligible effects on these populations.

San Nicolas Island has been identified by CDFG as 1 of 10 key locations for the recovery of black abalone (CDFG 2005c), and it has also been included in critical habitat for black abalone (76 FR 66806). The effect that a persistent colony of sea otters would have on black abalone at the island is uncertain, but the fact sea otters and black abalone historically co-occurred and currently co-occur at the island suggests that black abalone populations have sufficient crevice habitat there to afford refuge from sea otter predation and to allow the maintenance of viable populations (absent other factors influencing survival, most importantly disease). In its responses to comments in the final critical habitat designation for black abalone, NMFS states, “one of the only places in southern California where black abalone populations have been increasing and where multiple recruitment events have occurred since 2005 (*i.e.*, San Nicolas Island) is also the only place south of Point Conception where a growing population of southern sea otters exists, indicating that black abalone populations can recover and remain stable in the presence of sea otters” (66 FR 66806, 66808). Because natural sea otter range expansion under Alternative 3C would occur in the same manner as under the baseline, any effects of Alternative 3C are the same as those described for the baseline. Consequently, we do not assign a level of significance.

In the long term, sea otters would probably continue to expand their range, but historic rates of range expansion indicate that it would likely be many decades before sea otters reoccupied the Southern California Bight. The final status review for black abalone ranks the severity of the overall threat level posed by sea otter predation as “medium” (see Table 6, Van Blaricom *et al.* 2009). It notes that although sea otters are known to prey on black abalone, the quantitative ecological strength of the interaction is poorly understood (Van Blaricom *et al.* 2009). It further notes that the effects of sea otter predation on black abalone populations are difficult to predict because they vary in space and time with the movement of particular sea otters (with individualized prey specializations) into and out of foraging locations (Van Blaricom *et al.* 2009). In areas without sufficient cryptic and inaccessible habitat, into which black abalone populations may have expanded following the human-caused extirpation of sea otters, black abalone will be vulnerable to predation resulting from sea otter range expansion unless recovery actions include the relocation or aggregation of exposed individuals into cryptic habitat. In areas of the Southern California Bight with sufficient cryptic and inaccessible habitat, portions of the black abalone population will be shielded from sea otter predation. In its final rule designating critical habitat for black abalone, NMFS concluded, “the best available data do not support the idea that sea otter predation was a major factor in the decline of black abalone populations or that it will inhibit the recovery of the species" (76 FR 66806, 66808).

CRITICAL HABITAT

Critical habitat for black abalone includes a number of areas both within the current sea otter range and outside the current sea otter range (in southern California waters) (76 FR 66806). If sea otters do recolonize the Southern California Bight gradually over the course of several decades, then their range will overlap with black abalone critical habitat in southern California, just as it currently overlaps with black abalone critical habitat in central California. The primary constituent elements of critical habitat essential for the conservation of black abalone are: rocky substrate; food resources; juvenile settlement habitat; suitable water quality; and suitable nearshore circulation patterns (76 FR 66806). Of these five elements, only one, food resources, may potentially be affected by sea otters. Under Alternative 3C, as under the baseline, sea otters would generally be expected to improve food resources for adult black abalone through predation on sea urchins. However, ecological relationships are complex, and it is likely that numerous positive and negative interactions would occur simultaneously.

Because under Alternative 3C there is no effect on black abalone relative to the baseline, we would not request formal consultation with NMFS under Section 7 of the ESA before selecting this alternative. However, we recognize our affirmative responsibilities under the ESA and fully support recovery efforts for endangered abalone. To lessen the risk that natural range expansion of sea otters (which would occur both under baseline conditions and under alternatives that terminate the translocation program) could interfere with recovery efforts for black abalone, we are committed to working closely with NMFS to share information that may affect recovery actions for this species. Specifically, we are working with NMFS to convene a working group composed of managers and scientists that have southern sea otter and abalone expertise to benefit the recovery of endangered abalone and sea otter. We are also pursuing a Memorandum of Understanding with NMFS to formalize this and other cooperative efforts to facilitate the recovery of sea otters alongside the recovery of endangered abalone.

6.7.3.3 Southern Sea Otter

Effects on southern sea otters resulting from the implementation of Alternative 3C are the same as for the baseline, except for potential positive effects resulting from regulatory changes if incidental take is affecting sea otters (see section 6.7.12). Within 10 years, sea otters would continue to expand their range along the mainland coastline to Carpinteria (lower bound) or Oxnard (upper bound) and would increase in number at San Nicolas Island. Within 10 years, Alternative 3C is expected to result in a positive effect of low significance as a result of regulatory changes.

In the longer term, under Alternative 3C, as under baseline conditions, sea otters may expand their range naturally into the Southern California Bight. This scenario maximizes the opportunity for southern sea otter recovery by allowing sea otters to recolonize historic habitat. Although the marine habitat in the Southern California Bight has been degraded by a multitude of human activities, the southern sea otter range has expanded into this area. Sea otters in southern California waters would be subject to the benefits and risks associated with this habitat, as described under baseline conditions (see section 6.2.3.3). Allowing natural range expansion avoids the potential threat to the species caused by capturing and releasing sea otters in other parts of the mainland range and avoids the potential for injuring or killing individual sea otters removed from the management zone.

Alternative 3C reflects all recommendations made in the revised recovery plan for the southern sea otter with respect to the translocation program (USFWS 2003). The revised recovery plan continues to focus on efforts to increase the size of the southern sea otter's population. However, it no longer recommends translocating sea otters as a means to achieve this goal and in fact advises against additional translocations (USFWS 2003). The revised plan also registers the recovery team's recommendation to declare the translocation program a failure, allow natural range expansion to occur, and allow the colony at San Nicolas Island to remain at the island rather than capturing these sea otters and releasing them in the mainland range (USFWS 2003). .

In all respects except the regulatory changes that pertain to the southern sea otter under this alternative, the effects of Alternative 3C are the same as for the baseline. The potential benefit of the reversion to "threatened" status for southern sea otters is difficult to estimate because its value can be realized only in reference to future actions that may affect members of the species found in the Southern California Bight. Because there are presently relatively few sea otters in the areas designated as a management zone, and incidental takes are not currently known to be occurring there, any benefit to sea otters would be speculative. At most, we would expect a beneficial effect of low significance within 10 years (defined as an effect on some individuals but no effect at the local population level). However, as indicated above, this benefit is speculative, in that it will not occur if sea otters are not being incidentally taken. Even if incidental take were to occur in the future, the benefit of increased regulatory protections would be realized by sea otters only if the incidental take were 1) detected and 2) prevented or minimized by means of measures included in incidental take authorizations.

To evaluate potential effects on sea otters, we would complete intra-Service consultation under Section 7 of the ESA before selecting this alternative.

6.7.4 COMMERCIAL FISHERIES

For a discussion of the regulatory environment (including as it pertains to commercial fisheries) see section 6.7.12.

6.7.4.1 Sea Urchin Fishery

Effects on the commercial sea urchin fishery resulting from the implementation of Alternative 3C are the same as for the baseline. Along the affected coastline (Point Conception to Carpinteria or Point Conception to Oxnard), the 10-year landings average is 56,360 pounds and 61,016 pounds, respectively. We assume that once an area is permanently occupied by sea otters, the commercial sea urchin fishery would no longer be viable in that area. Thus, we assume that sea urchin landings along the affected coastline would decrease 10 percent each year (5,636 pounds under the lower bound scenario or 6,102 pounds under the upper bound scenario), to zero landings in 2021. Around San Nicolas Island, the 10-year landings average is 351,333 pounds. We assume that commercial sea urchin landings in this area would decrease by approximately 10 percent over 10 years. Thus, we assume that sea urchin landings from San Nicolas Island would decrease by approximately 1 percent (2,705 pounds) each year, from

351,333 pounds to 348,628 pounds in 2012 to 345,922 pounds in 2013, and so forth to 324,280 pounds in 2021.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial sea urchin landings would approach zero because sea urchin fishers would fish other areas where their catch per unit effort would be greater.

6.7.4.2 Spiny Lobster Fishery

Effects on the commercial lobster fishery resulting from the implementation of Alternative 3C are the same as for the baseline. Along the affected coastline (Point Conception to Carpinteria or Point Conception to Oxnard), the 10-year landings averages are 54,674 pounds and 75,649 pounds, respectively. We assume that once an area is permanently occupied by sea otters, the commercial lobster fishery would no longer be viable in that area. Thus, we assume that lobster landings along the affected coastline would decrease 10 percent each year (5,467 pounds to Carpinteria or 7,565 pounds to Oxnard), to zero landings in 2021. Around San Nicolas Island, the 10-year landings average is 41,622 pounds. We assume that the commercial lobster fishery in this area would decrease by approximately 10 percent over 10 years. Thus, we assume that lobster landings from San Nicolas Island would decrease by about 1 percent (320 pounds) each year, from 41,622 pounds to 41,302 pounds in 2012 to 40,981 pounds in 2013, and so forth to 38,417 pounds in 2021.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial lobster landings would likely approach zero in these areas because lobster fishers would fish other areas where their catch per unit effort would be greater.

6.7.4.3 Crab Fishery

Effects on the commercial crab fishery resulting from the implementation of Alternative 3C are the same as for the baseline. Along the affected coastline (Point Conception to Carpinteria or Point Conception to Oxnard), the 10-year landings average is 253,572 pounds and 385,743 pounds, respectively. We assume that once an area is permanently occupied by sea otters, the commercial crab fishery would no longer be viable in that area. Thus, we assume that crab landings along the coastline would decrease 10 percent each year (25,357 pounds to Carpinteria or 38,574 pounds to Oxnard), to zero landings in 2021. Around San Nicolas Island, the 10-year landings average is 10,634 pounds. We assume that the commercial crab fishery in this area would decrease by approximately 10 percent over 10 years. Thus, we assume that crab landings from San Nicolas Island would decrease by about 1 percent (82 pounds) each year, from 10,634 pounds to 10,553 pounds in 2012 to 10,471 pounds in 2013, and so forth to 9,816 pounds in 2021.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial crab landings would approach zero because crab fishers would fish other areas where their catch per unit effort would be greater.

6.7.4.4 Sea Cucumber Fishery

Effects on the commercial sea cucumber fishery resulting from the implementation of Alternative 3C are the same as for the baseline. Along the affected coastline (Point Conception to Carpintera or Point Conception to Oxnard), the 10-year landings average is 155,714 pounds and 158,636 pounds, respectively. We assume that once an area is permanently occupied by sea otters, the commercial sea cucumber fishery would no longer be viable in that area. Thus, we assume that sea cucumber landings along the affected coastline would decrease 10 percent each year (15,571 pounds to Carpinteria or 15,864 pounds to Oxnard), to zero landings in 2021. Around San Nicolas Island, the 10-year landings average is 53,683 pounds. We assume that the commercial sea cucumber fishery in this area would decrease by approximately 10 percent over 10 years. Thus, we assume that sea cucumber landings from San Nicolas Island would decrease by about 1 percent (413 pounds) each year, from 53,683 pounds to 53,270 pounds in 2012 to 52,856 pounds in 2013, and so forth to 49,549 pounds in 2021.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial sea cucumber landings would approach zero because sea cucumber fishers would fish other areas where their catch per unit effort would be greater.

6.7.4.5 Gill and Trammel Net Fishery

6.7.4.5.1 Halibut Fishery

Under Alternative 3C, the regulatory environment would change (see section 6.7.12). The area from Point Conception to the Mexican border would become subject to the regulations currently in effect throughout the remainder of the southern sea otter's range. Commercial halibut landings using gill and trammel net gear along the coastline from Point Conception to Port Hueneme would be affected within 10 years only if the State or NMFS responded to the change in regulatory environment by imposing an additional depth restriction on the use of gill and trammel net gear in this area. It is important to note that the State or NMFS could choose not to act even if sea otters did return to the coastline southeast of Point Conception. Therefore, commercial halibut landings using gill and trammel net gear in this area would either be 1) unaffected (low estimate) or 2) eliminated (high estimate).

The incidental taking of southern sea otters in commercial fisheries is currently prohibited within the translocation zone, and it would remain prohibited if this alternative were selected. Therefore, the change in the regulatory environment that would occur under this alternative would not result in any additional impetus for the State or NMFS to impose supplementary depth restrictions on the use of gill and trammel net gear at San Nicolas Island.

Summary of Impacts

In the lower estimate (no additional closure), there would be no impacts. In the upper estimate (immediate closure), losses would accumulate because halibut landings using gill or trammel net gear would be eliminated from Santa Barbara to Port Hueneme. Landings would decrease an anticipated maximum 601,000 pounds over 10 years from 2012 to 2021. Table 6-76 shows that the total non-discounted maximum loss to the halibut fishery over 10 years for Alternative 3C would total about $2.5 million, and the total discounted loss for this alternative would be about $2.2 million (discounted at 3 percent) or $1.7 million (discounted at 7 percent).

To determine the regional impact of decreased halibut revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 3C would result in a decrease of $3.2 million to $4.2 million in total output over 10 years discounted at 7 percent and 3 percent, respectively.

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. In the lower estimate (no additional closure), there would be no impacts. In the upper estimate (immediate closure), the expected decrease in halibut landings resulting from implementation of Alternative 3C would constitute 21 percent of halibut landings in the Southern California Bight (all gear types) (Table 6-77). Thus Alternative 3C is expected to result in either 1) no effect or 2) a negative effect of high significance (see Table 5-1 for definitions of levels of significance).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea

TABLE 6-76 HALIBUT LANDINGS: EFFECTS OF ALTERNATIVE 3A – UPPER ESTIMATE (ADDITIONAL DEPTH RESTRICTION SANTA BARBARA TO PORT HUENEME)

Year	Decrease in Commercial Landings (Pounds)	Ex-Vessel Revenue*	Ex-Vessel Discounted Revenue (3%)*	Ex-Vessel Discounted Revenue (7%)*
2012	60,064	-$276,953	-$253,451	-$226,076
2013	60,064	-$276,953	-$246,069	-$211,286
2014	60,064	-$276,953	-$238,902	-$197,463
2015	60,064	-$276,953	-$231,943	-$184,545
2016	60,064	-$276,953	-$225,188	-$172,472
2017	60,064	-$276,953	-$218,629	-$161,189
2018	60,064	-$276,953	-$212,261	-$150,644
2019	60,064	-$276,953	-$206,079	-$140,789
2020	60,064	-$276,953	-$200,076	-$131,578
2021	60,064	-$276,953	-$194,249	-$122,970
Total	600,640	-$2,504,669	-$2,226,846 (PV@3%)	-$1,699,012 (PV@7%)

Note: Values are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price received for halibut from 2000 to 2009, which is $4.61 per pound in 2009 dollars.

TABLE 6-77 WHITE SEABASS LANDINGS: EFFECTS OF ALTERNATIVE 3C – UPPER ESTIMATE (ADDITIONAL DEPTH RESTRICTION SANTA BARBARA TO PORT HUENEME)				
Year	**Decrease in Commercial Landings (Pounds)**	**Ex-Vessel Revenue***	**Ex-Vessel Discounted Revenue (3%)***	**Ex-Vessel Discounted Revenue (7%)***
2012	117,129	-$284,638	-$260,484	-$232,350
2013	117,129	-$284,638	-$252,898	-$217,149
2014	117,129	-$284,638	-$245,532	-$202,943
2015	117,129	-$284,638	-$238,380	-$189,667
2016	117,129	-$284,638	-$231,437	-$177,258
2017	117,129	-$284,638	-$224,696	-$165,662
2018	117,129	-$284,638	-$218,152	-$154,824
2019	117,129	-$284,638	-$211,798	-$144,696
2020	117,129	-$284,638	-$205,629	-$135,230
2021	117,129	-$284,638	-$199,640	-$126,383
Total	1,171,294	-$2,846,384	-$2,288,645 (PV@3%)	-$1,746,162 (PV@7%)

Note: Values are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price received for white seabass from 2000 to 2009, which is $2.43 per pound in 2009 dollars.

otters recolonized these areas, it is possible that the State or NMFS would close commercial halibut fishing using gill and trammel net gear in additional areas. The removal of sea otters from San Nicolas Island could 1) slow the rate of eventual dispersal of sea otters into the southern areas of the Southern California Bight or 2) increase the rate of dispersal because unsettled sea otters could colonize new areas. Therefore, it is not possible to predict the effects of removal of sea otters from San Nicolas Island on additional depth restrictions on the use of gill and trammel net gear in other areas.

6.7.4.5.2 White Seabass Fishery

Under Alternative 3C, the regulatory environment would change (see section 6.5.12). The area from Point Conception to the Mexican border would become subject to the regulations currently in effect throughout the remainder of the southern sea otter’s range. Commercial white seabass landings using gill and trammel net gear along the coastline from Point Conception to Port Hueneme would be affected within 10 years only if the State or NMFS responded to the change in regulatory environment by imposing an additional depth restriction on the use of gill and trammel net gear in this area. The possibility that the State or NMFS would act may be decreased or delayed, relative to the baseline, by the short-term removal of sea otters from the coastline southeast of Point Conception as required under this alternative, but sea otters would be expected to return to the coastline eventually. It is important to note that the State or NMFS could choose not to act even if sea otters did return to the coastline southeast of Point Conception. Therefore, commercial white seabass landings using gill and trammel net gear in this area would either be 1) unaffected (low estimate) or 2) eliminated (high estimate).

The incidental taking of southern sea otters in commercial fisheries is currently prohibited within the translocation zone, and it would remain prohibited if this alternative were selected. Therefore, the change in the regulatory environment that would occur under this alternative would not result in any additional impetus for the State or NMFS to impose supplementary depth restrictions on the use of gill and trammel net gear at San Nicolas Island.

Summary of Impacts

In the lower estimate (no additional closure), there would be no impacts. In the upper estimate (immediate closure), losses would accumulate because white seabass landings using gill or trammel net gear would be eliminated from Santa Barbara to Port Hueneme. Landings would decrease an anticipated maximum 1.2 million pounds over 10 years from 2012 to 2021. Table 6-77 shows that the total non-discounted loss to the white seabass fishery over 10 years for Alternative 3C would total about $2.8 million, and the total discounted loss for this alternative would be about $2.3 million (discounted at 3 percent) or $1.7 (discounted at 7 percent).

To determine the regional impact of decreased white seabass revenue, we use an input-output model. The model assumes that the regional economy is defined as the coastal community (the counties of Santa Barbara, Ventura, Los Angeles, Orange, and San Diego). The model further assumes that purchases for gear and vessel services and any earnings remain within the regional economy. Given these assumptions, the regional economic impact of Alternative 3C would result in a decrease of $3.2 million to $4.3 million in total output over 10 years discounted at 7 percent and 3 percent, respectively.

As described in Chapter 5, we define levels of significance in this SEIS by viewing projected effects on an entity or activity within the regional context of that entity or activity. In the lower estimate (no additional closure), there would be no impacts. In the upper estimate (immediate closure), the expected decrease in white seabass landings resulting from implementation of Alternative 3C would constitute 42 percent of white seabass landings in the Southern California Bight (all gear types) (Table 6-20). Thus Alternative 3C is expected to result in either 1) no effect or 2) a negative effect of very high significance (see Table 5-1 for definitions of levels of significance).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas, it is possible that the State or NMFS would close commercial white seabass fishing using gill and trammel net gear in additional areas. The removal of sea otters from San Nicolas Island could 1) slow the rate of eventual dispersal of sea otters into the southern areas of the Southern California Bight or 2) increase the rate of dispersal because unsettled sea otters could colonize new areas. Therefore, it is not possible to predict the effects of removal of sea otters from San Nicolas Island on additional depth restrictions on the use of gill and trammel net gear in other areas.

6.7.5 Marine Aquaculture

Effects on marine aquaculture resulting from Alternative 3C are the same as for the baseline (local, episodic reduction of mussel and/or Pacific oyster densities in the Santa Barbara Channel). We do not assign a level of significance to marine aquaculture because of the extent of uncertainty involved and because there is no change from the baseline.

Beyond 10 years, marine aquaculture operations located in other portions of the Southern California Bight may be affected by sea otters, but these effects are expected to be relatively minor because 1) there are few registered open-water aquaculture operations in the remainder of the Southern California Bight (*i.e.*, not in Santa Barbara Channel); 2) under baseline conditions, sea otter range expansion (if it continues to occur) is expected to occur gradually over the course of many decades; and 3) sea otters are not likely to affect abalone or finfish aquaculture operations and would likely affect mussel operations only locally and episodically. Depending on the production methods, the presence of sea otters in the Southern California Bight may affect the shellfish aquaculture that is anticipated under NOAA's Ten Year Strategic Plan, National Marine Aquaculture Policy, and National Shellfish Initiative.

6.7.6 Seafood Processing Industry (Sea Urchins)

Effects on the seafood processing industry resulting from the implementation of Alternative 3C are the same as for the baseline. Sea otter predation is projected to reduce the total commercial sea urchin harvest in the Southern California Bight, and thus inputs to southern California sea urchin processing facilities, by 3 percent over the next 10 years due to (1) the elimination of the commercial sea urchin fishery along the coastline from Point Conception to Carpinteria or Oxnard, and (2) the 10 percent decline of the commercial sea urchin harvest at San Nicolas Island. Whether sea otters would reoccupy other areas of the Southern California Bight in subsequent years would be a function of sea otter demographic rates, food supply, and other variables. Those areas reoccupied by sea otters would cease to be a source of sea urchin inputs to the seafood processing industry, but the magnitude and timing of this potential future change is unknown.

