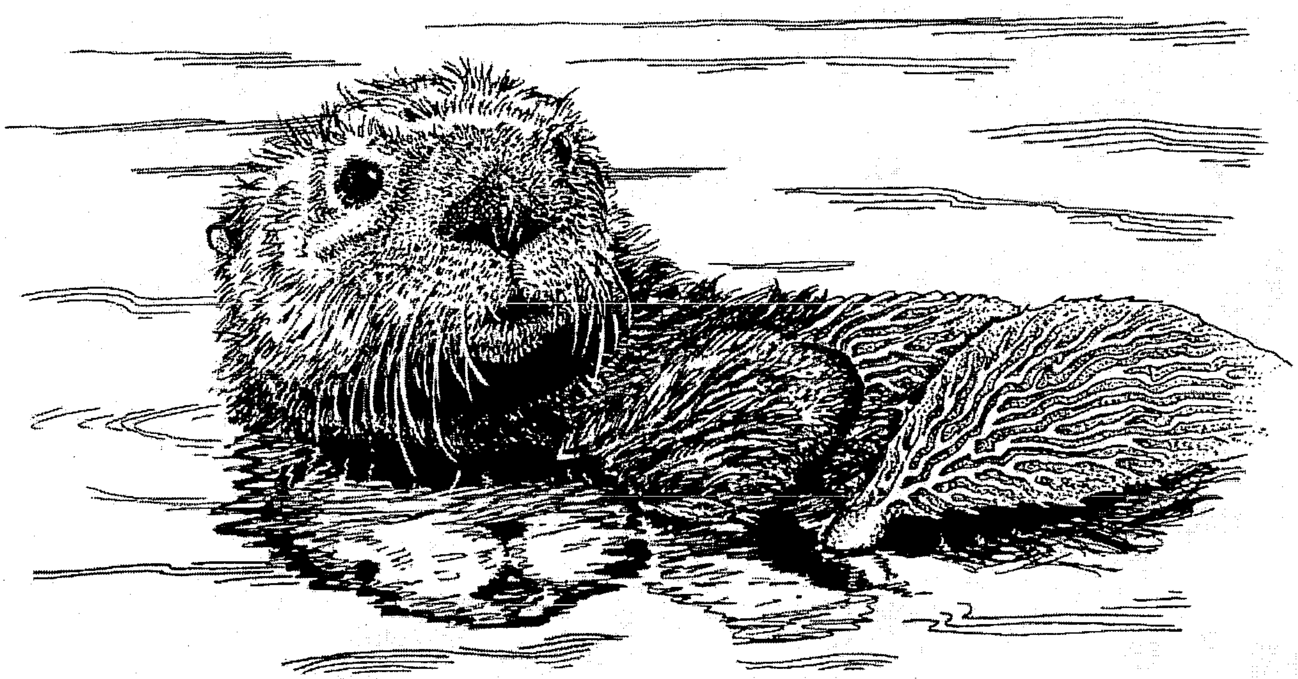
U.S. Fish & Wildlife Service

Final Revised Recovery Plan for the Southern Sea Otter
(Enhydra lutris nereis)



Final Revised Recovery Plan for the Southern Sea Otter (*Enhydra lutris nereis*)

U.S. Fish and Wildlife Service
Region 1
Portland, Oregon

(Original Approved: February 3, 1982)

Approved: [signature]
Manager, California/Nevada Operations Office

Date: 2/24/2003

Acknowledgments

We would like to acknowledge the staff of the Ventura Fish and Wildlife Office, the Southern Sea Otter Recovery Team, and the technical consultants to the Recovery Team for their contributions to this final revised recovery plan. We appreciate the long-term commitment of the recovery team and their assistance in preparing this recovery plan over the period of development. Special thanks are due to Carl Benz, Doug DeMaster, and Jim Estes for preparation and review of the recovery plan, and to Greg Sanders and Lilian Carswell for their assistance with final editing and formatting. The cover illustration was provided courtesy of Patricia Farris.

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U.S. Fish and Wildlife Service. 2003. Final Revised Recovery Plan for the Southern Sea Otter (*Enhydra lutris nereis*). Portland, Oregon. xi + 165 pp.

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Preface

The southern sea otter (*Enhydra lutris nereis*) is listed as threatened under the Endangered Species Act of 1973, as amended, and is therefore also recognized as depleted under the Marine Mammal Protection Act of 1972, as amended. The general goal of the Endangered Species Act is to recover listed species until they are no longer in danger of extinction, or likely to become so in the foreseeable future. Under the Marine Mammal Protection Act, Federal agencies are charged with managing marine mammals to their optimum sustainable population level (i.e., maximizing net productivity of the population). For the sea otter, the optimum sustainable population level is believed to be greater than the population level needed for recovery under the Endangered Species Act. We (the U.S. Fish and Wildlife Service) formed a Southern Sea Otter Recovery Team (Recovery Team) and finalized a recovery plan for the species in 1982. In 1989, we reconvened the Recovery Team and asked them to review and recommend changes to the existing recovery plan.

A draft revised recovery plan for the southern sea otter was completed in 1991. The 1991 draft plan recommended the threshold for delisting under the Endangered Species Act be made equivalent to the lower limit of the optimum sustainable population level under the Marine Mammal Protection Act, which was then believed to be a population size of 5,400 animals with a range extending from Point Conception, California, to the Oregon border. The Recovery Team made this recommendation because they lacked information to quantify particular risks, such as that of major oil spills, to the sea otter population. The recommendation was controversial, however, and the 1991 draft plan was never finalized.

Based on public comments received on the 1991 draft revised recovery plan, the Recovery Team adopted a different approach, population viability analysis (see Soulé 1987), to develop objective delisting criteria for the species as required by the Endangered Species Act. This approach required information on the probability of an oil spill occurring within the range of the southern sea otter, the likelihood of a spill of a particular size occurring, and the expected level of mortality associated with an oil spill event of a particular size. Between 1992 and 1995, we responded to the Recovery Team's need for information by contracting with experts to model oil spill scenarios and evaluate risk to sea otters (see Appendices B and C). In determining a course of action to recover the southern sea otter, we used the best available scientific information as a standard. We assembled a diverse group of stakeholders as technical consultants to review and comment on the recovery criteria and objectives developed by the Recovery Team.

We and the Recovery Team completed the second revised draft of the recovery plan in early 1995. The draft was released for public comment in July 1996. Two significant findings were reported after release of the draft revision. First, the number of dead sea otters stranded on the beach increased significantly from previous years. This increase in dead strandings coincided with a decline in southern sea otter population counts starting about 1995 and continuing through 1999. Second, large numbers of sea otters were reported near Point Conception at the southern end of the range.

As of July 1996, we and the Recovery Team believed that a major oil spill occurring within the sea otter's range remained the primary factor determining the likelihood of otters persisting in California. Therefore, we identified two approaches that would lead to delisting the southern sea otter under the Endangered Species Act: 1) increasing the range of sea otters in California to lessen the risk of a single oil spill event reducing the otter population below a viable level, and 2) decreasing the likelihood of a major oil spill event within the sea otter's range. We based our approach for recovering the species on the premise that, while much progress has been made to reduce the risk to sea otters in California posed by an oil spill, it is not possible to eliminate or reduce the likelihood of a major oil spill sufficiently to consider delisting this population at its 1996 abundance and distribution.

Because of the nature and magnitude of public comments on the 1996 draft revised recovery plan, we requested that the Recovery Team review and make recommendations on the plan a third time. Another draft was released to the public in January 2000. Public comments were reviewed by the Recovery Team in January 2001, and changes based on these comments are incorporated into this final plan. As part of our response to these comments, we asked the Recovery Team to complete a trend analysis to determine the population size that would be robust enough for us to detect a declining trend in abundance reliably prior to the population reaching the threshold for endangered status. In April 2002, we solicited comments from peer reviewers on the methodology used in the trend analysis. These comments are included in Appendix E.

We and the Recovery Team recognize that once the range and number of otters increase sufficiently, or the likelihood of an oil spill event to the otter population decreases to a level yet to be quantified, the southern sea otter will be considered for delisting under the Endangered Species Act. Prior to delisting we must review five listing factors: 1) the present or threatened destruction, modification, or curtailment of habitat; 2) overutilization for commercial, recreational, scientific, or educational purposes; 3) disease or predation; 4) inadequacy of existing regulatory mechanisms; and 5) other natural or man-made factors affecting the population's continued existence. Our findings, if supportive of delisting, will be published in the *Federal Register* as a proposed rule to delist the southern sea otter along with a solicitation of public comments. After reviewing comments received, we will publish our final decision.

In addition, the southern sea otter will continue to be protected under the Marine Mammal Protection Act after its removal from the List of Endangered and Threatened Wildlife (*i.e.*, delisting under the Endangered Species Act); sea otter surveys are expected to continue under administration of the Marine Mammal Protection Act. Furthermore, at present the southern sea otter is automatically treated as a depleted population under the Marine Mammal Protection Act because it is listed under the Endangered Species Act. Based on recent analyses of sea otter carrying capacity (Laidre *et al.* 2001), we currently estimate the lower limit of the optimum sustainable population to be approximately 8,400 individuals. Consequently, after delisting the population will still be below its optimal sustainable population level (thus still qualifying for depleted status), and we will likely initiate or be petitioned to initiate the process of formally designating this population as depleted under the Marine Mammal Protection Act.

In preparing this recovery plan, the Recovery Team has principally cited peer-reviewed literature, as opposed to what is often referred to as "gray literature." Requests for additional information on the details of this plan for recovering the southern sea otter or our justification for specific conclusions should be directed to the U.S. Fish and Wildlife Service. Questions on sea otter biology and management in California should be directed to the U.S. Fish and Wildlife Service, the California Department of Fish and Game, or other organizations that have been active in discussions related to the classification of the southern sea otter as threatened under the Endangered Species Act.

Executive Summary

Current Species Status: The southern sea otter (*Enhydra lutris nereis*) population presently contains about 2,150 animals and ranges between Half Moon Bay and Point Conception along the coast of central and southern California. Range-wide population counts declined at a rate of approximately 5 percent per year between 1995 and 1999, although this declining trend has been less certain in recent years. The translocated colony at San Nicolas Island contains about 27 individuals, including pups. Although more than 70 births are known to have occurred at San Nicolas Island from 1987 to 2002, the population size has remained small and its future prospects are uncertain.

The main threats to the southern sea otter are habitat degradation (including oil spills and other environmental contaminants) and human take (including shooting, entanglement in fishing gear, and harassment). Oil spills, which could occur at any time, could decimate the sea otter population. The reasons for the recent decline in abundance are unknown, but it may be in part related to one or more of the following factors: 1) infectious disease resulting from increased immune deficiencies or elevated parasite and pathogen exposure; 2) incidental mortality caused by commercial fishing activities; or 3) food resource limitation.

Habitat Requirements and Limiting Factors: Sea otters occupy hard- and soft-sediment marine habitats from the littoral zone to depths of less than 100 meters (330 feet), including protected bays and exposed outer coasts. Most individuals occur between shore and the 20-meter (65-foot) depth contour.

The southern sea otter population was exploited to near extinction from an estimated historical population (in California) of approximately 16,000 animals (Laidre *et al.* 2001). Since the early 1970s, population counts have ranged between 1,250 and 2,300 animals. Population counts declined from the mid-1970s to the early 1980s, then increased from the mid-1980s to the mid 1990s. There was little range expansion during the latter period. Between 1995 and 1999, population counts declined, but the population's range expanded both to the south and the north. The current population status is less certain, with recent counts being relatively stable. The decline from the mid 1970s to the early 1980s apparently resulted from entanglement mortality in fishing gear. Once the entanglement problem was identified and rectified through State regulations, the population immediately began to increase again. The cause of the recent decline remains uncertain. In the 20th century, the southern sea otter population never increased at the species' maximum potential of 17 to 20 percent per year, although this rate of increase is typical of recovering populations in Washington, British Columbia, and Alaska (Estes 1990*a*).

The depressed population growth rate for the southern sea otter population is largely due to elevated mortality, as opposed to reproductive depression or emigration. Infectious disease is the single most important known cause of mortality. Other known sources of mortality include shark attacks, shooting, entanglement in fishing gear, and starvation. These sources of mortality are rare or absent in growing sea otter populations in Washington, Canada, and parts of Alaska.

Recovery Objective: Our recovery objective for the southern sea otter is to manage human activities that may jeopardize the continued existence of the species or damage or destroy habitat critical to its survival such that the species recovers to the point where it can be removed from the List of Endangered and Threatened Wildlife. Because the population is currently not increasing, it is not possible to predict if or when the species will be considered recovered under the Endangered Species Act. To remove its designation as a depleted population under the Marine Mammal Protection Act, the population would likely have to increase further (after delisting under the Endangered Species Act) to reach its optimal sustainable population level (equivalent to 50 to 80 percent of its current carrying capacity). The lower bound of the optimal sustainable population level is approximately 8,400 animals for the entire California coast, based on estimated historic population levels.

Recovery Criteria: The Endangered Species Act specifically lists five factors that must be considered in evaluating the status of a listed or candidate species. The following criteria were developed to provide guidance on when reclassification is appropriate. Prior to delisting the southern sea otter or changing its status to endangered, we must undertake a formal review of all five factors, and a summary of that review must be made available to the public for comment. A final determination on classification is based on the initial evaluation of the five original listing factors and public comments.

ENDANGERED: The southern sea otter population should be considered for reclassification as endangered under the Endangered Species Act if the population declines to a level fewer than or equal to an effective population size of 500 animals (Mace and Lande 1991). Until better information is available, we recommend using a multiplier of 3.7 to convert effective population size to actual population size (Ralls *et al.* 1983), or 1,850 animals. Therefore, the southern sea otter population should be considered endangered if, based on standard survey counts (*i.e.*, spring surveys), the average population level over a 3-year period is fewer than or equal to 1,850 animals.

THREATENED: The southern sea otter population should be considered threatened under the Endangered Species Act if the average population level over a 3-year period is greater than 1,850 animals, but fewer than 3,090 animals.

DELISTED: The southern sea otter population should be considered for delisting under the Endangered Species Act when the average population level over a 3-year period exceeds 3,090 animals.

Actions Needed:

- Monitor southern sea otter demographics and life history parameters to determine population size, rate of change, and distribution. Evaluate supporting habitat for changes in types, abundance, distribution, and use (*e.g.* resting, haul out, feeding, breeding, natal area, peripheral feeding/resting areas, offshore areas) and changes in its estimated carrying capacity by mapping habitat types.

- Protect the population and reduce or eliminate the identified potential limiting factors related to human activities, including: managing petroleum exploration, extraction, and tankering to reduce the likelihood of a spill along the California coast to insignificant levels; minimizing contaminant loading and infectious disease; and managing fishery interactions to reduce sea otter mortality incidental to commercial fishing to insignificant levels.

- Conduct research to understand the factor, or factors, limiting the current growth rate of the California population and refine recovery goals from which management actions can be identified and implemented.

- Evaluate failure criteria for the translocation program to determine if the experimental population at San Nicolas Island has met one or more failure criteria and whether continuation of sea otter containment may jeopardize the sea otter population or hinder recovery.

Estimated Cost of Recovery: The total estimated cost of recovery over 20 years is $10,219,700, plus additional costs that are yet to be determined.

Date of Recovery: Delisting may be considered when the population reaches the delisting criterion of 3,090 individuals. If the population immediately achieved and maintained an annual growth rate of 5 percent (the historic maximum for the California population), it could reach the delisting criterion in approximately 10 years. However, given that the population is currently not increasing, and that the reasons for the lack of increase have so far neither been clearly identified nor remedied, it is not yet possible to predict a likely time to recovery.

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I. Introduction

We (the U.S. Fish and Wildlife Service) approved the first southern sea otter recovery plan in 1982. Since that time there have been numerous additions to our knowledge about the species and several important developments that pertain to conservation and management of the southern, or California, sea otter population.[1] New information obtained through the 1980s is summarized in a detailed species account (Riedman and Estes 1990). A comprehensive summary of information obtained since 1990 on the southern sea otter is not available, although Estes *et al.* (2003) provide a summary of trends in abundance, reproduction, and mortality through 1999. In 1989, we reconvened the Southern Sea Otter Recovery Team (Recovery Team) to review and recommend changes to the existing recovery plan. Based on comments from the Recovery Team, we prepared a draft revised recovery plan and, in August 1991, solicited comments from constituent groups and the general public. A second draft revised recovery plan, released in 1996, incorporated many of the comments that we received on the August 1991 revision. A third draft revised recovery plan, which incorporated new information, was released in January 2000 for public comment. This final revised plan, like the previous drafts, was prepared by us based on recommendations from the Recovery Team.

It is important to note that 1) recovery teams are expected to provide advice on needed recovery actions based solely on biological and ecological considerations; 2) recovery plans that we develop and adopt are not regulatory documents and do not require the cooperating parties to implement recovery actions; and 3) implementation of recovery actions by us or another lead agency may require additional analysis of environmental and social impacts under the National Environmental Policy Act or California Environmental Quality Act.

The southern sea otter has a recovery priority of 9C. This designation indicates that the southern sea otter is regarded as a subspecies with a moderate level of threat but a high potential for recovery. The "C" in the priority designation indicates that recovery of the species may be in conflict with development projects or activities. Specifically, the recovery of the southern sea otter under the Endangered Species Act could potentially conflict with several State-managed fisheries in California, as well as with the transport and extraction of oil and natural gas products along the coast of California.

