Appendix A

Tier 2 Evaluation of Fishing and Fish Habitat Restoration Actions

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Appendix A1

Construct Artificial Reefs and Fishing Access Improvements

A1.1 GOALS AND NEXUS TO INJURY

As a result of the historical releases of DDTs and PCBs by the Montrose defendants, several species of fish, particularly those associated with soft sediments, in certain coastal areas continue to accumulate levels of contamination that make it advisable for people to avoid or limit their consumption. The goal of constructing artificial reefs and fishing access improvements is to restore lost fishing services by changing the species composition of fish in selected fishing areas. In this appendix, we categorize fish species based on the habitats with which they are most commonly associated. The term “bottom” is commonly used to describe the substratum. Thus, soft-bottom fishes are those that are commonly associated with sand or mud substrata, and hard-bottom fishes are those that are commonly associated with reef or rocky substrata. An additional category of fish, water-column-feeding fish, refers to pelagic fishes that feed on prey that is suspended in the water column (e.g., pelagic zooplankton).

The premise of this restoration action is that fish, particularly white croaker, that are associated with soft-bottom habitats feed on benthic organisms from the contaminated sediments and are consequently the most highly contaminated species. In contrast, fish associated with hard-bottom or pelagic habitats feed on organisms that are either living in the water column or attached to hard substrate and are consequently less contaminated. This premise is supported both by (1) data collected by the Los Angeles County Sanitation Districts, which demonstrate a repeated pattern of lower contamination levels in kelp bass and black surfperch relative to white croaker, and (2) the current fish consumption advisories, which are broader and more restrictive for white croaker than for hard-bottom species.

The construction of a reef is likely to change the types of fish in an area because soft-bottom species do not typically inhabit reef habitats (Allen 1999). The primary benefit of these projects will be to displace these highly contaminated, soft-bottom fishes with water-column-feeding and hard-bottom species, which tend to be lower in contamination. Building reefs will also provide ecosystem benefits by increasing the production of fish whose tissues contain lower concentrations of contaminants (Dixon and Schroeter 1998). Reef construction may be complemented at some sites by improvements to fishing access (e.g., piers or other amenities) to promote the use of the enhanced fishing sites, to heighten awareness of how habitat affects the concentration of contaminants in different species of fish, and to provide compensatory restoration for past losses in fishing opportunities due to limitations imposed by fish consumption advisories.

Both elements of this restoration action (using artificial reefs to replace contaminated soft-bottom fishes with hard-bottom species and constructing improved public access to such sites) have a strong relationship to the lost fishing services of the Montrose case and act as both primary and compensatory restoration of lost fishing opportunities. The reef element also addresses the objective of restoring fish and the habitats on which they depend.

A1.2 BACKGROUND

Artificial reefs have been employed extensively throughout the world, including California coastal waters, as a means to improve fishing, diversify fish communities, and increase productivity. Artificial reefs may be broadly classified according to their fundamental purposes:

fishing reefs and fish production reefs. A fishing reef (sometimes referred to as a Fish Aggregation Device [FAD]) typically provides little or no fish production value itself, functioning instead to aggregate certain species for the purpose of recreational or commercial catch. A production reef is constructed to promote settlement, growth, and survival of resident reef species over a long time frame for the purpose of increasing fish production. It is also possible to design projects that incorporate both elements, for instance by placing fishing reefs in proximity to production reefs or by restricting fishing to a limited portion of a reef that is sufficiently large to allow the remaining areas to function undisturbed as production sites and to sustain the fishing portion. Natural reef habitats act both to aggregate and to produce fish.

The California Department of Fish and Game (CDFG) administers the California Artificial Reef Program (California Fish and Game Code Sections 6420–6425), which has a long history of designing and constructing artificial reefs for purposes of increasing local production and abundance of fishes that are targeted by recreational anglers. To date, approximately 30 artificial reefs have been constructed involving over 100 modules and a broad range of designs and goals (Figure A1-1). Although some reefs in California have been called “fishing or fishing opportunity reefs,” the California definition of artificial reef requires that fishing reefs be designed and constructed to function as habitat that supports a productive and sustainable marine community typical of natural reef habitats rather than simply functioning as a FAD. This approach has generated a large amount of information regarding species composition, community succession, and productivity for artificial reefs (Ambrose 2000, Dixon and Schroeter 1998).

The CDFG program has developed a specific definition of artificial reefs that includes the contingency that they simulate natural reef habitats:

> “Artificial reef” means manmade or natural objects intentionally placed in selected areas of the marine environment to duplicate those conditions that induce production of fish and invertebrates on natural reefs and rough bottoms, and that stimulate the growth of kelp or other mid-water plant life which creates natural habitat for those species. (California Fish and Game Code Section 6421a)

Additional information on reef productivity and community structure has been generated in the past two decades by construction of a series of “developmental” reefs specifically designed to evaluate and compare how various design elements affect biological productivity and community structure. Developmental reefs have been built at Pendleton, Pitas Point, Santa Monica Bay, Marina Del Rey #2, Oceanside #2, Pacific Beach, Carlsbad, and Topanga. These developmental reefs generally consist of a series of rock modules with different rock sizes, relief profiles, and depths in paired replicates. The California Fish and Game Code states that “production” reefs would ultimately be built based on the information gained from the study of these “developmental” reefs (California Fish and Game Code Section 6420). However, due to cuts in funding for the CDFG artificial reef program, the intended studies of the existing developmental reef sites have not occurred (Parker, pers. comm., 2004).

A1.2.1 Relevant Models for Reefs That Would Meet MSRP Restoration Objectives

Increasingly, artificial reefs have been constructed to replace or mitigate for aquatic resources impacted by human activities (Ambrose 1994). Mitigation reefs have been constructed in recent years at several sites within the Southern California Bight, including Bolsa Chica, Long Beach Harbor, near the Angels Gate entrance to Los Angeles Harbor, in San Diego Bay, and offshore of Camp Pendleton. To mitigate for impacts to a kelp forest caused by releases of warm water by the San Onofre Nuclear Generating Station (SONGS), the utilities that operate SONGS are currently developing near San Clemente what may eventually be the largest mitigation reef in the United States (SCE 2004).