6.7.7 Kelp Harvest

Effects on commercial kelp harvesting resulting from the implementation of Alternative 3C are the same as for the baseline. Sea otter predation on herbivores is generally expected to promote the growth of dense beds of giant kelp (for a description of the relationship between sea otters and kelp abundance, see section 6.2.2). However, because kelp distribution in areas of suitable substrate is not strictly correlated with grazing pressure (storms, pollution, water temperature, and other factors can also limit kelp), the magnitude of impact to this industry cannot be reasonably predicted. Within 10 years, sea otters are expected to reduce invertebrate prey populations only along the coastline from Point Conception to Carpinteria or Oxnard and at San Nicolas Island. Sea otters would likely have a greater effect in the former area, where they are expected to reach the densities required to reduce populations of invertebrate herbivores considerably. However, the reestablishment of kelp canopy in areas where it is limited by grazing pressure may require a decade or more to occur after the reduction of herbivore populations (Dayton and Tegner 1984), and thus no changes in kelp may be noticeable immediately.

The impact around San Nicolas Island is likely to be minimal over the next 10 years because the sea otter population is expected to reach only 21 percent of the estimated carrying capacity for the island. Although some increased predation on invertebrate herbivore populations at the island is expected, San Nicolas Island presently has extensive kelp forests. The predicted increase in sea otter numbers would not likely result in noticeable effects, but the persistence and density of these kelp beds may be enhanced. We do not assign a level of significance to kelp harvesting because of the extent of uncertainty involved and because there is not change relative to the baseline.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. Those areas reoccupied by sea otters would likely exhibit a general increase in the distribution and abundance of kelp where it is limited by invertebrate herbivores.

6.7.8 Recreational fishing

Recreational fishing activities that may be affected by sea otters include lobster fishing, abalone fishing, and finfish fishing. Lobster fishing and finfish fishing are addressed below. Abalone diving is included under “Abalone Fishery Restoration” (section 6.7.9).

6.7.8.1 Lobster Fishing

Effects on lobster fishing resulting from the implementation of Alternative 3C are the same as for the baseline. Under Alternative 3C, lobster fishing trips would be eliminated along the coastline from Point Conception to Carpinteria or from Point Conception to Oxnard as sea otters gradually establish range in the area. Assuming that this decrease would be distributed evenly across 10 years, lobster fishing trips would decrease 10 percent (less than 1 trip) each year to zero trips in 2021. Around San Nicolas Island, the average number of annual trips is 434. Using the same approach as for the coastline area, trips around San Nicolas Island are predicted to decrease about 1 percent per year over 10 years from 434 trips (10-year average) to 431 trips in 2012 to 428 trips in 2013, and so forth to 401 trips in 2021. Because the data represent only CPFVs (no private fishing trips are included), the number of lobster fishing trips may be underestimated. Because effects are the same as under the baseline, they are not significant.

Information from the limited number of lobster report cards returned from 2008-2011 (which represent private trips as well as trips made on CPFVs) suggests that under Alternative 3C, as under the the baseline (assuming that all lobster fishing trips are eliminated as a result of sea otter recolonization of the coastline to Carpinteria or Oxnard within the next 10 years), the total number of trips in the Southern California Bight will be reduced by 3-7 percent. Because the proportion of trips to San Nicolas Island is already so small, the projected increase in the number of sea otters there would not be expected to have a detectable effect on the total number of trips in the Southern California Bight. These proportional reductions should be considered provisional because they are based on limited data.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, recreational lobster fishing trips in these areas would likely approach zero. These effects are the same as under the baseline.

6.7.8.2 Finfish Fishing

The effects of Alternative 3C are the same as for the baseline. As described for the baseline, the presence of sea otters may improve habitat for recreationally important finfish and thus have a positive effect on the abundance of finfish available for harvest. Such changes would likely require more than 10 years to become noticeable (because the reestablishment of giant kelp canopies in areas where sea urchin grazing is limiting kelp is expected to take at least 10 years) and could occur gradually over several decades. A discussion of the long-term effects of sea otter predation on the kelp forest community, including finfish production, is given in section 6.2.2.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized areas of the Southern California Bight at the densities seen in the mainland range for comparable habitat, recreational finfish fishing would benefit.

We do not assign a level of significance to recreational finfish fishing because of the extent of uncertainty involved.

6.7.9 Abalone Fishery Restoration

The effects of Alternative 3C on abalone fishery restoration are the same as for the baseline. As described for the baseline, within 10 years sea otter range expansion along the coastline towards Carpinteria or Oxnard would preclude the reestablishment of abalone fishing in that area. However, it does not appear that there is any potential for reopening the abalone fishery (for any species) during the next 10 years, regardless of the presence or absence of sea otters, except possibly at San Miguel Island, where a limited fishery for red abalone is currently being considered (see section 6.2.9). Because the abalone fishery is unlikely to be reopened along the mainland coastline towards Carpinteria or Oxnard within 10 years, and because sea otters are not expected to recolonize the northern Channel Islands within 10 years, sea otters would likely have no effect on the potential for reopening any abalone fishery in the short term.

Over the next 10 years, sea otters at San Nicolas Island (CDFG statistical blocks 813 and 814) are expected to increase from 11 percent of carrying capacity in 2012 to 21 percent of carrying capacity in 2021. Abalone populations at San Nicolas Island are expected to persist as sea otter predation increases. However, densities of large individual abalone would likely eventually be reduced to a point that would preclude reestablishment of an abalone fishery at the island. If the colony at San Nicolas Island persists as projected, the area surrounding the island would likely be disqualified from abalone fishery consideration on the grounds that it is not “outside of the sea otter range” (CDFG 2005c).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized areas of the Southern California Bight at the densities seen in the mainland range for comparable habitat, the restoration of an abalone fishery in these areas would not be viable. Whether or when an abalone fishery could be reestablished in the absence of sea otters is uncertain, but it is clear that sea otter range expansion would preclude the possibility of recreational or commercial abalone fishing in reoccupied areas. At San Miguel Island, red abalone populations are apparently stable (Karpov *et al.* 2000). Eventual colonization of San Miguel Island by sea otters would reduce the densities of red abalone present there (Hines and Pearse 1982) and thus reduce but not eliminate the potential for these populations to contribute reproductively to other areas in the Southern California Bight. This reduced reproductive potential could have a detrimental effect on the eventual re-opening of the red abalone fishery in other areas of the Southern California Bight, if such a re-opening were proposed, even if sea otters were not present in these other areas.

We do not assign a level of significance to abalone fishery restoration because of the extent of uncertainty involved.

6.7.10 ECOTOURISM AND NON-MARKET VALUE

Effects on ecotourism resulting from the implementation of Alternative 3C are the same as for the baseline. Over the next 10 years, southern sea otters are expected to recolonize the stretch of coastline from Point Conception to Carpinteria or to Oxnard, with a median number of 73 to 299 sea otters residing year-round south of Point Conception by the end of the 10-year period. Tourism, based on sea otter watching, would be enhanced with sea otters residing along a coastline accessible by a well-traveled highway and near busy areas like the Santa Barbara harbor. Overall economic value of this tourism is difficult to quantify and would not necessarily result in increased economic activity because the tourism market in Santa Barbara is likely saturated and tourist vessels are limited by available space in Santa Barbara harbor. Rather, it would likely manifest itself as an added value to other tourist draws in the area.

While additional tourism may not be generated within the next 10 years along the affected stretch of coastline, a non-market value can be estimated for the increasing population of sea otters. Applying Hageman's estimate for the non-market value of sea otters would result in $15.0 million to $34.3 million. This analysis assumes that today's California households have the same non-market value for sea otters as those households in 1985.

The sea otter colony at San Nicolas Island is expected to increase by an average of 7 percent annually over the next 10 years, resulting in an estimated population size of 103 in 2021. This change represents an increase of 50 sea otters from the 53 sea otters estimated for 2012. San Nicolas Island is not currently an important destination for ecotourism (U.S. Department of Defense 2002) relative to the other Channel Islands because of its isolation from other islands, its distance from the mainland, and the periodic closure of its surrounding waters for military operations. We do not expect ecotourism in this area to grow considerably (in terms of number of trips) due to the increased abundance of sea otters. Rather, the quality of recreational trips that do occur at San Nicolas Island would likely be enhanced due to increased opportunities to see sea otters. However, applying Hageman's estimate for the non-market value of sea otters would result in $8.8 million over 10 years for the sea otters at San Nicolas Island.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonize other areas of the Southern California Bight, ecotourism would likely be enhanced in those areas.

We do not assign a level of significance to ecotourism/non-market value because of the extent of uncertainty involved.

6.7.11 FEDERAL AND STATE AGENCY PROGRAMS

We do not assign a level of significance to effects on agency programs because these effects and programs are various and cannot be meaningfully compared with a single set of criteria. For a discussion of the regulatory environment, see section 6.7.12.

6.7.11.1 U.S. Fish and Wildlife Service

The effects of Alternative 3C on southern sea otter recovery are also addressed in section 6.7.3.3 ("Southern Sea Otter"). Here we address our ability to meet our mandates under the ESA and MMPA and give the implementation costs of the alternative.

ABILITY TO MEET MANDATE

Alternative 3C provides the best opportunity for us to meet our mandate to bring southern sea otters to recovery and to their Optimum Sustainable Population level in California for three reasons: 1) it maximizes the area available for sea otters to recolonize; 2) it does not require the movement of any sea otters, which can have a detrimental effect on the individuals moved as well as on the receiving population; and 3) it makes additional legal protections available to sea otters in the Southern California Bight (should these become necessary) by reverting their status to that of sea otters in the mainland range (*i.e.*, threatened).

Alternative 3C would permit the possible eventual expansion of sea otters throughout their historic range in the Southern California Bight. Although the time that would be required for sea otters to reach recovery and their Optimum Sustainable Population level is unknown, Alternative 3C would likely result in a more rapid colonization of the Southern California Bight than Alternatives3A and 3B because the colony at San Nicolas Island would be allowed to remain there. If the colony persisted, it could eventually become a source of dispersing sea otters.

Alternative 3C, like Alternatives 3A and 3B, differs notably from the baseline with respect to the regulatory provisions that would apply to sea otters in the Southern California Bight because the management and translocation zones would no longer exist. For a discussion of these provisions, see section 6.7.12.

IMPLEMENTATION COSTS (10-YEAR PERIOD)

The change in the regulatory provisions that apply to sea otters in the Southern California Bight under Alternative 3C could result, in the long term, in increased coordination and consultation between USFWS and other parties regarding activities that may affect the southern sea otter. Costs resulting from an increased consultation workload are not included here because few or no activities requiring consultation presently occur or are expected to occur in the area that sea otters would likely reoccupy within the next 10 years. No implementation costs are associated with Alternative 3C.

6.7.11.2 Channel Islands National Park

The effects of Alternative 3C are the same as under the baseline scenario. Alternative 3C would allow sea otters to recolonize the Southern California Bight. While no effects of sea otters would be expected within 10 years, sea otters would likely eventually re-establish their range within Park boundaries. Alternative 3C is consistent with the mission and mission-related goals of CINP to protect and restore natural ecosystems and to practice ecosystem management.

Under Alternative 3C, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.7.12). This change could result, in the long term, in increased coordination and consultation between USFWS and Channel Islands National Park regarding activities that may affect the southern sea otter if sea otters recolonize historic range within Park boundaries.

6.7.11.3 Channel Islands National Marine Sanctuary

The effects of Alternative 3C are the same as under the baseline scenario. Alternative 3C would allow sea otters to recolonize the Southern California Bight. While no effects of sea otters would be expected within 10 years, sea otters would likely eventually re-establish their range within Sanctuary boundaries. Alternative 3C is consistent with the mission of CINMS to conserve and enhance the biodiversity, ecological integrity, and cultural legacy of areas of special national significance.

Under Alternative 3C, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.7.12). This change could result, in the long term, in increased coordination and consultation between USFWS and Channel Islands National Marine Sanctuary regarding activities that may affect the southern sea otter if sea otters recolonize historic range within Sanctuary boundaries.

6.7.11.4 California Department of Fish and Game

Effects on the recovery of white and black abalone and sea otters are discussed under "Candidate, Threatened, and Endangered Species" (section 6.7.3). Effects on existing commercial fisheries and the restoration of the abalone fishery are discussed under "Commercial Fisheries" (section 6.7.4) and "Abalone Fishery Restoration" (section 6.7.9). Effects on MPAs and the restoration of depleted abalone species that are not federally listed are discussed here.

MARINE PROTECTED AREAS

Effects on MPAs are the same as under the baseline scenario. Alternative 3C would allow sea otters to recolonize the Southern California Bight. While the effects of sea otters would be expected to be limited to the five MPAs along the mainland coastline west of Carpinteria/Oxnard and Begg Rock SMR near San Nicolas Island within 10 years, sea otters would likely eventually re-establish their range within additional MPAs. In this case, Alternative 3C would have a positive effect on MPAs overall. For a full discussion of the expected effects of sea otters on MPAs, see section 6.2.11.4.

RESTORATION OF DEPLETED ABALONE SPECIES (NOT FEDERALLY LISTED)

Enhancement activities include the translocation or aggregation of adult stocks, larval outplanting, captive breeding to obtain large individuals for outplanting, and the establishment of MPAs (CDFG 2005c). The effects of Alternative 3C are the same as under the baseline scenario. Under baseline conditions, sea otters are expected to recolonize the mainland coastline to Carpinteria (lower bound) or Oxnard (upper bound) within the next 10 years and to recolonize other areas of the Southern California Bight gradually in the longer term. Natural sea otter range expansion could negatively affect State efforts to enhance abalone populations by means of larval outplanting if outplanting efforts were planned for habitats lacking sufficient cryptic habitat to shield abalone from sea otter predation. Negative effects would be lessened to the extent that outplanting efforts were conducted in cryptic habitat that is inaccessible to sea otters or in areas outside the range into which sea otters naturally expanded. The translocation or aggregation of adult stocks would likely be unaffected by sea otters, as one purpose of translocation is to protect adults from predation or other threats, and it would seem likely that abalone would be translocated into, or aggregated in, sufficiently protective crevice habitat. Natural range expansion of sea otters into the Southern California Bight would not affect other enhancement activities, such as captive breeding or the establishment of MPAs.

6.7.11.5 U.S. Navy/Department of Defense

The effects of Alternative 3C on the U.S. Navy/DOD are regulatory and are the same as under Alternatives 3A and 3B (assuming sea otters returned to the island after their removal under those alternatives). Under Alternative 3C, the translocation program would be declared a failure, and the management zone and translocation zone would be abolished. As a consequence, the regulatory environment would change (see section 6.7.12). The change in the regulatory provisions that apply to sea otters in the Southern California Bight under Alternative 3C will result in increased coordination and consultation between USFWS and the U.S. Navy/DOD regarding activities that may affect the southern sea otter at San Nicolas Island or in other areas that sea otters may eventually colonize within the Pt. Mugu Sea Range or SOCAL Range Complex..

Under Alternative 3C, sea otters would not be removed from San Nicolas Island. To date, we have no evidence that defense-related activities have had any adverse effects on sea otters at San Nicolas Island or in the management zone. However, the U.S. Navy/DOD anticipates probable future changes in the type and tempo of military testing and training activities in response to evolving international threats and military technologies. Under Alternative 3C, an intensification of military activities in the nearshore waters of the island would likely trigger the need for additional regulatory compliance on the part of the U.S. Navy/DOD. To minimize the impacts of the U.S. Navy/DOD's increased regulatory obligations, we would propose to coordinate with the U.S. Navy/DOD to develop a programmatic consultation for activities that may affect southern sea otters at San Nicolas Island or to seek other potential mutually agreeable solutions. Although future Naval program requirements may change, necessitating multiple consultations over time, programmatic consultations can cover anticipated activities until these requirements change, thereby minimizing the regulatory burden on the Navy associated with ESA compliance with respect to sea otters. The U.S. Navy/DOD is currently required to obtain an Incidental Harassment Authorization under the MMPA for the incidental non-lethal "take by harassment" of marine mammals during missile and target launch operations at San Nicolas Island. The requirement to complete Section 7 consultation for sea otters in the areas surrounding San Nicolas Island would constitute an additional regulatory burden on the U.S. Navy/DOD relative to the baseline.

Although the range of the southern sea otter is predicted to extend only to Carpinteria (lower bound) or Oxnard (upper bound) (see section 6.1.4.1) within the 10-year time horizon (this area of the coastline is outside the boundaries of the Point Mugu Sea Range and the SOCAL range complex), individual sea otters have traveled and will likely continue to travel into and out of other areas of the Southern California Bight during this period. Whether sea otter range expansion would extend to other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. Where sea otters were present, the U.S. Navy/DOD would be subject to the full requirements and authorizations of the ESA and MMPA for activities that may affect the species. Currently, the U.S. Navy/DOD is required to consult with USFWS on actions that may affect other listed species under the ESA and to request Incidental Harassment Authorization under the MMPA for activities affecting other marine mammals. We would propose to add southern sea otters to a programmatic Biological Opinion for other species listed under the ESA at San Clemente Island and to address southern sea otter requirements under the MMPA concurrently with the Incidental Harassment Authorization process the Navy already undergoes with NMFS for other marine mammal species. These processes would occur only when sea otters were present in those areas of the Southern California Bight.

The magnitude of the increased regulatory burden on the U.S. Navy/DOD would depend on the eventual abundance of sea otters in naval ranges throughout southern California and the types of naval activities proposed to be conducted there. In the event that USFWS determined in a future Section 7 consultation that proposed Naval operations were likely to result in jeopardy to the sea otter, Section 7(j) of the ESA requires the Endangered Species Committee, and ad hoc committee made of up the heads of several federal agencies, including but not limited to, the Secretaries of Interior, Commerce, Agriculture, and Army, to grant an exemption from the requirements of Section 7(a)(2) "for any agency action if the Secretary of Defense finds that such exemption is necessary for reasons of national security." Similarly, the Navy may seek a National Defense Exemption from requirements of the MMPA. These options may be exercised by the Secretary of Defense if deemed appropriate.

6.7.11.6 Bureau of Ocean Energy Management

The effects of Alternative 3C are regulatory and are the same as under Alternatives 3A and 3B. Under Alternative 3C, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.7.12). This change could result in increased coordination and consultation between USFWS and BOEM regarding activities that may affect the southern sea otter. However, the added consultation and permitting requirements for actions that may affect sea otters in the Southern California Bight would likely impose only a minor additional regulatory burden on BOEM for the following reasons: 1) the physical presence of the oil industry is expected to diminish offshore of California over the next several decades (BOEM pers. comm. 2010); 2) all proposed actions that may affect *other* threatened or endangered species or marine mammals are already subject to consultation and permitting requirements under the ESA and MMPA; 3) the regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of this alternative, and requirements for consultations or permits related to the southern sea otter have been minimal; 4) southern sea otters would not be present in most of southern California for decades (if range expansion continues to occur).

6.6.11.7 National Marine Fisheries Service

National Marine Fisheries Service activities that occur within or overlap with the nearshore areas of the Southern California Bight are diverse. These activities include implementing recovery actions for federally listed threatened and endangered species and managing federal fisheries.

Information on endangered white and black abalone and NMFS-led recovery efforts for these species is given under "Candidate, Threatened, and Endangered Species." Federally managed fisheries are discussed here.

The effects of Alternative 3C are regulatory and are the same as under Alternatives 3A and 3B. Under Alternative 3C, the translocation program would be declared a failure, and the management zone and translocation zone would be abolished. As a consequence, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.6.12). This change may result in increased coordination and consultation between USFWS and NMFS regarding activities that may affect the southern sea otter. NMFS would be required to consult under Section 7 of the ESA and to comply with other applicable laws on actions that may affect sea otters in the Southern California Bight. Take of southern sea otters caused by commercial fisheries cannot be authorized under section 118 of the MMPA. However, any changes would likely be minor. The current regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of this alternative, and requirements for consultations or permits related to the southern sea otter have been minimal. We expect that effects on federally managed fisheries in the Southern California Bight would also be minimal due to the gear types used and/or the depths in which these fisheries are pursued.

6.7.12 Regulatory Environment

The regulatory environment under Alternative 3C is identical to the regulatory environment under Alternatives 3A and 3B, although the actual effects of regulatory changes relative to the baseline depend on the presence or absence of sea otters in the Southern California Bight.

Under Alternative 3C, as under Alternatives 3A and 3B, the translocation program would be declared a failure and terminated, the management and translocation zones would be abolished, and the provisions of Public Law 99-625 would become inoperative. California Fish and Game Code section 8664.2 would also become inoperative. As a result, all activities that may affect southern sea otters within the Southern California Bight would be fully subject to the ESA, the MMPA, and California state law, including applicable consultation requirements and take prohibitions under these laws.

All federal agencies planning activities that may affect southern sea otters in the Southern California Bight would be required to consult with USFWS under Section 7 of the ESA and seek authorization for incidental take of sea otters under the ESA and provisions of the MMPA. If otherwise allowable under applicable state law, including California Fish and Game Code section 4700, non-federal activities that would result in take of southern sea otters in California would require incidental take authorization from the USFWS under section 10(a)1(B) of the ESA and section 101(a)(5) of the MMPA. Incidental take of southern sea otters in commercial fisheries cannot be authorized under the MMPA. Therefore, incidental take of southern sea otters in commercial fisheries throughout the Southern California Bight would be prohibited, as it is currently prohibited throughout the remainder of the range of the species (north of Point Conception). Intentional take would continue to be prohibited unless authorized, as under the current regulations.