A. Systematics

A comprehensive study of geographical variation in cranial morphology of the sea otter was done under the U.S./U.S.S.R. Agreement on Cooperation in the Field of Environmental Protection (Project 02.05-61, Marine Mammals). This study provides the strongest evidence to date that the California population should be afforded subspecific status (*Enhydra lutris nereis*) (see Wilson *et al.* 1991). Recent molecular studies indicate that the southern sea otter population has monophyletic mitochondrial DNA and

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[1] The terms "southern sea otter," "California sea otter," and "California population of sea otters" have been used interchangeably in the past, and we use these terms interchangeably throughout this document.

several unique mitochondrial DNA haplotypes (*i.e.*, unique genetic components) when compared to the Alaskan populations (Sanchez 1992, Cronin *et al.* 1996).

B. Ecology

1. Distribution and Abundance. The most recent published accounts of the distribution and abundance of the species (*Enhydra lutris*) are provided by Rotterman and Simon-Jackson (1988) and Estes (1992). This information is now more than a decade old and was published before the significant population changes of the 1990s occurred.

Following near-extinction because of exploitation during the 18th and 19th centuries, sea otters were legally protected from take in 1911 through the International Fur Seal Treaty. Because of subsequent population increases, sea otters have 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. However, during the 1990s the number of otters declined precipitously over large areas of western Alaska (Estes *et al.* 1998). The average rate of decline in this region has been about 17 percent per year, for a total population reduction of perhaps 80 to 90 percent in many areas (Doroff *et al.* 2003). The likely cause of these declines is predation by killer whales (Estes *et al.* 1998). Thus, whereas the world population of sea otters was thought until recently to be well in excess of 100,000 individuals, the current total is probably much less. The most recent information indicates that population has declined to a common, low density, at least through the Aleutian archipelago (Doroff *et al.* 2003).

The historical range of the species southeastward from Prince William Sound to central Baja California remains uninhabited except for translocated colonies in southeast Alaska, British Columbia, and Washington, the remnant population in central California, and the translocated colony at San Nicolas Island (Figure 1).

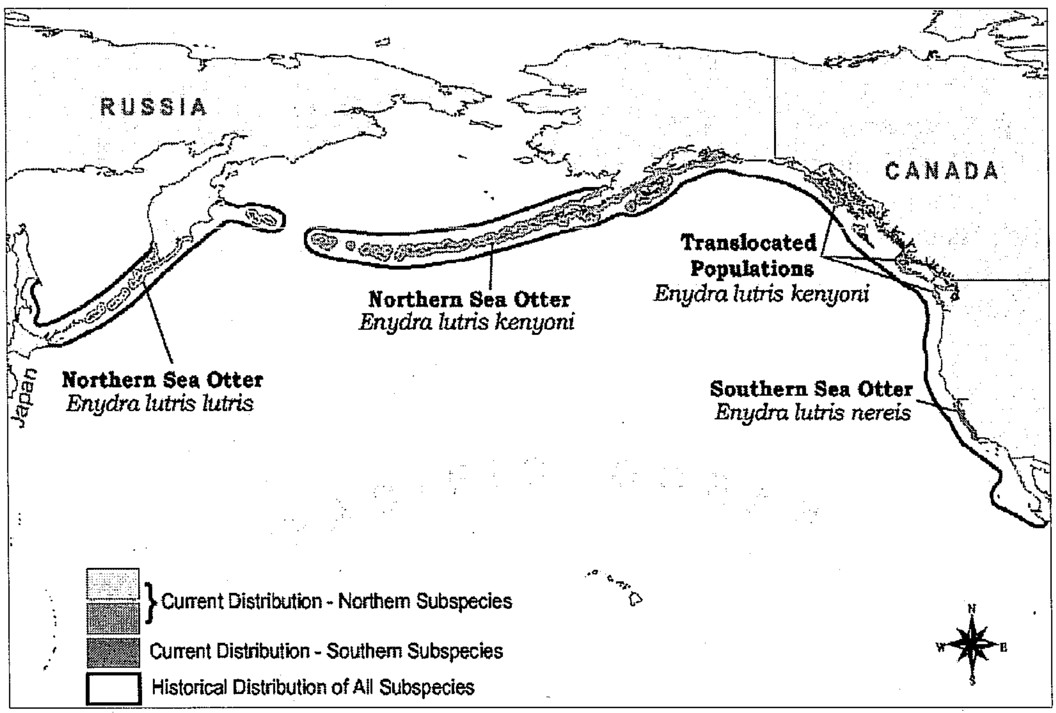

Figure 1. Historical range of the sea otter.

The translocated colonies in southeast Alaska, British Columbia, and Washington increased at rates of 17 to 20 percent per year through the 1980s (Estes 1990a). Unpublished information from periodic or occasional ongoing surveys of these populations indicates that these increases are continuing.

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 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 is somewhat arbitrary because individuals frequently wander well beyond the distributional limits of most of the rest of the population. Nonetheless, it is clear that 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. As the southern sea otter population increased during the following decades, range expansion to the south was always more rapid than it was to the north. By the late 1980s, the range of the southern sea otter had increased to include the area between about Point Año Nuevo at the north and Point Sal at the south. Although the number of otters continued to increase through the mid 1990s, range expansion to the south slowed, and to the north it essentially ceased during this period. By 1995, sea otters were commonly seen as far south as Point Arguello, and in 1998 a substantial number of otters dispersed southward beyond Point Conception (Figure 2).

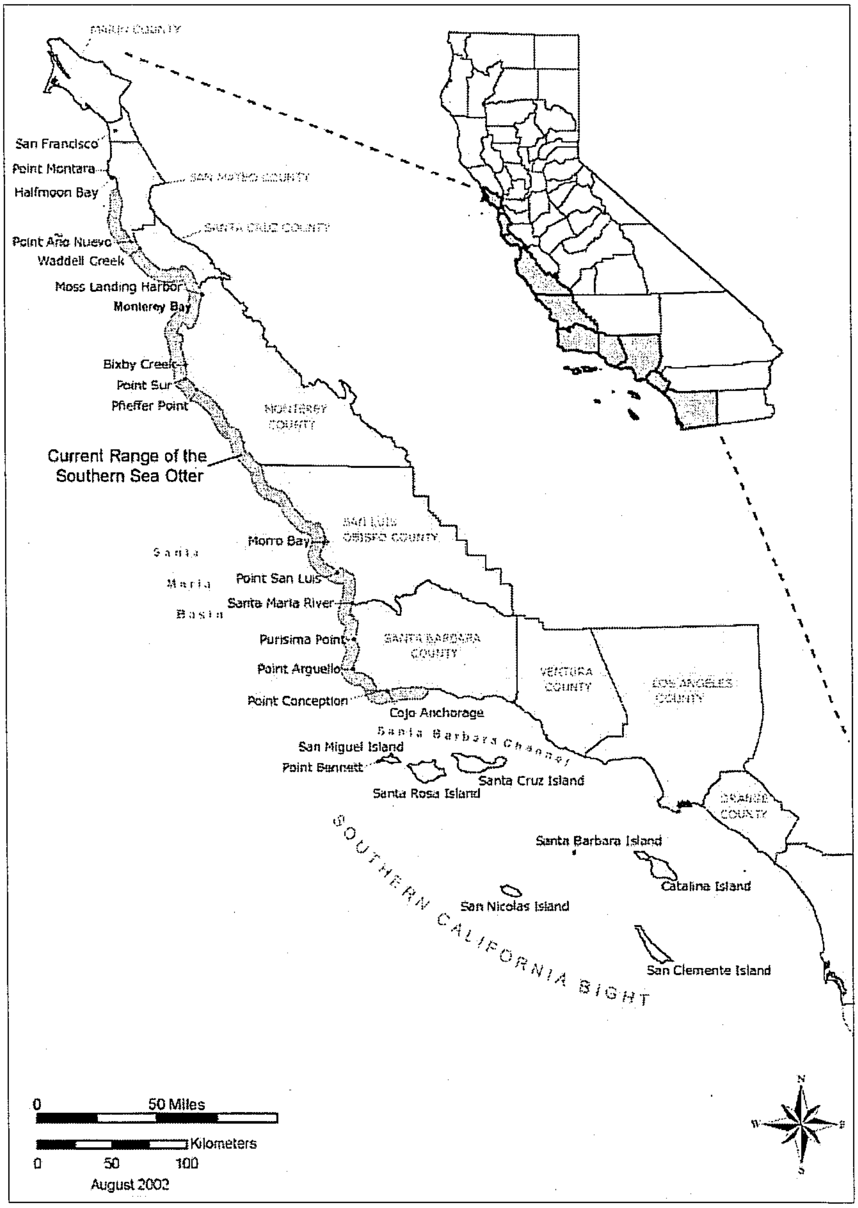

Figure 2. Current range of the southern sea otter.

Population abundance of the southern sea otter has steadily increased throughout the 20th century, except during two periods (Appendix A). By 1976, the population numbered an estimated 1,789 individuals. However, this estimate had declined to 1,443 by 1979, and to 1,372 by 1984.

Standardized range-wide counts were initiated in 1982. Surveys are done during spring and fall, but the spring surveys have traditionally been used to assess population status because they are both consistently higher than fall surveys in a given year and less variable among years. The number of animals counted during the spring surveys remained essentially constant between 1982 and 1985, but thereafter the population steadily increased until 1995, when 2,377 otters were counted (Figure 3). However, in each of 4 successive years (1996, 1997, 1998, and 1999), the total number of animals counted progressively declined, to a low of 2,090 in 1999. This declining trend was evident in both the yearly counts (Figure 3) and in the same data plotted as 3-year running averages (Figure 4). Use of a running average is intended to reduce year-to-year vagaries in any given count, thereby emphasizing overall trends. Recent spring surveys (conducted in 2000, 2001, and 2002) counted 2,317, 2,161, and 2,139 otters, respectively. These most current data suggest that the population is relatively

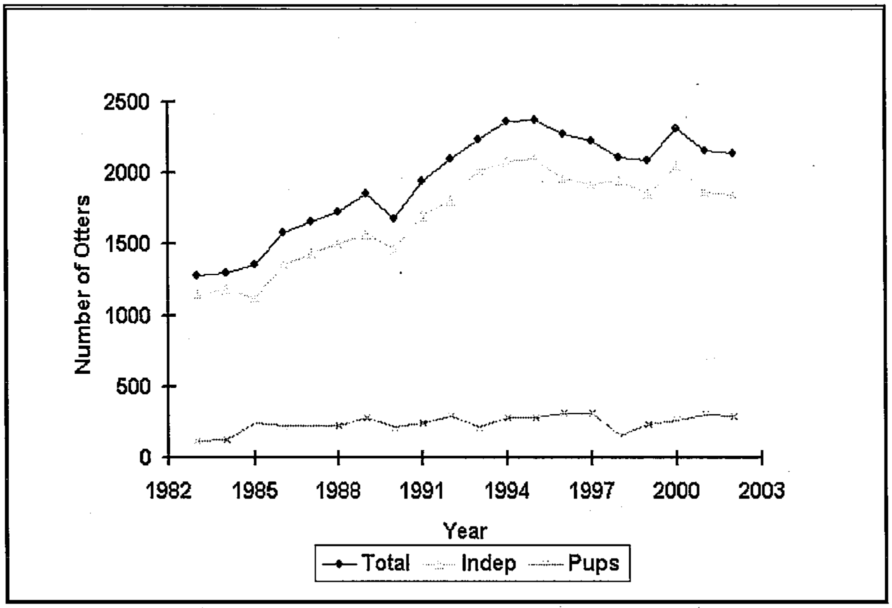

Figure 3. Total number of sea otters counted from 1982 through 2002 during spring surveys. Source: U.S. Geological Survey (2002) http://www.werc.usgs.gov

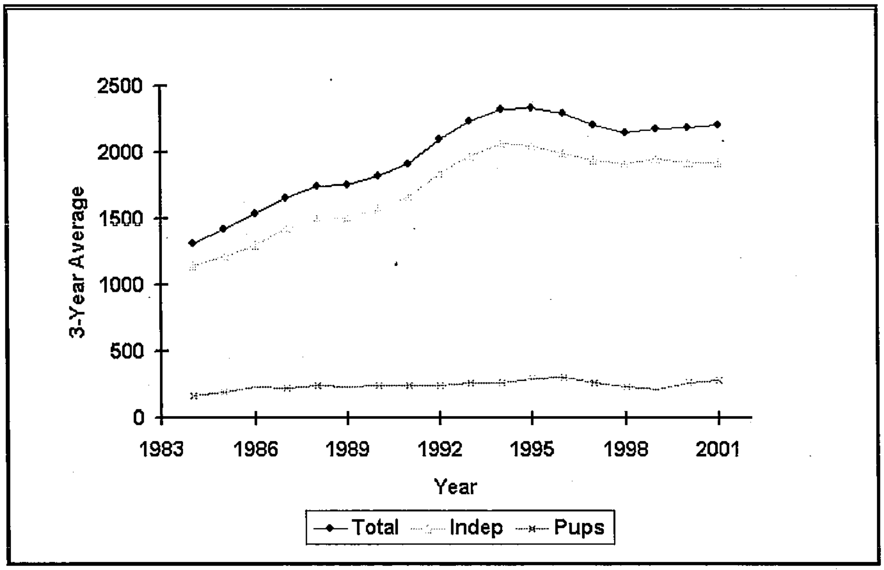

Figure 4. Total number of sea otters counted during the spring surveys, plotted as 3-year running averages. Source: U.S. Geological Survey (2002) http://www.werc.usgs.gov

stable; however, it is unclear whether the declining trend has actually been arrested.

2. Biology. The sea otter is the largest member of the family Mustelidae and the smallest species of marine mammal in North America. As one of the few marine representatives of the order Carnivora, the sea otter evolved to inhabit a narrow ecological zone, adapting to the nearshore ecosystem and preferring rocky shoreline with kelp beds. Body size varies among populations. Adult sea otters average about 30 kilograms (65 pounds) for males and 20 kilograms (45 pounds) for females; average lengths are about 135 centimeters (4.5 feet) and 125 centimeters (4 feet) for males and females, respectively. Forepaws are padded, have claws, and are used in feeding and grooming. Hind limbs are posteriorly oriented and flipper-like for swimming. The tail is less than one-third the body length and of uniform thickness from base to tip.

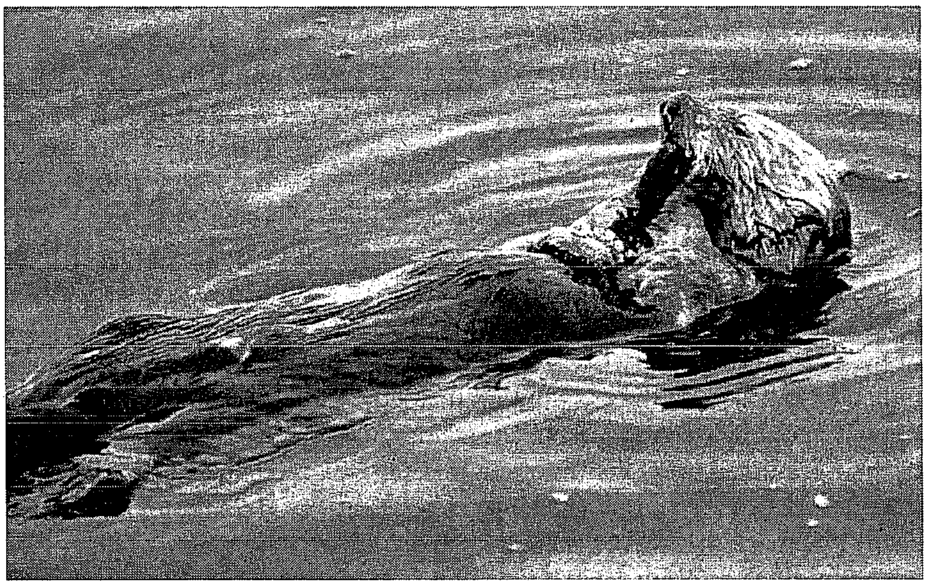

Figure 5. Sea otter eating crab. Photo by J. G. Hall, from Mammal Images Library, American Society of Mammalogists. Used by permission.

The pelage consists of sparse guard hairs and dense underfur. Underfur density may reach 100,000 or more follicles per square centimeter (650,000 per square inch). Color varies from dark brown to reddish brown, and in older individuals the head, neck, and shoulders often become grizzled. There is little subcutaneous fat and no layer of blubber for energy storage and thermo-insulation as in pinnipeds (seals) and cetaceans (whales). Insulation from cold sea water is provided entirely by air trapped in the fur. The general biology of the sea otter is reviewed in detail by Riedman and Estes (1990).

3. Food Habits. Sea otters eat numerous species of invertebrates (Figure 5) and, in some areas (*e.g.*, Alaska), fishes. By comparing neighboring long-established and recently-established populations from several locations in the North Pacific Ocean, Estes *et al.* (1981) concluded that dietary diversity increased with increased population density and the presumed increase in competition for food. This finding was thought to be consistent with optimal foraging theory because sea otters are known to reduce the abundance of their most profitable prey. However, more recent studies have shown that while there is high variation between the diets of individual sea otters in California, the diet of any particular individual typically consists of only several main prey types (Lyons 1989, Riedman and

Estes 1990, Estes *et al.* in press). Due to reductions in invertebrates and the consequent enhancement of kelp beds and some kelp-associated fishes that follow the recovery and growth of sea otter populations, individual otters from several long-established populations in Alaska and Russia consume large quantities of fish. These interactions enhance production (Duggins *et al.* 1989) and may actually increase the equilibrium density (the density of sea otters when a state of equilibrium amongst habitat components exists) of sea otter populations (Estes 1990a). As sea otter populations declined in western Alaska during the 1990s, kelp forest fishes became rare or absent in the diets of local populations (Watt *et al.* 2000, Estes and Tinker, unpubl. report).