The study design and findings of the SONGS[1] reef pilot program are particularly relevant to the development of a reef construction program for the Montrose Settlements Restoration Program (MSRP). Although the primary goal of the SONGS reef program is to replace lost kelp forest

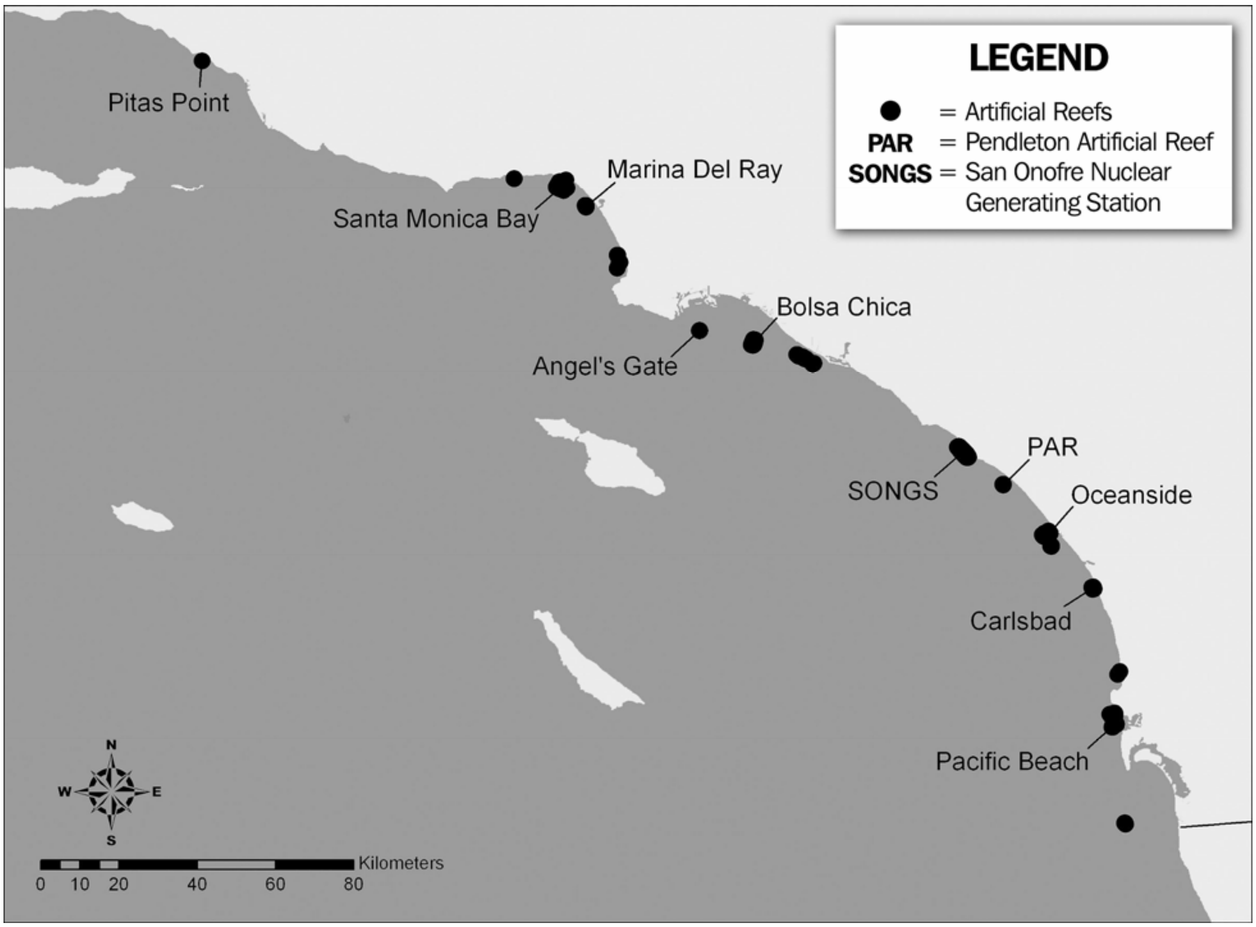


Figure A1-1. Artificial reefs in the Southern California Bight.

[1] Much of the information regarding the SONGS reef program is based on a phone interview with Dr. Steven Schroeter, who has been a principal investigator on the project since its inception.

habitat, the changes in fish community structure that occur would be relevant to the MSRP goal of providing cleaner fish for anglers. The utilities operating SONGS have developed a series of standards that the constructed reef must meet to achieve the desired level of mitigation and a 5-year pilot program to study how different reef designs perform in achieving these standards.

After reviewing the findings of previous studies, the SONGS parties designed and constructed an experimental modular reef system to investigate the importance of substrate (quarry rock versus concrete) and reef material coverage density (40 percent, 60 percent, and 80 percent) on kelp recruitment and growth as well as a more general analysis of community structure. Other issues evaluated in the SONGS pilot study will include the differences between high-relief and low-relief reefs (i.e., the variations in the sizes of the materials making up the reef), kelp out-planting versus natural recruitment, and several other considerations.

The SONGS 5-year evaluation study is scheduled to end in 2005. The Trustees will use the information generated by this and other developmental reefs to optimize the design of new artificial reefs to create a sustainable means for providing cleaner fish in the areas impacted by the contamination associated with the Montrose case.

A1.2.2 Designing for Sustainability

Artificial and natural reefs both attract fish and contribute to fish production under the right conditions (Ambrose 1994, Dixon and Schroeter 1998). Reef-based production can be estimated using several models, but most production estimates are based on estimating the standing stock on the reef at one or more points in time (Dixon and Schroeter 1998). Such estimates of changes in the overall biomass of fish do not differentiate between new fish production (i.e., gonadal production) and recruitment of fish from other areas (e.g., MEC Analytical Systems 1991).

For a constructed reef to add more fish to a total population, the fish population must be limited by the availability of reef habitat (Dixon and Schroeter 1998). Although it is uncertain whether fish populations are limited by the availability of reef habitat in Southern California, it is clear that reef habitat is rare relative to soft-bottom habitat (Cross and Allen 1993). Relative scarcity does not prove habitat limitation, but it is possible that building reefs will increase the number of potential settlement sites for juvenile reef fishes. Given the growing awareness that the settlement and early juvenile period is a significant mortality bottleneck for many marine fishes (e.g., Bailey and Houde 1989), particularly for reef-dwelling species (Victor 1986), an increase in potential settlement sites may increase survival through the early juvenile period.

The question of the relative importance of recruitment versus production remains unanswered for most marine reef fishes and for both natural and artificial reefs, but it is likely that both processes play a role (Dixon and Schroeter 1998). For example, certain artificial reef habitats in Southern California have supported self-sustaining populations of fish over more than a decade (Pondella et al. 2002) and have acted as a source of larval production that contributes significantly to the larval supply in the Southern California Bight (Stephens and Pondella 2002) However, the ability to confirm recruitment versus production is typically complicated by the high level of inter-annual variability in recruitment that occurs for most marine fish, the multiple recruitment bottlenecks that are likely to exist during early life history (e.g., first-feeding and settlement), and the difficulty in measuring the abundance of early-stage juveniles.

Because the focus of an MSRP reef program is to provide cleaner fish to anglers, the critical element is the degree to which the composition of fish species at a fishing site changes in favor of those that are less contaminated, rather than whether the reef increases the overall biomass of fish available. Nevertheless, the question of how reefs affect fish production is still relevant to this restoration effort, as the construction of new reefs may lead to increased local fishing pressure on fishing sites. This pressure could be addressed in a number of ways. A sufficiently large reef could be constructed to be sustainable despite the anticipated increase in fishing pressure. Alternatively, a reef could be placed in proximity to existing reefs where fishing is restricted or to Marine Protected Areas , thus incorporating into the reef design a source of fish to replace those caught at the fishing reef by anglers.