This change in the regulatory environment would not be likely to result in substantial effects on activities now being conducted within the Southern California Bight for several reasons:

1) The current regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of Alternatives 3A, 3B, or 3C in the Southern California Bight. Commercial fishing activities, harbor maintenance, oil and gas exploration, and other human activities are similar in the two sections of coastline. Along the central coast, requirements for consultations and take authorizations under the ESA and MMPA related to the southern sea otter have been minimal, and we would expect the same to be the case for the Southern California Bight. This is because there are few otherwise legal activities that result in take of southern sea otters and because the southern sea otter's historic habitat, although somewhat degraded, is essentially intact.

2) Southern sea otters would not be present in most of southern California for many decades. In fact, we cannot reliably assert that range expansion will occur at all. Critical habitat has not been designated for the southern sea otter and is not proposed or required (the southern sea otter was listed under the ESA prior to passage of the requirement to designate critical habitat). With no sea otters present in most of the Southern California Bight and no designated critical habitat, the likelihood that adverse interactions between sea otters and human activities would occur would be less than the likelihood that currently exists along the central coast, where substantial numbers of sea otters are found, and where the regulatory environment is the same as that proposed under Alternatives 3A, 3B, and 3C.

3) If the translocation program were declared a failure and terminated, California Fish and Game Code section 4700 would prohibit all take, as defined and applied under state law, of southern sea otters with the exception of take authorized under an approved NCCP, and the MMPA would prohibit incidental take of southern sea otters by commercial fisheries. Nevertheless, commercial fisheries in the Southern California Bight are unlikely to be adversely affected by the change in regulatory environment because few fisheries will likely interact with sea otters. Gill-net fisheries, historically a concern for incidental take of sea otters, are currently prohibited in most of the nearshore waters of southern California and the offshore Channel Islands where sea otters would be found (Marine Resources Protection Act, California Constitution Article 10B). Dive fisheries (sea urchin, abalone) are extremely unlikely to result in take of sea otters by virtue of the methods they employ to harvest shellfish. Trap fisheries (lobster, crab, live-fish) could potentially result in the entrapment and drowning of sea otters and thus could be affected by a change in the regulatory environment. However, there are few data to assess the possibility of incidental take of southern sea otters in these fisheries, and therefore we cannot reliably anticipate the impact of this regulatory change on this segment of the commercial fishing community.

6.8 Summary and Comparison of Potential Impacts

What follows is a summary of the biological and socioeconomic effects of each alternative evaluated.

6.8.1 ALTERNATIVE 1

6.8.1.1 Biological Effects

Under Alternative 1, sea otters would remain at San Nicolas Island but would be removed from all other areas of the Southern California Bight. As a consequence, ecosystem changes associated with the presence of sea otters (see section 6.2.2) would occur only at San Nicolas Island. Should the number of sea otters at San Nicolas Island continue to increase, at some point we would expect macroinvertebrates, like abalone and sea urchins, to be restricted to habitat that provides refuge from sea otter predation. Macroalgal assemblages would also likely change. The exact nature and magnitude of ecological change is unknown; however, it is likely that the change would result in an ecological community more closely resembling that which occurred naturally prior to the extirpation of sea otters from this area of their historic range during the fur trade.

White and black abalone are listed as endangered under the ESA. Alternative 1 would exclude sea otters from the management zone (most of the Southern California Bight) in perpetuity, thereby limiting the effects of sea otter predation on these species as they recover. Within 10 years, the benefits to these species of abalone are expected to be of low and moderate significance, respectively, because the area that sea otters would have recolonized within this period has not been identified as an important area for the recovery of either species, except a short stretch of coastline from Point Conception to just southeast of Government Point, which represents a small portion of the critical habitat that has been proposed for black abalone. In the long term, the benefits to these abalone species would be expected to be moderate, primarily because of the depths that white abalone typically occupy (which tend to be deeper than sea otters usually dive) and because of the ability of black abalone to maintain reproductively viable populations in cryptic habitat that is inaccessible to sea otters (where sufficient cryptic and inaccessible habitat exists).

Southern sea otters would be affected negatively by Alternative 1. Starting in 1998, large groups of sea otters began moving into the designated management zone from the parent population. Alternative 1 would prevent natural range expansion into historic habitat and cause the disruption of natural behaviors, thereby hindering recovery and possibly causing long-term, large scale adverse effects on the species. The management zone would eliminate about 37 percent of the carrying capacity (for sea otters) of California. Effects on the southern sea otter are expected to be adverse and of high significance.

6.8.1.2 Socioeconomic Effects

Beneficial effects of low to moderate significance would accrue to commercial (sea urchin, lobster, crab, and sea cucumber) and recreational fisheries (lobster) as a result of the implementation of Alternative 1. Beneficial effects of low significance would accrue to the seafood processing industry. Beneficial effects of undetermined significance would accrue to marine aquaculture and abalone fishery restoration. Adverse effects of undetermined significance would likely accrue to the kelp harvesting industry, recreational finfish fishing, and ecotourism and non-market value because of the exclusion of sea otters from the management zone. Effects on the halibut and white seabass fisheries would remain unchanged from the baseline.

Alternative 1 would also affect the programs of USFWS and other agencies. The cost of maintaining the management zone over a 10-year period is just under $7 million (discounted at 3 percent), and it would diminish our opportunity, relative to the other alternatives, to meet our mandates to recover sea otters under the ESA and to bring them to their Optimum Sustainable Population level under the MMPA. Under this alternative, CINP and Channel Islands National Marine Sanctuary would be unable to restore a key component of the historic marine ecosystem, and CDFG would be hindered in its efforts to achieve ecological balance in the Channel Islands and South Coast Marine Protected Areas. The U.S. Navy/DOD would continue to be exempt from endangered species consultation requirements with regard to sea otters in either the management zone or translocation zone, and BOEM would continue to be exempt from endangered species consultation requirements with regard to sea otters in the management zone. The existing obligation of these agencies to conference on actions that are likely to jeopardize the continued existence of the southern sea otter or, should critical habitat be proposed in the future, on actions likely to adversely modify such proposed critical habitat would continue.

6.8.2 ALTERNATIVE 2

6.8.2.1 Biological Effects

Under Alternative 2, the sea otter colony would remain at San Nicolas Island, and sea otters from the mainland population could expand their range naturally along the coastline as far as the city of Santa Barbara and, ultimately, into the nearshore areas surrounding San Miguel and Santa Rosa Islands. Maintenance of the modified management zone under Alternative 2 would allow sea otters to recolonize additional nearshore marine habitat in the Southern California Bight relative to Alternative 1, but it would prevent additional range expansion along the mainland coastline that is projected to occur under baseline conditions, namely the area from Santa Barbara to Carpinteria (lower bound) or Oxnard (upper bound) (see section 6.1.4.1).

If sea otters expanded their range into the areas open to them, the changes described in section 6.2.2 would likely occur. In areas recolonized by sea otters, macroinvertebrates, such as abalone and sea urchins, would likely be restricted to habitat that provides refuge from sea otter predation. Macroalgal assemblages would also likely change. The exact nature and magnitude of ecological change is unknown; however, it would likely result in an ecological community more closely resembling that which occurred prior to the extirpation of sea otters from the area during the fur trade.

Alternative 2 would provide white and black abalone with less protection from sea otter predation than would Alternative 1, but the modified zone would cover much of the area of the Southern California Bight suitable for these species. Within 10 years, Alternative 2 is expected to provide a very low benefit to white and black abalone, relative to the baseline, because the stretch of mainland coastline that sea otters would be prevented from recolonizing (Santa Barbara to Carpinteria or Oxnard), has not been identified as an important recovery area for either white or black abalone. In the long term, the benefits to these abalone species would be expected to be moderate, primarily because of the depths that white abalone typically occupy (which tend to be deeper than sea otters usually dive) and because of the ability of black abalone to maintain reproductively viable populations in cryptic habitat that is inaccessible to sea otters (where sufficient cryptic and inaccessible habitat exists).

Sea otters would be allowed under Alternative 2 to re-occupy a greater portion of their historic habitat than they would be under Alternative 1. However, the continued removal of sea otters from the redefined management zone would hinder recovery of the species and would also likely make it more difficult to bring sea otters to their Optimum Sustainable Population level under the MMPA. The modified management zone would eliminate about 27 percent of the carrying capacity (for sea otters) of California.

6.8.2.2 Socioeconomic Effects

Within 10 years, beneficial effects of very low to moderate significance would accrue to commercial (sea urchin, lobster, crab, and sea cucumber) and recreational fisheries (lobster) as a result of the implementation of Alternative 2. Beneficial effects of very low significance would accrue to the seafood processing industry. Beneficial effects of undetermined significance would accrue to marine aquaculture and abalone fishery restoration. Adverse effects of undetermined significance would likely accrue to the kelp harvesting industry, recreational finfish fishing, and ecotourism and non-market value because of the exclusion of sea otters from the modified management zone. Effects on the halibut and white seabass fisheries would remain unchanged from the baseline.

In the long term, shellfish fisheries, both commercial and recreational (lobster fishing), would likely be eliminated in the areas re-occupied by sea otters. Changes in the fisheries would likely take place over many years or decades. If in the future sea otters recolonized San Miguel and Santa Rosa Islands, the loss of these areas would be a greater impact on the sea urchin fishery, and possibly the crab, sea cucumber, and lobster fisheries, than loss of other areas of comparable size in southern California because these islands are important fishing grounds. Similarly, recolonization of these islands could have a disproportionate effect on efforts to restore the abalone fishery. Possible long-term effects at San Miguel and Santa Rosa Islands are the same as would be expected under the baseline but are losses in relation to Alternative 1. If sea otters continue to expand their range, over time the modified management zone would represent a benefit (of unknown magnitude) relative to the baseline for fisheries located within the modified zone because sea otters would be removed, in perpetuity, from that area. Relative to the baseline, possible future benefits would also accrue to marine aquaculture, the seafood processing industry, and abalone fishery restoration within the modified management zone. Adverse effects of undetermined significance would likely accrue to the kelp harvesting industry, recreational finfish fishing, and ecotourism and non-market value within the modified management zone because of the exclusion of sea otters.

The effects of Alternative 2 on agencies would be similar to the effects of Alternative 1. The cost of maintaining the modified management zone would be about $6.4 million over 10 years (discounted at 3 percent). The effects on sea otters (as described under "Biological Effects") would hinder our ability to recover the species and to bring the population to its Optimum

Sustainable Population level. The reduced size of the management zone under Alternative 2 would allow CINP and the Channel Islands Marine Sanctuary to work towards attaining their goal of restoration of the marine ecosystem in areas within their jurisdiction at two of the five islands they manage. The U.S. Navy/DOD would continue to be exempt from endangered species consultation requirements with regard to sea otters at San Nicolas Island and throughout the redefined management zone, and BOEM would be exempt from endangered species consultation requirements with regard to sea otters in the modified zone as well. The existing obligation of these agencies to conference on actions that are likely to jeopardize the continued existence of the sea otter or, should critical habitat be proposed in the future, on actions likely to adversely modify such proposed critical habitat would continue. Both agencies would be required to consult on activities affecting sea otters outside the redefined management zone.

6.8.3 ALTERNATIVES 3A-3C

The effects of Alternatives 3A-3C are generally similar to those for the baseline (status quo).

6.8.3.1 Biological Effects

Under Alternatives 3A-3C, sea otters may expand their range naturally throughout the entire Southern California Bight. Should sea otters expand their range, we would expect macroinvertebrates, like abalone and sea urchins, to be restricted to habitat that provides refuge from sea otter predation. Macroalgal assemblages would also likely change. The exact nature and magnitude of ecological change is unknown; however, the change would likely result in an ecological community more closely resembling that which occurred naturally prior to the extirpation of sea otters from this area of their historic range during the fur trade.

Alternatives 3A-3C would not provide white and black abalone with the protection of a management zone as would Alternatives 1 and 2. However, as sea otter range expansion is expected to occur gradually, and as both abalone species have some refugia from sea otter predation (white abalone in deep waters and, potentially, at offshore banks, and black abalone in cryptic and inaccessible habitat), sea otters are expected to have moderate effects on white and black abalone. Because of the ability of white and black abalone to make use of these refugia, only a portion of each abalone population would be exposed to sea otter predation even in general areas of the Southern California Bight that sea otters would eventually reoccupy.

Sea otters may eventually re-occupy any or all of their historic habitat under Alternatives 3A-3C. The allowance of natural range expansion clearly benefits recovery efforts under the ESA and provides the best opportunity for southern sea otters to reach their Optimum Sustainable Population level under the MMPA. Risks to individual animals subject to removal from a management zone (as under Alternative 1 or 2) would be eliminated, natural range expansion would be unimpeded, and the extension of sea otters' range over a larger area would reduce the risk that a single catastrophic event, such as an oil spill, could cause extinction of the species. Additionally, the risk to the parent population resulting from the continual reintroduction of sea otters from the Southern California Bight would be avoided.

Although removal of sea otters from San Nicolas Island (as required under Alternatives3A and 3B) could possibly increase the rapidity with which other areas of the Southern California Bight were recolonized (removal would likely result in the attempted return of some of these sea otters and the establishment of small groups in other areas of the Southern California Bight, such as at San Miguel Island), it could also result in the deaths of some individuals and overall would be detrimental to the colony. It could also result in the disturbance of animals in the receiving population. Therefore, Alternative 3C would be more conducive to the attainment of recovery goals and achievement of the Optimum Sustainable Population level than Alternatives 3A and 3B.

6.8.3.2 Socioeconomic Effects

Shellfish fisheries, both commercial and recreational (lobster), would likely be eliminated in areas re-occupied by sea otters. The portion of the halibut and white seabass fisheries using gill and trammel net gear may be eliminated in shallow areas of the Southern California Bight outside the existing closure if sea otters recolonize those areas and additional protective gear closures are put in place. Changes in the fisheries would likely take place over many years or decades, with some localized areas along the coastline to Carpinteria (lower bound) or Oxnard (upper bound) being affected within the next 10 years. Widespread fishery changes across the southern California Bight would be gradual, taking place over many decades. In the long term, marine aquaculture, the seafood processing industry, and abalone fishery restoration would not benefit, relative to the baseline, as they would under Alternatives 1 and 2.

Under Alternatives 3A-3C, kelp harvesting, recreational finfish fishing, and ecotourism/non-market value would be generally enhanced.

Federal activities that may affect southern sea otters in the southern California Bight would require consultation under Section 7 of the ESA. Exemption from consultation requirements, as authorized under Public Law 99-625, would no longer be applicable. CINP and the Channel Islands Marine Sanctuary would be able to work towards attaining their goal of restoring the marine ecosystem in all areas within their jurisdiction.

Commercial and recreational fisheries would no longer be exempt from the incidental take prohibitions of the ESA and the MMPA within the former management zone. Instead, the same general provisions that apply to sea otters in central California would apply to sea otters in the Southern California Bight. While Section 7 and Section 10 the ESA provide means to authorize incidental take of sea otters, the MMPA does not provide means to authorize the incidental take of sea otters by commercial fisheries.

Several sub-alternatives are presented for consideration should the translocation program be formally declared a failure (50 CFR §17.84(d)(8)). The actions and impacts related to these sub-alternatives are summarized below.

6.8.4 ALTERNATIVE 3A

Potential impacts of Alternative 3A include all of the impacts noted above for Alternative 3. Additional effects would result from the removal of sea otters from San Nicolas Island and the management zone. Some sea otters captured and moved from San Nicolas Island and the management zone may die, and the relocation of sea otters naturally moving into the management zone may have adverse effects on the parent population (depending on the numbers of sea otters removed from the management zone). The removal of sea otters from San Nicolas

Island could have unpredictable effects. Although the colony's removal is generally expected to slow but not eliminate range expansion and subsequent competition with shellfisheries, it is also possible that it could speed recolonization because some sea otters may try to return and may establish the seed of a colony elsewhere in the Southern California Bight. Overall, removing sea otters from San Nicolas Island and the management zone and placing them in the mainland range would likely be extremely disruptive, if not harmful, to the animals removed, and disruptive also to animals in the receiving population. Both the displaced animals and the receiving population would suffer disturbance to their social structure and encounter increased competition for food.

6.8.5 Alternative 3B

Potential impacts of Alternative 3B include all of the impacts noted above for Alternative 3. Additional effects would result from the removal of sea otters from San Nicolas Island. Some sea otters captured and moved from San Nicolas Island may die. The removal of sea otters from San Nicolas Island could have unpredictable effects. Although the colony's removal is generally expected to slow but not eliminate range expansion and subsequent competition with shellfisheries, it is also possible that it could speed recolonization because some sea otters may try to return and may establish the seed of a colony elsewhere in the Southern California Bight. Overall, removing sea otters from San Nicolas Island and placing them in the mainland range would likely be extremely disruptive, if not harmful, to the animals removed, and disruptive also to animals in the receiving population. Both the displaced animals and the receiving population would suffer disturbance to their social structure and encounter increased competition for food.

6.8.6 Alternative 3C (Preferred Alternative)

Potential impacts of Alternative 3C include all of the impacts noted above for Alternative 3. This alternative would likely result in a more rapid reoccupation of historic sea otter habitat in the Southern California Bight than Alternatives 3A or 3B and may accelerate changes in affected fisheries. This alternative represents the most favorable option for the accomplishment of sea otter recovery goals because it allows for natural range expansion and would likely increase the resiliency of the species in the event of a catastrophic oil spill or similar event in a portion of its range.

TABLE 6-78 SUMMARY OF BIOLOGICAL IMPACTS BY ALTERNATIVE

Impact Topic			No Action	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C (Preferred Alternative)
Nearshore Marine Ecosystem		10 yrs.	Top carnivore returns to area PC to CP or OX, increases use of habitat at SNI; invertebrate densities decrease PC to CP or OX and slightly at SNI	No return of top carnivore; invertebrate densities increase near Cojo Anchorage, remain same in SCB except decrease slightly at SNI	Top carnivore returns to area PC to SB, increases use of habitat at SNI; invertebrate densities decrease PC to SB and slightly at SNI	Top carnivore returns to area PC to CP or OX, invertebrate densities decrease PC to CP or OX but increase slightly at SNI in short-term		Top carnivore returns to area PC to CP or OX, increases use of habitat at SNI; invertebrate densities decrease PC to CP or OX and slightly at SNI (same as No Action)
		Sig.	**Significance criteria not defined**					
		Long term	Top carnivore gradually returns to SCB, kelp/ biodiversity increases in reoccupied areas throughout SCB, ecosystem enhanced	Top carnivore never returns to most of SCB nearshore area; ecosystem enhanced only at SNI	Top carnivore never returns to much of SCB nearshore area; ecosystem enhanced PC to SB and at SNI, SMI, and SRI but not in remainder of SCB	Possible delay in SCB ecosystem enhancement from removing SNI sea otters; otherwise, top carnivore gradually returns to SCB, kelp/ biodiversity increases in areas throughout SCB, ecosystem enhanced (almost same as No Action)		Top carnivore gradually returns to SCB, kelp/ biodiversity increases in reoccupied areas through-out SCB, ecosystem enhanced (same as No Action)
Candidate, Threatened, and Endangered Species	**White Abalone**	10 yrs.	Likely predation on shallow-living individuals PC to CP or OX and slight increase in predation on shallow-living individuals at SNI; possible (-) local population effects	Likely benefit to shallow-living individuals PC to CP or OX and possible (+) local population effects; at SNI, same as No Action	Likely predation on shallow-living individuals PC to SB; likely benefit to shallow-living individuals SB to CP or OX; at SNI, same as No Action	Same as No Action PC to CP or OX; possible slight short-term benefit to shallow-living individuals at SNI from removing SNI sea otters		Likely predation on shallow-living individuals PC to CP or OX and slight increase in predation on shallow-living individuals at SNI; possible (-) local population effects (same as No Action)
		Sig.		**Beneficial effect, low significance**	**Beneficial effect, very low significance**	**Beneficial effect, very low significance**		**No change**
		Long term	Predation on shallow-living individuals; (-) local population effects in areas of SCB	Benefit to shallow-living individuals in mgmt. zone; (+) local population effects in areas of SCB	Benefit to shallow-living individuals in modified mgmt. zone; (+) local population effects in	Possible benefit to shallow-living individuals in SCB from slowed range expansion; otherwise, predation on shallow-living individuals; (-) local population effects in areas of SCB reoccupied by SSO (almost same as No Action)		Predation on shallow-living individuals; (-) local population effects in areas of SCB reoccupied by SSO (same as No