Activity budgets (activity patterns and the amount of time allocated to various activities) have been proposed as indicators of population status (Estes *et al.* 1982, 1986) based on comparative diurnal observations of high- and low-density populations. This indicator is based on the assumption that as growing populations reduce the abundance of their preferred prey, the time required for individuals to achieve their nutritional needs should increase. However, sea otters also feed at night (Loughlin 1979, Garshelis 1983), and there is extensive variation in the activity of individuals both among and within age and sex classes (Ralls and Siniff 1990). Thus, the utility of activity-time budgets to assess population status is debatable (Garshelis *et al.* 1990, Estes 1990*b*, Gelatt *et al.* 2002). Nonetheless, the collective evidence indicates that sea otters spend more time feeding as their populations approach equilibrium.

4. Reproduction. Long-term records from marked individuals have established that most adult female sea otters give birth to a single pup each year (Siniff and Ralls 1991, Jameson and Johnson 1993). The collective data, which are not necessarily representative for the entire population, indicate that the average birth rate of adult females is about 0.90 per year, or perhaps somewhat higher (Riedman *et al.* 1994, Monson *et al.* 2000). In contrast with most carnivores and all other lutrine (otter) species, but consistent with other marine mammals, except the polar bear, litter size is typically one (Estes 1989). Twin births occur rarely, and seldom, if ever, do both young survive to weaning (Jameson and Bodkin 1986). Records from tagged animals also have suggested that females typically attain sexual maturity after 3 years, but that weaning success by primiparous females (females with their first litters) is relatively low (Riedman *et al.* 1994, Monson *et al.* 2000). The age of sexual maturity in males is less well known but appears to be about 5 years. However, the age at which males actually first successfully breed may be somewhat less than or considerably longer than 5 years, depending on population status and social context.

In California, most births occur from late February to early April. The seasonality is not highly synchronous, in that births may occur throughout the year, and the birth peak may extend over several months (Siniff and Ralls 1991). The birth peak is seasonally asynchronous in some parts of central California (Riedman *et al.* 1994).

Age-specific reproductive schedules of sea otters appear to be largely invariant among subspecific populations. Population growth or decline is thus a consequence of variation in age-specific mortality schedules (Estes *et al.* 1996, Monson *et al.* 2000).

5. Mortality. Assessment of sea otter mortality in recent years is based almost exclusively on information obtained from beach-cast carcasses (Estes *et al.* 2003). Two measures are available: 1) the number of carcasses retrieved, and 2) the cause of death in fresh carcasses. The number of carcasses recovered through time shows an overall pattern that is roughly consistent with population growth (Figure 6). However, the 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 several departures from a time-constant relationship (Figure 7).

These data suggest that mortality was roughly constant at about 5 percent during the period when the population was growing (*i.e.*, from about 1985 through 1995) but was somewhat higher during periods of apparent decline (*i.e.*, the early 1980s and from 1996 through 1999).

Postmortem examinations are conducted by the U.S. Geological Survey's National Wildlife Health Center and the California Department of Fish and Game–Marine Wildlife Veterinary Care and Research Center. Records of cause of death are maintained by the Biological Resources Division of the U.S. Geological Survey. Net entanglement is estimated to have caused an average of 80 deaths per year (Wendell *et al.* 1985) from at least the mid-1970s to the early 1980s. Entanglement mortality appears to have caused the population to decline during that period because restrictions on the use of gill and trammel nets were followed by a resumption of population growth (Estes 1990*a*). There is also evidence that the rate of pre-weaning mortality in central California is higher than it is in growing populations in Alaska (Siniff and Ralls 1991, Riedman *et al.* 1994, Monson *et al.* 2000), perhaps explaining, in part, the comparatively low growth rate in the southern sea otter population. However, the age composition of beach-cast sea otters in California demonstrates that prime-age adults also have experienced elevated mortality rates (Estes *et al.* 1996).

Three possible explanations for the recently increased mortality and reduced population abundance of the southern sea otter have been suggested: increases in the rate of infectious disease; incidental losses in coastal fishing gear; and decreases in food abundance. It should be recognized that two or more of these factors may affect the dynamics of the southern sea otter at a given time. Because thorough necropsies have been done on the fresh carcasses since 1992, it is possible to make a preliminary evaluation of the disease hypothesis. Inasmuch as the elevated mortality rate and declining abundance did not begin until about 1995, the incidence of mortality induced by infectious disease also should have increased concurrently if this factor were solely responsible for population-level changes. There is no clear evidence in the available data for changes in the rate of infectious disease since 1992. However, it should be noted that the level of infestation by acanthocephalan parasites (*Polymorphus* spp.) has apparently undergone a significant increase over the years (Thomas and Cole 1996). In some cases such infestation causes infectious disease(acanthocephalan peritonitis), and it

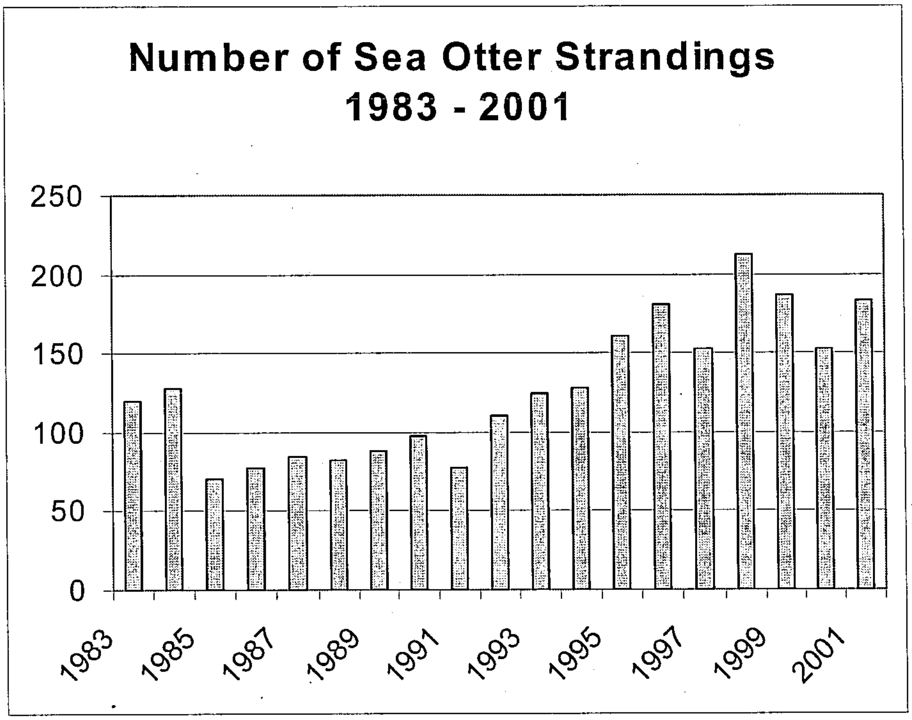

Figure 6. Number of beach-cast sea otter carcasses recovered by year from 1968 through 2001. Source: U.S. Geological Survey, unpublished data (2002)

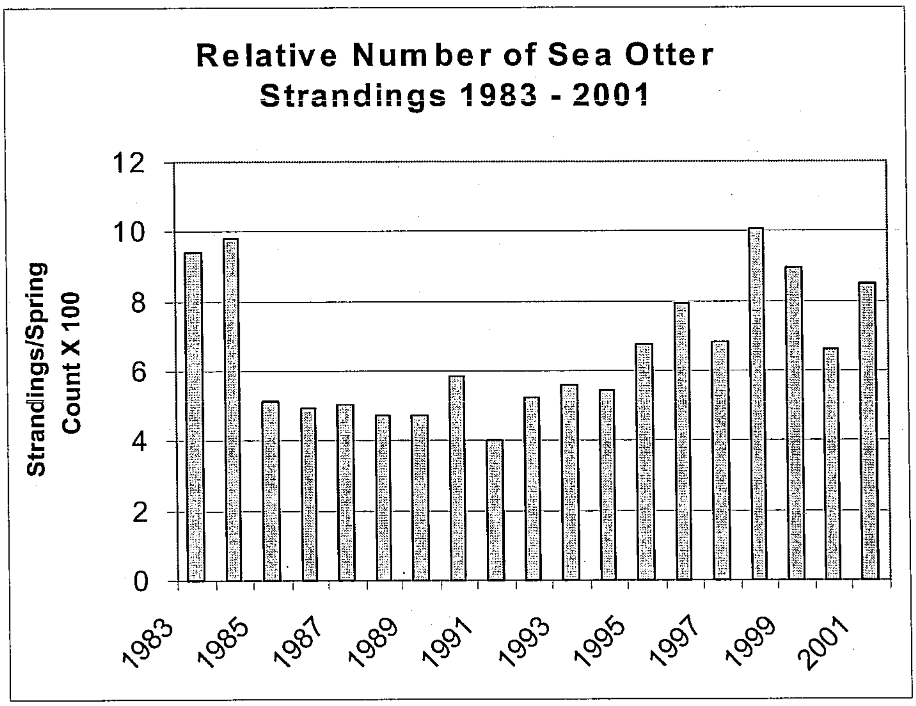

Figure 7. Relative number of sea otter carcasses retrieved by year. Proportions were determined by dividing the number of carcasses recovered by the number of otters counted in the spring surveys (x100). Source: U.S. Geological Survey, unpublished data (2002).

is possible that the increase in infestation has also caused increases in disease rates. Lafferty and Gerber (2002) have shown that the proportion of the population found dead on the beach in any given year is positively correlated with the proportion of carcasses found to have acanthocephalans, which gives a preliminary indication that acanthocephalans may play a role in mortality trends of southern sea otters.

Two further conclusions can be drawn concerning the importance of infectious disease to southern sea otters. The first is that infectious disease must be an important factor in causing the slow growth rate of the southern sea otter population. Because disease is responsible for roughly 40 percent of the deaths in animals obtained from the salvage program, and the reproductive rate of southern sea otters is comparable to that of other populations that are growing more rapidly, it follows that the growth rate of the California population would be substantially higher in the absence of disease. However, the southern sea otter population has never increased at more than about 5 percent per year, which implies that during the period of recovery the magnitude of mortality in California has never been reduced to the levels found in other more rapidly growing sea otter populations. Infectious diseases in the southern sea otter are almost entirely the consequence of parasites and microbes for which the sea otter is not a natural host (K. Lafferty, U.S. Geological Survey, pers. comm.).

While coastal pot and set net fisheries are known to have intensified in recent years, and there are unconfirmed reports of otters having been incidentally drowned, sufficient information to evaluate this potential source of mortality is not presently available. A recent analysis of information from the carcasses recovered during the period 1968-99 indicates that the mortality rate is elevated during the summer months, and that since 1994 the number of carcasses recovered per year is positively correlated with fin fish landings in the coastal live trap fishery (Estes *et al.* 2003).

6. Community Ecology. Evidence gathered to date indicates that there are important interactions between sea otters and the ecosystems in which they live and forage. Otter predation reduces many prey populations, including herbivorous invertebrates exploited in commercial and recreational fisheries. Similarly, the distribution and abundance of food resources likely have important effects on the behavior and population status of sea otters.

The community ecology of sea otters was discussed by various authors in a volume edited by VanBlaricom and Estes (1988). Food web relationships emanating from the influence of sea otter predation in kelp forest communities are proving to be complex and far-ranging (*e.g.*, Irons *et al.* 1986, Duggins *et al.* 1989, Estes *et al.* 1989, summarized by Estes 1996), although much of the work in this area has been done in British Columbia, Alaska, and Russia. Studies in Alaska have shown that sea otters have similarly dramatic and perhaps far-ranging influences in soft-sediment communities (Kvitek *et al.* 1993). Further studies of community relationships are proposed in Recovery Task 4.4.

C. Reasons for Listing

The southern sea otter population was listed as threatened in 1977 because of 1) its small size and limited distribution, and 2) potential jeopardy to the remaining habitat and population by oil spills (42 *FR* 2965, January 14, 1977). A major spill of oil from a tanker in the waters in the vicinity of the range of the southern sea otter has traditionally been considered to be the most serious potential threat to the species. Since listing, however, pollution and incidental take in fisheries have also been recognized as substantial problems. Given that the sea otter population in California is currently not increasing despite the absence of oil spills, and that populations in western Alaska are declining precipitously for other reasons as well, a broader range of threats to the population must be considered. These threats include the possibility of recently introduced disease organisms, mortality incidental to commercial fishing, and the adverse effects of pollution on the general well-being of sea otters. It is also becoming evident that the sea otter and its coastal habitat are threatened by events occurring in adjacent habitats, both on land and in the open sea (Estes *et al.* 1997, 1998, Nakata *et al.* 1998).

Petroleum Development Problems. Oil spills have long been thought to be a major threat to sea otter populations. Early studies demonstrated that sea otters are vulnerable to oil contamination (Kooyman and Costa 1979, Siniff *et al.* 1982), and concern over the likelihood of a spill in central California was a main reason for listing the California population. Several recent spills, most notably that of the tanker vessel *Exxon Valdez* in Prince William Sound, have led to a number of conclusions regarding the influence of oil spills on sea otters:

1. The expected number of oil spill events over the next 30 years that are likely to affect the southern sea otter has been estimated. For spills greater than 160,000 liters (1,000 barrels) in the vicinity of the range of the southern sea otter, this estimate is approximately 6 (see Appendix B).

2. The probability of death in sea otters as a result of contact with oil following an oil spill is likely to be no less than 50 percent (see Appendix C). A minimum estimate of 50 percent mortality following contact has been reported; however, this estimate is likely to be lower than actual losses (*i.e.*, negatively biased).

3. Rehabilitation of oiled sea otters following a major spill, where hundreds or thousands of sea otters have been exposed to oil, is expensive, may be detrimental to some individuals, and is of questionable benefit to the population (Estes 1991, 1998). In Prince William Sound, most of the oiled otters were not and could not be captured. Most of the otters that were heavily oiled could not be saved. Some of the otters that were captured and brought to the rehabilitation centers for treatment were either unoiled or so lightly oiled that the stress of capture and rehabilitation efforts may have exceeded the damage, if any, caused by oil.

The above considerations are not intended to diminish the contribution of the State of California in establishing oil-spill response facilities. It can be safely concluded that these facilities will contribute to the rehabilitation of sea otters following spills that are small to moderate in size. However, at this time, we do not believe it is possible to avoid a catastrophic loss to the sea otter population in the event of a major spill in the vicinity of the sea otter's current range.

Oil and Gas Activities on the Federal Outer Continental Shelf Offshore California. Although tanker oil spills have been considered a significant threat to the southern sea otter, offshore oil development and production was not a factor in its listing. However, since 1977, offshore oil and gas activities have increased. Currently, there are 23 oil and gas platforms producing from 43 leases in Federal outer continental shelf waters offshore California. Nineteen of these platforms are located in the Santa Barbara Channel and Santa Maria Basin. In addition, companies have submitted requests for suspensions and schedules of activities for exploration and development of the remaining 36 undeveloped leases, most of which (32) are in the Santa Maria Basin. The 36 leases are organized into 9 undeveloped units and 1 lease. On November 12, 1999, the Minerals Management Service granted the request for suspension.

If all the activities proposed for the undeveloped units are pursued and approved by local, State, and Federal agencies, a number of activities are expected to occur during the next decade or so, including:

1. The maximum use of extended-reach drill technology from existing and new platforms, which will reduce the need for more platforms and exploration rigs.

2. The drilling of six or seven delineation/exploration wells from existing platforms or a single mobile drilling unit and about 10 production wells from existing platforms.

3. The installation of four to six new outer continental shelf platforms.

4. The decommissioning of six to eight existing outer continental shelf platforms.

5. The possible construction of one new onshore facility in northern Santa Barbara County.

6. The retirement of a number of aging onshore processing and handling facilities.

Under this scenario, the physical presence of the oil industry would diminish offshore over the next decade, although current production levels could be sustained for some time to come. All of these actions will undergo rigorous environmental review by the Minerals Management Service under the National Environmental Policy Act and, for those actions that may affect threatened or endangered species, consultation under section 7 of the Endangered Species Act. New or revised oil exploration and development plans for Federal outer continental shelf waters will also require a consistency review by the California Coastal Commission.

D. Past and Ongoing Recovery Efforts

Incidental Take in Fisheries. Sea otters are sometimes killed in fishing gear. Most often the cause of death is drowning when an otter becomes entangled or otherwise trapped in nets or traps. The California Department of Fish and Game manages California's nearshore fisheries and implements regulations to protect sea otters from incidental take.

Gill and Trammel Net Restrictions. Since 1985, the California State Legislature has enacted legislation to reduce the level of incidental take of sea otters in gill and trammel nets. Currently, State law prohibits the use of gill or trammel nets (essentially nets with stretched mesh greater than 8.9 centimeters [3.5 inches]) from Waddell Creek (in Santa Cruz County) to Point Sal (in Santa Barbara County) in waters 55 meters (30 fathoms) or less at mean low water (California Senate Bill No. 2563). The Director of the California Department of Fish and Game may, by public announcement, allow the use of gill or trammel nets in all, or any part of, the area south of Point San Luis (in San Luis Obispo County) to Point Sal for a specific period. This determination must be based on a finding that the use of those nets will not result in any incidental take of sea otters. The Director shall immediately rescind this authorization if (s)he determines that further use of those nets may result in the accidental entanglement or take of sea otters. In April 2002, the Director enacted a temporary emergency closure of gill-net fishing from Point Reyes (in Marin County) to Point Arguello (in Santa Barbara County) in waters 110 meters (60 fathoms) or less. This closure further reduced incidental take of sea otters; it was made permanent in September 2002.

Live Fish Trap Fisheries. In the 1990s, a shallow-water live fish fishery using pot traps developed. Initially, the fishery was largely unregulated, and concern arose that sea otters could become incidentally trapped and drowned. Controlled experiments conducted by the U.S. Geological Survey and the Monterey Bay Aquarium confirmed that sea otters could enter traps with no size restrictions on the entrances. The California Department of Fish and Game now requires 13-centimeter (5-inch) rings to be placed in live fish traps used along the central coast. We provided rings to fishermen during the first year of the program to assist with the transition of the fishery.