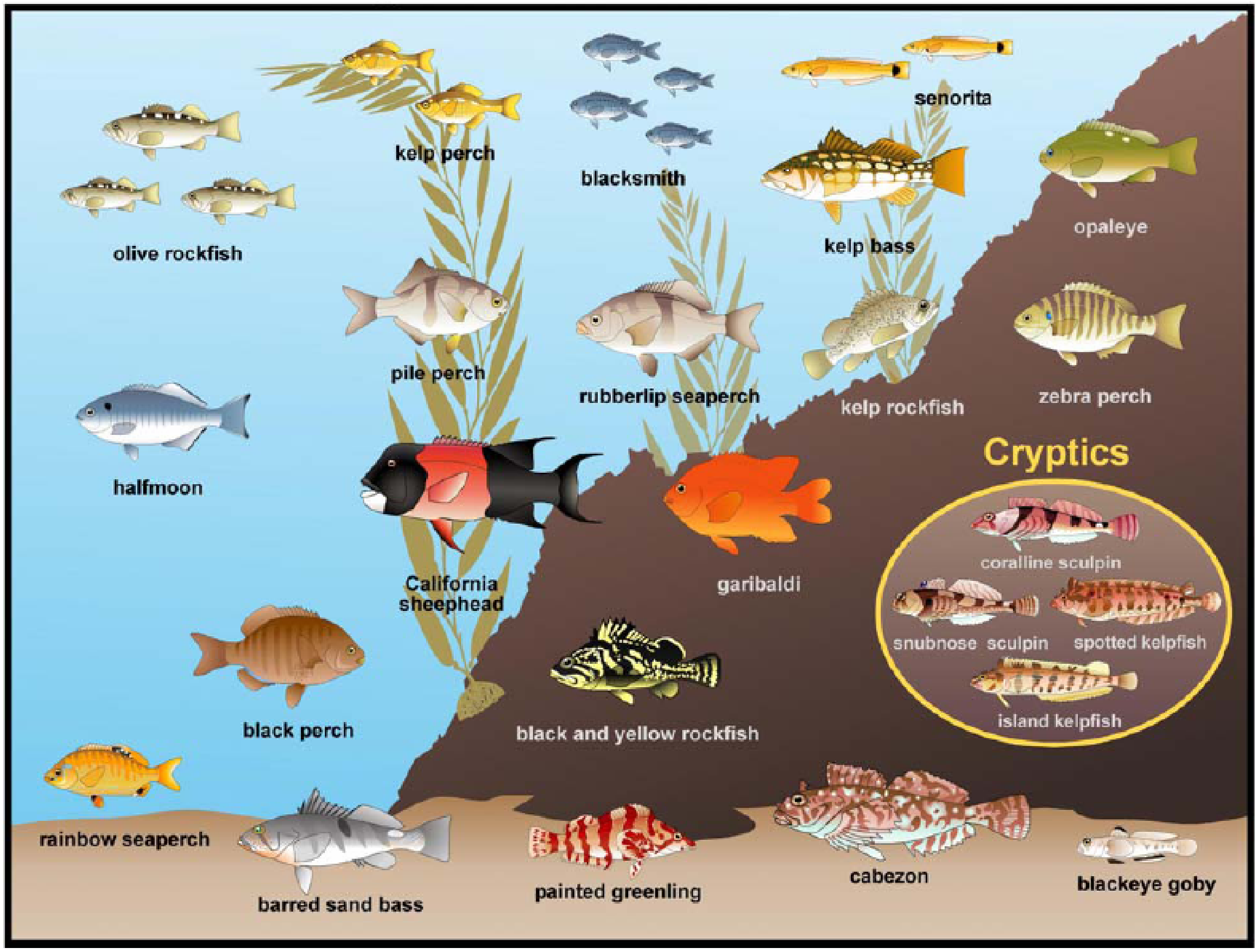
A fishing site enhancement program in Washington state provides one way of increasing the sustainability of fishing on artificial reefs. In 1974, the Washington Department of Fisheries began a marine fish enhancement program that involved building shore-based fishing structures (i.e., piers) and construction of "habitat enhancement" (reefs) around the structures to increase production/density of fish around them (Buckley 1982). These projects found that fishing structures that included habitat enhancement were much more productive and sustainable than those that did not. Also, the design of the enhancement was such that approximately 20 percent of the enhanced habitat was available to anglers using the fishing structure. The remaining 80 percent of the enhanced habitat was established as "production" zones and was protected against fishing from boats. This design resulted in sustainable fishing over a 50- to 10-year evaluation period.

The Washington study described a successional pattern in community structure where the reef community shifted from juveniles who appeared to be seeding unoccupied habitats to adults that appeared to be more resident. The conclusions of this study also suggested that the continuing availability of fish for fishing from pier structures was maximized via three mechanisms: (1) enhancement of the habitat surrounding structure to increase aggregation/production of fish; (2) episodic aggregation events producing periods of high catches; and (3) the presence of local resident fish that maintained catches during periods of low levels of aggregation. The third mechanism was promoted and sustained largely because significant components of the resident fish populations were protected from fishing.

Reefs can have substantial impacts on the local availability of fish that are lower in contamination. Although species that occur on a constructed reef are not the same as those that occur on soft-bottom habitats, constructed reefs support a diverse and productive community, and the species that occur on reefs perform many of the same ecological roles as those that occupy soft-bottom habitats (Ambrose 1994). Also, in a review of the literature pertaining to white croaker, Allen (1999) found that this species is never associated with any hard-bottom substrate, including natural or constructed reefs. Figure A1-2 is a schematic showing the fish assemblage associated with the rocky habitats adjacent to the Los Angeles breakwater (from Froeschke et al. 2005).

A1.3 PROJECT DESCRIPTION AND METHODS

The construction of artificial reefs and fishing access improvements is evaluated in this appendix at a non-site-specific, conceptual level for the MSRP Restoration Plan and programmatic Environmental Impact Statement/ Environmental Impact Report. The Trustees will further develop and design the details of the program as described below during the implementation phase of restoration and will prepare additional environmental documentation pursuant to the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA) prior to final site selection and construction for each reef project.



(Source: Froeschke et al. 2005)

Figure A1-2. Fish assemblage adjacent to the Los Angeles breakwater.

The MSRP reef program will entail two types of activities. The first activity will be the construction of reefs to increase the availability of fish species that are lower in DDTs and PCBs. The second activity will be to implement improvements to fishing access and amenities to promote the use of the newly enhanced fishing sites, heighten awareness of the reasons why reefs were built in the vicinity of the fishing locations, and to act as compensatory restoration for past lost fishing opportunities.

A1.3.1 Reef Development

The development of the reef-building component will follow a five-step sequence: (1) contaminant and angler use evaluation; (2) site selection; (3) reef design; (4) reef construction; and (5) monitoring. This sequence is likely to be iterative, with some or all steps being applied to each constructed reef.

Step 1: Contaminant and Angler Use Evaluation

This step involves developing a detailed understanding of the spatial and species-specific patterns of contamination in the fishes commonly targeted by anglers in the Southern California Bight, and combining this information with information on fishing practices and preferences at different locations as obtained from surveys of anglers. This analysis will be guided by sediment contamination levels, as these levels will be the determiners of local resuspension of contaminants during reef construction and local bioaccumulation levels in the residents of the constructed reef.