TABLE 6-78 SUMMARY OF BIOLOGICAL IMPACTS BY ALTERNATIVE

Impact Topic			No Action	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C (Preferred Alternative)
			reoccupied by SSO	that would have been reoccupied by SSO	areas of SCB that would have been reoccupied by SSO			Action)
	Black Abalone	10 yrs.	Likely predation on emergent individuals PC to CP or OX and slight increase in predation on emergent individuals at SNI; possible (-) local population effects, esp. from PC to Government Point	Likely benefit to emergent individuals PC to CP or OX and possible (+) local population effects, esp. from PC to Government Point; at SNI, same as No Action	Likely predation on emergent individuals PC to SB and possible (-) local population effects, esp. from PC to Government Point; likely slight benefit to emergent individuals SB to CP or OX; at SNI, same as No Action	Likely predation on emergent individuals PC to CP or OX; possible (-) local population effects, esp. from PC to Government Point (same as No Action PC to CP or OX); likely benefit to emergent individuals and (+) local population effects at SNI from removing SNI sea otters		Likely predation on emergent individuals PC to CP or OX and slight increase in predation on emergent individuals at SNI; possible (-) local population effects, esp. from PC to Government Point (same as No Action)
		Sig.		**Beneficial effect, moderate significance**	**Beneficial effect, very low significance**	**Beneficial effect, moderate significance**		**No change**
		Long term	Predation on emergent individuals; (-) local population effects in areas of SCB reoccupied by SSO	Benefit to emergent individuals in mgmt. zone; (+) local population effects in areas of SCB that would have been reoccupied by SSO	Benefit to emergent individuals in modified mgmt. zone; (+) local population effects in areas of SCB that would have been reoccupied by SSO	Possible benefit to emergent individuals in SCB from slowed range expansion; otherwise, predation on shallow-living individuals; (-) local population effects in areas of SCB reoccupied by SSO (almost same as No Action)		Predation on emergent individuals; (-) local population effects in areas of SCB reoccupied by SSO (same as No Action)
	Southern Sea Otter	10 yrs.	Sea otters gradually expand range along coastline toward CP or OX and increase by an average of 7% per year at SNI	Range expansion restricted to north of PC; possible injury or death of moved sea otters; range-wide disturbance of behavior; at SNI, same as No Action	Sea otters gradually expand range along coastline toward SB; range expansion restricted to northwest of SB; possible injury or death of moved sea otters; range-wide disturbance of behavior; at	Possible (speculative) benefit to individuals from protections afforded by incidental take provisions Possible death or injury to sea otters removed (short-term) from SNI and potential disturbance of animals in the receiving population Possible death or injury to sea otters removed (short-term) from mgmt. zone and potential disturbance of		

TABLE 6-78 SUMMARY OF BIOLOGICAL IMPACTS BY ALTERNATIVE									
Impact Topic			**No Action**	**Alternative 1**	**Alternative 2**	**Alternative 3A**	**Alternative 3B**	**Alternative 3C** (Preferred Alternative)
					SNI, same as No Action	animals in the receiving population		
		Sig.		**Adverse effect, high significance**	**Adverse effect, high significance**	**Adverse effect, moderate significance**	**Adverse effect, moderate significance**	**Beneficial effect, low significance**
		Long term	Maximizes habitat available for sea otter recovery	Range restricted in perpetuity; approximately 37% of carrying capacity of CA for sea otters eliminated by mgmt. zone	Range restricted in perpetuity; approximately 27% of carrying capacity of CA for sea otters eliminated by modified mgmt. zone	Maximizes opportunity for sea otter recovery and attainment of OSP through habitat available and possible benefit afforded by incidental take provisions (same as No Action except incidental take provisions)		
				Range-wide disturbance of behavior; possible injury or death to moved sea otters; increased vulnerability to oil spills, disease, etc.		Recovery possibly slowed by removal of SNI sea otters		
				Cumulative effects of range restriction and containment would likely have long-term, large scale adverse effects on species	Cumulative effects of range restriction and containment may have long-term, large scale adverse effects on species			

CP=Carpinteria
OSP=Optimum Sustainable Population level for sea otters
OX=Oxnard
PC=Point Conception
SB=Santa Barbara
SNI=San Nicolas Island
SCB=Southern California Bight
SSO=southern sea otters

Local population level = Change in population densities of some age- or size-classes in the affected species' range or change in population densities of all age- or size-classes in a limited area of the affected species' range
Species level = Change in population densities in a substantial portion of the affected species' range that would likely affect its long-term survival

TABLE 6-79 SUMMARY OF SOCIOECONOMIC IMPACTS BY ALTERNATIVE

Impact Topic			No Action	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C (Preferred Alternative)
Commercial Fisheries	**Sea Urchin Fishery**	10 yrs.	Landings from PC to CP or OX decrease 10% per year to zero in 2021 & 1% per year at SNI; landings in other areas not affected	+$1.8 million over 10 years (representing a gain of 3% for the SCB sea urchin fishery as a whole)	+$89,584 to $110,448 over 10 years (representing a gain of 0.1 to 0.2% for the SCB sea urchin fishery as a whole)	+$314,885 over 10 years (representing a gain of 0.4% for the SCB sea urchin fishery as a whole) from avoided short-term losses at SNI		Landings from PC to CP or PC to OX decrease 10% per year to zero in 2021 & 1% per year at SNI; landings in other areas not affected (same as No Action)
		Sig.		**Beneficial effect, low significance**	**Beneficial effect, very low**	**Beneficial effect, very low significance**		**No change**
		Long term	Landings decrease in areas of SCB reoccupied by sea otters	Benefit to sea urchin fishery of unknown magnitude		Landings decrease in areas of SCB reoccupied by sea otters (same as No Action)		
				No decrease in SCB landings due to sea otters except at SNI	No decrease in SCB landings due to sea otters except from PC to SB & at SNI			
	Spiny Lobster Fishery	10 yrs.	Landings from PC to CP or OX decrease 10% per year to zero in 2021 & 1% per year at SNI; landings in other areas not affected	+$4.2 million to $5.3 million over 10 years (representing a gain of 6% to 7% for the SCB lobster fishery as a whole)	+$1.3 to $2.4 million over 10 years (representing a gain of 2 to 4% for the SCB lobster fishery as a whole)	+$397,268 over 10 years (representing a gain of 0.6% for the SCB lobster fishery as a whole)		Landings from PC to CP or OX decrease 10% per year to zero in 2021 & 1% per year at SNI; landings in other areas not affected (same as No Action)
		Sig.		**Beneficial effect, low significance**	**Beneficial effect, low significance**	**Beneficial effect, very low significance**		**No change**
		Long term	Landings decrease in areas of SCB reoccupied by sea otters	Benefit to lobster fishery of unknown magnitude		Landings decrease in areas of SCB reoccupied by sea otters (same as No Action)		
				No decrease in SCB landings due to sea otters except at SNI	No decrease in SCB landings due to sea otters except from PC to SB & at SNI			
	Crab Fishery	10 yrs.	Landings from PC to CP or OX decrease 10% per year to zero in 2021 & 1% per year at SNI; landings in other areas not affected	+$2.1 million to $3.1 million over 10 years (representing a gain of 15 to 16% for the SCB crab fishery as a whole)	+$1.1 to $2.1 million over 10 years (representing a gain of 8 to 16% for the SCB crab fishery as a whole)	+$17,337 over 10 years (representing a gain of 0.1% for the SCB crab fishery as a whole)		Landings from PC to CP or OX decrease 10% per year to zero in 2021 & 1% per year at SNI; landings in other areas not affected

							(same as No Action)
		Sig.		**Beneficial effect, moderate significance**	**Beneficial effect, low significance to beneficial effect, moderate significance**	**Beneficial effect, very low significance**	**No change**
		Long term	Landings decrease in areas of SCB reoccupied by sea otters	Benefit to crab fishery of unknown magnitude No decrease in SCB landings due to sea otters except at SNI	No decrease in SCB landings due to sea otters except from PC to SB & at SNI	Landings decrease in areas of SCB reoccupied by sea otters (same as No Action)	
	Sea Cucumber Fishery	10 yrs.	Landings from PC to CP or OX decrease 10% per year to zero in 2021 & 1% per year at SNI; landings in other areas not affected	+$1.2 million over 10 years (representing a gain of 18% for the SCB sea cucumber fishery as a whole)	+$508,692to $530,494 over 10 years (representing a gain of 8% for the SCB sea cucumber fishery as a whole)	+$63,497 over 10 years (representing a gain of 1% for the SCB sea cucumber fishery as a whole)	Landings from PC to CP or OX decrease 10% per year to zero in 2021 & 1% per year at SNI; landings in other areas not affected (same as No Action)
		Sig.		**Beneficial effect, moderate significance**	**Beneficial effect, low significance**	**Beneficial effect, low significance**	**No change**
		Long term	Landings decrease in areas of SCB reoccupied by sea otters	Benefit to sea cucumber fishery of unknown magnitude No decrease in SCB landings due to sea otters except at SNI	No decrease in SCB landings due to sea otters except from PC to SB & at SNI	Landings decrease in areas of SCB reoccupied by sea otters (same as No Action)	
	Halibut Fishery	10 yrs.	No regulatory change	No regulatory change so no effect	Closure from PC to SB already fully protective of sea otters, so no effect in area excluded from modified management zone	+$0 to $2.5 million over 10 years (representing a loss of 0 to 21% for the SCB halibut fishery as a whole)	
		Sig.		**No change**	**No change**	**No change to adverse effect, high significance**	
		Long term	No regulatory change	No regulatory change so no effect	Possible additional gear restrictions at SMI and SRI	Landings eliminated in areas of SCB reoccupied by sea otters if the State or NMFS close gill and trammel net gear fishing as a result of change in regulatory environment	
	White Seabass Fishery	10 yrs.	No regulatory change	No regulatory change so no effect	Closure from PC to SB already fully protective of sea otters, so no effect in area	+$0 to $2.8 million over 10 years (representing a loss of 0 to 42% for the SCB white seabass fishery as a whole)	

				excluded from modified management zone		
	Sig.		**No change**	**No change**	**No change to adverse effect, very high significance**	
	Long term	No regulatory change	No regulatory change so no effect	Possible additional gear restrictions at SMI and SRI	Landings eliminated in areas of SCB reoccupied by sea otters if the State or NMFS close gill and trammel net gear fishing as a result of change in regulatory environment	
Aquaculture	10 yrs.	Local, sporadic reduction in mussel densities at offshore oil platforms to the 1-2 mussel-producing leaseholders in the SB Channel	Slight benefit to the 1-2 mussel-producing leaseholders in the SB Channel from absence of risk of local, sporadic clearing of patches in mussel colonies	Same as No Action within 10 years or possible very slight benefit to mussel-producing leaseholders from restriction of range expansion between SB and OX under upper-bound range expansion scenario	Local, sporadic reduction in mussel densities at offshore oil platforms to the 1-2 mussel-producing leaseholders in the SB Channel (same as No Action)	
	Sig.	**Significance criteria not defined**				
	Long term	Sporadic losses at unprotected open-water marine aquaculture leases	Slight benefit to marine aquaculture leaseholders in mgmt. zone from absence of sporadic losses at unprotected open-water aquaculture leases	Slight benefit to marine aquaculture leaseholders in modified mgmt. zone from absence of sporadic losses at unprotected open-water aquaculture leases	Sporadic losses at unprotected open-water marine aquaculture leases (same as No Action)	
Seafood Processing Industry (Sea Urchins)	10 yrs.	Inputs to sea urchin processing facilities from PC to CP or OX decrease 10% per year to zero in 2021 & 1% per year at SNI; inputs from other areas not affected	Possible benefit to sea urchin processing facilities from 3% increase in inputs from SCB	Same as No Action within 10 years or very slight benefit to sea urchin processing facilities from 0.2% increase in inputs from SCB under upper-bound range expansion scenario	Possible benefit to sea urchin processing facilities from 0.4% increase in SCB landings resulting from removal of sea otters from San Nicolas Island	Inputs to sea urchin processing facilities from PC to SB or PC to CP decrease 10% per year to zero in 2018 & 1% per year at SNI; inputs from other areas not affected (same as No Action)
	Sig.		**Beneficial effect, low significance**	**No change to beneficial effect, very low significance**	**Beneficial effect, very low significance**	**No change**
	Long term	Elimination of inputs to sea	Benefit to sea urchin processing facilities of unknown magnitude		Adverse effects of unknown magnitude; elimination of inputs to sea urchin processing	

			urchin processing facilities from areas recolonized by sea otters	No decrease in SCB inputs due to sea otters except at SNI	No decrease in SCB inputs due to sea otters except PC to SB and at SNI	facilities from areas recolonized by sea otters (same as No Action)	
Kelp Harvest		10 yrs.	Possible enhancement of kelp stability and persistence PC to SB (may require more than 10 years) and at SNI	No enhancement of kelp stability and persistence PC to SB but same as No Action at SNI	Same as No Action within 10 years or possible very slight detriment to kelp stability and persistence from restriction of range expansion between SB and OX under upper-bound range expansion scenario	Possible slight loss of kelp available for harvest at SNI resulting from removal of sea otter colony; otherwise, same as No Action	Possible enhancement of kelp stability and persistence PC to SB (may require more than 10 years) and at SNI (same as No Action)
		Sig.	**Significance criteria not defined**				
		Long term	Likely increase in kelp available for harvest in areas reoccupied by sea otters	Adverse effect on kelp harvesting industry of unknown magnitude No increase in kelp available for harvest in SCB except enhancement of kelp beds at SNI	Adverse effect on kelp harvesting industry of unknown magnitude No increase in kelp available for harvest in SCB except enhancement of kelp beds PC to SB and at SNI	Likely increase in kelp available for harvest in areas reoccupied by sea otters (same as No Action)	
Recreational fishing	**Lobster Diving**	10 yrs.	Lobster fishing trips PC to CP or OX decrease 10% per year (about 1 trip) to zero in 2021& 1% per year at SNI (from 434 to 395 trips per year); trips in other areas not affected	Average annual benefit of 0.5 lobster fishing trips, representing less than 1% of the annual average of SCB lobster fishing trips (8,322)	Same as No Action within 10 years or possible very slight benefit to lobster fishing from restriction of range expansion between SB and CP under lower-bound range expansion scenario or expansion between SB and OX under upper-bound scenario; change undetectable in the context of the baseline number of coastal fishing trips	Average annual benefit of 48 trips, representing less than 1% of the annual average of SCB lobster fishing trips (8,322)	Lobster fishing trips PC to CP or OX decrease 10% per year (about 1 trip) to zero in 2021 & 1% per year at SNI (from 434 to 395 trips per year); trips in other areas not affected (same as No Action)
		Sig.		**Beneficial effect, very low significance**	**No change to beneficial effect, very low significance**	**Beneficial effect, very low significance**	**No change**
		Long term	Decrease or elimination of	Benefit to recreational lobster fishing of unknown magnitude		Decrease or elimination of lobster fishing trips in areas recolonized by sea otters (same as No	

			lobster fishing trips in areas recolonized by sea otters	No decrease in SCB lobster dives due to sea otters except at SNI	No decrease in SCB lobster dives due to sea otters except PC to SB and at SNI	Action)	
	Finfish Fishing	10 yrs.	Possible enhancement of kelp-canopy-associated finfish PC to CP or OX but not likely noticeable within 10 years; possible enhancement of finfish habitat and production at SNI	No enhancement of kelp-canopy-associated finfish PC to CP or OX but not likely noticeable within 10 years; possible enhancement of finfish habitat and production at SNI	Same as No Action within 10 years or possible very slight loss of enhancement of kelp-canopy-associated finfish SB to CP due to restriction of range expansion between SB and CP under upper-bound range expansion scenario; not likely noticeable within 10 years	Possible decline in kelp-canopy-associated finfish if kelp stability and persistence decreases at SNI due to removal of sea otters; otherwise, same as No Action	Possible enhancement of kelp-canopy-associated finfish PC to SB but not likely noticeable within 10 years; possible enhancement of finfish habitat and production at SNI (same as No Action)
		Sig.	**Significance criteria not defined**				
		Long term	Possible enhancement of kelp- associated finfish and recreational fishing in SCB where sea otters recolonize range	Possible adverse effect on recreational finfish fishing of unknown magnitude		Possible enhancement of kelp-associated finfish and recreational fishing in SCB where sea otters recolonize range (same as No Action)	
				No enhancement of recreational finfish fishing in SCB except at SNI	No enhancement of recreational finfish fishing in SCB except PC to SB and at SNI		
Abalone Fishery Restoration		10 yrs.	No effect in 10 years because no chance of abalone fishery restoration in this time, but presence of sea otters PC to SB and at SNI would exclude these areas from possible future abalone fishery consideration	No effect in 10 years because no chance of abalone fishery restoration in this time, but PC to SB would not be excluded from possible future abalone fishery consideration	No effect in 10 years because no chance of abalone fishery restoration in this time, but SB to CP would not be excluded from possible future abalone fishery consideration	Probably no effect from removal of sea otters from SNI because possible abalone fishery restoration is expected to require decades; most likely same as No Action	No effect in 10 years because no chance of abalone fishery restoration in this time, but presence of sea otters PC to SB and at SNI would exclude these areas from possible future abalone fishery consideration (same as No Action)
		Sig.	**Significance criteria not defined**				
		Long term	Possible abalone fishery restoration precluded in areas of SCB reoccupied by sea otters	Possible abalone fishery restoration precluded at SNI but not in other areas of SCB	Possible abalone fishery restoration precluded PC to SB and at SNI but not in other areas of SCB	Possible abalone fishery restoration precluded in areas of SCB reoccupied by sea otters (same as No Action)	

Ecotourism and Non-Market Value		10 yrs.	Increase in non-market benefits of sea otters totaling $13.2 to $32.5 million	No enhancement of ecotourism PC to CP or OX but ecotourism enhanced at SNI. $13.2 to $32.5 million in non-market benefits for CA households would not be realized over 10 years	Same as No Action within 10 years or some loss of non-market value relative to baseline under upper-bound range expansion scenario depending on distribution of sea otters along coastline	Removal of sea otters may result in decreased non-market benefits if sea otters do not survive after being moved from SNI; otherwise same as No Action		Same as No Action
		Sig.	**Significance criteria not defined**					
		Long term	Enhancement of ecotourism/non-market value in areas of SCB reoccupied by sea otters	No enhancement of ecotourism/non-market value in SCB except at SNI	No enhancement of ecotourism/non-market value in SCB except PC to SB and at SNI	Enhancement of ecotourism/non-market value in areas of SCB reoccupied by sea otters (same as No Action)		
Agency Programs	**U.S. Fish and Wildlife Service**	10 yrs.	--	-$7.0 million to maintain management zone over 10 years	-$6.4 million to maintain modified management zone over 10 years	-$1.6 million (over 3 years)	-$848,000 (over 2 years)	Same as No Action
		Sig.	**Significance criteria not defined**					
		Long term	Maximum opportunity to meet mandate to recover southern sea otter under ESA and to bring its population to OSP under MMPA	Difficult or impossible to meet mandate to recover southern sea otter under ESA and to bring its population to OSP under MMPA	Would likely make it difficult to meet mandate to recover southern sea otter under ESA and to bring its population to OSP under MMPA	Removal of SNI colony would have adverse effects on individual sea otters and may slow future recovery; possible benefit from incidental take provisions; otherwise, maximum opportunity to meet mandate to recover southern sea otter under ESA and to bring its population to OSP under MMPA		Possible benefit from change in incidental take provisions; otherwise, maximum opportunity to meet mandate to recover southern sea otter under ESA and to bring its population to OSP under MMPA
	Channel Islands National Park	10 yrs.	No effect within 10 years					
		Sig.	**Significance criteria not defined**					
		Long term	Consistent with mission and "Park Mission Goals" to protect and restore natural ecosystems within the Park	Not consistent with mission and "Park Mission Goals" to protect and restore natural ecosystems within the Park	Allows Park to fulfill mission and "Park Mission Goals" to protect and restore natural ecosystems in two of five islands within the Park	Consistent with mission and "Park Mission Goals" to protect and restore natural ecosystems within the Park (Same as No Action)		

	Channel Islands National Marine Sanctuary	10 yrs.	No effect within 10 years			
		Sig.	**Significance criteria not defined**			
		Long term	Consistent with mission to conserve and enhance biodiversity and ecological integrity in the Sanctuary	Not consistent with mission to conserve and enhance biodiversity and ecological integrity in the Sanctuary	Allows Sanctuary to fulfill mission to conserve and enhance biodiversity and ecological integrity in two of the five islands within the Sanctuary	Consistent with mission to conserve and enhance biodiversity and ecological integrity in the Sanctuary (Same as No Action)
	California Dept. of Fish and Game (MPAs)	10 yrs.	No effect within 10 years			
		Sig.	**Significance criteria not defined**			
		Long-term	Consistent with many objectives outlined for Channel Islands MPAs; adverse effect on fishery enhancement goals for sea urchins, lobster, crabs, and abalone	Inconsistent with many objectives outlined for Channel Islands MPAs; consistent with fishery enhancement goals for sea urchins, lobster, crabs, and abalone		Consistent with many objectives outlined for Channel Islands MPAs; adverse effect on fishery enhancement goals for sea urchins, lobster, crabs, and abalone
	U.S. Navy/DOD	10 yrs.	No consultation requirements under Section 7 of ESA for actions that may affect southern sea otters in mgmt. zone or translocation zone except for actions that may jeopardize the continued existence of the species			Consultation requirement for all actions that may affect the southern sea otter in the SCB; requirements may potentially be met with programmatic consultation
		Sig.	**Significance criteria not defined**			
		Long-term	Same as above			Same as above
	BOEM	10 yrs.	No consultation requirements under Section 7 of ESA for actions that may affect southern sea otters in management zone except for actions that may jeopardize the continued existence of the species; consultation requirement for all actions that may affect the southern sea otter in the translocation zone			Consultation requirement for all actions that may affect the southern sea otter in the SCB
		Sig.	**Significance criteria not defined**			
		Long-term	Same as above			Same as above

Note: All dollar amounts shown here are discounted at 3%
CP=Carpinteria
ESA=Endangered Species Act
MMPA=Marine Mammal Protection Act
MPAs=Marine Protected Areas
OSP=Optimum Sustainable Population level for southern sea otters
OX=Oxnard
PC=Point Conception
PH=Port Hueneme
Sig.= Significance
SB=Santa Barbara
SCB=Southern California Bight
SNI=San Nicolas Island

6.9 Cumulative Effects

Cumulative effects are those impacts that "result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Even if an individual project has a minor effect, significant environmental effects may result from the combination of the minor effects of multiple individual actions over time (CEQ 1997).
This section analyzes potential cumulative impacts of the proposed action, Alternative 3C (which we have also identified in this final SEIS as the preferred alternative), and other alternatives when added to impacts from other past, present, and reasonably foreseeable future actions in the region.