Translocation Program. Our 1982 recovery plan identified the translocation of southern sea otters as an effective and reasonable recovery action. The translocation program, authorized by Public Law 99-625, includes two main components: the creation of an experimental southern sea otter colony by means of translocation and the creation and maintenance of a management zone. These elements are discussed below.

Public Law 99-625. On November 7, 1986, the U.S. Congress enacted Public Law 99-625, which specifically authorized the translocation and management of southern sea otters. In accordance with this law, we developed a translocation plan that included the following details: the number, age, and sex of sea otters proposed to be relocated; the manner in which sea otters were to be captured, translocated, released, monitored, and protected; specification of a zone into which the experimental population would be introduced (translocation zone); specification of a zone surrounding the translocation zone that did not include the range of the parent population or adjacent range necessary for the recovery of the species (management zone); measures, including a funding mechanism, to isolate and contain the experimental population; and a description of the relationship of the implementation of the plan to the status of the species under the Endangered Species Act and to determinations under section 7 of the Endangered Species Act. The purposes of the management zone are to facilitate management of southern sea otters and containment of the experimental population within the translocation zone, and to prevent, to the maximum extent feasible, conflicts between the experimental population and other fishery resources within the management zone. Any sea otter found within the management zone is to be treated as a member of the experimental population. Under Public Law 99-625, we are required to use all feasible nonlethal means to capture sea otters in the management zone and to return them to the translocation zone or to the range of the parent population. With the exception of defense-related actions, sea otters in the translocation zone are afforded essentially the same protection as the present population in central California.

Translocation of Sea Otters. The history and status of translocated sea otter populations through the early 1980s is summarized by Jameson *et al.* (1982). Only Alaska sea otters (*E. l. kenyoni*) were used in those translocations. Since that time, the translocated population in Oregon has become extinct, whereas populations in southeast Alaska, British Columbia, and Washington have increased at high rates since becoming established. The estimated sizes of these populations in 1989 were summarized by Estes (1990*a*). An analysis of earlier data indicates that each of these translocated populations declined from 60 to 90 percent of their original size in the year or two following release, followed by a period of slow growth (Estes *et al.* 1989).

In August of 1987, we began translocating southern sea otters to San Nicolas Island in the Southern California Bight. This translocation was undertaken for the joint purposes of management and research, pursuant to the authority of Public Law 99-625. Dispersal of the translocated animals after their release at San Nicolas Island proved to be a serious obstacle to the translocation effort. The translocation strategy changed several times during the project in an effort to circumvent this difficulty. Early results indicated that adults were more prone to leave than juveniles, and subsequently only juveniles were moved. A later analysis, however, indicated that adult and juvenile loss rates were not substantially different, and that the continued translocation of juveniles was also unlikely to result in the establishment of a colony.

The last sea otter was released at San Nicolas Island in July 1990, for a total of 140 sea otters translocated. Of the 140 sea otters released at San Nicolas Island, the fate of 70 is known. Three were found dead at San Nicolas Island within a few days of being translocated. Thirty-six are known to have returned to the parent population range, and 18 were either captured (11) or found dead (7) in the management zone, months to years after they were translocated. At least 13 sea otters are thought to have remained at San Nicolas Island after their release. The remainder are suspected 1) to have returned to the mainland or moved to the management zone, where they have not yet been found, or 2) to have died. Precipitous declines resulting from dispersal similar to that seen at San Nicolas Island were also noted in the translocations to Alaska, British Columbia, and Washington, which were eventually successful, but the numbers of otters in these colonies began to increase within several years. The number of otters at San Nicolas Island has only slowly increased since 1993 and is currently (as of June 2002) about 27 animals, with at least

73 pups having been born into the population.

Maintenance of the Management Zone and Southern Range Expansion of the Mainland Population. Public Law 99-625 requires, as part of the translocation program, the maintenance of a management (otter-free) zone that surrounds the translocation zone. We, in cooperation with the California Department of Fish and Game, are required to implement a containment program for the nonlethal removal of sea otters found within the management zone. Initially, when sea otters were found in the management zone, it was typically as individuals or pairs. These animals either were captured by us and moved out of the management zone, or they left the zone of their own accord. However, in 1990, a group of 10 otters (including 2 pups) was reported near Point Bennett on San Miguel Island. Subsequent observations suggested that this group was resident, a likely consequence of the translocation. Between 1990 and 1993, 14 sea otters (11 independent, 3 dependent) from this area were captured and relocated to the northern portion of the mainland population. In 1993, sea otter containment activities ceased. An aerial survey conducted in October 1999 found four sea otters at San Miguel Island, but a ground survey conducted in September 2001 failed to find any sea otters at the island.

In March of 1998, approximately 65 sea otters were found in and near Cojo Anchorage, just south and east of the northern boundary of the management or "otter-free" zone. By April, the number grew to over 100. Commercial fishermen and recreational sport divers called on us to begin capturing and relocating those animals out of the management zone as directed by the containment provisions of Public Law 99-625.

Scientists familiar with the seasonal movements of sea otters noted that this group of animals was likely to stay in the area through the spring and early summer and return to the parent range during the late summer or fall. There was additional speculation that some animals were likely to return to the Cojo Anchorage area sometime in the late winter or early spring. The sea otters did indeed return, and groups of sea otters have seasonally moved into and out of the management zone each year since 1998. The largest group was observed in February 1999 and numbered 152 animals. The most recent spring sea otter survey, conducted in May 2002, found 8 otters in the management zone.

Members of the Recovery Team and interested environmental organizations expressed concerns to us about the possible adverse effects to the sea otter population if capture and relocation efforts were attempted, recognizing that Public Law 99-625 required that we undertake such efforts. Given recent data indicating that the number of southern sea otters observed during annual counts was declining, these groups raised concerns that the capture and relocation of a large number of sea otters could result in the deaths of animals, disrupt the existing social structure of resident groups, increase competition for resources, and possibly exacerbate population decline.

In 2000, we completed an internal consultation under section 7 of the Endangered Species Act and determined that resumption of the containment program would jeopardize the southern sea otter population (U.S. Fish and Wildlife Service

2000). Removal of sea otters from the management zone has been discontinued pending the results of a reevaluation of the southern sea otter translocation program and completion of a supplement to our original environmental impact statement for the program.

Supplement to the 1987 Environmental Impact Statement. In the late 1990s it became clear that many objectives of the southern sea otter translocation program were not being achieved, and substantial new information had become available concerning the translocation of sea otters. In July 2000, we announced our intent to prepare a supplement to the original Environmental Impact Statement (EIS) for the translocation of southern sea otters released in 1987 (65 FR 46172). Scoping workshops were held, and a scoping report was completed in April 2001. The supplemental EIS will provide updated information and evaluate alternatives being considered for the future of the translocation program. We are planning to release the supplemental EIS for public review in 2003.

Vessel Traffic Management. The National Oceanic and Atmospheric Administration, represented by the Monterey Bay National Marine Sanctuary, and the U.S. Coast Guard began working together in 1997 with key stakeholders to create a plan for managing large vessel traffic (*e.g.*, crude oil tankers, commercial vessels greater than 300 gross tons, and barges) in the Monterey Bay Sanctuary and beyond to reduce the risk of oil spills, groundings, and collisions. A group of stakeholders, including Federal, State, and local governments, environmental groups, and industry, reviewed past practices and risks and recommended a package of strategies. The plan includes the following elements:

Distance from Shore. Recommended distances offshore of Point Sur and Pigeon Point strengthen informal patterns of current practices and, where necessary, shift vessels farther offshore to reduce the level of threats to resources. The recommended distances, by vessel types, are as follows: tankers, 93 kilometers (50 nautical miles[2]); barges, 46 kilometers (25 nautical miles); Hazmat ships, 46 kilometers (25 nautical miles) northbound, 56 kilometers (30 nautical miles) southbound; large commercial vessels 23.5 kilometers (12.7 nautical miles) northbound, 29.6 kilometers (16 nautical miles) southbound off Pigeon Point, 28 kilometers (15 nautical miles) northbound, 37 kilometers (20 nautical miles) southbound off Point Sur.

Large commercial vessels and ships carrying hazardous materials should travel along Recommended Tracks at the above distances, which were approved by the International Maritime Organization in May of 2000 and are now marked on nautical charts. Implementation of this recommendation began in December 2000. Implementation of the recommended distance offshore for tankers would involve negotiation of an industry agreement covering all foreign and domestic carriers of crude oil, building on the existing Western States Petroleum Association agreement covering the Alaskan trade.

Traffic Separation Schemes. Modifications were recommended and implemented for two traffic separation schemes (specific

[2] 1 nautical mile = 1.15 statute miles

traffic lanes that help organize vessels as they approach major ports). The "southern approach" of the San Francisco traffic separation scheme was shifted slightly to the west to reduce the risk of groundings along the San Mateo coastline and to improve north-south alignment with the proposed Recommended Route for large commercial vessels. A 33-kilometer (18-nautical-mile) extension to the Santa Barbara Channel was also recommended and implemented to aid navigation of vessels. These two shifts were pre-approved by the International Maritime Organization in 1990 and 1985, respectively, but required domestic implementation by the U.S. Coast Guard, which occurred in July of 2000.

Monitoring and Reporting. Voluntary radio call-ins by vessels within about 9 kilometers (5 nautical miles) of shore were recommended to report the position of vessels at three points: at Point Arguello, Point Sur, and the existing check in/check out of the San Francisco Vessel Traffic Service. This reporting system would enhance the ability of response agencies to react quickly to an accident or vessel breakdown, enable an evaluation of the effectiveness of routing measures, and provide an opportunity to inform mariners of the sensitivity of the Sanctuary's resources. Timely implementation of an Automated Information System, an electronic system that reports a vessel's position, is also recommended. International implementation of an Automated Information System would reduce the need for some of the intermediate radio call-in points.

Rescue Vessel Network. Development of a Rescue Vessel Network would enable response agencies to identify and direct the nearest potential rescue vessel to the location of a distressed vessel more quickly. This network would allow for the identification of tugs or other vessels capable of rescue and the tracking of their positions by means of the existing system of check-in with the Vessel Traffic Service, the proposed voluntary reporting system, and, when operational, the Automated Information System.

Near-miss Reporting. Timely implementation was recommended for a national near-miss reporting system, which is currently being planned by the U.S. Coast Guard, the Maritime Administration, and industry groups. This system would provide valuable insight into dangerous conditions before they precipitate an accident.

Education. The overall vessel management package should include a strong education campaign for mariners to provide information on the sensitivity of Sanctuary resources, details on the new management measures, and the importance of compliance. A laminated flyer outlining these topics was developed, and 3,000 copies were distributed to the maritime industry in the fall of 2000.

Oiled Wildlife Care Network. The fish and wildlife provisions of California's Lempert-Keene-Seastrand Oil Spill Prevention and Response Act (OSPRA) (Government Code § 8574.7) parallel or exceed the Federal Oil Spill Pollution Act of 1990 (OPA-90) in most respects. Under OSPRA, the California Department of Fish and Game–Office of Spill Prevention and Response (OSPR) has developed contingency plans to protect wildlife in the event of an oil spill, established methods to assess injuries to natural resources, identified wildlife rescue and rehabilitation stations, and developed restoration plans for wildlife resources (including habitat) following an oil spill. OSPRA also provides for the establishment and funding of the Oiled Wildlife Care Network (OWCN) (Government Code § 8670.37.5) as an essential component of California's wildlife response capability.

The OWCN maintains a corps of professionally trained volunteers, paid staff, and veterinarians. When California wildlife are affected by an oil spill, these personnel retrieve oiled animals, evaluate the animals' need for treatment, and remove oil from the animals. OWCN personnel then rehabilitate affected animals, locate them to suitable release sites, and monitor post-release survival. The OWCN has instituted 24 permanent wildlife care participant facilities along the coast of California. Five facilities with extensive marine mammal care capability and expertise are prepared to cooperate in the cleaning and rehabilitation of sea otters. These facilities include: California Department of Fish and Game–Marine Wildlife Veterinary Care and Research Center (Santa Cruz); the Monterey Bay Aquarium; the Marine Mammal Center (Marin County); Sea World (San Diego); and Long Marine Laboratory (University of California, Santa Cruz). Floating pens for holding large numbers of rehabilitated or preemptively captured sea otters may be installed at Moss Landing Harbor (Monterey County) in cooperation with Duke Energy Power Services or at Horseshoe Bay (Marin County) in cooperation with the National Park Service and the U.S. Army.

More information on OWCN may be found at www.vetmed.ucdavis.edu/owcn/. Copies of California's Wildlife Response Plan, including special procedures for handling sea otters, may be found at www.dfg.ca.gov/Ospr/.

Research. Numerous research projects on sea otters have been initiated or completed since the Southern Sea Otter Recovery Plan was first published in 1982. The major projects concerning southern sea otters are listed below.

Translocation of Southern Sea Otters to San Nicolas Island (U.S. Fish and Wildlife Service). The main research-related purposes of this project were to: i) evaluate and develop techniques for translocating sea otters, ii) evaluate the status of the sea otter population in central California, iii) evaluate the ecological importance of sea otters in nearshore communities, and iv) evaluate and develop methods for containment of sea otter populations. Most studies at San Nicolas Island have been terminated or severely reduced in scope. The colony and the coastal ecosystem are still being monitored.

Determine the status of the southern sea otter population (Minerals Management Service). This study, now complete, had two main purposes: i) to determine the behavior and demography of sea otters in California, and ii) to model the impacts of a possible oil spill on that population. A final report from the study has been published (Siniff and Ralls 1988), as have subsequent papers in peer-reviewed journals (*e.g.*, Ralls and Siniff 1990; Siniff and Ralls 1991; Ralls *et al.* 1989, 1992, 1995, 1996*a*, 1996*b*).

Population biology and behavior of sea otters at the northern end of their range in California (Monterey Bay Aquarium). The purpose of this study is to obtain long-term records of marked sea otters to obtain basic life history information and longitudinal profiles of the behavior of individuals. This study is ongoing and involves OSPR, University of California at Davis, and the Oiled Wildlife Care network. The reproductive data are summarized in Riedman *et al.* (1994).

Causes of mortality in southern sea otters. The purpose of this study is to determine the cause of death in stranded sea otters. An assessment of records obtained from 1968-99 was recently completed (Estes *et al.* 2003). Detailed necropsies of fresh carcasses have been conducted since 1992 by veterinary pathologists from the National Wildlife Health Center in Madison, Wisconsin, the California Department of Fish and Game, and the University of California at Davis. The main finding from this effort is that about 40 percent of the deaths result from infectious disease (Thomas and Cole 1996). These efforts are continuing.

Potential effects of oil on sea otters. Mink were used as a model for sea otters in oil exposure trials. Groups of mink were exposed briefly to oil slicks of Bunker C fuel and Alaska North Slope crude, and other groups were exposed via their diet. Results verified that mink are a good model, and that petroleum released into the environment may have both short and longer term consequences (*e.g.*, reduced reproductive success in both the first and second generation).

Immune response system. Reagents and methods to assess the function of the immune system of sea otters have been developed and are currently being tested on live captured and fresh dead sea otters by veterinary pathologists from the California Department of Fish and Game.

Contaminants in the southern sea otter. Tissue samples were obtained from sea otter carcasses collected in central California, southeast Alaska, and the Aleutian Islands to determine whether contaminant levels were elevated in the southern sea otter. These analyses show that PCB and especially DDT residues occur at elevated levels in the southern sea otter (Estes *et al.* 1997, Bacon *et al.* 1999).

Genetic differential of sea otter populations. Blood and other tissue samples were obtained from sea otters in California, Washington, British Columbia, several regions of Alaska, the Commander Islands, and mainland Russia to determine geographical patterns in the genetic structure of populations. Mitochondrial DNA analysis shows haplotype differentiation among many of these populations, including the southern sea otter (Sanchez 1992, Cronin *et al.* 1996)

E. Summary of the Problem and Basis for Recovery

The southern sea otter population presently contains about 2,150 individuals and ranges along about 500 kilometers (300 miles) of coastline from Half Moon Bay to Point Conception. The population is currently not increasing. In all discussions of population size, the estimate of population is considered to be the number of otters actually recorded during standardized spring surveys. A minimum estimate of historical abundance in California is approximately 16,000 animals (Laidre *et al.* 2001).

The southern sea otter population was listed as threatened in 1977 because of its small size and limited distribution and concern about the effects of human disturbance (especially oil spills) on the population and its habitat. It subsequently became apparent that the population was not recovering quickly, despite Federal and State protection. The original recovery plan (1982) identified the need to establish by translocation one or more colonies to eliminate the possibility that a major oil spill or series of smaller spills could jeopardize the population. The intent behind translocation was to enhance the sea otter's range and population size. The slow rate of population growth, evident in the mid to late 1980s, was viewed as inadequate to expand the sea otter range rapidly enough so that the impacts to the population would be reduced should a spill occur. These factors led to the development of a plan to establish a second colony of sea otters via translocation from central California to San Nicolas Island.

The translocation program was intended to accomplish two interrelated purposes: 1) to establish a second colony sufficiently far from the existing population to minimize the likelihood of simultaneous loss from catastrophic or chronic events, and 2) to serve as a large-scale research experiment. Research associated with the translocation was designed to achieve the following goals: 1) to understand sea otter population dynamics, in particular growth-limiting factors; 2) to understand the ecology of sea otter foraging and the community role of sea otter predation in central and southern California waters; 3) to develop methods for translocating sea otters; and 4) to evaluate and develop methods for containing sea otters. This research was undertaken in response to a significant management dilemma: the protection and conservation of sea otters on the one hand, and the understanding and managing of conflicts between sea otters and shellfish fisheries on the other. These factors were the principal forces behind the joint management/research translocation program put in place in 1987 via the Endangered Species Act, the National Environmental Policy Act process, Public Law 99-625, and Federal regulation.