The results of the fish contamination survey and the angler survey will be entered into a geographical information system (GIS) database to facilitate analysis and to generate a first-level evaluation of potential sites for reef construction. The fish contamination data will come primarily from the contaminant survey that MSRP is currently conducting in collaboration with the EPA; results are expected late in 2005. These results, coupled with those from the angler surveys that the State of California is conducting as part of the Marine Recreational Fishing Statistical Survey (MRFSS)[2] as well as those conducted by the Trustees and EPA in 2002 and 2003, will identify areas where high levels of angler activity are coupled with a large disparity between contamination levels in soft-bottom versus hard-bottom fishes.

Although detailed data identifying differences in contamination levels among species and locations are not yet available to conduct this analysis, evaluations of previous contaminant data (Figure A1-3) have been used to provide initial indications of likely regions for deployment of artificial reefs (Figure A1-4). Figure A1-3 displays historical data showing levels of contamination in three species of fish commonly collected in the Southern California Bight. At the time of these surveys, white croaker were contaminated above the State of California trigger levels (screening but non-regulatory concentrations of potential concern are indicated by the reference line in Figure A1-3) over a much broader geographic range than the other two species. These earlier data suggest reefs constructed in areas adjacent to the Palos Verdes Shelf may achieve MSRP restoration objectives (Figure A1-4). The updated and more detailed data will be

[2] The MRFSS in California is now an expanded program called the California Recreational Fishing Survey.

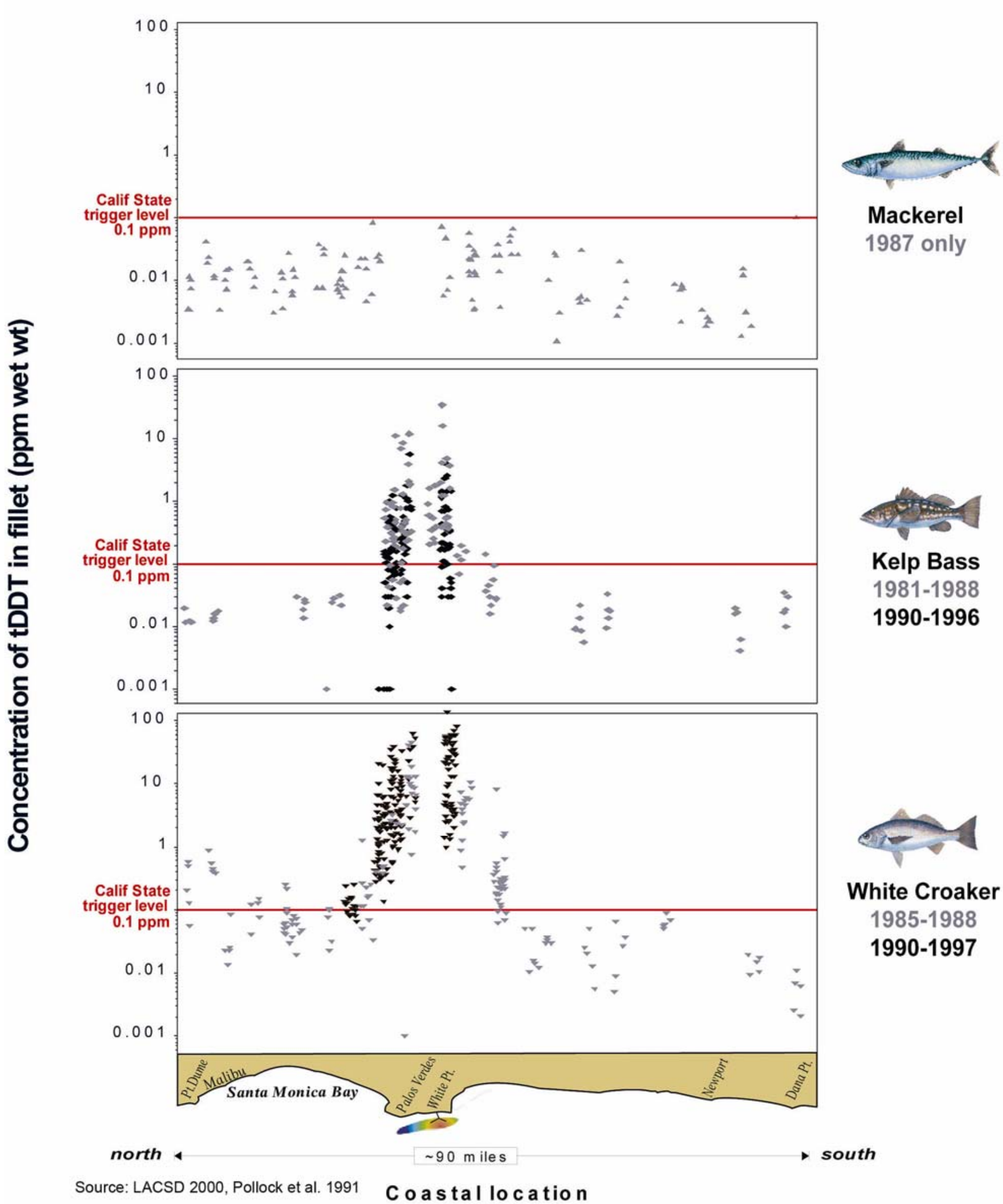


Figure A1-3. DDT in fish fillet between Malibu and Dana Point.