6.9.1 METHODOLOGY

Because no entity exists in isolation, all impacts on affected resources are necessarily cumulative. Many cumulative effects are therefore addressed either explicitly or implicitly in our analysis of the direct and indirect effects of the alternatives under consideration (sections 6.2-6.8). The purpose of cumulative effects analysis is not to explore the effects of the proposed action on the universe, but to focus on "important issues of national, regional, or local significance" (CEQ 1997). The analysis should focus on "whether the proposed action will have effects similar to other actions in the area and whether the resources have been historically affected by cumulative actions" (CEQ 1997). Furthermore, the analysis should be conducted from the perspective of the resource rather than from the perspective of the proposed action (CEQ 1997). Based on input received during scoping, during the comment period on the 2005 draft SEIS, and during the comment period on the 2011 revised draft SEIS, we have focused on three resource categories for cumulative effects analysis in this section of the document: white abalone, black abalone, and commercial and recreational fisheries in light of the establishment of South Coast Marine Protected Areas.

The cumulative effects analysis presented here is based on the potential effects of Alternative 3C (terminating the translocation program and not removing sea otters residing within the translocation or management zones at the time the decision to terminate is made). Potential effects are to be evaluated "to the point at which the resource is no longer affected significantly" (CEQ 1997). In the present analysis, we interpret this threshold to be until recovery or other relevant thresholds are met. The geographic scope of cumulative effects analysis of natural systems should follow natural ecological boundaries (CEQ 1997). Therefore, we use the historic range of white abalone and black abalone, respectively, as the geographic boundaries for analysis. For commercial and recreational fisheries in light of the establishment of South Coast Marine Protected Areas, we evaluate the potential for effects continuing indefinitely into the future. The relevant geographic scope of analysis for this cumulative impacts topic is the Southern California Bight.

6.9.2 WHITE ABALONE

For a description of white abalone biology, range, and threats, please see section 4.3.3.1. For a description of the baseline and analysis of the direct and indirect effects of the alternatives under consideration on white abalone, please see sections 6.2.3.1, 6.3.3.1, 6.4.3.1, 6.5.3.1, 6.6.3.1, and 6.7.3.1. The cumulative effects analysis presented here draws on our discussion in these sections and on information in the final rule listing white abalone as endangered (66 FR 29046; May 29,

2001) and the Final White Abalone Recovery Plan (NMFS 2008), which are hereby incorporated by reference. The geographic scope of analysis is the historic range of white abalone: from Point Conception, California, to Punta Abreojos, Baja California, Mexico. The temporal scope of analysis is from the 18^{th} and 19^{th} centuries, when the fur trade removed sea otters, a natural predator of abalone, from the nearshore marine ecosystem, to an indefinite point in the future (time to recovery is unknown, but will likely require several decades (NMFS 2008)).

6.9.2.1 Contribution of past actions to cumulative effects

White abalone were not described as a species until 1940, so past actions that affected white abalone before 1940 are impossible to identify. However, it is likely that the extirpation of southern sea otters from most of their historic range (which encompassed the entire range of white abalone) during the fur trade of the 18^{th} and 19^{th} centuries allowed white abalone to colonize shallower waters that would have been within the depth range utilized by sea otters. Commercial overfishing is considered to be the primary cause of the major decline in white abalone abundance, with a precipitous decline in abundance occurring during the 1970s (66 FR 29046). Competition for food and space with sea urchins and other abalone species may have been a factor in the decline of the species (66 FR 29046). Factors that are not considered likely to have been a major factor in the decline of the species include the loss or modification of habitat, withering syndrome, and predation by sea otters (66 FR 29046). The effects of climate change are unknown (NMFS 2008). Based on commercial fishing records, the white abalone population in Mexico is believed to be depleted, but there is insufficient information to determine the status of the species in that portion of its range (NMFS 2008).

6.9.2.2 Contribution of present actions to cumulative effects

The California Fish and Game Commission closed the California white abalone fishery in 1996. Current threats include (from most severe to least severe) extremely low levels of abundance and increased distance between individuals (leading to reproductive failure); inability to implement conservation and research measures due to limited funding and lack of coordination among agencies; inadequate enforcement; reduced genetic diversity; the spread of disease due to outplanting; illegal harvest; anthropogenic habitat modification; and climate change (NMFS 2008). Current measures include collecting broodstock and breeding white abalone in captivity for outplanting to the wild; surveying to locate surviving white abalone; and monitoring to evaluate abalone recruitment (NMFS 2008). A network of 49 MPAs and 3 special closures in southern California was designated in 2010 and took effect on January 1, 2012 (see section 6.2.11.4). These MPAs may provide white abalone additional protection from illegal harvest due to increased law enforcement.

6.9.2.3 Contribution of proposed action and other alternatives to cumulative effects

The proposed action would terminate the translocation program, allowing natural range expansion to continue to occur throughout southern California (likely over the course of several decades) and allow the sea otters at San Nicolas Island to remain there. Under the baseline, enforcement of the management zone is suspended. Thus, the proposed action would neither speed up nor slow down the natural range expansion that is currently occurring. As a result, there would be no cumulative effects on white abalone relative to the baseline. Selection of the proposed action would preclude selection of Alternatives 1 or 2, thereby also precluding the potential benefit (relative to the baseline) of capturing and removing sea otters from the management zone. The white abalone recovery plan identifies six broad recovery actions, one of which, Recovery Action 3 (protect white abalone populations and their habitat), could potentially be affected by sea otters. Specifically, the ongoing natural expansion of the southern sea otter population could negatively affect efforts under Recovery Action 3.3 (protect white abalone populations and habitat as they are discovered or established through enhancement) through predation if white abalone populations naturally recover or are established within the depth range utilized by sea otters and within the geographic area reclaimed by natural sea otter range expansion. These effects are the same as under the baseline (No Action) alternative. The recovery plan evaluates the severity of risk posed by the combined effect of predation from all natural sources (including sea otters) as "moderate" and ranks the threat overall as a 9 (1 being highest priority, and 10 being lowest priority). It does not propose the control of natural predation (including predation by sea otters) as a recovery action for white abalone.

Alternatives 1 and 2 would exclude sea otters from much of the Southern California Bight in perpetuity, potentially benefitting shallow-living individuals at the local population level. Alternatives 3A and 3B are similar to the proposed action in the long term.

6.9.2.4 Contribution of future actions to cumulative effects

Continuing climate change will have unknown effects on white abalone. Outplanting efforts may successfully increase the densities of white abalone in the wild.

6.9.2.5 Cumulative effect

White abalone are listed as endangered throughout their range. Although time to recovery is unknown, it is expected to require decades. The main cause of the decline of white abalone, overfishing, has been addressed with the closure of the white abalone fishery in 1996, but adult abalone are currently at densities too low to reproduce successfully. Under the baseline, enforcement of the management zone is suspended. Thus, the proposed action would neither speed up nor slow down the natural range expansion that is currently occurring. As a result, there would be no cumulative effects on white abalone relative to the baseline. The proposed action, when considered in relation to past, present, and future actions, does not significantly alter the relationship of white abalone to any biological or regulatory thresholds.

6.9.3 BLACK ABALONE

For a description of black abalone biology, range, and threats, please see section 4.3.3.2. For a description of the baseline and analysis of the direct and indirect effects of the alternatives under consideration on black abalone, please see sections 6.2.3.2, 6.3.3.2, 6.4.3.2, 6.5.3.2, 6.6.3.2, and 6.7.3.2. The cumulative effects analysis presented here draws on our discussion in these sections and on information in the final rule listing black abalone as endangered (74 FR 1937; January 14, 2009), the black abalone status review (Van Blaricom *et al.* 2009), and the final rule designating black abalone critical habitat (75 FR 59900; September 28, 2010), which are hereby incorporated by reference. The geographic scope of analysis is the historic range of black abalone: from Crescent City, California, to southern Baja California, Mexico. The temporal scope of analysis is from the 18th and 19th centuries, when the fur trade removed sea otters, a natural predator of abalone, from the nearshore marine ecosystem, to an indefinite point in the future (time to recovery has not been estimated).

6.9.3.1 Contribution of past actions to cumulative effects

The extirpation of southern sea otters from most of their former range is believed to have been responsible for the large aggregations of black abalone evident in California and Mexico during the nineteenth and twentieth centuries (Haaker *et al.* 2001). However, beginning in the mid-1980s, black abalone populations suffered major declines, prompting a closure of the commercial and recreational fishery in 1993. NMFS added black abalone to its list of candidate species in 1999 (64 FR 33466) and listed it as endangered under the ESA in 2009 based on a number of risks, "especially: (1) the spread of and mortality caused by a disease called withering syndrome; (2) low adult densities below the critical threshold density required for successful spawning and recruitment; (3) elevated water temperatures that have accelerated the spread of withering syndrome; (4) reduced genetic diversity that will render extant populations less capable of dealing with both long- and short-term environmental or anthropogenic challenges; and (5) illegal harvest" (74 FR 1937). A final status review report was issued in 2009 (Van Blaricom *et al.* 2009). Critical habitat was finalized in 2011 (76 FR 66806).

Although this species was harvested for human consumption, its value compared to other abalone species was relatively low. As a consequence, the collapse of black abalone stocks occurred late in the serial depletion that characterized the commercial abalone fishery before its complete closure in 1997 (Haaker *et al.* 2001). Annual landings of black abalone peaked in 1973 at almost 2 million pounds but declined by 1990 to only 13 percent of previous levels (which averaged about 700,000 pounds annually between 1972 and 1984) (Haaker *et al.* 2001). An estimated 3.5 million individuals were taken in the commercial and recreational fisheries (Rogers-Bennett *et al.* 2002, cited in Van Blaricom *et al.* 2009). Declines were especially dramatic in the Channel Islands, formerly a major population center for black abalone, where the commercial fishery focused its efforts from 1970-1993 (74 FR 1937).

The severe decline in abundance of black abalone has been exacerbated by a disease called withering syndrome. Withering syndrome began affecting black abalone populations in southern California in the mid-1980s and had spread northward into areas of the coast north of Point Conception by the early 2000s (Bergen and Raimondi 2001). The disease has eliminated black abalone from large areas of its former range, including the mainland coast of southern California (Haaker *et al.* 2001, Miner *et al.* 2006). Elevated seawater temperature, while not believed to be necessary for the occurrence of withering syndrome and the onset of mass mortality, is thought to promote these conditions (Bergen and Raimondi 2001, Raimondi *et al.* 2002). Mass mortalities appear to be followed by recruitment failure, either as a result of limited dispersal of larvae, lack of appropriate settlement habitat (due to changes in intertidal species assemblages following the elimination of adults), or the continued effects of the disease agent (Miner *et al.* 2006). Significant declines in abundance (more than 90 percent) have occurred at most (76 percent) of the long-term monitoring sites in California (Tissot 2007, cited in Van Blaricom *et al.* 2009). The relative importance of overfishing and withering syndrome in Mexico to the overall status of the species is uncertain due to the lack of sufficient information (74 FR 1937).

6.9.3.2 Contribution of present actions to cumulative effects

The California Fish and Game Commission closed the black abalone fishery in 1993. The primary threat to black abalone remains withering syndrome (74 FR 1937). Additional threats include elevated seawater temperatures (which elevate the risk of transmission of, and mortality from, withering syndrome), predatory pressure from natural predators (gastropods, octopuses, lobsters, sea stars, fishes, and sea otters) on populations that have suffered severe declines as a result of past actions, and poaching (74 FR 1937). State regulations imposed in 2009 requiring the monitoring of the health of abalone at aquaculture facilities will likely reduce the threat of the spread of disease (74 FR 1937). Critical habitat for black abalone was proposed in 2010 (75 FR 59900) and finalized in 2011 (76 FR 66806). A network of 49 MPAs and 3 special closures in southern California was designated in 2010 and took effect on January 1, 2012 (see section 6.2.11.4). These MPAs may provide black abalone additional protection from illegal harvest due to increased law enforcement, but the problem of poaching will likely continue to persist elsewhere.

6.9.3.3 Contribution of proposed action and other alternatives to cumulative effects

The proposed action would terminate the translocation program, allowing natural range expansion to continue to occur throughout southern California (likely over the course of several decades) and allow the sea otters at San Nicolas Island to remain there. Under the baseline, enforcement of the management zone is suspended. Thus, the proposed action would neither speed up nor slow down the natural range expansion that is occurring. As a result, there would be no cumulative effects on black abalone relative to the baseline. Selection of the proposed action would preclude selection of Alternatives 1 or 2, thereby also precluding the potential benefit (relative to the baseline) of capturing and removing sea otters from the management zone. If local recovery of black abalone populations occurred in areas lacking sufficient cryptic habitat, whether naturally or as a result of outplanting efforts, sea otters would likely have a detrimental effect on these populations. However, if future recovery actions for black abalone included relocating or aggregating exposed individuals in crevice habitat sufficiently deep to afford protection from sea otter predation, then sea otters would likely have more limited effects on these populations. These effects are the same as under the baseline (No Action) alternative. The final status review for black abalone ranks the severity of the overall threat level posed by sea otter predation as “medium” (see Table 6, Van Blaricom *et al.* 2009).

Alternatives 1 and 2 would exclude sea otters from much of the Southern California Bight in perpetuity, potentially benefitting emergent (non-cryptic) individuals at the local population level. Alternatives 3A and 3B are similar to the proposed action in the long term.

CRITICAL HABITAT

Critical habitat for black abalone includes a number of areas both within the current sea otter range and outside the current sea otter range (in southern California waters) (76 FR 66806). One segment of mainland coastline designated as critical habitat (from Montana de Oro State Park in San Luis Obispo County, to just south of Government Point, Santa Barbara County) overlaps slightly with the stretch of mainland coastline within the action area that is already occupied, or is expected to be recolonized, by sea otters within 10 years. The area of overlap extends along 11.3 km (7 mi) of coastline from Point Conception to just southeast of Government Point. The remainder of this portion of the mainland coastline has not been designated as critical habitat. All of the Channel Islands have been designated as critical habitat except the military-owned San Nicolas Island and San Clemente Island, which are covered by integrated natural resources management plans (76 FR 66806). If sea otters do recolonize the Southern California Bight gradually over the course of several decades, then their range will overlap with black abalone critical habitat in southern California, just as it currently overlaps with black abalone critical habitat in central California. The primary constituent elements of critical habitat essential for the conservation of black abalone are: rocky substrate; food resources; juvenile settlement habitat; suitable water quality; and suitable nearshore circulation patterns (76 FR 66806). Of these five elements, only one, food resources, may potentially be affected by sea otters. Under the proposed action, sea otters would generally be expected to improve food resources for adult black abalone through predation on sea urchins. However, ecological relationships are complex, and it is likely that numerous positive and negative interactions would occur simultaneously.

Alternatives 1 and 2 would exclude sea otters from much of the Southern California Bight in perpetuity, potentially preventing the enhancement of food resources. Alternatives 3A and 3B are similar to the proposed action in the long term.

6.9.3.4 Contribution of future actions to cumulative effects

Continuing ocean warming will likely exacerbate the effects of withering syndrome. Outplanting efforts may successfully increase the densities of black abalone in the wild.

6.9.3.5 Cumulative effect

Black abalone are listed as endangered throughout their range. Time to recovery has not been estimated. A primary cause of the decline of black abalone, overfishing, has been addressed with the closure of the black abalone fishery in 1993, but black abalone remain at low densities and subject to recruitment failure. Withering syndrome continues to affect black abalone, although genetically based disease resistance may occur in rare instances (Van Blaricom *et al.* 2009). Under the baseline, enforcement of the management zone is suspended. Thus, the proposed action would neither speed up nor slow down the natural range expansion that is currently occurring. As a result, there would be no cumulative effects on black abalone relative to the baseline. The proposed action, when considered in relation to past, present, and future actions, does not significantly alter the relationship of black abalone to any biological or regulatory thresholds.

6.9.4 Commercial and Recreational Fisheries in Light of the Establishment of South Coast Marine Protected Areas in the Southern California Bight

For a description of commercial and recreational fisheries that may be affected by the alternatives under consideration, please see sections 4.4.2 and 4.4.6. For a description of the baseline and analysis of the direct and indirect effects of the alternatives under consideration on commercial and recreational fisheries, please see sections 6.2.4, 6.2.8, 6.3.4, 6.3.8, 6.4.4, 6.4.8, 6.5.4, 6.5.8, 6.6.4, 6.6.8, 6.7.4, and 6.7.8. The cumulative effects analysis presented here draws on our discussion in these sections and on information in the South Coast Marine Protected Areas Project Final Environmental Impact Report (URS 2010), which is hereby incorporated by reference. The geographic scope of analysis is the Southern California Bight. The temporal scope of analysis is from the 18th and 19th centuries, when the fur trade removed sea otters, a natural predator of benthic invertebrates, from the nearshore marine ecosystem, to an indefinite point in the future.

6.9.4.1 Contribution of past actions to cumulative effects

The extirpation of southern sea otters from most of their former range is believed to have been responsible for the high densities of benthic invertebrates in California and Mexico during the nineteenth and twentieth centuries that allowed for the development of a number of commercial and recreational shellfish fisheries (Estes and Van Blaricom 1985). Whereas some species, such as spiny lobster, have been commercially fished in southern California waters since the late nineteenth century, other species were not harvested commercially until relatively recently. The commercial sea urchin fishery in southern California was initiated in 1971, when harvesting began as part of a NMFS program to develop fisheries for species identified as “underutilized.” The fishery was viewed, in part, as a way to reduce destructive grazing on kelp by sea urchins, which were formerly killed by applications of quicklime, by divers with hammers, and by removal with suction dredges after baiting with kelp (Foster and Schiel 1985). Sea cucumbers were first harvested in California in the late 1970s. Landings in commercial fisheries have fluctuated over time with the influence of climatic patterns, market conditions, fishing pressure, and changes in regulation.

Gill and trammel nets were used increasingly from the 1960s to the mid-1980s to catch rockfish, California halibut, white seabass, California barracuda, soupfin shark, angel shark, white croaker, and other nearshore species. At the peak of gill and trammel net use in 1985, 1,122 permits were issued (Schultze 2001). Because of conflicts with sport fisheries and mortality to seabirds and marine mammals due to entanglement in the nets, California citizens voted in a 1990 initiative to ban gill-net fishing in shallow waters, resulting in the Marine Resources Protection Act of 1990 (California Constitution Article 10B). This ban took full effect in 1994. With respect to southern California, it prohibits the use of gill and trammel nets in waters less than 70 fathoms or within one mile of the Channel Islands, whichever is less, and generally prohibits the use of gill and trammel nets within three nautical miles offshore of the mainland coast from Point Arguello to the Mexican border (Marine Resources Protection Act 1990). Since the implementation of gill and trammel net depth restrictions, hook-and-line landings of halibut have increased, especially in the San Francisco area. Gear types used to catch white seabass historically have included gill nets, hook-and-line, and round haul nets. Drift gillnets are currently the main gear used, although some fish are caught commercially using hook-and-line (CDFG 2001). Halibut and white seabass fisheries account for most shallow water (less than 104 m or 341 ft) gill and trammel net landings outside the existing closures in the northern portion of the Southern California Bight, where sea otters are expected to expand their range in the near future.

An MPA network on the five northernmost Channel Islands (San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara) was designated in 2003. A five-year review of this MPA network was conducted in 2008 to determine preliminary biological and socioeconomic effects. The review found the following:

> (A)reas within MPAs experienced increased growth of kelp forests, greater density and biomass of fish and invertebrate species commonly targeted by fishing efforts, a larger proportion of large individuals in lobster populations, and a greater proportion of piscivores in the fish community. Socioeconomic monitoring results indicated a slight decline in the number of commercial fishing vessels at the islands, and mixed responses

in commercial fisheries at the islands. In terms of value, compared to the rest of southern California, the rock crab and sea urchin fisheries at the islands increased more; lobster and squid fisheries increased less; the sea cucumber fishery declined less; and sheephead and rockfish fisheries declined more. Numbers of recreational fishing visits and non-consumptive uses were not substantially affected (Department *et al.* 2008, cited in URS 2010).