Four major events have occurred subsequently that alter the need and rationale for the translocation program. These events are listed below:

1. Evidence became available in the early 1980s that entanglement in fishing gear (gill and trammel nets) was having an important limiting influence on the southern sea otter population. Restrictions and closures were imposed, and a subsequent resurgence in population growth was taken as evidence that gear entanglement had indeed caused the population to decline. The establishment of one or more sea otter colonies by translocation was proposed in the original plan because, at that time, the population was not growing, and reasons for the lack of growth were unknown. Active intervention in the form of a translocation was considered necessary to expedite sea otter range expansion to ensure recovery.

With renewed population growth from the late 1980s to the mid-1990s, however, additional translocations were no longer believed to be an efficient means of recovering the southern sea otter population, in large measure because of their high cost and low probability of success. This assessment represented a fundamental change in recovery strategy. The fact that the population is not increasing reinforces the need for this changed recovery strategy. The precipitous declines in sea otter numbers that have recently occurred in western Alaska raise additional concerns about the long-term welfare of the southern sea otter.

2. The *Exxon Valdez* oil spill confirmed many of the worst fears about the consequences of such events. The spill was uncontrollable and spread over 670 linear kilometers (400 miles) in 30 days–an area greatly exceeding the present range of the sea otter in central California plus that of the translocated colony at San Nicolas Island. The distance over which oil rapidly spread during the *Exxon Valdez* disaster indicates that the translocated colony at San Nicolas Island could not provide a reasonable safeguard against an oil spill of this magnitude. Moreover, it is estimated that several thousand sea otters died in the *Exxon Valdez* oil spill (Garrott *et al.* 1993, DeGange *et al.* 1994), a number at least equaling and probably exceeding the present size of the California population. Efforts to save and rehabilitate oiled sea otters were of little or no value to the population.

3. The translocation of southern sea otters to San Nicolas Island has been less successful than originally hoped for as a means of establishing a second, self-sustaining population of southern sea otters (Figure 8). Our final rule for the establishment of an experimental population of southern sea otters (52 FR 29754) described expected population growth at San Nicolas Island in terms of three basic stages: a transplant stage, an initial growth and reestablishment stage, and a post-establishment and growth stage. The

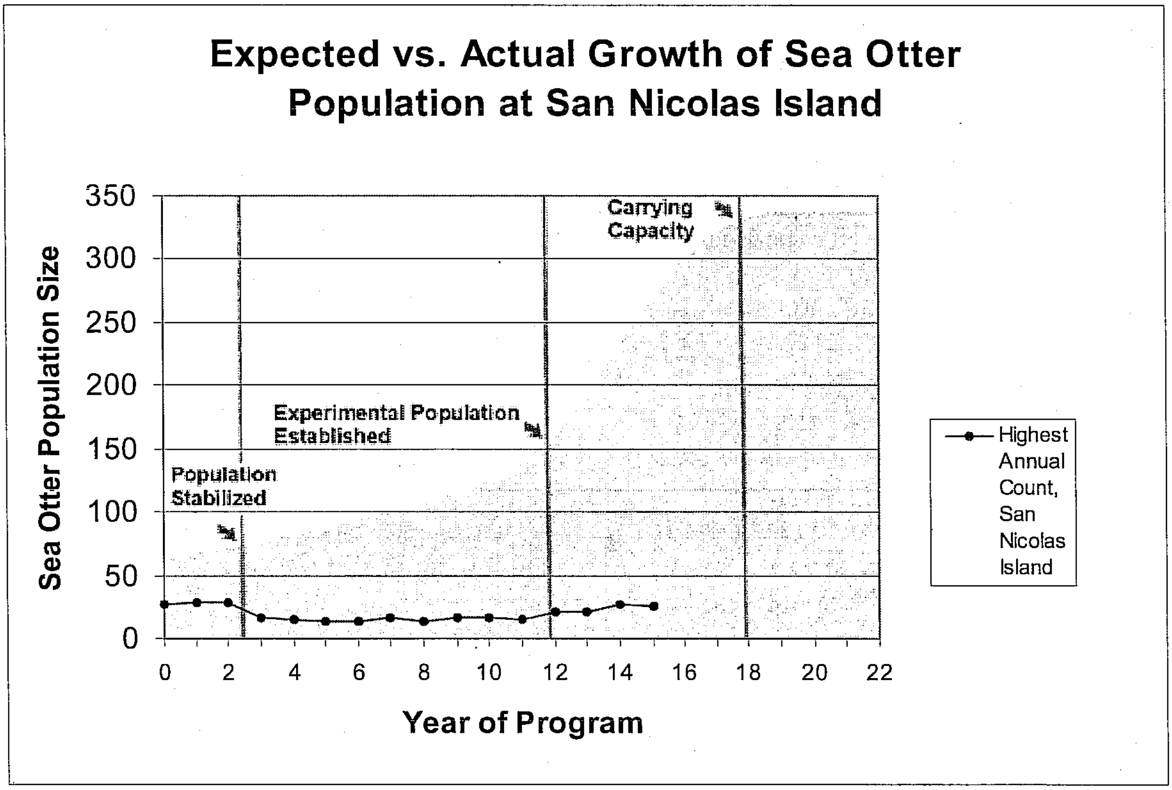

Figure 8. Expected vs. actual growth of sea otter population at San Nicolas Island. Expected growth curve is from original Environmental Impact Statement for translocation program (U.S. Fish and Wildlife Service 1987). Vertical lines demarcate the originally anticipated stages of transplantation, initial population growth and reestablishment, growth of established population, and attainment of equilibrium density at carrying capacity.

transplant stage would end when the population was stabilized, with a sufficient mix of healthy males and females totaling 70 animals (or the number of animals translocated, whichever was less). This stage was expected to require one or more years. The initial growth and reestablishment stage would end when the experimental population was established, with at least 150 animals and a minimum annual recruitment of 20 animals for at least 3 of the most recent 5 years. This stage was expected to require at least 5 to 6 years after stabilization of the population. The post-establishment and growth stage would end when the population reached carrying capacity, an estimated minimum of 280 (but as many as 400-500) animals. A minimum of 10 years was expected for the population to reach carrying capacity.

Figure 8 represents our original expectations for population growth at San Nicolas Island and superimposes our actual results to date. Although 140 sea otters were moved to San Nicolas Island from 1987 to 1990, as of the end of 2002, the population numbered only 29 animals. Some of the translocated animals are known to have returned to the mainland, but the fate of most remains unknown. A similar response occurred following all other translocations, most of which were eventually successful. However, even if the population at San Nicolas Island persists, many years will be required before the population is large enough to be considered an effective reserve to buffer against possible local extinction. In addition, our earlier assumption that the mainland population, if decimated by an oil spill or other event, could be restored using small numbers of animals from the San Nicolas Island colony may not be realistic given the tendencies of translocated sea otters to disperse.

4. Maintenance of a management or "no-otter" zone using nonlethal means has proven costly and ineffective. Large numbers of otters (50-100 animals) have been observed frequenting the northern end of the management zone from 1998 to 2001. These animals appear to move into and out of the zone seasonally from areas along the mainland to the north. Because this movement of southern sea otters initially occurred at a time when the population counts were declining, it is clear that it did not occur as a result of the population increasing in size. Our experience to date indicates that sea otters removed from the management zone are capable of returning to it even after being moved more than 300 kilometers (200 miles). The rapidity with which southern sea otters can move throughout their range makes maintenance of a management zone difficult if not impossible.

Clearly, the intent and purpose of the translocation program have not been met. Therefore, our present strategy for recovering the southern sea otter is to 1) determine the cause of increased mortality, 2) mitigate that cause, and 3) allow the number and range of sea otters to increase to such a size that *a*) there will be enough survivors to recolonize the range without genetic bottleneck effects (loss of genetic diversity due to small population size) in the event of a major oil spill in central California, and *b*) the population will be large enough that we can expect to be able to detect with adequate statistical assurance a declining trend in abundance prior to the population reaching the threshold for endangered status.

Concurrently, effective implementation of the vessel management plan is crucial to minimize the likelihood of future oil spills. The Recovery Team believes that the primary action for promoting the recovery of the southern sea otter at this time should be the cessation of the management zone, and that without such a change in management, the likelihood of recovery will be significantly lessened due to the stress and social disruption of capturing animals and relocating them from the management zone. We have taken this recommendation and other information under consideration and are evaluating alternative courses of action through the National Environmental Policy Act process. After completion of this process, we will issue a record of decision on the future of the translocation program.

Given the problem as summarized above, the remainder of this section describes the recovery criteria, and the basis for these criteria, for southern sea otters. As noted previously, prior to changing the classification of the southern sea otter under the Endangered Species Act, we must evaluate the five factors associated with causing extinction: 1) the present or threatened destruction, modification, or curtailment of habitat; 2) overutilization for commercial, recreational, scientific, or educational purposes; 3) disease or predation; 4) inadequacy of existing regulatory mechanisms; and 5) other natural or man-made factors affecting the population's continued existence. The criteria described below are intended to be triggers that would cause us to move forward with the five-factor evaluation prior to developing a proposal to reclassify the southern sea otter, either to endangered status or to delisted status under the Endangered Species Act.

The minimum population size that can be considered viable is one that is large enough to accommodate natural selection and to allow the population to be resilient to changes in the environment. Franklin (1980) argued that an effective population size (Ne) of 500 is satisfactory on genetic grounds, because at or above this population level the loss of genetic variation due to small population size is balanced or exceeded by the gains of mutation. However, it is important to note that the number of individuals in a population required to achieve a genetically effective population size of 500 may be several times greater than 500 (Frankel and Soulé 1981). Mace and Lande (1991) reported that the genetically effective population size is typically 20 to 50 percent of the actual population size. On the other hand, Lande reported that a minimum of 5000 animals were needed to maintain genetic diversity at an evolutionary time scale (thousands of years). At this point, based on the recommendations of the Recovery Team, we are using a threshold of a minimum effective population size of 500 sea otters as the basis for our management of southern sea otters under the Endangered Species Act. Until better information is available, we will use the 27 percent figure proposed for sea otters by Ralls *et al.* (1983) as the ratio of effective population size to actual population size. Therefore, an actual minimum viable population of approximately 1,850 animals is required to maintain a genetically viable population.[3] This number will be used as

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[3] A N_e/N ratio of 0.27, where N_e is the effective population and N is the actual population size, was proposed by Ralls *et al.* (1983). Therefore, minimum viable population size is calculated as 500 times the reciprocal of 0.27 (1/0.27=3.7) or approximately 1,850 animals.

the threshold population level for designation of the southern sea otter population as endangered. That is, the threshold population level of 1,850 animals is the criterion that would trigger a five-factor evaluation of the need to reclassify the southern sea otter as endangered. This criterion may be summarized as follows:

> ENDANGERED: The southern sea otter population should be considered for reclassification as endangered under the Endangered Species Act if the population declines to a level fewer than or equal to an effective population size of 500 animals (Mace and Lande 1991). Until better information is available, we recommend using a multiplier of 3.7 to convert effective population size to actual population size (Ralls *et al.* 1983), or 1,850 animals. Therefore, the southern sea otter population should be considered endangered if, based on standard survey counts (*i.e.*, spring surveys), the average population level over a 3-year period is fewer than or equal to 1,850 animals.

The criteria for listing the southern sea otter as threatened are based on the definition given in the Endangered Species Act: a threatened species is one that is threatened with becoming endangered in the near future. In the case of the southern sea otter, the potential for mortality caused by oil spills continues to be a primary threat. Additionally, the inherent variability in survey counts is such that the population needs to be large enough that we will be able to detect trends in abundance reliably prior to the population declining to endangered status. Therefore, we derive the threshold population level between threatened status and delisted status under the Endangered Species Act as the number of southern sea otters needed to ensure with reasonable certainty that an excess of 1,850 would survive following a major oil spill event, such as the *Exxon Valdez* oil spill (40 million liters [250,000 barrels]), and to ensure that a declining trend of 5 percent per year is detected before the population reaches the threshold level for endangered status. A summary of the assumptions behind our derivation of this number, given the current distribution of sea otters in California and their current population dynamics, follows:

1. There is a threat that a major oil spill will occur in the vicinity of the range of the southern sea otter that could significantly affect the population (see Appendix B).

We and the Recovery Team recognize the importance and capability of the new California Department of Fish and Game oil spill response facilities in California. It is likely that in the event of an oil spill, adverse impacts to sea otters will be mitigated to some unknown extent. However, as the *Exxon Valdez* oil spill demonstrated, it is not possible to eliminate the possibility that, due to weather conditions or other unforseen circumstances, a large number of sea otters will die following a major oil spill, even with the best efforts of the California Department of Fish and Game's oil spill response team.

The Minerals Management Service has assembled data on oil volume released from spills in United States waters involving 160,000 liters (1,000 barrels[4]) or more of

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[4] 1 barrel = 42 gallons or 158.9 liters

crude oil. Based on these and other data (Card *et al.* 1975), 6 spills of 160,000 liters (1,000 barrels) or greater are predicted over the next 30 years in the vicinity of the range of the southern sea otter. The frequency of spills of between 160,000 to 1,600,000 liters (1,000 to 10,000 barrels) is greater than the frequency of spills between 1.6 million and 16 million liters (10,000 and 100,000 barrels). However, even though the probability of a major spill is relatively small, such spills cannot be ignored in the management of the southern sea otter. Large oil spills, even if much smaller than the *Exxon Valdez* oil spill, can potentially affect a large number of otters. For example, in the worst-case expectation for an oil spill of approximately 5 million liters (31,250 barrels), oil would contact 1,119 sea otters (Appendix B). At this time, we do not believe that calculating a specific probability for spills of a specific size or greater is a meaningful exercise relative to defining criteria for the recovery of sea otters in California. Rather, we and the Recovery Team are satisfied that an oil spill of sufficient size to reduce the number of sea otters in California to fewer than 1,850 animals is possible, given current abilities to contain oil (see Townsend and Glazer 1994) and to rehabilitate oiled sea otters.

2. Between 880 and 1600 southern sea otters could contact oil following a 40 million-liter (250,000-barrel) oil spill event (the size of the *Exxon Valdez* spill) in central California (see Appendix B).

The impact of an oil spill on sea otters in California would depend on the size of the spill, the type of oil, the distance offshore of the spill, the location of the spill along the coastline, environmental conditions at the time of the spill, and the nature and effectiveness of containment and clean-up operations and efforts to capture and rehabilitate oiled otters. It is not possible to make exact predictions about how many otters will be contacted by a spill without this information. Based on the simulations summarized in Figure 13 of Appendix B, a 40 million-liter (250,000-barrel) spill in the existing sea otter range would contact approximately 880 sea otters at least 10 percent of the time (90th percentile of distribution). Perhaps more meaningful are the median expected number (50th percentile) and worst-case number of contacts following such a spill, or 100 and 1,600 otters, respectively. We and the Recovery Team believe that using 1,240, a figure intermediate between 880 and 1,600, is both conservative and risk averse (*i.e.*, as uncertainty regarding the number of sea otters to be contacted following an oil spill increases, the estimated number of sea otters contacted will increase). The Recovery Team has recommended against using the worst-case estimate from the simulation studies described in Appendix B because this estimate is highly dependent on the particular scenario modeled in a particular simulation and is therefore expected to change dramatically if a new simulation analysis is performed.

3. In the absence of reliable data on survivability of oiled sea otters in the wild, it is assumed that all sea otters coming into contact with oil will die (see Appendix C).

The available data on sea otter mortality following an oil spill event are inadequate to predict precisely the level of otter mortality that will occur (Appendix C). Specifically, information from the *Exxon Valdez* oil spill event on the mortality rate of oiled otters immediately following the spill is not available, and information on the survival of otters that had already lived through the first week following the spill is likely to be positively biased. Further complications are presented by the difficulty of estimating oil-spill-related mortality rates in California (where the coastline contains relatively few refuges for otters from an oil spill) based on mortality rates in Prince William Sound. Until additional information is available, a conservative approach should be taken. Therefore, we have assumed that all otters contacted by oil within 21 days of a spill will die. From several of the public comments on the 1996 draft of the recovery plan revision, it was clear that this point was misinterpreted by many. The confusion over not using the "worst-case" contact value of 1,600 otters, but rather the 90th percentile value of 880, is understandable. However, to reiterate, given the assumption that 1,240 otters will be contacted by oil following a major spill, we and the Recovery Team recommended further assuming that all sea otters that contact oil will die. Given the efforts of the California Department of Fish and Game to develop oil spill response facilities in California and to implement a protocol for responding to an oil spill in the sea otter's range, this assumption is probably conservative.

4. Over the next 5 years, the distribution of sea otters in California will not change appreciably. This assumption is based on the fact that population size has not increased and the range of the southern sea otter has changed little over the past 5 years.

Because the sea otter population in California is currently not increasing, it is difficult to predict when recovery will be achieved. We and the Recovery Team have assumed that, over the next 5 years, the current distribution of sea otters in California will not change to the extent that the results of the findings reported in Appendix B are invalidated. Should this assumption prove false, we will undertake a re-analysis of the oil spill/sea otter contact simulation studies.

5. A running 3-year average of population size adequately incorporates the existing degree of uncertainty in assessing the abundance of sea otters in California.