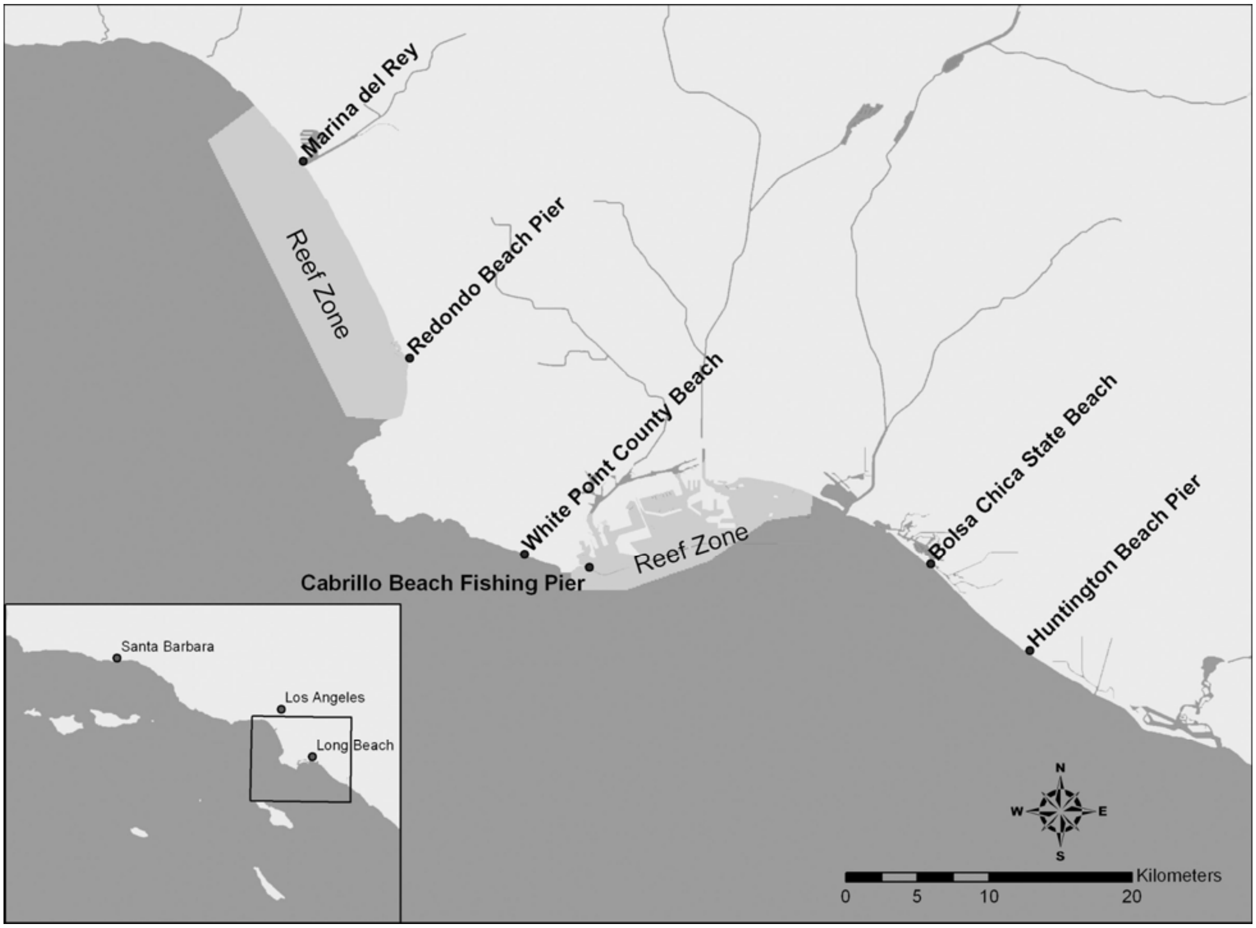


Figure A1-4. Potential zones for deployment of artificial reefs (indicated by gray-shaded areas).

used both to confirm the viability of these regions for restoration reef construction and to provide the detailed information necessary to determine specific project locations within the regions.

Step 2: Site Selection

In Step 2, the Trustees will refine and prioritize site and design considerations for individual reef projects, building on the broader site evaluation performed in Step 1. The Trustees will evaluate a comprehensive set of considerations, including:

- The potential effects of reef placement on sediment transport
- The suitability of the existing bottom substrate for placement of reef material
- The potential effects on navigation and recreational uses
- The presence of historically important sites
- The potential effects on essential fish habitat and species of concern
- The levels of local public support or opposition

- The proximity to other existing reef habitat or kelp beds
- The proximity to point-sources of pollutants (e.g., wastewater outfalls or storm drains)
- The potential for funding partnerships
- Current land management plans for the location.

The site identification step will involve an iterative proposal and review process; an initial list of a small number of candidate sites might be developed, publicly reviewed, and further refined. This step will include consultation with local jurisdictions and publicized workshops for interested parties to participate and comment on potential reef sites.

Placing new reefs adjacent to or sufficiently near existing similar habitat to allow for migration of fish from existing to new reefs will receive priority consideration. If new reefs are placed near existing reefs or kelp beds or are used to bridge gaps between existing isolated reefs, then the new reefs may generate benefits beyond those that would accrue from isolated reef construction. Such bridge or extension reefs could be designed to promote additional functions, such as the creation of nursery areas or the development of diverse reef habitats containing both high- and low-relief features, a range of depths, and structural complexity. Proximity to kelp forest habitats would increase the likelihood of natural recruitment of kelp to the constructed reef.

Shore-based fishing sites will receive highest priority, but offshore sites may be considered for fish production benefits. The justification for placing a higher priority on shore-based fishing sites is that anglers fishing from the shore or from piers generally have fewer choices regarding the habitats over which they fish than do boat anglers. The outcome of Step 2 will be a limited number of sites (e.g., two or three) to carry forward into subsequent steps.

Step 3: Reef Design

Step 3 will determine the final form of the constructed reefs. This step will incorporate results from past and ongoing artificial reef evaluation projects (e.g., the Pendleton Artificial Reef and SONGS), the input of experts in the field, and the limitations associated with the specific reef site identified in Step 2. Considerations to address include material type, the nature of existing sediments in the area, amount of relief, patchy versus even coverage, kelp outplanting versus reliance on natural recruitment of kelp, the fraction of the reef that would be available to anglers for fishing versus the fraction that would be less available or specifically protected for production, and the connections with existing artificial or natural reef habitats. Step 3 will also design the pre- and post-construction monitoring that will take place to determine the effectiveness of the restoration effort. The final result of this step will be supplemental NEPA and CEQA documentation for one or more individual reef construction projects; this documentation will be released for public comment. After public comments are incorporated, permit applications will be submitted.

Step 4: Reef Construction

Step 4 will be initiated after the acquisition of appropriate permits and final design work, including identification of specific construction methods and sources of materials, determination of the contracting and construction management approaches, and establishment of funding partnerships. For planning purposes the Trustees anticipate constructing reefs at two to three locations over a 5-year period.

Step 5: Monitoring and Long-Term Oversight

The purpose of monitoring a constructed restoration reef is to document the abundance, species composition, size frequency, and contamination levels of the fishes that occupy the reef as the community develops. The following discussion provides a template for the fish contaminant component of the monitoring that can be applied to any MSRP reef project. The monitoring of species composition, abundance, and size structure will follow the protocols established as part of the long-term shallow subtidal fish monitoring programs in other parts of California (e.g., the Partnership for Interdisciplinary Studies of Coastal Oceans and the National Parks Service kelp forest monitoring survey).

The Trustees have two fundamental incentives for collecting fish contaminant data from a restoration reef. The first incentive stems from the likelihood that MSRP will be building reefs sequentially rather than simultaneously. Thus, the information on fish species abundance, species composition, and contamination levels gained from one reef project could be applied to the design and location of future reef projects. In this way, the MSRP reef program will be implemented using an adaptive management strategy to maximize the positive impacts of each constructed reef.

The second incentive for monitoring fish contamination levels is that the Trustees will provide empirical confirmation that the reef has improved fishing by increasing opportunities to catch less-contaminated fish. There is good reason to believe that the fish that occupy the constructed reef habitat immediately after construction may differ in contamination levels from those that occupy the reef later because of the successional nature of community development on created reefs. The early inhabitants of a constructed reef are almost entirely transient individuals that move in from other areas and that may reflect bioaccumulation rates in areas adjacent to the reef site. The proportion of resident individuals that reflect bioaccumulation rates more local to the site typically increases as time passes. The monitoring of restoration reefs should reflect the need to estimate contamination levels in fish in both the short term and the longer term.