6.9.4.2 Contribution of present actions to cumulative effects

A network of 49 MPAs and 3 special closures in southern California (South Coast MPAs) was designated in 2010 and took effect on January 1, 2012 (see section 6.2.11.4). Major commercial fisheries within the South Coast Study Region, in which the South Coast MPAs have been newly designated, include market squid, sea urchin, California spiny lobster, coastal pelagic finfish, spot prawn, and California halibut (taken with hook and line or trawl gear) (URS 2010). Gill and trammel net fisheries are not identified as major commercial fisheries within the South Coast Study Region. It is expected that effects of the newly designated southern California MPAs on commercial and recreational fisheries would be similar to the effects detected thus far for the Channel Islands MPAs designated in 2003.

6.9.4.3 Contribution of proposed action and other alternatives to cumulative effects

The proposed action would terminate the translocation program, allowing natural range expansion to continue to occur throughout southern California (likely over the course of several decades) and allow the sea otters at San Nicolas Island to remain there. Under the baseline, enforcement of the management zone is suspended. Thus, the proposed action would neither speed up nor slow down the natural range expansion that is currently occurring. As a result, there would be no cumulative effects on the commercial sea urchin, spiny lobster, crab, or sea cucumber fisheries or the recreational lobster or finfish fisheries, relative to the baseline. Gill and trammel net fisheries have already been prohibited in most southern California waters within the dive depth range of sea otters. Effects resulting from the proposed action are limited to potential indirect effects on the gill and trammel net fisheries for halibut and white seabass if the change in the regulatory status of sea otters triggers additional depth restrictions on these fisheries. However, gill and trammel net fisheries are not identified as major commercial fisheries in the area newly designated as the South Coast MPAs.

Alternatives 1 and 2 would exclude sea otters from much of the Southern California Bight in perpetuity, benefiting commercial fisheries for sea urchins, spiny lobsters, crabs, and sea cucumbers and the recreational lobster fishery. Beneficial cumulative effects could accrue to the rock crab, sea urchin, and sea cucumber fisheries (which may increase in value in the presence of MPAs). The exclusion of sea otters from much of the Southern California Bight in perpetuity would likely dampen any negative effects on the value of the spiny lobster fishery that may result from the designation of MPAs. The gill and trammel net fisheries for halibut and white seabass may benefit because in the absence of sea otters or a change in their regulatory status, there would be no impetus for additional depth restrictions to protect sea otters. Alternatives 3A and 3B are similar to the proposed action in the long term. Because gill and trammel net fisheries are not identified as major commercial fisheries in the area newly designated as the South Coast MPAs, there would be no cumulative effects on the gill and trammel net fisheries for halibut and white seabass arising from the combined effects of the proposed action (or any of the alternatives) and the South Coast MPAs.

6.9.4.4 Contribution of future actions to cumulative effects

Ocean warming and acidification, fishing pressure, changes in market value, and potential future regulatory changes may change the distribution and abundance of commercially and recreationally exploited species. Southern Coast MPAs will likely benefit commercial and recreational fisheries outside the MPAs in the form of "spillover effects."

6.9.4.5 Cumulative effect

The proposed action would terminate the translocation program, allowing natural range expansion to continue to occur throughout southern California (likely over the course of several decades) and allow the sea otters at San Nicolas Island to remain there. Under the baseline, enforcement of the management zone is suspended. Thus, the proposed action would neither speed up nor slow down the natural range expansion that is currently occurring. As a result, there would be no cumulative effects resulting from the proposed action on the commercial sea urchin, spiny lobster, crab, or sea cucumber fisheries or the recreational lobster or finfish fisheries, relative to the baseline. Effects resulting from the proposed action are limited to potential indirect effects on the gill and trammel net fisheries for halibut and white seabass if the change in the regulatory status of sea otters triggers additional depth restrictions on these fisheries. However, gill and trammel net fisheries are not identified as major commercial fisheries in the area newly designated as the South Coast MPAs. Thus, there are no significant cumulative effects resulting from the proposed action in combination with the effects of the South Coast MPAs.

6.9.5 SUMMARY OF CUMULATIVE EFFECTS

TABLE 6-80 CUMULATIVE EFFECTS ON WHITE ABALONE AND BLACK ABALONE					
Entity	**Past actions**	**Present actions**	**Proposed action**	**Future actions**	**Cumulative effect**
White abalone	Increase in abundance of white abalone in shallow-water habitat due to extirpation of sea otters; severe population declines due to overfishing	Continuing fishery closure; collection of broodstock and breeding of white abalone in captivity for outplanting to the wild; surveying and monitoring efforts	Effects of sea otter predation on shallow-living individuals, affecting white abalone at local population level (same as baseline)	MPAs may afford additional protection from poaching; outplanting efforts may successfully increase densities	White abalone remain endangered (time to recovery is unknown)
Black abalone	Increase in abundance of emergent (non-cryptic) black abalone due to extirpation of sea otters; severe population declines due to overfishing and withering syndrome	Continuing fishery closure; continuing threat posed by ocean warming and withering syndrome; continuing threat of poaching	Effects of sea otter predation on emergent individuals, affecting black abalone at local population level (same as baseline)	Ocean warming will likely exacerbate withering syndrome. MPAs and critical habitat may afford additional protection from poaching; outplanting efforts may successfully increase densities	Black abalone remain endangered (time to recovery has not been estimated)
Commercial and recreational fisheries in light of the establishment of South Coast Marine Protected Areas in the Southern California Bight	Increase in abundance of nearshore benthic invertebrates due to extirpation of sea otters; ban on gill-net fishing in shallow waters imposed by Marine Resources Protection Act of 1990; MPA network on the five northernmost Channel Islands designated in 2003.	Network of 49 MPAs and 3 special closures in southern California (South Coast MPAs) designated in 2010 and effective as of January 1, 2012	Effects of sea otter predation on sea urchin, spiny lobster, crab, and sea cucumber fhiseries (same as baseline); potential indirect effects on the gill and trammel net fisheries for halibut and white seabass if the change in the regulatory status of sea otters triggers additional depth restrictions on these fisheries	Ocean warming and acidification, fishing pressure, changes in market value, and potential future regulatory changes may change the distribution and abundance of commercially and recreationally exploited species; South Coast MPAs will likely benefit commercial and recreational fisheries outside the MPAs in the form of "spillover effects."	No significant cumulative effects resulting from the proposed action in combination with the effects of the South Coast MPAs

6.10 Other Considerations Required by NEPA

A. Possible conflicts between the Preferred Alternative and objectives of federal, state, and local land-use plans, policies, and controls for the area concerned.

The preferred alternative does not conflict with the objectives of federal, regional, state, and local land use plans, policies, and controls. Table 6-81 summarizes environmental compliance for the preferred alternative.

TABLE 6-81 RELATIONSHIP BETWEEN THE PREFERRED ALTERNATIVE AND THE OBJECTIVES OF FEDERAL, STATE, AND LOCAL LAND USE PLANS, POLICIES, AND CONTROLS

Plans, Policies, and Controls	Responsible Agency	Status of Compliance
National Environmental Policy Act (42 United States Code (U.S.C.) §4321 *et seq.*)	U.S. Fish and Wildlife Service	This final SEIS has been prepared in accordance with the Council on Environmental Quality regulations implementing NEPA. The preparation of this final SEIS and the provision for its public review are being conducted in compliance with NEPA.
Coastal Zone Management Act (CZMA) (16 Code of Federal Regulations (C.F.R.) §1451 *et seq.*) California Coastal Act (14 California Code of Regulations (C.C.R.))	California Coastal Commission	USWFS has determined that the preferred alternative is consistent with the policies of the California Coastal Act and has completed a Coastal Consistency Determination in accordance with the CZMA.
ESA (16 U.S.C. §1531)	National Marine Fisheries Service	USFWS has concluded that no consultation is required with NMFS because we have determined that there is no effect of the preferred alternative on white or black abalone relative to baseline conditions. USFWS has concluded intra-Service Section 7 informal consultation and determined that the preferred alternative is "not likely to adversely affect" the southern sea otter relative to baseline conditions.
EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (Executive Order 12898, 59 FR 7629 (Section 1-101))	U.S. Fish and Wildlife Service	Minority or low-income populations would not be disproportionately affected by the preferred alternative.

B. Energy requirements and conservation potential of various alternatives and mitigation measures.

The preferred alternative (Alternative 3C) has no energy requirements and thus has the greatest conservation potential of the alternatives considered. The remaining alternatives have various levels of energy requirements (fuel for boats, airplanes, and vans/trucks) associated with the monitoring, capture, and transport of sea otters. Of the remaining alternatives, energy requirements are lowest for 3B and next-lowest for 3A because these alternatives call for only the removal of sea otters from San Nicolas Island and/or the management zone. Energy requirements are highest for Alternative 1 and next-highest for Alternative 2, because these alternatives require maintenance of a management zone in perpetuity.

C. NATURAL OR DEPLETABLE RESOURCE REQUIREMENTS AND CONSERVATION POTENTIAL OF VARIOUS ALTERNATIVES AND MITIGATION MEASURES.

"Trophic downgrading," or the loss of apex predators from ecological systems, may have far-reaching and unanticipated effects on ecosystem processes (Estes *et al.* 2011). Sea otters are apex predators and "keystone species" (see section 6.2.2) in the nearshore marine ecosystems of the North Pacific Ocean, meaning that they have large-scale community effects disproportionate to their abundance, arising largely from their predation on herbivorous benthic invertebrates. Sea otters are expected to reduce the densities of benthic invertebrates in areas that they recolonize, restoring these populations to levels similar to what existed before the near-extinction of sea otters during the fur trade of the 18th and 19th centuries. The preferred alternative (Alternative 3C) has the greatest conservation potential of the alternatives considered because it would allow the threatened southern sea otter to recolonize its historic range in southern California waters. Of the remaining alternatives, conservation potential is highest for 3B and next-highest for 3A because these alternatives call for only the short-term removal of sea otters from San Nicolas Island and/or the management zone. Conservation potential is lowest for Alternative 1 and next-lowest for Alternative 2, because these alternatives require maintenance of a management zone (exclusion of sea otters) in perpetuity. See specific impact topics earlier in this chapter regarding potential effects on endangered white and black abalone.

D. URBAN QUALITY, HISTORIC AND CULTURAL RESOURCES, AND THE DESIGN OF THE BUILT ENVIRONMENT, INCLUDING THE REUSE AND CONSERVATION POTENTIAL OF VARIOUS ALTERNATIVES AND MITIGATION MEASURES.

This topic is not relevant to the alternatives under consideration.

List of Preparers

This final SEIS on the Translocation of Southern Sea Otters was prepared by the U.S. Department of Interior, Fish and Wildlife Service. The names and qualifications of persons who contributed to the SEIS are listed below.

Core Team: This team bears the primary responsibility for preparing the SEIS. The members are:

Lilian Carswell , Southern Sea Otter Recovery and Marine Conservation Coordinator. SEIS Project Leader. Responsible for overseeing the development, content, and writing of the final supplement. EDUCATION: B.A. (1991) Environmental Science (Biology Track) and English (double major), University of California, Berkeley. M.A. (1993) English, Columbia University, New York. Ph.D. (2004) English, Columbia University, New York. M.A. (2008) Ecology and Evolutionary Biology, University of California, Santa Cruz. EXPERIENCE: 2006-present, Southern Sea Otter Recovery and Marine Conservation Coordinator; 2001-2006, Biologist, Southern Sea Otter Recovery Program; 1999-2001, field biologist for U.S. Fish and Wildlife Service, U.S. Geological Survey, and U.S. Forest Service.

Erin Henderson. U.S. Fish and Wildlife Service. Economist, Division of Economics. Responsible for economic analysis. Primary author of economic effects discussion in Chapter 6. EDUCATION: B.A. (1997) Economics and Environmental Studies, Occidental College. M.S. (2001) Agricultural and Natural Resource Economics, Oregon State University. EXPERIENCE: 2002-present, Economist, Division of Economics; 2000-2002, Economist, Potomac Management Group.

2005 Draft SEIS Team: The names and qualifications of persons who contributed to the 2005 draft SEIS are:

Greg Sanders. U.S. Fish and Wildlife Service. Southern Sea Otter Recovery Program Coordinator and Supplement Project Leader. Responsible for overseeing the development, content, and writing of the draft supplement. EDUCATION: B.A. (1983) Aquatic Biology, University of California, Santa Barbara. EXPERIENCE: 2000-2005, Coordinator, Southern Sea Otter Recovery Program; 1994-2000, Supervisor, Division of Habitat Conservation; 1987-1994, Field Biologist, Southern Sea Otter Translocation Program.

Lilian Carswell. U.S. Fish and Wildlife Service. Southern Sea Otter Recovery Program Biologist. Responsible for content and for writing, editing, and formatting the SEIS.

Erin Henderson. U.S. Fish and Wildlife Service. Economist, Division of Economics. Responsible for economic analysis. Primary author of economic effects discussion in Chapter 6.

References

Abbott, D.P. and E.C. Haderlie. 1980a. Echinodermata: Introduction. Pp. 115-116, *in* R.H. Morris, D.P. Abbott, and E.C. Haderlie, eds. 1980. Intertidal Invertebrates of California. Stanford, CA: Stanford University Press.

Abbott, D.P. and E.C. Haderlie. 1980b. Crustacea and other arthropods: Introduction. Pp. 499-503, *in* R.H. Morris, D.P. Abbott, and E.C. Haderlie, eds. 1980. Intertidal Invertebrates of California. Stanford, CA: Stanford University Press.

Abbott, D.P. and E.C. Haderlie. 1980c. Mollusca: Introduction to the phylum and to the class Gastropoda. Pp. 227-229, *in* R.H. Morris, D.P. Abbott, and E.C. Haderlie, eds. 1980. Intertidal Invertebrates of California. Stanford, CA: Stanford University Press.

Abbott, D.P. and E.C. Haderlie. 1980d. Prosobranchia: Marine snails. Pp. 230-307, *in* R.H. Morris, D.P. Abbott, and E.C. Haderlie, eds. 1980. Intertidal Invertebrates of California. Stanford, CA: Stanford University Press.

Aldrich, K., Curtis J., and Drucker S. 2001. A Cost-Benefit Analysis of Public Law 99-625: Sea Otter-Shellfishery Conflicts in Santa Barbara and Ventura Counties. M.S. Thesis. University of California, Santa Barbara.

Bakun, A. 2006. Wasp-waist populations and marine ecosystem dynamics: navigating the “predator pit” topographies. Progress in Oceanography 68:271-288.

Barsky, K.C. 2001. California Spiny Lobster. Pp. 98-100, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California’s Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Bedford, D. 2001. Giant Kelp. Pp. 277-81, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California’s Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Bedford, D. 2005. Personal communication. Associate Biologist, Kelp Monitoring and Management. Marine Region, California Department of Fish and Game. Los Alamitos, California.

Benech, S.V. 1977. Preliminary investigations of the giant red urchin resources of San Luis Obispo County, California, *Strongylocentrotus franciscanus* (Agassiz). Thesis. California Polytechnic University, San Luis Obispo, California, USA.

Bentall, G.B. 2005. Morphological and behavioral correlates of population status in the southern sea otter: a comparative study between central California and San Nicolas Island. Masters Thesis, University of California, Santa Cruz, CA, unpublished.

Bergen, L. and P. Raimondi. 2001. PISCO Update: Withering Syndrome in Black Abalone. *Ecosystem Observations: MBNMS Annual Report, 2001.* http://www.piscoweb.org/outreach/pubs/abalone.html Accessed 19 March 2003.

Boardman, A.E., Greenberg, D.H., Vining, A.R., Weimer, D.L. 1996. Existence Value. Pp. 237-249, *in* Cost-Benefit Analysis: Concepts and Practice. Upper Saddle River, NJ: Prentice Hall.

Bodkin, J.L. and B.E. Ballachey. 1996. Monitoring the status of the wild sea otter population: field studies and technique. Pp. 14-19 *in* Endangered Species Update: Conservation and Management of the Southern Sea Otter (vol. 13, no. 12). Ann Arbor: University of Michigan.

Breen, P.A., T.A. Carson, J.B. Foster, and E.A. Stewart. 1982. Changes in the subtidal community structure associated with British Columbia sea otter transplants. Marine Ecology Progress Series 7:13-20.

Butler, J., M. Neuman, D. Pinkard, R. Kvitek, G. Cochrane. 2006. The use of multibeam sonar mapping techniques to refine population estimates of the endangered white abalone. Fishery Bulletin 104(4).

Cameron, G.A. and K.A. Forney. 2000. Preliminary estimates of cetacean mortality in California/Oregon gillnet fisheries for 1999. Paper SC/S2/O24 presented to the International Whaling Commission, 2000 (unpublished). 12 pp. Available from NMFS, Southwest Fisheries Science Center, P.O. Box 271, La Jolla, California, 92038, USA.

Carretta, J.V. 2001. Preliminary estimates of cetacean mortality in California gillnet fisheries for 2000. Paper SC/53/SM9 presented to the International Whaling Commission, 2001 (unpublished). 21 pp. Available from NMFS, Southwest Fisheries Science Center, P.O. Box 271, La Jolla, California, 92038, USA.

CDFG (California Department of Fish and Game). 1976. A proposal for sea otter protection and research, and request for the return of management to the state of California. 270pp. Available from the California Department of Fish and Game, Sacramento.

CDFG (California Department of Fish and Game). 1995. Annual Report of Statewide Fish Landings by the Commercial Passenger Fishing Vessels (CPFV) Fleet.

CDFG (California Department of Fish and Game). 1996. Annual Report of Statewide Fish Landings by the Commercial Passenger Fishing Vessels (CPFV) Fleet.

CDFG (California Department of Fish and Game). 1997. Annual Report of Statewide Fish Landings by the Commercial Passenger Fishing Vessels (CPFV) Fleet.

CDFG (California Department of Fish and Game). 1998. Annual Report of Statewide Fish Landings by the Commercial Passenger Fishing Vessels (CPFV) Fleet.

CDFG (California Department of Fish and Game). 1999a. Letter to Michael Spear, U.S. Fish and Wildlife Service, regarding the draft evaluation of the southern sea otter translocation program and the draft biological opinion on the containment program for the southern sea otter. Dated May 11. Sacramento, California.

CDFG (California Department of Fish and Game). 1999b. Annual Report of Statewide Fish Landings by the Commercial Passenger Fishing Vessels (CPFV) Fleet.

CDFG (California Department of Fish and Game). 2000a. Draft Final Environmental Document, Giant and Bull Kelp Commercial and Sport Fishing Regulations. State Clearinghouse Number 2000012089. http://www.dfg.ca.gov/mrd/kelp_ceqa/index.html Accessed 6 Feb. 2003.

CDFG (California Department of Fish and Game). 2000b. Annual Report of Statewide Fish Landings by the Commercial Passenger Fishing Vessels (CPFV) Fleet.

CDFG (California Department of Fish and Game). 2001. Annual Report of Statewide Fish Landings by the Commercial Passenger Fishing Vessels (CPFV) Fleet.

CDFG (California Department of Fish and Game). 2002a. Commercial Fisheries Data by Species, Year, and Block. Personal communication. Jana Robertson, Management Services Technician, email: jroberts@dfg.ca.gov. Marine Fisheries Statistical Unit, California Department of Fish and Game, Los Alamitos, California.

CDFG (California Department of Fish and Game). 2002b. Annual Report of Statewide Fish Landings by the Commercial Passenger Fishing Vessels (CPFV) Fleet.

CDFG (California Department of Fish and Game). 2002c. Draft abalone recovery and management plan. http://www.dfg.ca.gov/mrd/armp/index.html

CDFG (California Department of Fish and Game). 2003. Annual Report of Statewide Fish Landings by the Commercial Passenger Fishing Vessels (CPFV) Fleet.

CDFG (California Department of Fish and Game). 2004. Annual Status of the Fisheries Report Through 2003. http://www.dfg.ca.gov/marine/status/report2003/entire.pdf.

CDFG (California Department of Fish and Game). 2005a. Commercial Fisheries Data by Species, Year, and Block. Personal communication. Jana Robertson, Management Services Technician, email: jroberts@dfg.ca.gov. Marine Fisheries Statistical Unit, California Department of Fish and Game, Los Alamitos, California.

CDFG (California Department of Fish and Game). 2005b. California Department of Fish and Game Statistics. http://www.dfg.ca.gov/licensing/statistics/statistics.html Accessed 12 May 2005.

CDFG (California Department of Fish and Game). 2005c. Final abalone recovery and management plan. http://www.dfg.ca.gov/mrd/armp/index.html

CDFG (California Department of Fish and Game). 2006a. Commercial Fisheries Data by Species, Year, and Block. Personal communication. Jana Robertson, Management Services Technician, email: jroberts@dfg.ca.gov. Marine Fisheries Statistical Unit, California Department of Fish and Game, Los Alamitos, California.

CDFG (California Department of Fish and Game). 2006b. California Department of Fish and Game Statistics. http://www.dfg.ca.gov/licensing/statistics/statistics.html Accessed 29 August 2006.

CDFG (California Department of Fish and Game). 2006c. Commercial Sea Cucumber Fishery. Personal communication. David Ono, Marine Biologist, email: dono@dfg.ca.gov. Marine Region, California Department of Fish and Game, Santa Barbara, California.

CDFG (California Department of Fish and Game). 2008a. Commercial Fisheries Data by Species, Year, and Block. Personal communication. Jana Robertson, Management Services Technician, email: jroberts@dfg.ca.gov. Marine Fisheries Statistical Unit, California Department of Fish and Game, Los Alamitos, California.