The annual rate of increase for the southern sea otter population between 1982 and 1993 was approximately 5 percent per year with a coefficient of variation of 0.09. During this 12-year time period, the number of otters counted from one year to the next increased 10 times and decreased 2 times. Statistically, this fluctuation is not unexpected given the observed coefficient of variation. Whereas using a 2-year running average results in two cases where the population apparently declined one year relative to the previous year, using a 3-year running average results in a more consistent portrayal of population trends. Based on these observations and the recommendation of the Recovery Team, we will use a 3-year running average to characterize population size during a given year. Several of the public comments addressed this recommendation. Specifically, recommendations were made to incorporate a specified rate of increase for some specified period of time into the classification criteria. One such comment from the public was that a criterion for delisting should be that the population has a discrete rate of growth that is greater than 1.0. We and the Recovery Team note that any delisting criteria that require a population to be greater than the current population size meet this requirement. However, the Recovery Team was unable to recommend a specific threshold for a rate of increase that should be associated with delisting at this time.

6. The population size at which the protective provisions of the Act are no longer needed must be sufficiently robust that we will be able to detect trends in abundance reliably prior to the population deteriorating to endangered status.

The actual number of southern sea otters will never be known with certainty, nor will the rate of change be known with certainty. Therefore, the Recovery Team used a simple regression analysis (Gerrodette 1987) to compute the number of years required to detect a trend given the estimated sample variability and rate of change. Two assumptions were made in applying this model: the coefficient of variation (cv), a measure of precision, is 0.1 (10 percent); and increases and decreases in abundance of the California sea otter population are approximately linear. Assuming a sample variation in annual counts of 10 percent and a population decline of 5 percent per year, it would take 10 years to detect reliably (*i.e.*, type I error equals 0.10) a decline prior to reaching a population size of 1,850. A 5 percent rate of decline over a 10-year period resulting in a population of 1,850 animals would require an initial population size of 3,090. In other words, a population of 3,090 animals or larger (*i.e.* 1,850 + 1,240) is sufficiently large that we can expect to be able to detect with adequate statistical assurance a significant (*i.e.*, greater than 5 percent per year) declining trend in abundance prior to the population reaching the threshold for endangered. Based on comments from the Recovery Team, we believe it is reasonable to assume that annual counts of sea otter abundance can be made with a coefficient of variation of 10 percent or less, although this parameter is not estimated as part of the current survey protocol.

In summary, given that the goal of management prior to delisting the species under the Endangered Species Act is to have a minimum of 1,850 otters in California following a major oil spill event and also to be able to detect reliably a population decline before reaching this number, the necessary abundance of sea otters in California, averaged over a 3-year period, is equal to 1,850 (the minimum viable population size), plus 1,240 (a size sufficient to incorporate an expected level of mortality from an oil spill the size of the *Exxon Valdez* and to allow for the reliable detection of a population decline), or 3,090 animals.

Accordingly, the preliminary or milestone criteria for threatened and delisted status for the southern sea otter under the Endangered Species Act are as follows:

> THREATENED: The southern sea otter population should be considered threatened under the Endangered Species Act if the average population level over a 3-year period is greater than 1,850 animals, but fewer than 3,090 animals.
>
> DELISTED: The southern sea otter population should be considered for delisting under the Endangered Species Act when the average population level over a 3-year period exceeds 3,090 animals.

The above regression analysis uses relatively simple statistical methods and incorporates the best information currently available on southern sea otter populations. However, it should be noted that the analysis assesses recovery criteria with respect to trends in single-year counts rather than considering multiple-year averages, and may potentially be sensitive to assumptions about sampling error and survey bias. Following recommendations of the Recovery Team, we plan to conduct a more complex simulation-based analysis to evaluate the robustness of the recovery criteria in this context. If available, the results of this simulation analysis will be incorporated into the next status review or recovery plan revision for the species.

Furthermore, we and the Recovery Team recognize that, should the population of southern sea otters achieve the preliminary delisting criteria, a full evaluation of all five factors for listing specified in the Endangered Species Act would have to be undertaken prior to a change in status. The evaluation should include a calculation of the probability of the population remaining above or below the relevant threshold population level. For example, if the population were being considered for delisting, it would be reasonable for us to calculate the probability that the population would remain above the threshold for delisting (3,090 animals) over the next 10 years. Similarly, if the population were being considered for uplisting to endangered, it would be reasonable for us to calculate the probability that the population would remain below the threshold for endangered (1,850 animals) over the next 5 years. Many of the parameter values used to determine the preliminary listing and delisting criteria are also tentative (*i.e.*, ongoing analyses may produce better estimates of one or more of the parameter values). For example, additional studies on the trajectories of oil spills in California based on oceanographic and meteorological data might significantly improve the estimate of the number of otters that could be contacted by spilled oil. Likewise, improvements in the ability of the oil industry and the State to contain oil and to rehabilitate sea otters following a major oil spill could change the expectation of the number of otters likely to be contacted following a spill and the number of oiled otters that would be expected to survive.

However, it should be recognized that the number of otters that make up this population will never be known with certainty. Nor will the rate of change be known with certainty. Therefore, it is necessary for the classification criteria to incorporate uncertainty and the extent to which changes in abundance can be reliably detected. Based on public comments and recommendations from the Recovery Team, we believe that an adequate minimum threshold difference between the criteria for endangered and threatened status is 1,240 animals. This number is roughly the decrease in animals over a 10-year period that could be detected reliably with the current level of precision in counting sea otter abundance off the coast of California if the decline were at a rate of 5 percent annually. This number also represents a plausible number of otters that might be killed in a short period of time if there were an oil spill of a magnitude comparable to that of the *Exxon Valdez.*

F. Strategy of Recovery

The southern sea otter population, as of spring 1995, occupied approximately 384 kilometers (240 miles) of coastline in central California and consisted of approximately 2,400 animals. The most recent survey data (spring 2002) indicate that the population numbers about 2,150 animals and occupies approximately 500 kilometers (300 miles) of coastline in California. Oil spills remain a primary threat to the persistence of this population, although the fact that the population is currently not increasing in the absence of any such spill-related effects points out that other factors are of importance as well. Oil spills have traditionally been afforded disproportionately great concern because they were thought to be uniquely capable of causing catastrophic, short-term declines. However, the large-scale catastrophic declines in sea otters that have recently occurred in western Alaska are clearly not the result of oil spills. Therefore, oil spills may not be the only threat with the potential for causing short-term decimation or extinction of the southern sea otter population.

The magnitude of potential large spills and their effects were well illustrated by the 1989 *Exxon Valdez* oil spill in Prince William Sound, Alaska. Minimizing the likelihood of oil spills through implementation of an effective vessel management plan is thus critical to sea otter conservation, though it is unlikely that the threat of a major oil spill can be completely eliminated. Because of the inherent difficulties in establishing colonies of sea otters by translocation and the likelihood of an oil spill affecting southern California, the translocated population of otters at San Nicolas Island cannot be considered significant as a reservoir for repopulating the parent population in the event of a spill. Therefore, the sea otter population in California must be allowed to expand in number and distribution to levels that will secure its natural persistence in the event of a major oil spill or series of smaller spills.

Based on the recommendations of the Recovery Team, we have concluded that additional translocations are not the best way to accomplish the objective of increasing the range and number of sea otters in California. We believe that range expansion of sea otters in California will occur more rapidly if the existing population is allowed to recover passively than it would under a recovery program that includes translocating sea otters. Further, the Recovery Team believes that, given changed circumstances such as the recent observed decline in abundance and the shift in the distribution of otters to include the range designated as an otter-free-zone, it is in the best interest of recovery of the southern sea otter population to declare the experimental translocation of sea otters to San Nicolas Island a failure and to discontinue the maintenance of the otter-free-zone in southern California. The details supporting this recommendation are provided in Appendix D. We are currently reevaluating the translocation program through the National Environmental Policy Act process. If the translocation program is declared a failure, the Recovery Team believes it would be beneficial to allow the otters currently on San Nicolas Island to remain there rather than capturing them and returning them to the mainland population.

II. Recovery

A. Objectives and Criteria

The overall recovery goal under the Endangered Species Act is to establish the long-term viability of the southern sea otter population sufficiently to allow delisting the species. To achieve this goal, coastal vessel traffic should be regulated (or managed) in a way that will minimize the risk of accidents in and near the southern sea otter range, and the southern sea otter population must be allowed to increase in number and range.

The primary objectives of this recovery plan are to create the conditions that will allow the southern sea otter to increase in numbers and distribution and to identify appropriate conservation actions to address the threats to this species. Such actions include, but are not limited to, determining the cause or causes of the population's lack of growth, identifying actions necessary to mitigate those causes, continuing efforts to reduce the probability and impacts of an oil spill in and near the sea otter's range, and continuing efforts to minimize the incidental take of sea otters in coastal net and trap fisheries.

Our recovery strategy is to create the conditions that will enable the southern sea otter population to increase to a size that allows the species to persist following most natural or human-caused perturbations. This level is expected to be met when the population size reaches an average level of 3,090 animals or greater over a 3-year period. This delisting criterion is based on information currently available and may be revised on the basis of new information (including research specified as recovery tasks). Prior to any decision to delist this species, we will complete a status review of the southern sea otter evaluating all five factors identified in the Endangered Species Act. We recognize that both the current population and the minimum population size necessary for delisting under the Endangered Species Act are well below the optimal sustainable population level for this species and that the southern sea otter will likely continue to be considered a depleted population under the Marine Mammal Protection Act.

Given that the population is currently not increasing, it is not possible to predict if or when recovery will occur. The cause or causes of the lack of population growth must be determined and mitigated to the extent possible. Although the cause or causes of the lack of population growth remain unclear, initial efforts will focus on elimination of mortality incidental to commercial fisheries and curtailment of habitat degradation that may be causing or contributing to mortality of the southern sea otter.

A summary of the listing criteria, associated threats, and recovery tasks for the southern sea otter is given in Table 1.

Table 1. Summary of Threats and Recommended Recovery Actions.

LISTING FACTOR	THREAT	RECOVERY CRITERION	TASK NUMBERS
A	Restriction of range due to management zone	1	Evaluate translocation program in light of changed circumstances and determine whether one or more failure criteria have been met (see Task 5)
C	Disease	1	Collect and analyze tissues for evidence of stress or disease; determine sources of disease agents and stress; minimize factors causing stress and disease (see Tasks 1.2, 4.3.4, 4.3.5, 4.3.6)
D	Incidental take in fishing gear	1	Evaluate causes of otter mortality; monitor incidental take in commercial fisheries; evaluate the effectiveness of fishing regulations for preventing sea otter take; evaluate incidental take in trap/pot fisheries; determine and take possible steps to reduce or eliminate sea otter mortality incidental to fisheries (see Tasks 1.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4)
E	Oil spills	1	Implement and monitor USCG vessel management plan; assess current risk of tanker accidents and other sources of oil spills, including off-shore oil platforms, pipelines, and marine terminals; implement an oil spill contingency plan that includes a sea otter response plan (see Tasks 2.1.1, 2.1.2, 2.2)
E	Contaminants	1	Evaluate causes of otter mortality; analyze tissues from southern sea otters for environmental contaminants and archive tissues for future analysis; determine sources of environmental contaminants; determine contaminant levels in sea otter prey and habitat (see Tasks 1.2, 4.3.1, 4.3.2, 4.3.3)
E	Intentional take	1	Evaluate causes of otter mortality; minimize intentional take (see Tasks 1.2, 3.2)

Listing Factors:

A. The present or threatened destruction, modification, or curtailment of its habitat or range
B. Overutilization for commercial, recreational, scientific, or educational purposes (not a factor)
C. Disease or predation
D. The inadequacy of existing regulatory mechanisms
E. Other natural or manmade factors affecting its continued existence

Recovery Criterion:

1. The average population level over a 3-year period exceeds 3,090 animals.

B. Narrative Outline

1. Monitor existing and translocated populations.

We recognize that one of the most critical activities concerning the conservation and management of the southern sea otter will be to continue ongoing monitoring programs for population abundance and distribution. Given the rapidity with which otter populations can decline (see Estes *et al.* 1998), surveys should be performed at a minimum of once a year and ideally twice a year. Population count data are the only effective measure of trends in abundance and are critical in evaluating the success of measures taken to mitigate the currently high level of mortality. Further, because the definition of recovery is dependent on these data, ongoing systematic population monitoring is required to determine when the species has recovered sufficiently to allow delisting.

1.1 Monitor the abundance and distribution of otters in California.

Standardized surveys of the mainland southern sea otter population, initiated in 1982, should be continued twice annually (in May and November) to monitor trends in the size and distribution of the population. Those segments of the population's range that are accessible by road and suitable for counting from shore should continue to be surveyed by teams of two observers using binoculars and Questar telescopes. The areas counted from shore should be divided into units that can be surveyed by a single team in no more than 2 to 3 days. Each unit should be surveyed by progressing among established observation posts from which contiguous viewing areas can be counted. The location, group size, activity, and number and size (small or large) of dependent young should be recorded on field maps. Aerial surveys from fixed-wing aircraft should be used to provide counts of the remaining areas that cannot be surveyed from shore. Similar measurements should be taken in the aerial surveys. Similarly, the population of sea otters at San Nicolas Island (and any other location in the Southern California Bight) should be monitored. The data should be tabulated and entered into a database file after each survey and used to establish updated trends in abundance, range, density, and pup production of the southern sea otter population. These surveys would need to continue through the time of delisting, and should be continuous and comparable with post-delisting monitoring surveys developed under task 1.3 below.

If the proportion of the population counted from the ground surveys changes appreciably over time, it is recognized that a calibration study would be necessary to evaluate the potential for bias in estimating trends in abundance and total abundance.

This database will serve as the principal means of assessing the status of the southern sea otter population and should be reported annually by us to the Congress, Marine Mammal Commission, and California Department of Fish and Game.

1.2 Evaluate the causes of mortality of otters that strand on California beaches.

Salvaged otters can provide an enormous amount of information on the population with no removals or harassment of individual otters. Necropsy data are critical in evaluating various hypotheses concerning how stress and disease interact to limit growth rates in sea otter populations. Mortality data (sex ratios, age composition, percent mature, percent pregnant, condition indices) are valuable in testing hypotheses concerning trends in status that could be expected as populations recover. Finally, information on the cause of death (disease, fishery-related, etc.) is important in determining which factors are responsible for the reduced rate of increase in the southern sea otter population and whether these factors can be mitigated.

We, the California Department of Fish and Game, U.S. Geological Survey, and our other research partners have continued this type of monitoring as an ongoing activity over the last 30 years. In 1992, the National Wildlife Health Center (U.S. Geological Survey, Madison, Wisconsin) began a necropsy program of beach-cast carcasses. This program has begun to provide important new information on the causes and patterns of mortality. In 1998, the California Marine Wildlife Veterinary Care and Research Center began participating in the necropsy program to evaluate causes of sea otter mortality. Because mortality has been identified as the general agent of depressed growth in the southern sea otter population, the National Wildlife Health Center and the California Marine Wildlife Veterinary Care and Research Center should continue this program to obtain adequate sample sizes for analysis of causes of mortality.

We have received reports concerning the illegal killing or injury of otters. However, the occurrence of such incidents appears to be low and sporadic. Therefore, direct monitoring of this threat is not warranted. Rather, we should pursue incidents on a case-by-case basis and indirectly monitor annual losses of otters caused by illegal killing by enhancing the existing marine mammal salvage program of the National Marine Fisheries Service. Where illegal killing is suspected, carcasses will be recovered and X-rayed to determine if an animal has been shot. The number of strandings and necropsy results should be reported annually.

Finally, data on the dates and locations of sea otter carcass recoveries have not been compared with data regarding the locations and magnitude of gill net fisheries in different years and seasons to look for a possible cause-effect relationship. Likewise, data concerning the types and levels of contaminants, parasites, and evidence of diseases found in beach-cast carcasses have not been thoroughly analyzed to determine if any of the data vary by location. Preliminary evaluations suggest that the sources of certain contaminants or diseases may be localized. A more comprehensive evaluation of the relevant data sets should be completed.

1.3. Develop and implement a post-delisting monitoring plan.

Before delisting the southern sea otter, a post-delisting monitoring plan should be developed. This monitoring protocol should yield data that is readily comparable to the current monitoring methods, and should have adequate power to detect significant population declines that might cause us to reconsider the decision to delist. Costs of implementation are dependent on specifications of the monitoring plan, yet to be developed. Post-delisting monitoring under the Endangered Species Act should continue for at least five years; in addition, continued monitoring to assess population status relative to the optimum sustainable population under the Marine Mammal Protection Act is expected to continue indefinitely after delisting.

2. Implement plans to reduce the probability of an oil spill occurring in the sea otter range and a plan to minimize the effects of an oil spill on the otter population, in the event that one occurs.

Oil spill risk from large vessels that traffic along the California coast remains a primary threat to the sea otter population. A plan was completed by the U.S. Coast Guard and Monterey Bay National Marine Sanctuary to reduce oil spill risk from vessel traffic. The focus of additional efforts should be on promoting and developing resources for full implementation of existing plans to reduce oil spill risk.

2.1 Minimize the risk of vessel accidents and other possible sources of oil spills and associated threats.

Oil spill risks within and adjacent to the sea otter's range should be identified and a plan developed to minimize oil spill risk to the southern sea otter population.

2.1.1 Implement vessel management plans that minimize the risk of vessel accidents and other possible sources of oil spills.

During 1997 and 1998, the National Marine Sanctuary and the U.S. Coast Guard worked with a diverse group of representatives including Federal, State, and local governments, the oil and shipping industry, and environmental groups to develop vessel traffic management measures to protect the Monterey Bay Sanctuary (which effectively covers the mainland range of the southern sea otter) from the threat of a catastrophic oil spill. As part of this effort, these groups reviewed the available information on vessel routes and operations (including relevant statutes, regulations, and enforcement programs), the current level of risk of an oil spill, and the means available to minimize risks. The group's recommendations are provided in Part I of this plan.