Contaminant monitoring will cover a suite of species that represents the diversity of eco-types targeted by local anglers. Southern California is home to a diverse assemblage of fishes, and anglers target many of these fish. For example, in 2003 anglers in Southern California reportedly landed over 120 species of fish (RecFin 2005). This taxonomic diversity encompasses a diversity of foraging modes, home ranges, and habitat associations, even within the subset of fish species that frequent reef and hard-bottom habitats. The proposed contaminant monitoring scheme will encompass this diversity by sampling representative species that forage at different trophic levels and are associated with different microhabitat types.

The Trustees plan to adopt a strategy of partnering with other agencies and organizations to obtain pilot-level information on reef designs and placement. This strategy will result in the greatest benefit in terms of achieving MSRP restoration goals. For example, a partnership opportunity exists in a reef project that the Port of Los Angeles (POLA) has proposed off of Point Fermin. The application of the reef-fish contaminant monitoring program to the proposed POLA reef would benefit the MSRP reef planning efforts in at least two ways. First, the POLA reef deployment is likely to occur before any MSRP reef construction. Thus, the fish contamination data from the POLA reef would be available to assist in the siting and design of the MSRP reefs. These data would provide indications of contaminant levels in the fish that in succession occupy such a reef and might be useful in obtaining public acceptance and permitting for MSRP reefs sited in similar areas with transitional levels of sediment contamination.

Second, reef monitoring for the POLA project will also document whether and how fishing practices have been affected by the project. Thus, surveys of anglers will be conducted to determine the effects of the project on fishing practices and preferences. These surveys will identify the fish being caught by anglers and retained for consumption before and after reef construction. This information will aid the Trustees in their efforts to design and construct reefs that have positive fishing benefits.

In the long term, it is anticipated that MSRP-constructed reefs will become part of the existing California artificial reef program, which is administered by the California Department of Fish and Game (California Fish and Game Code Sections 6420–6425).

A1.3.2 Fishing Access Improvements

During the reef development steps outlined above, the Trustees will also consider whether the improvements to fishing access and amenities at the sites under consideration for reefs would complement the restoration of lost fishing services. Several types of improvement will be considered, including parking improvements, construction or extension of piers to ensure optimal fishing access to constructed reefs, and increases in the number of or improvements in fish cleaning stations, lighting, benches, railings, restroom facilities, etc. Interpretive signs, displays, kiosks, or other materials may also be provided to explain to the public the need for and the function of the fishing restoration actions. Consideration and evaluation of improvements to access and amenities at these locations will be conducted in parallel with reef site design and development and will entail close consultation with local and state jurisdictions and interested users.

The Trustees have conducted preliminary analysis of the cost of pier construction and the construction of associated amenities. The unit cost of pier construction appears to be on the order of $200 per square foot or more; thus, the cost of constructing a pier of 50,000 square foot would likely exceed $10 million. Because MSRP restoration funding is limited and the primary objective of this restoration approach is reef construction, the Trustees would likely place a cap on the proportion of funding devoted to access improvements to ensure that sufficient funds are available for reef construction.

A1.4 ENVIRONMENTAL BENEFITS AND IMPACTS

This analysis addresses the environmental consequences of constructing artificial reefs and fishing access improvements at a broad conceptual level, as no specific sites have been proposed or evaluated. Additional NEPA and CEQA documentation will be required to address site-specific environmental considerations.

A1.4.1 Biological

Benefits

Reefs provide habitat for a multitude of marine fishes, invertebrates, and plants. The displacement of the sandy or muddy bottom habitat with a hard-bottom substrate would increase the diversity and may increase the number of the animal and plant biota in the area. Reefs act as nursery and spawning habitat for a variety of species native to the Southern California Bight. Reefs also act as a substrate for the recruitment and growth of giant kelp, which are also an important component of critical nursery habitat for many fish and invertebrate species. In addition, the fish productivity of rocky reef habitat has been estimated to be between 9 and 23 times that of sandy bottom habitat (MEC Analytical Systems 1991).

Recent declines in certain species of groundfish on the west coast, including rockfish complexes, have led to increased restrictions on fishing for these species. To the extent that reefs constructed under the MSRP program function as production sites for these or similar species (e.g., should reef design include a fish production/nursery component that increases the abundances of rockfishes), reefs may benefit the management and recovery of these depleted species of fish.

Because reef-associated fish typically contain lower concentrations of DDTs and PCBs than soft-bottom species, constructed reefs would benefit the biological organisms that prey on fish in the vicinity of the constructed reefs, as the organisms preying on fish would be exposed to reduced levels of these contaminants.

Once constructed, an artificial reef would provide benefits for many decades with minimal operational and maintenance costs.

Impacts

In general, hard-bottom or reef habitat is one of the most important but least abundant habitats in the Southern California coastal marine environment (Cross and Allen 1993). Soft-bottom substrates (i.e., sand and mud) predominate in an overwhelming percentage of the marine area along the coast from Point Dume to Dana Point (Ambrose 1994). Thus, conversion of habitat from soft-bottom to reef on the scale feasible under this restoration program would not significantly reduce the total available soft-bottom habitat to those species that rely on it. It is possible that constructing reefs may impact the availability of some other limited inshore habitat or resource, such as eelgrass beds. Also, soft-bottom habitat in nearshore waters of California are spawning areas for market squid (*Loligo opalescens*), which is an important commercial species in California. In addition, sheltered, shallow soft-bottom areas in certain locations (e.g., inside the Los Angeles and Long Beach Harbor breakwaters) provide important nursery areas for several fish species, including California halibut. The specific locations of each constructed reef will be studied and selected such that limited natural habitats are not covered or compromised.

Artificial reefs are known to be aggregators of marine life; such sites are popular fishing and diving locations because of the large numbers of fish and invertebrates attracted to the structures for habitat and food. Because of the popularity of these sites for anglers, fish mortality could increase in the vicinity of newly constructed reefs. Such an effect might also occur as a result of improvements to fishing access and amenities that increase the number of fishing trips to a site. Thus, before a reef is constructed at a given site, appropriate steps will be taken to ensure that reef design, size, placement, and long-term management will accommodate the anticipated increases in fishing and other uses of the reef site.

At a conceptual level, reef construction projects are not likely to adversely affect threatened or endangered species or essential fish habitat. However, detailed analysis will be performed at a site-specific level before a reef is constructed.

A1.4.2 Physical

Benefits

The benefits of artificial reefs to the physical environment would be nominal. To the extent that the material used to construct a reef is taken from the demolition of concrete structures, the beneficial reuse of this material would divert it from land disposal and conserve a corresponding increment of landfill space. Other trade-offs related to the transportation and disposal of materials (such as reduced air quality impacts relative to land disposal) would occur, but whether they would have net positive or net negative consequences cannot be determined until site-specific implementation factors are determined.