CDFG (California Department of Fish and Game). 2008b. California Department of Fish and Game Statistics. http://www.dfg.ca.gov/licensing/statistics/statistics.html Accessed 3 June 2008.

CDFG (California Department of Fish and Game). 2008c. Status of the Fisheries Report: An Update through 2006. http://www.dfg.ca.gov/marine/status/report2006/entire.pdf.

CDFG (California Department of Fish and Game). 2009. Laws and regulations governing the harvest of kelp and other marine plants in California: an informational packet. 34 pp.

CDFG (California Department of Fish and Game). 2010a. Commercial Fisheries Data by Species, Year, and Block. Personal communication. Jana Robertson, Management Services Technician, email: jroberts@dfg.ca.gov. Marine Fisheries Statistical Unit, California Department of Fish and Game, Los Alamitos, California.

CDFG (California Department of Fish and Game). 2010b. California Department of Fish and Game Statistics. http://www.dfg.ca.gov/licensing/statistics/statistics.html Accessed September 2010.

CDFG (California Department of Fish and Game). 2010c. Status of the Fisheries Report: An Update through 2008. http://www.dfg.ca.gov/marine/status/report2008/entire.pdf.

CDFG (California Department of Fish and Game). 2011. Review of selected California fisheries for 2010: coastal pelagic finfish, market squid, ocean salmon, groundfish, highly migratory species, Dungeness crab, spiny lobster, spot prawn, Kellett's whelk, and white seabass. CalCOFI Report 52:13-35. http://calcofi.org/publications/calcofireports/v52/Vol_52_13-35.Fisheries.pdf

CDFG (California Department of Fish and Game). No date. White Seabass Fishery Management Plan, Final. http://www.dfg.ca.gov/marine/wsfmp/index.asp.

CEQ (Council on Environmental Quality). 1997. Considering Cumulative Effects under the National Environmental Policy Act. 64 pp. + appendices.

CINP (Channel Islands National Park). n.d. Strategic Plan for Channel Islands National Park, 1999-2005. http://www.nps.gov/chis/admin/fy00strategicplan.htm Accessed 27 Jan. 2003.

CINMS (Channel Islands National Marine Sanctuary). 2002a. Channel Islands National Marine Sanctuary Revision: Introduction. http://www.cinms.nos.noaa.gov/marineres/manplan.html Revised 31 Oct. 2002. Accessed 27 Jan. 2003.

CINMS (Channel Islands National Marine Sanctuary). 2002b. Sanctuary Information. http://www.cinms.nos.noaa.gov/drop_down/mission.html Revised 13 Sept. 2002. Accessed 27 Jan. 2003.

CINMS (Channel Islands National Marine Sanctuary). 2002c. Sanctuary Marine Life. http://www.cinms.nos.noaa.gov/animals/animals.stm. Accessed 9 April 2002

Colegrove, K.M., M.E. Grigg, D. Carlson-Bremer, R.H. Miller, F.M.D. Gulland, D.J.P. Ferguson, D. Rejmanek_, B.C. Barr, R. Nordhausen, A.C. Melli, and P.A. Conrad. 2011. Discovery of three novel coccidian parasites infecting California sea lions (Zalophus californianus), with evidence of sexual replication and interspecies pathogenicity. Journal of Parasitology 97(5):868-77.

Conrad, P.A., M.A. Miller, C. Kreuder, E.R. James, J. Mazet, H. Dabritz, D. Jessup, F. Gulland, M. Grigg, M. 2005. Transmission of *Toxoplasma*: clues from the study of sea otters as sentinels of *Toxoplasma gondii* flow into the marine environment. International Journal of Parasitology 35:1155–1168.

Conte, F.S. and T. Moore. 2001. Culture of oysters. Pp. 500-506 *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Cooper, J., M. Wieland, and A. Hines. 1977. Subtidal abalone populations in an area inhabited by sea otters. TheVeliger 20:163-167.

County of Santa Barbara Energy Division. 2002. Natural Oil Seeps and Oil Spills. 28 pp. http://www.countyofsb.org/energy/information/seepspaper.asp

Cowen, R.K., C.R. Agegian, and M.S. Foster. 1982. The maintenance of community structure in a central California giant kelp forest. J. Exp. Biol. Ecol. 64:189-201.

Cross, J.N. and L.G. Allen. 1993. Fishes. Pp. 459-540, *in* M.D. Dailey, D.J. Reish, and J.W. Anderson, eds., Ecology of the Southern California Bight: A Synthesis and Interpretation. Berkeley, CA: University of California Press.

Culver, C.S. and A.M. Kuris. 2001. Sheep Crab. Pp. 115-7, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Dailey, M.D., J.W. Anderson, D.J. Reish, and D.S. Gorsline. 1993a. The Southern California Bight: Background and Setting. Pp. 1-18, *in* M.D. Dailey, D.J. Reish, and J.W. Anderson, eds., Ecology of the Southern California Bight: A Synthesis and Interpretation. Berkeley, CA: University of California Press.

Dailey, M.D., D.J. Reish, and J.W. Anderson, eds. 1993b. Ecology of the Southern California Bight: A Synthesis and Interpretation. Berkeley, CA: University of California Press.

Davis, G.E. 1993. Mysterious demise of the southern California black abalone, *Haliotis cracherodii* Leach 1814. Journal of Shellfish Research 17(3):871-875.

Day, E.G. 1998. Ecological interactions between abalone (*Haliotis midae*) juveniles and sea urchins (*Parechinus angulosus*) off the south-west coast of South Africa. Ph.D. dissertation, University of Cape Town, South Africa. 174 pp.

Dayton, P.K. 1985. Ecology of kelp communities. Ann. Rev. Ecol. Syst. 16:215-45.

Dayton, P.K. and M.J. Tegner. 1984. The importance of scale in community ecology: a kelp forest example with terrestrial analogs. Page 457, in Price, P.W., C.N. Slobodchikoff, and W.S. Gaud, eds. 1984. *A New Ecology: Novel Approaches to interactive Systems.* New York: Wiley.

Dayton, P.K., M.J. Tegner, P.B. Edwards, and K.L. Riser. 1998. Sliding baselines, ghosts, and reduced expectations in kelp forest communities. *Ecological Applications* 8(2), 309-322.

Dean Runyan Associates. 2011. California travel impacts by county, 1992-2009: 2010 preliminary State and regional estimates. Prepared for California Travel & Tourism Commission, 980 9th Street, Suite 480, Sacramento, CA 95814. 141 pp.

Dean, T.A., S.C. Schroeter, and J.D. Dixon. 1984. Effects of grazing by two species of sea urchins (*Strongylocentrotus franciscanus* and *Lytechinus anamesus*) on recruitment and survival of two species of kelp (*Macrocystis pyrifera* and *Pterygophora californica*). Mar. Biol. 78(3):301-13.

DeMaster, D.P. 1998. Letter to Michael Spear, Regional Director, Region 1, U.S. Fish and Wildlife Service, June 1.

Dewar, H., M. Domeier, and N. Nasby-Lucas. 2004. Insights into young of the year white shark, *Carcharodon carcharias*, behavior in the Southern California Bight. Environmental Biology of Fishes 70:133–143.

Doak, D.F. 2011. Modeling southern sea otter population dynamics under different management alternatives. Unpublished.

Doroff, A.M., J.A. Estes, M.T. Tinker, D.M. Burn, and T. Evens. 2003. Sea otter population declines in the Aleutian archipelago. In review.

Duggins, D.O. 1980. Kelp beds and sea otters: an experimental approach. Ecology 61:447-53.

Duggins, D.O. 1988. The effects of kelp forests on nearshore environments: biomass, detritus, and altered flow. Pp. 192-201, *in* G.R. Van Blaricom and J.A. Estes, eds., The Community Ecology of Sea otters. Berlin: Springer-Verlag.

Duggins, D.O., S.A. Simenstad, and J.A. Estes. 1989. Magnification of secondary production by kelp detritus in coastal marine ecosystems. Science 245:170-173.

Duggins, D.O., J.E. Eckman, and A.T. Sewell. 1990. Ecology of understory kelp environments. II. Effects of kelps on recruitment of benthic invertebrates. Journal of Experimental Marine Biology and Ecology 143:27–45.

Durham, J.W., C.D. Wagner, and D.P. Abbott. 1980. Echinoidea: The Sea Urchins. Pp. 160-76, *in* R.H. Morris, D.P. Abbott, and E.C. Haderlie, eds. 1980. Intertidal Invertebrates of California. Stanford, CA: Stanford University Press.

Ebeling, A.W. and D.R. Laur. 1988. Fish populations in kelp forests without sea otters: effects of severe storm damage and destructive sea urchin grazing. Pp. 169-191, *in* G.R. Van Blaricom and J.A. Estes, eds. 1988. *The Community Ecology of Sea Otters*. Berlin: Springer-Verlag.

Ebeling, A.W., D.R. Laur, and R.J. Rowley. 1985. Severe storm disturbances and reversal of community structure in a southern California kelp forest. Mar. Biol. 84:287-94.

Ebert, E.E. 1968a. A food-habits study of the southern sea otter, *Enhydra lutris nereis*. California Department of Fish and Game 54:33-42.

Ebert, E.E. 1968b. California sea otter-census and habitat survey. Underwater Naturalist 1968:20-23.

Ebert, E. 2001. Culture of Abalone. Pp. 494-495, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Ebert, T.A. and J.R. Southon. 2003. Red sea urchins (*Strongylocentrotus franciscanus*) can live over 100 years: confirmation with A-bomb ^{14}carbon. Fish. Bull. 101(4):915-22.

Emmett, R.L., S.L. Stone, S.A. Hinton, and M.E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries. Volume II: Species Life History Summaries. ELMR Rep. No. 8. NOAA/NOS Strategic Environmental Assessments Division, Rockville, MD. 329 pp.

Engle, J.M. 1979. Ecology and growth of juvenile California spiny lobster, *Panulirus interruptus* (Randall). Sea Grant Dissertation Series, USCSC-TD-03-79. 298 p.

Engle, J.M. 1994. Perspectives on the Structure and Dynamics of Nearshore Marine Assemblages of the California Channel Islands. Pp. 13-26, *in* W.L. Halvorson and G.J. Maender, The Fourth California Islands Symposium: Update on the Status of Resources. Santa Barbara Museum of Natural History, Santa Barbara, CA.

Erlandson, J., T.C. Rick, R. Vellanoweth. 2008 A canyon through time: archaeology, history, and ecology of the Tecolote Canyon area, Santa Barbara County, California. Salt Lake City: University of Utah Press.

Estes, J.A. 1990. Growth and equilibrium in sea otter populations. J. Anim. Ecol. 59:385-401.

Estes, J.A. and J.F. Palmisano. 1974. Sea otters: their role in structuring nearshore marine communities. Science 185:1058-60.

Estes, J.A. and G.R. Van Blaricom. 1985. Sea otters and shellfisheries. Pp. 187-235, *in* J.R. Beddington, R.J.H. Beverton, and D.M. Lavigne, eds. 1985. Marine Mammals and Fisheries. London: George Allen and Unwin.

Estes, J.A. and C. Harrold. 1988. Sea otters, sea urchins, and kelp beds: some questions of scale. Pp. 116-150, *in* G.R. Van Blaricom and J.A. Estes, eds. 1988. *The Community Ecology of Sea Otters*. Berlin: Springer-Verlag.

Estes, J.A. and D.O. Duggins. 1995. Sea otters and kelp forests in Alaska: generality and variation in a community ecological paradigm. *Ecological Monographs* 65 (1), 75-100.

Estes, J.A., N.S. Smith, and J.F. Palminsano. 1978. Sea otter predation and community organization in the western Aleutian islands, Alaska. Ecology 59:822-833.

Estes, J.A., D.R. Lindberg, and C. Wray. 2005b. Evolution of large body size in abalones (*Haliotis*): patterns and implications. Paleobiology 31(4): 591-606.

Estes, J.A., B.B. Hatfield, and M.T. Tinker. *No date*. Biological Analysis of Sea Otters and Coastal Marine Ecosystems in Central and Southern California: Synopsis and Update. Unpublished white paper.

Estes, J.A., M.T. Tinker, T.M. Williams, and D.F. Doak. 1998. Killer whale predation on sea otters linking oceanic and nearshore ecosystems. Science 282:473-476.

Estes, J.A., B.B. Hatfield, K. Ralls, and J. Ames. 2003a. Causes of mortality in California sea otters during periods of population growth and decline. Marine Mammal Science 19(1):198-216.

Estes, J.A., M.T. Tinker, A.M. Doroff, and D.M. Burn. 2005a. Continuing sea otter population declines in the Aleutian archipelago. Marine Mammal Science. 21:169-172.

Estes, J.A., M.L. Riedman, M.M. Staedler, M.T. Tinker, and B.E. Lyon. 2003b. Individual variation in prey selection by sea otters; patterns, causes, and implications. Journal of Animal Ecology 72:144-155.

Estes, J.A., J. Terborgh, J.S. Brashares, M.E. Power, *et al.* 2011. Trophic downgrading of Planet Earth. Science 333:301-306.

Fanshawe, S.; Van Blaricom, G.R.; Shelly, A.A. 2003. Restored top carnivores as detriments to the performance of marine protected areas intended for fishery sustainability: a case study with red abalones and sea otters. Conservation Biology 17(1):273-283.

Forney, K.A., S.R. Benson, and G.A. Cameron. 2001. Central California gill net effort and bycatch of sensitive species, 1990-1998. Pages 141-160 in Seabird Bycatch: Trends, Roadblocks, and Solutions, E.F. Melvin and J.K. Parrish, eds. Proceedings of an International Symposium of the Pacific Seabird Group, University of Alaska Sea Grant, Fairbanks, Alaska, 212 pp.

Foster, M.S. 1975. Algal succession in a *Macrocystis pyrifera* forest. Mar. Biol. (Berl.) 32:313-29.

Foster, M.S. 1990. Organization of macroalgal assemblages in the northeast Pacific: the assumption of homogeneity and the illusion of generality. Hydrobiologia 192:21-33.

Foster, M.S., and D.R. Schiel. 1985. The ecology of giant kelp forests in California: a community profile. US Fish Wildl. Serv. Biol. Rep. 85 (7.2). 152 pp.

Foster, M.S., and D.R. Schiel. 1988. Kelp communities and sea otters: keystone species or just another brick in the wall? Pp. 92-108, *in* G.R. Van Blaricom and J.A. Estes, eds., The Community Ecology of Sea Otters. Berlin: Springer-Verlag.

Gao, K. and K.R. McKinley. 1994. Use of macroalgae for marine biomass production and CO_2 remediation: a review. Journal of Applied Phycology 6:45060.

Gerber, L.R., M.T. Tinker, D.F. Doak, J.A. Estes, and D.A. Jessup. 2004. Mortality sensitivity in life-stage simulation analysis: A case study of southern sea otters. Ecological Applications 14:1554-1565.

Gerrodette, T. and D.P. DeMaster. 1990. Quantitative determination of optimum sustainable population level. Marine Mammal Science 6:1-16.

Gibson AK, Raverty S, Lambourn DM, Huggins J, Magargal SL, et al. 2011. Polyparasitism is associated with increased disease severity in *Toxoplasma gondii*-infected marine sentinel species. PLoS Negl Trop Dis 5(5): e1142. doi:10.1371/journal.pntd.0001142

Gotshall, D.W., L.L. Laurent, and F.E. Wendell. 1976. Diablo Canyon power plant site ecology study annual report July 1 1974 – June 30 1975. California Department of Fish and Game, Marine Resources Administrative Report 76-8.

Haaker, P.L., K. Karpov, L. Rogers-Bennett, I. Taniguchi, C.S. Friedman, and M.J. Tegner. 2001. Abalone. Pp. 89-97, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Hackett, S.C., D. King, M.D. Hansen, and E. Price. 2009. The Economic Structure of California's Commercial Fisheries. A Report in Fulfillment of Contract P0670015, California Department of Fish and Game. Available at http://www.dfg.ca.gov/marine/economicstructure.asp.

Hageman, R. 1985. Valuing Marine Mammal Populations: Benefit Valuations in a Multi-Species Ecosystem. Administrative Report LJ-85-22. National Marine Fisheries Service, La Jolla, CA.

Hankin, D. and R.W. Warner. 2001. Dungeness Crab. Pp. 107-11, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Harrold, C. and D.C. Reed. 1985. Food availability, sea urchin grazing, and kelp forest community structure. Ecology 66:1160-9.

Hatfield, B.B., J.A. Ames, J.A. Estes, M.T. Tinker, A.B. Johnson, M.M. Staedler, and M.D. Harris. 2011. The potential for sea otter mortality in fish and shellfish traps. Endangered Species Research 13:219–229.

Herbinson, K. and M. Larson. 2001. Sand Crab. Pp. 138-9, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Herrick, S.F. Jr. and D. Hanan. 1988. A review of California entangling net fisheries, 1981-1986. National Oceanic and Atmospheric Administration Technical Memorandum. National Marine Fisheries Service. NOAA-TM-NMFS-SWFC-108. 39 pp.

Hickey, B.M. 1993. Physical Oceanography. Pp. 19-70, *in* M.D. Dailey, D.J. Reish, and J.W. Anderson, eds., Ecology of the Southern California Bight: A Synthesis and Interpretation. Berkeley, CA: University of California Press.

Hines, A.H. and J.S. Pearse. 1982. Abalones, shells, and sea otters: dynamics of prey populations in central California. Ecology 63:1547-1560.

Hobday, A.J. and M.J. Tegner. 2000. Status review of white abalone (*Haliotis sorenseni*) throughout its range in California and Mexico. NOAA Technical Memorandum NOAA-TM-NMFS-SWR-035.

Hobday, A.J., M.J. Tegner, and P.L. Haaker. 2001. Over-exploitation of a broadcast spawning marine invertebrate: decline of the white abalone. Reviews in Fish Biology and Fisheries 10: 493-514.

Hoyt, E. 2001. Whale Watching 2001: Worldwide Tourism Numbers, Expenditures and Expanding Socioeconomic Benefits. Yarmouth Port, Massachusetts: International Fund for Animal Welfare. vi + 158pp.

Jameson, R.J. 1998. Sexual segregation in sea otters and its role in range expansion. The Otter Raft (newsletter of Friends of the Sea Otter) 60:6-8.

Jensen, S.K., J. Aars, C. Lydersen, K.M. Kovacs and K. Åsbakk. 2010. The prevalence of *Toxoplasma gondii* in polar bears and their marine mammal prey: evidence for a marine transmission pathway? Polar Biology 33(5):599-606.

Johnson, C.K., M.T. Tinker, J.A. Estes, P.A. Conrad, M. Staedler, M.A. Miller, D.A. Jessup and J.A.K. Mazet. 2009. Prey choice and habitat use drive sea otter pathogen exposure in a resource-limited coastal system. PNAS 106:2242-2247.

Kalvass, P. and L. Rogers-Bennett. 2001. Red sea urchin. Pp. 101-4, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Kannan, K., E. Perrotta, and N.J. Thomas. 2006. Association between perfluorinated compounds and pathological conditions in southern sea otters. Environmental Science & Technology 40:4943-4948.

Kannan, K., E. Perrotta, N.J. Thomas, and K.M. Aldous. 2007. A comparative analysis of polybrominated diphenyl ethers and polychlorinated biphenyls in southern sea otters that died of infectious diseases and noninfectious causes. Archives of Environmental Contamination and Toxicology 53:293–302.

Kanter, R.G. 1980. Biogeographic patterns in mussel community distribution from the Southern California Bight. Pp. 341-56, *in* D.M. Power, ed. 1980. The California Islands: Proceedings of a Multidisciplinary Symposium. Santa Barbara Museum of Natural History, Santa Barbara, CA.

Karpov, K. A., P.L. Haaker, I.K. Taniguchi, and L. Rogers-Bennet. 2000. Serial depletion and the collapse of the California abalone fishery (*Haliotis* spp.) fishery. Canadian Special Publication of Fisheries and Aquatic Sciences 130:11–24.

Kildow, J.T., C.S. Colgan, and J. Scorse. 2009. State of the U.S. ocean and coastal economies. National Ocean Economics Program. www.oceaneconomics.org.

Klimley, A.P. 1985. The aerial distribution and autecology of the white shark (*Carcharodon carcharias*), off the west coast of North America. Mem. South. Calif. Acad. Sci. 9:15–40.

Kreuder, C., M.A. Miller, D.A. Jessup, L.J. Lowenstine, M.D. Harris, J.A. Ames, T.E. Carpenter, P.A. Conrad, and J.A.K. Mazet. 2003. Patterns of mortality in southern sea otters (*Enhydra lutris nereis*) from 1998-2001. Journal of Wildlife Diseases 39:495-509.

Kreuder, C., M.A. Miller, L.J. Lowenstine, P.A. Conrad, T.E. Carpenter, D.A. Jessup, and J.A.K. Mazet. 2005. Evaluation of cardiac lesions and risk factors associated with myocarditis and dilated cardiomyopathy in southern sea otters (*Enhydra lutris nereis*). American Journal of Veterinary Research 66:289-299.

Kushner, D.J. 2002. Personal communication. Marine Biologist. Channel Islands National Park. Ventura, California.

Kushner, D.J., et al. 2010. Channel Islands National Park Kelp Forest Monitoring Program: Annual Report 2010. Natural Resource Data Series NPS/CHIS/NRDS.