Our original goal was to establish a vessel routing distance from shore such that an oil spill occurring within those lanes has a 1 percent chance or less of contacting the current sea otter range, and, if an accident occurs, an emergency response vessel can arrive from the port of origin and secure the disabled vessel prior to its grounding. Marine terminal operators should have a contingency plan and response equipment capable of immediately responding to and effectively containing and cleaning up a large-scale spill of any type of petroleum product transferred. With the exception of the 1 percent standard, which could not be met because of logistical constraints and the need to reach consensus, these goals have been achieved. The current vessel routing plan provides for volunteer compliance with International Maritime Organization approved routing lanes. The U.S. Coast Guard should monitor compliance by vessel operators to determine if the vessel management strategy is effective. If vessel operators are not adhering to the standards, the U.S. Coast Guard and the National Oceanic and Atmospheric Administration should pursue more stringent regulations.

2.1.2 Assess the degree to which vessel routing and oil spill response planning have reduced the risk and possible impacts of oil spills in and near the southern sea otter range.

Undertake an evaluation to determine the probability over the next 30 years of a major oil spill occurring in the vicinity of the southern sea otter range (including that from off-shore oil platforms, pipelines and marine terminals), and the degree to which the population may be affected, given recent and proposed changes in shipping routes and the State's and industry's ability to effectively respond to an oil spill.

2.2 Implement an oil spill contingency plan that includes a sea otter response plan.

If a large spill occurs within or adjacent to the sea otter's range, otters would likely become oiled and many or most of these animals would die. Although contingency planning efforts are not expected to protect large numbers of sea otters, rescue efforts to protect sea otters would most likely be implemented. The California Department of Fish and Game–Office of Spill Prevention and

Response has established an Oiled Wildlife Care Network that includes five facilities that are equipped and prepared to assist with the cleaning and rehabilitation of oiled wildlife, including sea otters. The location of oil spill containment, dispersant, and clean-up equipment has been identified in area plans as required by the Oil Spill Prevention Act of 1990. The California State legislature has made it mandatory that the oil industry operating in California maintain, by contract or other approved means, equipment and trained oil spill response teams. Deployment strategies within marine waters are typically under the direction of the U.S. Coast Guard, and the response teams engage in regular practice exercises. The expected effectiveness of various response procedures has been documented. Federal law (Endangered Species Act and Marine Mammal Protection Act) charges us with the protection and conservation of the sea otter, and actions may vary from no action to the capture, cleaning, and rehabilitation of oiled animals. We must work cooperatively with the State of California and other partners to implement an oil spill contingency plan and reduce the impact of oil spills on the southern sea otter population. (These plans are different from those that are required of tank ships, non-tank vessels and marine facilities under the OSPR contingency plan regulations.)

The California Department of Fish and Game–Office of Spill Prevention and Response has developed a Wildlife Response Plan for California, which includes special procedures for handling sea otters. This plan should be periodically updated and revised to address clearly the responsibilities and authorities of the U.S. Fish and Wildlife Service and the California Department of Fish and Game, and should include detailed guidance regarding advance preparation, capture, rehabilitation, and release of sea otters in California following an oil spill event. A response plan identifying specific actions for each agency and support organization should be appended, including pertinent names, positions, and phone numbers. A damage assessment strategy and implementation plan should also be included as an appendix.

3. Continue efforts to assess and to reduce or eliminate the incidental take of sea otters in coastal net and trap fisheries and other sources of take in California.

Sea otters are known to become entangled in gill and trammel nets and to swim into and become entrapped in pots and traps used in fisheries for various decapod crustaceans (crabs and lobsters) and fin fishes. Estimates of the incidental mortality of southern sea otters due to entanglement in gill nets during the late 1970s and 1980s exceeded 5 percent of the estimated population size in some years. Gillnet mortality was estimated to be zero between 1991 and 1994, but entanglements apparently increased again after 1994. Between 1995 and 1998, 0.7 to 1.3 percent of the southern sea otter population was estimated to have been killed per year in gillnets in Monterey Bay (Forney *et al.* 2001). Clearly, this level of mortality is significant. If it does not prevent recovery, it will certainly delay recovery and expose the population to increased risk of extirpation following a major oil spill. It is critical that the southern sea otter population be managed to expand in size and distribution as rapidly as possible to minimize the risk of losing the entire population. For this purpose, incidental and intentional take should be reduced to levels approaching zero mortality. It should be noted that Public Law 99-625 and 1994 amendments to the Marine Mammal Protection Act do not authorize the taking of sea otters incidental to commercial fisheries, except in the management zone.

As of January 1, 1991, with the 55-meter (30-fathom) closure for coastal gill and trammel nets (see Conservation Measures in text, California Senate Bill No. 2563), sea otter mortality from net entanglement was thought to have been virtually eliminated. In addition, in 1990 the National Marine Fisheries Service started an observer program using at-sea observers, providing data on incidental mortality rates relative to the distribution of fishing effort. The National Marine Fisheries Service observer program was active from 1990 to 1994, discontinued between 1995 and 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, the National Marine Fisheries Service recently estimated southern sea otter mortality in the halibut set gillnet fishery to have been 64 in1990, zero in 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, and Forney *et al.* 2001). The increase in estimated mortality in 1995 to 1998 was attributed to a shift in set gillnet fishing effort into areas where sea otters are found in waters deeper than 55 meters (30 fathoms). In September 2000, the set gillnet fishery was restricted by emergency regulation to protect sea otters and seabirds. The State of California has subsequently (September 2002) implemented a permanent ban on gill net fishing in waters shallower than 110 meters (60 fathoms) between Point Reyes in Marin County and Point Arguello in Santa Barbara County. We expect the implementation of this ban to virtually eliminate sea otter mortality in set gillnets north of Point Arguello. This case illustrates the importance of coordinating efforts to monitor fisheries and bycatch with other Federal and State agencies, and such collaborations should continue in the future.

3.1 Continue efforts to document levels of incidental take in various fisheries and to identify and implement measures necessary to eliminate or minimize this source of mortality.

3.1.1 Monitor the incidental take of sea otters in commercial fisheries.

We have coordinated efforts with the National Marine Fisheries Service to monitor sea otter mortality in coastal fisheries that take other marine mammal species under National Marine Fisheries Service jurisdiction. Other fisheries that take sea otters should also be monitored. Estimates of annual mortality should be made based on observed rates of mortality and total fishing effort, stratified by area. Reports of incidental take are currently relayed to us and the California Department of Fish and Game and, where possible, carcasses are recovered, examined for tags, and examined (or necropsied) for probable cause of death. Life history data are also collected. We should continue to coordinate monitoring efforts with the National Marine Fisheries Service to ensure that otters in newly occupied range (such as near Point Purisima) are not compromised by fishing activity. We should also make efforts to monitor any existing, new or expanded fisheries that a) use gear types known to have the potential to catch sea otters, and b) take place in areas used by sea otters.

3.1.2 Prepare a report that evaluates the effectiveness of regulations on the use of gill and trammel nets in California waters over the last 15 years.

Regulations imposed upon the gill and trammel net fishery to protect sea otters were first promulgated by the State of California in 1984. Continual take of sea otters in areas outside the restricted isobath (line indicating equal depth below the surface of a body of water) resulted in a series of additional regulations to protect the sea otter. Presently, gill and trammel net fishing is restricted to outside the 110-meter (60-fathom) isobath (under regulations finalized in September 2002) throughout most of the sea otter's range. This information should be assembled into a single report evaluating the effort to reduce incidental take by State regulation.

3.1.3 Evaluate the potential for incidental take of sea otters in trap and pot fisheries.

A coastal live trap fishery for kelp forest fishes developed in the early to mid 1990s, and its growth is coincident with a trend reversal (from increasing to declining) in abundance of the southern sea otter population. Laboratory experiments confirm that sea otters willingly enter these traps in apparent quest for the food they contain. Furthermore, unconfirmed reports indicate that sea otters have entered these traps and drowned in the wild. While the influence of any such losses on sea otter population trends remains uncertain, measures are needed to eliminate the possibility of sea otters being killed incidentally in these pot and trap fisheries.

Some work has been done to evaluate the effectiveness of steel rings placed in the entrances of traps. The California Department of Fish and Game now requires 13-centimeter (5-inch) rings to be placed in live fish traps used along the central coast. A survey of pot and trap fishermen concerning any observations of interactions (either loss of catch, damage to gear, or incidental mortality) should be conducted. Additionally, salvaged sea otter carcasses in areas where trap and pot fisheries occur should be examined for evidence of drowning. Further studies should be undertaken with captive sea otters to determine if and how otters get caught in traps and pots and to devise and evaluate additional mitigation measures.

3.1.4 Determine and take possible steps to reduce or eliminate sea otter mortality incidental to fisheries.

The information from the previous sub-tasks should be integrated into a single document summarizing sources of incidental take, current level of take, and effectiveness of previous efforts to reduce take. This document should also recommend actions necessary to reduce the level of take to near zero.

3.2 Minimize intentional take of southern sea otters.

As the southern sea otter population increases in number and range, malicious activities directed at the sea otter may increase. Measures to quickly identify and minimize these activities need to be implemented. Based on information obtained from the sea otter mortality monitoring program and other information obtained from law enforcement investigations, we and the California Department of Fish and Game should evaluate the nature and extent of intentional take of sea otters and develop a program to minimize its occurrence.

4. Evaluate assumptions used to estimate the population level at which southern sea otters could be considered recovered under the Endangered Species Act.

The Endangered Species Act requires recovery plans to include measurable recovery criteria. The criterion for delisting is based on the probability of an oil spill reducing the sea otter population to a level where it is likely to become in danger of extinction within the foreseeable future. It also incorporates the number of animals required to ensure that a declining trend of 5 percent per year can be reliably detected before the population reaches the threshold level for endangered status. Recovery of the southern sea otter depends critically on continued population growth; time to recovery is a direct function of the population growth rate.

Therefore, the present lack of growth of the southern sea otter population is a matter of concern. Additional studies are needed to 1) determine if human-caused factors have reduced the growth rate of the southern sea otter population below the potential for the species and whether or not the potential growth rate can be restored and 2) refine projections of how rapidly sea otters will expand their range and how this population would respond to a major oil spill that affected a significant portion of their range.

4.1 Estimate the current probability of the population being below 1,850 over the next 10 years. Incorporate this analysis into delisting criteria.

The delisting threshold of 3,090 animals was derived based on a population size that was large enough to withstand a decline in abundance over a reasonable time period that would be detectable prior to the population reaching the threshold for endangered (*i.e.* 1,850 animals). This calculation assessed trends in single-year counts based on empirically observed rates of change in the California population, and assumed that measurement error was the dominant source of variation in modeling population trajectories. To evaluate the sensitivity of the recovery criteria to these assumptions, an analysis that incorporates all sources of uncertainty (including bias and annual population fluctuations) should be undertaken to evaluate the robustness of the recovery criteria and the use of the 3-year running average approach to define the endangered and threatened thresholds. This analysis should be completed within the next 5 years and incorporated into the next revision of the Southern Sea Otter Recovery Plan.

4.2 Evaluate differences in life history parameters for sea otter populations throughout the North Pacific.

Sea otter populations in various geographic locations exhibit a wide range of growth rates and are thought to differ in life history parameters such as age-specific survival rates. The available information on sea otter life history parameters and population growth rates should be compiled and synthesized to better define the way in which the California population may differ from sea otter populations in other areas.

The following parameters should be estimated for several populations of sea otters: 1) gender-specific survival rates from birth to weaning, weaning to age 1 or 2, and adult survival; 2) average gender-specific size (*i.e.*, weight) at age 1, 2, and 3 years; 3) diurnal and nocturnal percent of time spent feeding; 4) species composition of the diet within the population and among individuals; 5) age of first reproduction; and 6) adult rate of reproduction.

The life history data should be used with population models to determine such things as 1) the critical life history stages in limiting sea otter population growth; 2) how local patterns of population change are related to identifiable life history features; 3) recovery times from various population depletion scenarios; and 4) demographic changes responsible for the cessation of population increase at carrying capacity.

A final report, based on the findings of these research programs, should compare life history parameters from different populations of sea otters and reach a conclusion regarding the differences between populations. Recommended management and research actions should be included.

4.3 Determine concentrations and possible effects of disease, stress, toxic trace elements, and organochlorines on sea otters.

Members of the mustelid family are among the most sensitive mammalian species to polychlorinated biphenyls (PCBs) and methyl mercury (Wren *et al.* 1987). PCBs and other toxic chemicals have been suspected in population declines of wild mink and a closely related species, the river otter (MacDonald and Mason, 1982). Chronic dietary exposure of hexachlorobenzene has been shown to adversely affect mink and ferret reproduction (Bleavins *et al.* 1984).

Risebrough (1989) reviewed data on concentrations of trace elements and organochlorine hydrocarbons in the southern sea otter collected over a 20-year period in California. PCBs in liver tissues of southern sea otters were in higher concentrations than those associated with reproductive failure in minks (Bacon *et al.* 1999). Risebrough (1989) recommended future study of synthetic organic contaminants in the sea otter's food web. These contaminants occur routinely in central California marine food webs (Martin 1985).

A study of organic pollutants in sea otters was recently completed (Bacon 1994, Bacon *et al.* 1999). Liver samples were collected from beach-cast or native harvested sea otters in three general regions: central California, southeast Alaska, and the central and western Aleutian Islands. It was anticipated that organic contaminants, already known to occur at unusually high concentrations in the California Current ecosystem, would be higher in the livers of animals from California than from Alaska. Sea otters from southeast Alaska had low levels (trace to fewer than 5 micrograms per kilogram of tissue wet weight) of the various classes of contaminants measured, thus providing a good standard of comparison as a "clean" population. Comparatively high levels of contaminants were measured from southern sea otters. Average concentrations of dichlorodiphenyltrichloroethane (DDT) and dichlorodiphenyldichloroethylene (DDE) were 846 micrograms per kilogram of tissue wet weight, and the level of total PCBs was about 200 micrograms per kilogram. Surprisingly, PCB levels in the Aleutian Islands exceeded those measured from southern sea otters, and DDT/DDE levels from the Aleutian otters were significantly greater than those from southeast Alaska.

Because otter populations in the Aleutian Islands were thriving at the time of the study, it is unlikely that PCBs alone are having a significantly detrimental impact on the southern sea otter population. However, impacts from the high DDT/DDE levels are less clear, and a collective or synergistic effect of the generally high level of organic contaminants in southern sea otters cannot be excluded.

Subsequent studies of contaminants founded in stranded southern sea otters have identified accumulation patterns of organochlorine pesticides and PCBs in southern sea otters stranded along the coast (Nakata *et al.* 1998) as well as the presence of butyltin residues, which are known to be immunosuppressant (Kannan *et al.* 1998).

Diseases, including acanthocephalan peritonitis, encephalitis (caused by the protozoan *Toxoplasma gondii*, which completes its life cycle in cats and can occur in cat feces), coccidioidomycosis, and various bacterial infections, are a significant but inadequately understood source of mortality for southern sea otters, and may be limiting population growth. Additional research is needed on population impacts, sources, transmission routes, and appropriate preventive measures related to infectious diseases.

4.3.1 Analyze tissues from southern sea otters for environmental contaminants and archive tissues for future analysis.

The high levels of organic contaminants in sea otters from California and far western Alaska are a matter of substantial concern. Although the use of some of these compounds is currently banned in the United States, they are being used in increasing amounts elsewhere in the world. Further, long-lasting pollutants are one of the most insidious threats to coastal marine ecosystems. This threat is especially relevant in California because of the large expected human population increase in California and the high likelihood that many of these people will live near the coast. Obtaining accurate measurements of contaminant residues in sea otter tissues is therefore critical. Since the literature is replete with examples of erroneous differences in various parameters due to handling and analytical techniques, as part of this task: 1) a standard protocol should be followed by all investigators cooperating on this project, 2) sample size requirements should be developed, and 3) a Quality Assurance/Quality Control (QA/QC) program should be initiated to reduce between-lab variability.

4.3.2 Determine the sources of environmental contaminants.

Although source identification of contaminants is difficult, there are many techniques that can provide useful information in this regard. Compounds from specific sources often have identifiable signatures. An evaluation of potential and likely sources of contaminants (*e.g.*, agricultural runoff, antifouling paints, treated waste water, municipal solid waste composts) to southern sea otters should be compiled and reported.

4.3.3 Determine contaminant levels in sea otter prey and in other components of the coastal food web and ecosystem.

Environmental contaminants that enter sea otters probably do so almost exclusively through their food. Therefore, it is important to know whether the contaminants are being obtained from some particular prey type, or whether prey types exist that could expose sea otters to high levels of contaminants if a switch in diet were to occur. These analyses should include San Nicolas Island. Parts of the southern California bight contain high levels of organic contaminants, especially DDT and DDE. However, contaminants were not considered in the decision to translocate sea otters to San Nicolas Island, and no information has been obtained subsequently on the levels of these compounds that might occur there.

4.3.4 Analyze tissues for evidence of stress or disease.

In 1992, the National Wildlife Health Center began a coordinated necropsy program for southern sea otters. Since this program was started, the proportion of fresh carcasses for which cause of death could not be determined has decreased substantially, and a number of new diseases and pathogenic conditions have been identified. The California Marine Wildlife Veterinary Care and Research Center has become operational, participates in this program, and has expanded the program to include carcasses other than those that are very fresh, as well as carcasses removed from fishing gear. We and the Recovery Team believe that the coordinated necropsy program is one of the most important new developments for the southern sea otter. Therefore, the National Wildlife Health Center and the California Marine Wildlife Veterinary Care and Research Center should continue this program. At least 5 years of study will be needed to obtain adequate sample sizes. This program should expand to include comparable analyses of carcasses of other sea otter populations to determine whether the specific diseases and incidence of infectious disease are unique to the southern sea otter. A final report should be prepared discussing the findings, and if evidence is found that disease or stress is limiting the population growth rate, a plan to minimize the problem should be included. [Implementation of a plan to identify the cause(s) of the problems(s) will likely require a multi-agency effort (Environmental Protection Agency, Regional Water Quality Control Boards, other agencies, industry, watershed councils, environmental groups, etc.)] If the existing research and monitoring programs are judged inadequate, steps should be taken to refocus or augment them as necessary.