Impacts

The placement of reefs in nearshore areas has the potential to alter the transport of sediment and affect the topography of adjacent subtidal and beach areas. Also, depending on the nature of the soft substrate in a given area, the depth to bedrock, and the slope, hard substrate dropped to the marine bottom may not perform as intended. The potential physical impacts from placing rock or rubble in a given area will be submitted to engineering analysis and supplemental review and evaluation performed.

The placement of concrete or rock materials into marine waters would cause short-term suspension of sediments at the site and result in short-term water quality impacts. The principal effect would be increased turbidity; however, depending on local conditions, the sediments at the reef site might contain elevated contaminant levels. The methods and timing for reef material placement may be adjusted in consultation with regulatory agencies to address such local conditions and reduce the short-term water quality impacts of the construction.

A1.4.3 Human Use

Benefits

Artificial reef construction in areas will displace highly contaminated soft-bottom species and replace them with less-contaminated hard-bottom and water-column species. This result will provide direct benefits to anglers whose fishing opportunities have been impacted by fish consumption advisories. Artificial reefs provide human use benefits beyond fishing, as they are also popular areas for scuba and free diving for purposes of recreation, hunting, and underwater photography. As with the biological benefits, the human use benefits will be sustained for a period of decades or longer with minimal operational or maintenance costs.

Improvements to fishing access may include the addition of various fishing site amenities, including fish-cleaning stations, benches, pier extensions, or parking improvements. Informational panels or kiosks might also be included at reef sites to inform and educate the public on the benefits of the project. Such improvements will be undertaken with the specific intent of improving human use at the fishing site, thereby compensating for past and ongoing lost fishing opportunities, and efforts will be made to ensure functional and aesthetic benefits.

Impacts

Depending on its location and design, an artificial reef can impact various human uses in an area. Potentially impacted uses include recreation (e.g., board, body, or wind surfing) and navigation. Constructed reefs displace soft-bottom species, so the anglers specifically targeting these species at the site would find it harder to catch these fish. The potential impacts to recreational and navigational uses will be a significant consideration as candidate sites are evaluated. One of the purposes of the survey of recreational and subsistence anglers that the Trustees undertook in 2002 and 2003 was to determine fishing preferences at fishing sites along the Los Angeles and Orange County coast. The data generated by this field intercept survey and the follow-up public involvement activities will be used to select sites that minimize negative impacts to anglers who may be exclusively targeting soft-bottom fishes. The survey findings will be included in subsequent site-specific environmental documentation that will be developed by the Trustees. It is unlikely that a reef will be constructed in an area used by surfers (e.g., in high-energy surf areas) because of the tendency of swells and waves to damage or destroy artificial reefs.

Construction activities at fishing sites (e.g., construction improvements to piers and the provision of amenities such as fish cleaning stations, parking, etc.) may cause short-term disruption to users of a site during the period of construction. Steps will be taken to minimize the impacts of construction; these steps will be addressed at the stage when site-specific plans are being considered.

A1.5 LIKELIHOOD OF SUCCESS/FEASIBILITY

Artificial reefs have been constructed in many areas along the coast of California and elsewhere to enhance fisheries and fish production and to replace lost habitat. Studies of previously constructed reefs (including the 5-year pilot reef project near San Clemente) have resulted in a substantial body of knowledge on the likely outcomes associated with different design attributes and implementation approaches. Although the principal purpose for an MSRP reef (i.e., displacing highly contaminated fish and attracting/producing less contaminated fish) may be novel, the likelihood is high that constructing reefs in suitable areas will achieve this purpose. Sufficient data are available to develop reasonable predictions about species abundance and composition in a constructed reef. The degree to which the changes in species composition will lower the contamination levels in the fish caught by anglers at a site can be predicted from measurements of contaminants in similar fish caught near the potential reef sites. Thus, it is feasible to design and place a reef to achieve this purpose; it is also feasible to scale the reef such that it will provide sustainable fishing services.

Appropriately placed artificial reefs increase the diversity of the local marine ecosystem and often attract increased recreational use. Where complemented with above-water enhancements (e.g., improvements to fishing access and associated recreational amenities), reefs are well suited for the goals of both restoring and compensating for lost fishing services.

Several potential reef sites exist within the regions indicated in Figure A1-4. The Trustees have not proposed specific reef sites at this stage. Rather, the Trustees will allocate funds for artificial reef construction and associated fishing access improvements. Selection and design of specific projects will be decided through further analysis, planning, and public review of site-specific proposals. In this context, the Trustees will seek to enter into partnerships with other parties willing to co-fund such work to leverage the use of natural resource restoration funds to obtain as many acres of new reef habitat as possible within the limits of available funding.

Regulatory approval and public acceptance of reef construction projects have been achieved in the past. However, recent efforts by POLA to obtain approval to construct a new artificial reef offshore of Point Fermin have been delayed pending resolution of concerns about the proximity of the site to contaminated sediments on the Palos Verdes Shelf. This case suggests that any proposal to construct a reef for the MSRP objective of displacing contaminated fish will require careful planning and coordination with interested parties. Nevertheless, there is general support for reef construction. Fishing organizations such as the United Anglers have expressed a desire for more artificial reef construction, and regulatory agencies have approved reef construction as a means for mitigating environmental impacts.

A1.6 PERFORMANCE CRITERIA AND MONITORING

Several performance criteria will be used to evaluate the effectiveness of a constructed artificial reef in meeting the Trustees' restoration goals: fish abundance, species composition, fish size distribution, and the fish contamination levels. Abundance and size distribution are important because an increase in fishing services requires sufficient abundances of legal-size fish to replace the displaced soft-bottom fish that occupied the fishing area prior to reef construction. The contamination levels in the fish that occupy the reef are clearly important because the goal is to increase the local abundance of cleaner fish. Each of these parameters may undergo a successional sequence after reef construction, so it will be necessary to implement a monitoring program that includes high temporal resolution (e.g., annual or biannual) monitoring initially followed by more infrequent monitoring later to determine the sustainability and stability of the reef community.

A1.7 EVALUATION

The Trustees have evaluated this restoration action against the screening and evaluation criteria developed to select restoration actions and have concluded that this action is consistent with these selection factors. This action will address the loss of natural resource services provided by fish, which was one of the natural resource injuries brought forward by the Trustees in the Montrose case. Species composition and the contamination levels of the fish occupying the reef site can be measured prior to and after reef construction and the net change in the availability of cleaner fish can be estimated by combining species distribution with species-specific contamination levels. Artificial reef construction has been shown to have pronounced local effects on species composition through the combined effects of production and attraction, so a reef is highly likely to produce local changes in species composition. Thus, larger-scale (i.e., regional) increases in population levels will not be required to have the desired restoration effect.

This action will require supplemental environmental documentation that will be prepared after development of site-specific proposals pursuant to NEPA and CEQA.