Lafferty, K.D. and D.J. Kushner. 2000. Population regulation of the purple sea urchin, *Strongylocentrotus purpuratus*, at the California Channel Islands. Pp. 379-81, *in* D.R. Browne, K.L. Mitchell, and H.W. Chaney, eds. 2000. Proceedings of the Fifth California Islands Symposium. U.S. Minerals Management Service, Pacific OCS Region. OCS Study No. 99-0038.

Laidre, K.L., R.J. Jameson, and D.P. DeMaster. 2001. An estimation of carrying capacity for sea otters along the California coast. Marine Mammal Science 17(2):294-309.

Larson, R.J. and E.E. DeMartini. 1984. Abundance and vertical distribution of fishes in a cobble-bottom kelp forest off San Onofre, California. National Marine Fisheries Service Fish. Bull. 73(3), 453-462.

Laur, D.R., A.W. Ebeling, and D.A. Coon. 1988. Effects of sea otter foraging on subtidal reef communities off central California. Pp. 151-67, *in* G.R. Van Blaricom and J.A. Estes, eds., The Community Ecology of Sea otters. Berlin: Springer-Verlag.

Leet, W.S., C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Leeworthy, V.R. and P.C. Wiley. 2002. Socioeconomic Impact Analysis of Marine Reserve Alternatives for the Channel Islands National Marine Sanctuary. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Special Projects. Silver Spring, Maryland. 118 pp. + appendices. http://marineeconomics.noaa.gov/reserves/analysis/analysis.pdf

Loomis, J. 2006. Estimating Tourism, Recreation and Existence Values of Sea Otter Expansion in California Using Benefit Transfer. Fort Collins, CO. Unpublished report.

Lorenson, T.D., F.D. Hostettler, R.J. Rosenbauer, K.E. Peters, J.A. Dougherty, K.A. Kvenvolden, C.E. Gutmacher, F.L. Wong, and W.R. Normark. 2009. Natural offshore seepage and related tarball accumulation on the California coastline—Santa Barbara Channel and the southern Santa Maria Basin; source identification and inventory. U.S. Geological Survey Open-File Report 2009-1225 and MMS report 2009-030. 116 pp. http://pubs.usgs.gov/of/2009/1225/

Lovas, S.M. and A. Torum. 2001. Effect of the kelp *Laminaria hyperborea* upon sand dune erosion and water particle velocities. Coastal Engineering 44:37-63.

Lowry, L.F. and J.S. Pearse. 1973. Abalones and sea urchins in an area inhabited by sea otters. *Marine Biology* 23:213-219.

Lucas, S. 2006. History and status of commercial live fish fisheries in California and the United States West Coast. SPC Live Reef Fish Information Bulletin 16:19-25.

Mann, K.H. 1982. Ecology of Coastal Waters. Berkeley, CA: University of California Press.

Mayer, K.A., M.D. Dailey, and M.A. Miller. 2003. Helminth parasites of the southern sea otter *Enhydra lutris nereis* in central California: Abundance, distribution and pathology. Diseases of Aquatic Organisms 53:77-88.

McArdle, D., S. Hastings, and J. Ugoretz. 2003. California Marine Protected Area Update. California Sea Grant College Program, Publication No. T-051, NOAA Grant #NA06RG0142.

McCormick, T.B. and J.L. Brogan. 2003. Early reproduction in hatchery-raised white abalone *Haliotis sorenseni*, Bartsch, 1940). Journal of Shellfish Research 22(3):825-829.

McCrary, M.D., D.E. Panzer, and M.O. Pierson. 2003. Oil and gas operations offshore California: status, risks, and safety. Marine Ornithology 31:43-49.

McCreary, S., R. Tuden, and G. Brazil. 2010. The Abalone Advisory Group report on management options for establishing a potential red abalone fishery at San Miguel Island. Prepared by CONCUR, Inc. 44pp.

McLean, J.H. 1962. Sublittoral ecology of kelp beds of the open coast near Carmel, California. Biological Bulletin 122:213-219.

Meffe, G.K. and C.R. Carroll. 1997. Principles of Conservation Biology. Sunderland, MA: Sinauer Associates.

Micheli, F., A.O. Shelton, S.M. Bushinsky, A.L. Chiu, A.J. Haupt, K.W. Heiman, C.V. Kappel, M.C. Lynch, R.G. Martone, R.B. Dunbar, and J. Watanabe. 2008. Persistence of depleted abalones in marine reserves of central California. Biological Conservation 141:1078-1090.

Miller, M.A., I.A. Gardner, C. Kreuder, D.M. Paradies, K.R. Worcester, D.A. Jessup, E. Dodd, M.D. Harris, J.A. Ames, A.E. Packham, and P.A. Conrad. 2002. Coastal freshwater runoff is a risk factor for *Toxoplasma gondii* infection of southern sea otters (*Enhydra lutris nereis*). International Journal for Parasitology 32:997-1006.

Miller M.A., W.A. Miller, P.A. Conrad, E.R. James, A.C. Melli, C.M. Leutenegger, H.A. Dabritz, A.E. Packham, D. Paradies, M. Harris, J. Ames, D.A. Jessup, K. Worcester, M.E. Grigg. 2008. Type X *Toxoplasma gondii* in a wild mussel and terrestrial carnivores from coastal California: new linkages between terrestrial mammals, runoff and toxoplasmosis of sea otters. International Journal of Parasitology 38(11):1319-28.

Miner, C.M., J.M. Altstatt, P.T. Raimondi, T.E. Minchinton. 2006. Recruitment failure and shifts in community structure following mass mortality of black abalone limit its prospects for recovery. Marine Ecology Progress Series 327:107-117.

Minnesota IMPLAN Group, Inc. 2002. IMPLAN System (2002 data and software). Stillwater, MN.

MMS (Minerals Management Service). 2005. Personal communication. U.S. Department of the Interior, Minerals Management Service. Pacific Region. Camarillo, California.

Monson, D., J.A. Estes, D.B. Siniff, and J.L. Bodkin. 2000. Life history plasticity and population regulation in sea otters. Oikos 90:457-468.

Moore, T. 2001a. Washington Clams. Pp. 447-48, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Moore, T. 2001b. Gaper Clams. Pp. 445-46, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Moore, T. 2002. Personal communication. Marine Aquaculture Coordinator. Marine Region Laboratory, California Department of Fish and Game. Bodega Bay, California.

Morris, R.H., D.P. Abbott, and E.C. Haderlie. 1980. Intertidal Invertebrates of California. Stanford, CA: Stanford University Press.

Murray, S.N. and R.N. Bray. 1993. Benthic Macrophytes. Pp. 304-68, *in* M.D. Dailey, D.J. Reish, and J.W. Anderson, eds., Ecology of the Southern California Bight: A Synthesis and Interpretation. Berkeley, CA: University of California Press.

Murray, S.N., M.M. Littler, and I.A. Abbott. 1980. Biogeography of the California Marine Algae with Emphasis on the Southern California Islands. Pp. 325-39, *in* D.M. Power, ed. 1980. The California Islands: Proceedings of a Multidisciplinary Symposium. Santa Barbara Museum of Natural History, Santa Barbara, CA.

Neilson, D.J. 2011. Assessment of the California Spiny Lobster (*Panulirus interruptus*). California Department of Fish and Game. 138 pp. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=41068&inline=true.

Neuman, M., B. Tissot, and G. VanBlaricom. 2010. Overall status and threats assessment of black abalone (*Haliotis cracherodii* Leach, 1814) populations in California. Journal of Shellfish Research 29(3):577–586.

Newsome, S.D., M.T. Tinker, D.H. Monson, O.T. Oftedal, K. Ralls, M.M. Staedler, M.L. Fogel, and J.A. Estes. 2009. Using stable isotopes to investigate individual diet specialization in California sea otters (*Enhydra lutris nereis*). Ecology 90:961–974.

NMFS (National Marine Fisheries Service). 2008. White Abalone Recovery Plan (*Haliotis sorenseni*), National Marine Fisheries Service, Long Beach, California. http://www.nmfs.noaa.gov/pr/recovery/plans.htm

Oshurkov, V.V., A.G. Bazhin, V.I. Lukin, and V.F. Sevost'yanov. 1988. Sea otter predation and the benthic community structure of Commander Islands. Biologia Morya (Vladivostok) 6:50-60.

Ostfeld, R.S. 1982. Foraging strategies and prey switching in the California sea otter. Oecologia 53:170-178.

Palmisano, J.F. 1983. Sea otter predation: its role in structuring rocky intertidal communities in the Aleutian Islands, Alaska USA. Acta Zool. Fenn. 174: 209-11.

Palmisano, J.F. and J.A. Estes. 1977. Ecological interactions involving the sea otter. P. 527, *in* M.S. Merritt and R.G. Fuller, eds. The Environment of Amchitka Island, Alaska. U.S. Energy Research and Development Administration, Springfield, Virginia.

Parker, D.O. 2001. Rock Crabs. Pp. 112-4, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Pattison, C.A. 2002. Personal communication. Associate Biologist (Marine/Fisheries), California Department of Fish and Game. Morro Bay, California.

Pattison, C.A. 2001. Pismo Clam. Pp. 135-7, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Pearse, J.S., and A.H. Hines. 1979. Expansion of a central California kelp forest following the mass mortality of sea urchins. Marine Biology 51:83-91

Price, R.J. and P.D. Tom. 1995. Sea Urchins. Sea Grant Extension Program Publication. University of California Cooperative Extension. http://seaurchin.org/Sea-Grant-Urchins.html

Radtke H.D. and Davis S.W. 2000. Description of the U.S. West Coast Commercial Fishing Fleet and Seafood Processors. Pacific States Marine Fisheries Commission. 96 pp. + appendices.

Raimondi, P.T., M.C. Wilson, R.F. Ambrose, J.M. Engle, and T.E. Minchinton. 2002. Continued declines of black abalone along the coast of California: are mass mortalities related to El Niño events? Marine Ecology-Progress Series 242:143-152.

Ralls, K., T. Eagle, and D.B. Siniff. 1988a. Movement patterns and spatial use of California sea otters. Pp. 33-63, *in* D.B. Siniff and K. Ralls. 1988. Population status of California sea otters. Final report to the Minerals Management Service, U.S. Department of the Interior 14-12-001-3003.

Ralls, K., B. Hatfield, and D.B. Siniff. 1988b. Feeding patterns of California sea otters. Pp. 84-105, *in* D.B. Siniff and K. Ralls. 1988. Population status of California sea otters. Final report to the Minerals Management Service, U.S. Department of the Interior 14-12-001-3003.

Rathbun G.B., R.J. Jameson., G.R. VanBlaricom, and R.L. Brownell. 1990. Reintroduction of sea otters to San Nicolas Island, California: preliminary results for the first year. *In*: P.J. Bryant and J. Remington, eds. Memoirs of the Natural History Foundation of Orange County, p. 99-114.

Reilly, P.N. Littleneck Clams. 2001. Pp. 451-52, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Richards, D.V. 2000. The status of rocky intertidal communities in Channel Islands National Park. Pp. 356-8, *in* D.R. Browne, K.L. Mitchell, and H.W. Chaney, eds. 2000. Proceedings of the Fifth California Islands Symposium. U.S. Minerals Management Service, Pacific OCS Region. OCS Study No. 99-0038.

Richards, J.B. and G.A. Trevelyan. 2001. Culture of Mussels. Pp. 496-9, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A

Status Report. California Department of Fish and Game.
http://www.dfg.ca.gov/mrd/status/index.html

Riedman, M.L. and J.A. Estes. 1990. The sea otter (*Enhydra lutris*): behavior, ecology, and natural history. U.S. Fish and Wildlife Service, Biol. Rep. 90(14). 126 pp.

Riedman, M.L., J.A. Estes, M.M. Staedler, A.A. Giles, and D.R. Carlson. 1994. Breeding patterns and reproductive success of California sea otters. J. Wildl. Manage. 58(3):391-399.

Rogers-Bennett, L. 2007. Is climate change contributing to range reductions and localized extinctions in northern (*Haliotis kamtschatkana*) and flat (*Haliotis walallensis*) abalones? Bulletin of Marine Science 81:283-296.

Rogers-Bennett, L., P.L. Haaker, K.A. Karpov and D. J. Kushner. 2002. Using spatially explicit data to evaluate Marine Protected Areas for abalone in southern California. Conservation Biology 16:1308-1317.

Scammon, C.M. 1968 (1874). The Marine Mammals of the Northwestern Coast of North America. New York: Dover Publications.

Schultze, D. 2001. Nearshore Ecosystem Fish Resources: Overview. Pp. 149-51, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Department of Fish and Game.
http://www.dfg.ca.gov/mrd/status/index.html

Sea Urchin Harvesters Association-California. 2001. California sea urchin processors.
http://seaurchin.org/processors.html Accessed 30 December 2002, 24 June 2005.

Seapy, R.R. and M.M. Littler. 1980. Biogeography of rocky intertidal macroinvertebrates of the Southern California Islands. Pp. 307-23, *in* D.M. Power, ed. 1980. The California Islands: Proceedings of a Multidisciplinary Symposium. Santa Barbara Museum of Natural History, Santa Barbara, CA.

Simenstad, C.A., J.A. Estes, and K.W. Kenyon. 1978. Aleuts, sea otters, and alternate stable-state communities. Science 200:403-411

Siniff, D.B. and K. Ralls. 1991. Reproduction, survival and tag loss in California sea otters. Marine Mammal Science 7:211-229.

Taylor, B.L. and D.P. DeMaster. 1993. Implications of non-linear density dependence. Marine Mammal Science 9:360-371.

Tegner, M.J. and P.K. Dayton. 1981. Population structure, recruitment, and mortality of two sea urchins (*Strongylocentrotus franciscanus* and *S. purpuratus*) in a kelp forest near San Diego, California. *Marine Ecology Progress Series* 77, 49-63.

Tegner, M.J. and P.K. Dayton. 2000. Ecosystem effects of fishing in kelp forest communities. *ICES Journal of Marine Science* 57, 579-589.

Thomas, N.J., and R.A. Cole. 1996. The risk of disease and threats to the wild population. Endangered Species Update 13:23-27.

Thompson, B., J. Dixon, S. Schroeter, and D.J. Reish. 1993. Benthic Invertebrates, *in* M.D. Dailey, D.J. Reish, and J.W. Anderson, eds. Ecology of the Southern California Bight: A Synthesis and Interpretation. Pp. 369-458. Berkeley, CA: University of California Press.

Thomson, C.J. 2001. Human Ecosystem Dimension. Pp. 47-66, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Tinker, M.T., D.F. Doak, and J.A. Estes. 2008a. Using demography and movement behavior to predict range expansion of the southern sea otter. Ecological Applications 18(7):1781–1794. Located in Appendix F of this document.

Tinker, M.T., G. Bentall, and J.A. Estes. 2008b. Food limitation leads to behavioral diversification and dietary specialization in sea otters. PNAS 105:560-565.

Tinker, M.T., J.A. Estes, K. Ralls, T.M. Williams, D. Jessup, and D.P. Costa. 2006a. Population Dynamics and Biology of the California Sea Otter (*Enhydra lutris nereis*) at the Southern End of its Range. MMS OCS Study 2006-007. Coastal Research Center, Marine Science Institute, University of California, Santa Barbara, California. MMS Cooperative Agreement Number 14-35-0001-31063.

Tinker, M.T., D.F. Doak, J.A. Estes, B.B. Hatfield, M.M. Staedler, and J. Bodkin. 2006b. Incorporating diverse data and realistic complexity into demographic estimation procedures for sea otters. Ecological Applications 16:2293-2312.

Tinker, M.T., D.P. Costa, J.A. Estes, and N. Wieringa. 2007. Individual dietary specialization and dive behaviour in the California sea otter: using archival time-depth data to detect alternative foraging strategies. Deep Sea Research II 54:330-342.

Tricas, T.C. & J.E. McCosker. 1984. Predatory behavior of the white shark (*Carcharodon carcharias*), with notes on its biology. Proc. Calif. Acad. Sci. 43:221–238.

Tutschulte, T.C. and J.H. Connell. 1981. Reproductive biology of three species of abalones (*Haliotis*) in southern California (USA). Veliger 23(3): 195-206.

Ugoretz, John. 2002. Final 2002 Environmental Document: Marine Protected Areas in NOAA's Channel Islands National Marine Sanctuary. Sections 27.82, 630, and 632 Title 14, California Code of Regulations. California Department of Fish and Game. State Clearing House Number 2001121116.

URS. 2010. South Coast Marine Protected Areas Project Final Environmental Impact Report. Prepared for California Fish and Game Commission, 1416 Ninth Street, Sacramento, CA 95814. State Clearinghouse #2010071012. Available at http://www.dfg.ca.gov/mlpa/finalimpact_sc.asp

U.S. Census Bureau. 2008. 2008 American Community Survey. http://factfinder.census.gov Accessed September 2010.

U.S. Department of Commerce, Bureau of Economic Analysis. 2003. State and Local Personal Income. http://www.bea.gov Accessed May 2005.

U.S. Department of Defense. 2002. Final Environmental Impact Statement /Overseas Environmental Impact Statement, Point Mugu Sea Range. Department of the Navy, Naval Air Systems Command, Naval Air Warfare Center Weapons Division, Point Mugu.

U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. 2006. National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

USFWS (U.S. Fish and Wildlife Service). 1982. Southern Sea Otter Recovery Plan. Regional Office, Portland, Oregon. 70 pp.

USFWS (U.S. Fish and Wildlife Service). 1987. Final Environmental Impact Statement, Translocation of Southern Sea Otters. Office of Sea Otter Coordination, Sacramento, California.

USFWS (U.S. Fish and Wildlife Service). 1989. Second Annual Report, Southern Sea Otter Translocation to San Nicolas Island, California, August 1988-July 1989. Ventura Endangered Species Recovery Office, Ventura, California.

USFWS (U.S. Fish and Wildlife Service). 1990. Third Annual Report, Southern Sea Otter Translocation to San Nicolas Island, California, August 1989-July 1990. Ventura Endangered Species Recovery Office, Ventura, California.

USFWS (U.S. Fish and Wildlife Service). 2000. Reinitiation of Formal Consultation on the Containment Program for the Southern Sea Otter (1-8-99-FW-81). California/Nevada Operations Office, Sacramento, California.

USFWS (U.S. Fish and Wildlife Service). 2006. National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. http://fa.r9.fws.gov/surveys/surveys.html Accessed 24 Sept. 2010.

USFWS (U.S. Fish and Wildlife Service). 2003. Final Revised Recovery Plan for the Southern Sea Otter (*Enhydra lutris nereis*). Portland, Oregon. xi + 165 pp.

U.S. Geological Survey. 2005. Status of Southern Sea Otters. http://www.werc.usgs.gov/otters/ Accessed 1 June 2005.

Van Blaricom, G.R. 1984. Relationships of sea otters to living marine resources in California: a new perspective. Page 361, *in* Lyle, V., ed. 1984. Collection of Papers Presented at the Ocean Studies Symposium, Nov. 7-11 1982, Asilomar, California. California Coastal Commission and California Department of Fish and Game, Sacramento.

Van Blaricom, G.R. and J.A. Estes, eds. 1988. The Community Ecology of Sea Otters. Berlin: Springer-Verlag.

Van Blaricom, G.R., M. Neuman, A. DeVogelaere, R. Gustafson, C. Mobley, D. Richards, S. Rumsey, and B. Taylor. 2009. Status review report for black abalone (*Haliotis cracherodii* Leach, 1814). NMFS Southwest Region, Long Beach, California. 135 pp.

Watson, J.C. 1993. Effects of sea otter *Enhydra lutris* foraging on rocky sublittoral communities off northwestern Vancouver Island, British Columbia. Dissertation. University of California, Santa Cruz, California, USA.

Wendell, F. 1994. Relationship between sea otter range expansion and red abalone abundance and size distribution in central California. California Fish and Game 80(2): 45-56.

Wendell, F. Aquaculture: Overview. 2001. P. 493, *in* W.S. Leet, C.M. Dewees, R. Klingbeil, and E.J. Larson, eds. 2001. California's Living Marine Resources: A Status Report. California Department of Fish and Game. http://www.dfg.ca.gov/mrd/status/index.html

Wendell, F.E., R.A. Hardy, and J.A. Ames. 1986. An assessment of the accidental take of sea otters, *Enhydra lutris*, in gill and trammel nets. California Department of Fish and Game, Mar. Res. Tech. Rep. No. 54, 31 pp.

Wild, P.W., and J.A. Ames. 1974. A report on the sea otter, *Enhydra lutris* L., in California. California Department of Fish and Game. Marine Resources Technical Report Number 20.

Wilmers, C.C., J.A. Estes, M. Edwards, K.L. Laidre, and B. Konar. 2012. Do trophic cascades affect the storage and flux of atmospheric carbon? An analysis of sea otters and kelp forests. Frontiers in Ecology and the Environment 10:409–415.

Wilson, D.E., M.A. Bogan, R.L. Brownell, Jr., A.M. Burdin, and M.K. Maminov. 1991. Geographic variation in sea otters, *Enhydra lutris*. J. Mamm., 72(1):22-36.

This page intentionally left blank.

Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, CA 93003

Ph 805/644 1766
Fx 805/644 3958

http://www.fws.gov/ventura

November 2012