4.3.5 Determine the sources of disease agents and stress.

Necropsy analysis of carcasses and tissues provides the means to identify evidence of stress and disease, but the sources of stress and disease are not all likely to be elucidated by this method alone. We recognize that the understanding of infectious disease must include a broader consideration of potential ecological forcing factors. The analysis of infectious disease also should include a thorough consideration of potential forcing factors, such as environmental contaminants, treated waste water, harmful algal blooms, and other agents capable of suppressing the sea otter's immune system. An evaluation of potential and likely sources of stress and disease to southern sea otters should be compiled and reported.

4.3.6 Implement all reasonable and prudent measures to minimize factors causing stress or disease in the southern sea otter population.

Based on the above reports, we should coordinate with all pertinent agencies and organizations (California Department of Fish and Game, National Oceanic and Atmospheric Administration, Environmental Protection Agency, National Marine Fisheries Service, UC Davis, Oiled Wildlife Care Network, Monterey Bay Aquarium, etc.) to identify the proper procedures and implement the actions necessary to minimize those factors known or believed to have debilitating effects on the southern sea otter population.

Federal, State, and local programs aimed at determining the sources, levels, and effects of anthropogenic contaminants on the health of the marine ecosystem and its component parts should be evaluated to assure that they are capable of detecting and eliminating sources of contaminants and diseases that may be posing threats to sea otters, directly or indirectly through the marine food web of which sea otters are a part. This effort should begin with an effort simply to identify all such programs. We recognize that a comprehensive analysis of sources, levels, and effects of anthropogenic contaminants on the health of the marine ecosystem will be extremely challenging.

4.4 Evaluate the potential for habitat-related differences in growth rates between populations of sea otters.

The assumption that otters in central California are at maximal levels relative to what the environment will support, and that these densities are representative of maximal levels throughout central and northern California, is critical in predicting rates of recovery. The relationship between habitat and population demography needs to be evaluated to determine if habitat is affecting population growth rates. This effort should include two major dimensions: 1) an analysis of the habitat itself, and 2) an analysis of demographic, behavioral, and physiological parameters of sea otters that are relevant to the potential for resource limitation.

Habitat surveys should continue. Mapping of habitat types should evaluate supporting habitat for changes in types, abundance, distribution, and use (*e.g.* resting, haul out, feeding, breeding, natal area, peripheral feeding/resting areas, offshore areas) and changes in its estimated carrying capacity. Evidence gathered to date indicates that there are important interactions between sea otters and the habitats in which they live and forage; otter predation reduces many prey populations, including herbivorous invertebrates and/or species exploited in commercial and recreational fisheries. Social and economic consequences of this interaction are the primary societal barrier to the natural expansion of sea otters and recovery of the California population. Furthermore, food resources (including fluctuations in food availability from events such as El Niño) likely have important effects on the behavior and population status of sea otters. These interactions have been discovered and documented in northern populations through comparison of areas with and without sea otters, or between areas in which the density of sea otters varies. However, some of the proposed interactions, including effects on commercial and recreational fisheries, have been questioned because of the potentially confounding effects of other variables that may fortuitously co-vary with sea otter populations. It is possible to provide more compelling evidence for or against these proposed processes by observing systems through time with varying densities of sea otters. This kind of monitoring is being done at San Nicolas Island and elsewhere by conducting habitat surveys of particular areas through time, while at the same time studying population trends and the foraging behavior of sea otters. Taken together, these data will provide a record of how expanding sea otter populations influence shellfish populations and other components of the coastal ecosystem, and how the behavior and demography of sea otter populations co-vary with these environmental changes.

A final report, based on the findings of these research programs, should compare habitat quality among sections of the California coast and reach a conclusion concerning the adequacy of the hypothesis that habitat quality is constant in central and northern California and whether the population growth rate is affected by habitat parameters. Information from these studies should be analyzed and used in reevaluating recovery criteria.

4.5 Estimate effective population size of the southern sea otter population.

Estimating the size at which the southern sea otter population should be considered endangered requires an estimate of effective population size. The estimate of effective population size used in this recovery plan is based solely on theoretical calculations (Ralls *et al.* 1983). Thus, an empirical estimate of the effective population size of the population would be useful.

Data on microsatellites (highly variable nuclear markers) can be used to estimate the effective population size (see Schwartz *et al.* 1998 for a review of these methods). The temporal allele method is the most reliable method for estimating effective population size from DNA data (Waples 1989, Luikart *et al.* 1998). This method examines the change in allele frequencies across several generations. In small populations, genetic drift drastically changes allele frequencies, while in larger populations allele frequencies remain stable. By calculating the change in allele frequencies over several sea otter generations, we can back calculate the effective population size that drives the change. Recently, both Bayesian and maximum likelihood methods have been applied to the temporal allele technique, providing more precise and accurate measures of effective population size.

Tissue samples (hind flipper punches) from sea otters captured for the 1987 translocation are available. DNA from tissue samples from otters captured in other projects should be saved for an appropriate genetic comparison with these earlier samples at some future time.

5. Evaluate the translocation program in light of changed circumstances and determine whether one or more failure criteria have been met.

In August 1998, we held two public meetings to provide information on the status of the translocation program, identify alternatives to consider, and solicit general comments and recommendations. At these meetings, we announced that we would begin the process of evaluating failure criteria established for the translocation plan. The technical consultants group for the Recovery Team, composed of representatives from the fishery and environmental communities as well as State and Federal agencies, was expanded to assist with evaluating the translocation program.

In March 1999, a draft evaluation of the translocation program was distributed to interested parties. The draft document included the recommendation that we declare the translocation program a failure because fewer than 25 sea otters remained in the translocation zone and reasons for the translocated otters' emigration or mortality could not be identified and/or remedied. We received substantive comments from agencies and the public following release of the draft for review.

On July 27, 2000, we published a notice of intent to prepare a supplemental EIS on the southern sea otter translocation program (65 *FR* 46172). The need for a supplemental EIS is based on changed circumstances and new information that we have gained since the original EIS on the translocation of southern sea otters was prepared in 1985 and 1986 (published in 1987). We are currently preparing the draft supplemental EIS, and plan to release it for public comment in 2003. The draft evaluation of the translocation program released in March 1999 will be finalized following further opportunity for public participation in the decision-making process and completion of the EIS. After completion of the final supplemental EIS, a record of decision will be published in the *Federal Register*.

6. **Improve captive sea otter management techniques.**

Captive sea otter management techniques should be improved to 1) increase our ability to successfully breed sea otters should the need arise to take a more active role in captive propagation efforts (perhaps including the development of a husbandry manual); 2) ensure adequate genetic diversity in the captive population by conducting genetic studies to assess genetic variability in wild and captive sea otter populations (including the maintenance of a comprehensive stud book for all southern sea otters in captivity); and 3) facilitate various research needs such as research on basic nutritional requirements for both sexes and all age classes to assess possible nutritional stress, and research to improve the success of rehabilitation and reintroduction efforts (*e.g.* of previously stranded or oiled otters). We intend to complete an enhancement permit in conjunction with improvements in the captive management program.

7. **Develop and implement a public education and outreach program.**

A public education and outreach program should be created to enhance public understanding, respect, and concern for southern sea otters. The successful implementation of some recovery tasks for the southern sea otter may depend on the awareness, support, cooperation, and involvement of the public. The apparent role of sea otters as indicators of the health of nearshore marine ecosystems provides a unique opportunity to address the community ecology of sea otters in California and the ecosystem of which they are a part.

7.1 **Develop and implement education and interpretation programs on southern sea otters and nearshore ecosystems.**

Education and interpretation programs should be designed to reach a wide audience, including school-age children, recreationists, visitors, and community members. These programs should address southern sea otter community ecology, life history, former and current range, past and present threats, and recovery actions. Supporting materials may include videos, brochures, workbooks, interpretive displays, traveling educational boxes, art and drama materials (for schoolchildren), posters, etc.

7.2 **Create opportunities for public involvement in the recovery of the southern sea otter and its associated ecosystems.**

Some of the recovery actions outlined in this recovery plan will directly affect, or be affected by, human activities that affect the nearshore marine environment. It is therefore imperative to maximize opportunities wherever possible for the involvement of interested and affected parties in the implementation of recovery tasks, both to garner support for recovery actions and to promote better understanding and cooperation between different groups. Volunteer or paid opportunities and training should be provided and the unique skills of interested and affected parties utilized wherever possible in order to foster mutual understanding and to encourage concern for the southern sea otter and the threats to its survival.

III. Literature Cited

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IV. Implementation Schedule

The following implementation schedule outlines actions and estimated costs for the recovery program. It is a guide for meeting the objectives discussed in the recovery section of this plan, and indicates task priorities, task descriptions, duration of tasks, responsible agencies, and estimated costs. These actions, when accomplished, should bring about the recovery of the southern sea otter and protect its habitat. As the estimated monetary needs for all parties involved in recovery are identified, this schedule reflects the total estimated financial requirements for the recovery of this species. Total costs for ongoing actions are estimated based on a hypothetical 20-year time to recovery; however, as noted above, a likely time to recovery cannot be projected because the population is currently not increasing and the reasons for the lack of increase have not yet been determined.

Tasks are arranged in priority order in the implementation schedule. The assigned priorities are defined as follows:

Priority 1–An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2–An action that must be taken to prevent a significant decline in species population or habitat quality, or some other significant negative impact short of extinction.

Priority 3–All other actions necessary to meet the recovery objectives.

The following abbreviations are used in the Implementation Schedule:

Task Duration

Cont.–The action will be implemented continually once initiated.

Ongoing–The action is currently being implemented and will continue until no longer necessary for recovery.

Responsible Party

*	Lead Agency
BRD	U.S. Geological Survey, Biological Resources Division
CDFG	California Department of Fish and Game
CDFG-MWVCRC	California Department of Fish and Game–Marine Wildlife Veterinary Care and Research Center
CDFG-OSPR	California Department of Fish and Game–Office of Spill Prevention and Response
EPA	U.S. Environmental Protection Agency

FWS	U.S. Fish and Wildlife Service
MBA	Monterey Bay Aquarium
NMFS-SWC	National Marine Fisheries Service–Southwest Center
NMFS-SWR	National Marine Fisheries Service–Southwest Region
MMS	U.S. Minerals Management Service
NOAA	National Oceanic and Atmospheric Administration, National Marine Sanctuaries
NPS	National Park Service
Other	Other parties yet to be determined
OWCN	U.C. Davis, Oiled Wildlife Care Network
USCG	U.S. Coast Guard

Time Period

FY	Federal fiscal year, from October 1 through September 30

Costs

TBD	Costs yet to be determined

Note: Costs of minimizing intentional take (Task 3.2) are generally embedded in law enforcement expenses and, because occurrence of intentional take appears to be uncommon and sporadic, are difficult to estimate in advance. Costs of identifying and minimizing disease and stress factors (Tasks 4.3.5 and 4.3.6) depend on results of future studies. Outreach expenses (Tasks 7.1 and 7.2) have largely not yet been identified pending development of a general public education and outreach program.

Southern Sea Otter Recovery Plan Implementation Schedule

Priority Number	Task Number	Task Description	Task Duration (years)	Responsible Party	Total Costs $1,000s[1]	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008
1	1.1	Monitor abundance and distribution, and determine if current estimates are negatively biased	Ongoing[3]	BRD* FWS CDFG MBA	360.0 140.0 200.0 100.0	18.0 7.0 10.0 5.0	18.0 7.0 10.0 5.0	18.0 7.0 10.0 5.0	18.0 7.0 10.0 5.0	18.0 7.0 10.0 5.0
1	1.2	Evaluate causes of otter mortality	Ongoing[3]	BRD FWS CDFG* NMFS-SWC MBA	700.0 140.0 1190.0 TBD 60.0	35.0 7.0 55.0 3.0	35.0 7.0 55.0 3.0	35.0 7.0 60.0 3.0	35.0 7.0 60.0 3.0	35.0 7.0 60.0 3.0
1	2.1.1	Implement and monitor USCG vessel management plan	Ongoing[3]	USCG* NOAA FWS	200.0 140.0 140.0	10.0 7.0 7.0	10.0 7.0 7.0	10.0 7.0 7.0	10.0 7.0 7.0	10.0 7.0 7.0
1	3.1.1	Monitor incidental take in commercial fisheries	2	FWS BRD CDFG NMFS-SWR*	TBD TBD TBD TBD					
1	3.1.2	Evaluate the effectiveness of fishing regulations for preventing sea otter take	1	FWS CDFG* NMFS-SWC	3.0 3.0 3.0	3.0 3.0 3.0				
1	3.1.3	Evaluate the potential for incidental take in trap/pot fisheries	1	FWS BRD* MBA	8.0 8.0 10.0	8.0 8.0 10.0				
1	3.1.4	Determine and take possible steps to reduce or eliminate sea otter mortality incidental to fisheries.	1	FWS CDFG* NMFS-SWC	3.0 3.0 3.0	3.0 3.0 3.0				

Priority Number	Task Number	Task Description	Task Duration (years)	Responsible Party	Total Costs $1,000s[1]	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008
1	3.2	Minimize intentional take	Ongoing[3]	FWS BRD CDFG* NMFS-SWR	TBD TBD TBD TBD					
1	4.1	Estimate the current probability of the population being below 1,850 over the next 10 years. Incorporate this analysis into delisting criteria.	2-3 months	FWS	15.0	15.0				
1	4.2	Evaluate differences in life history parameters of sea otters	5	FWS BRD* MBA	5.0 1,850.0 300.0	1.0 400.0 60.0	1.0 400.0 60.0	1.0 350.0 60.0	1.0 350.0 60.0	1.0 350.0 60.0
1	4.3.2	Determine sources of environmental contaminants	2	FWS CDFG* EPA NOAA MBA	4.0 225.0 12.0 12.0 6.0			2.0 75.0 6.0 6.0 3.0	2.0 150.0 6.0 6.0 3.0	
1	4.3.3	Determine contaminant levels in sea otter prey and habitat	2	NOAA CDFG*	225.0 225.0		75.0 75.0	150.0 150.0		
1	4.3.4	Collect and analyze tissues for evidence of stress or disease	5	BRD FWS CDFG* MBA	500.0 5.0 1,000.0 50.0	100.0 1.0 200.0 10.0	100.0 1.0 200.0 10.0	100.0 1.0 200.0 10.0	100.0 1.0 200.0 10.0	100.0 1.0 200.0 10.0
1	4.3.5	Determine sources of disease agents and stress	Unknown	FWS CDFG* NOAA EPA MBA	TBD TBD TBD TBD TBD					

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Priority Number	Task Number	Task Description	Task Duration (years)	Responsible Party	Total Costs $1,000s[1]	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008
1	4.3.6	Minimize factors causing stress and disease	Unknown	FWS CDFG* NOAA EPA	TBD TBD TBD TBD					
1	4.5	Estimate effective population size of the southern sea otter population.	1	FWS	60.0 (lab work only)		60.0			
1	5	Evaluate the translocation program in light of changed circumstances and determine whether one or more failure criteria have been met	1	FWS* BRD CDFG	200.00 5.0 5.0	200.0 5.0 5.0				
2	2.1.2	Assess current risk of tanker accidents and other possible sources of oil spills, including off-shore oil platforms, pipelines, and marine terminals	1	FWS USCG CDFG-OSPR* MMS	3.0 3.0 75.0 TBD	3.0 3.0 75.0				
2	2.2	Implement an oil spill contingency plan that includes a sea otter response plan.	Ongoing[3]	FWS CDFG-OSPR* MBA	22.0 60.0 20.0	2.0 3.0 1.0	2.0 3.0 1.0	1.0 3.0 1.0	1.0 3.0 1.0	1.0 3.0 1.0
2	4.3.1	Analyze tissues from southern sea otters for environmental contaminants and archive tissues for future analysis	Ongoing[3]	NBS FWS CDFG* MBA	40.0 40.0 40.0 40.0	2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0	2.0 2.0 2.0 2.0
3	1.3	Develop and implement a post-delisting monitoring plan	TBD[2] (develop before delisting)	BRD FWS* CDFG MBA	TBD					
3	4.4	Evaluate the potential for habitat related differences in growth rates between populations of sea otters	5	BRD* FWS MBA	625.0 5.0 50.0	125.0 1.0 10.0	125.0 1.0 10.0	125.0 1.0 10.0	125.0 1.0 10.0	125.0 1.0 10.0

Priority Number	Task Number	Task Description	Task Duration (years)	Responsible Party	Total Costs $1,000s[1]	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008
3	6	Improve captive sea otter management techniques	5	FWS MBA*& Others CDFG BRD	17.0 250.0 15.0 15.0	5.0 50.0 3.0 3.0	3.0 50.0 3.0 3.0	3.0 50.0 3.0 3.0	3.0 50.0 3.0 3.0	3.0 50.0 3.0 3.0
3	7.1	Develop and implement education and interpretation programs on southern sea otters and nearshore ecosystems.	Ongoing[3]	FWS MBA CDFG NOAA NPS Other	TBD 1000.0 TBD TBD TBD TBD	50.0	50.0	50.0	50.0	50.0
3	7.2	Create opportunities for public involvement in the recovery of the southern sea otter and its associated ecosystems.	Ongoing[3]	FWS MBA CDFG NOAA NPS Other	TBD TBD TBD TBD TBD TBD					
		Estimated Total Costs:			7,848+	1,547+	1,405+	1,541+	1,316+	1,149+

1 Total costs for ongoing tasks are estimated for a 20 year period.

2 Continued implementation of task expected to be necessary after delisting.

3 Task expected to be necessary until delisting of species.