A1.8 BUDGET

The Trustees have previously developed estimates of the cost and amount of artificial reef needed to replace the contaminated biomass of fish caused by the Montrose contamination (Ambrose 2000). These estimates ranged from $60,000/acre to $318,000/acre based on the construction of 1 to 9 acres of reef. This analysis revealed that the smallest reefs (1 to 2 acres) had by far the greatest per-acre construction costs ($318,000 and $250,000 per acre for the smallest and second smallest reefs, respectively). This estimate is subject to substantial variability due to several unknowns, such as the purchase cost of materials for reef construction. Furthermore, the density of reef material contributes substantially to the costs associated with reef construction. The SONGS reef project experienced a 20 percent decrease in construction costs between its high-density and its low-density reef treatments. The results of the SONGS analysis may help to identify the most cost-effective design for MSRP reefs.

This restoration program will proceed incrementally, with a goal of constructing two to three reefs in the 5-year period during the first phase of restoration. The costs of such a program may be broadly estimated as follows:

- Reef design, permitting, construction, and monitoring: Ambrose (2000) estimated an average cost of $170,000 per acre. Assuming 10 to 12 acres of coverage for each reef, each reef project would cost $1 million to $2 million. The 22.4-acre artificial SONGS reef cost $2.7 million to construct, suggesting construction costs of approximately $120,000 per acre.
- Construction of fishing access improvements: The cost of this construction has been estimated based on several potential actions that could be implemented at a number of fishing sites (MSRP Administrative Record). The estimated costs associated with building a new pier are approximately $200/ft^2, so the total cost of building a new pier that is similar in size to other piers in Southern California (e.g., the Redondo Pier, which is 70,000 ft^2) would be approximately $14 million. Thus, matching funds would be critical for undertaking such a project. The cost of installing access improvements to existing piers has been estimated to range from $92,000 to $368,240 depending on location and the needed improvements.

The two estimates cited above suggest a potential range of costs for each reef and access project of $2 million to $4 million.

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Appendix A2

Provide Public Information to Restore Lost Fishing Services

A2.1 GOALS AND NEXUS TO INJURY

The goal of this action is to build on the public outreach and education work initiated by the U.S. Environmental Protection Agency (EPA) through the establishment of the Fish Contamination Education Collaborative (FCEC). FCEC is a federal, state, and local partnership project aimed at addressing public exposure to contaminated fish in the Southern California coastal area. The FCEC focuses on educating the public about the human health hazards associated with DDT and PCB contamination in fish. Thus, the FCEC program provides information to help people reduce their exposure to DDTs and PCBs from the fish they eat.

The Natural Resource Trustees for the Montrose case (Trustees) will expand this ongoing effort to increase fishing services by providing information to anglers that allows them to make sound decisions about where and for which species to fish. The Trustees will also provide outreach materials that establish the link between the ecology and life history of a particular species and its tendency to bioaccumulate contaminants. This information would enable people to make knowledgeable choices about where, when, and for which species to fish to minimize their exposure to contaminants. This action has a strong nexus to the ongoing loss of natural resource services caused by the contaminants of the case (which have led to the imposition of state fishing advisories and other limitations on the human use values of fish).

A2.2 BACKGROUND

For several decades, high levels of DDTs and PCBs have been found in several species of fish commonly caught by anglers along the Southern California coast. White croaker, surfperches, kelp bass, and other species of fish collected from several sites along the Los Angeles County and Orange County coasts carry concentrations of DDTs and PCBs in edible tissues that exceed the guidelines and standards set by federal and state agencies for safe consumption (OEHHA 2003). This situation represents a loss of natural resource value to the public and constitutes a per se injury under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations for damage assessment (Title 43 Code of Federal Regulations [CFR] Part 11.62).

The current state fish consumption advisories were established in 1991 for Southern California coastal locations between Point Dume and Dana Point. These advisories identify eight species and species groups of fish in eleven locations; anglers are advised to either not consume these fish or limit their consumption of these fish (OEHHA 2003). In addition to these fish consumption advisories released by the State of California, the EPA and the U.S. Food and Drug Administration (FDA) have released general fish consumption advisories for locally caught fish (USEPA 2004b) that are based largely on mercury contamination.

The federal advisories suggest that in the absence of site- and/or species-specific advisories generated by local governments, anglers should consume no more than one meal per week of locally caught fish. Thus, consumption of fish should be limited to a maximum of one meal per week where data are absent or do not include mercury concentrations. If data from the Montrose Settlements Restoration Program (MSRP)/EPA-funded fish contamination survey identify species and/or locations where contaminant levels are low enough that the consumption recommendations may be increased to more than one meal per week (i.e., above the EPA/FDA recommendations), this result would constitute a clear increase in fishing opportunities for those species and locations.

Because contamination levels are not uniform but vary by location and species of fish, and because existing data on fish contamination are out of date and incomplete, it is difficult for anglers to make informed choices about fishing and fish consumption. In some instances, this lack of current information may result in anglers and those to whom they supply some of their catch being exposed to DDTs and PCBs through unknowing consumption of contaminated fish. The EPA's current outreach program specifically addresses such incidences. However, in other cases, the lack of current and complete information may lead potential anglers to alter their fishing habits or avoid fishing altogether out of concern about fish contamination and the uncertainties surrounding it. This issue is the one on which the Trustees will focus their attention.

A2.2.1 EPA Institutional Controls

The EPA established a program of institutional controls (ICs) in 2001 as a set of initial actions to address the immediate human health risks associated with the consumption of fish contaminated with DDTs and PCBs from the Palos Verdes Shelf. Public outreach is one component of the ICs program.

The objectives of the public outreach program established by the EPA are to reduce the health risks associated with eating fish contaminated with DDTs and PCBs by increasing awareness and understanding of fish consumption advisories and building local capacity to address fish contamination issues. To implement this work, the EPA convened a Seafood Contamination Task Force, which is now known as the FCEC. The FCEC is a consortium of federal, state, and local government agencies, local institutions, and community-based organizations that provides a means of coordinating the development and implementation of a public outreach program with direct stakeholder involvement at all levels. The FCEC also serves as a decision-making body for the public outreach and education component of the ICs program and serves in an advisory role to the EPA on other Palos Verdes Shelf IC activities.

The EPA started the full implementation of the public outreach and education program in January 2003. The MSRP Trustees have been an active partner in the FCEC from its beginning and have consistently provided technical support and materials for the program. The materials provided by the Trustees were used as part of an outreach pilot project that was designed to evaluate the viability of outreach as a restoration action. The response to these materials has been overwhelmingly positive, with numerous requests for additional and updated materials.

A2.2.2 The Role of MSRP

With adequate fish contamination data, it is possible to identify and promote optimal fishing opportunities and thus increase public use and enjoyment of fish services. Furthermore, by expanding the information available to encompass other contaminants that are of general concern with regard to fish consumption (e.g., mercury) and including analyses of fish that are less likely to be contaminated, more complete advice regarding the risks and benefits of eating fish can be provided to the public.

This action complements and expands on the current outreach efforts spearheaded by the EPA, which focus on warning citizens about where they should avoid fishing or which fish they should avoid catching and eating based solely on DDT and PCB concentrations. The EPA is not able to include analyses of and therefore outreach regarding mercury due to limitations imposed on them by Superfund laws. Although the information generated by the EPA's outreach efforts is a critical component of addressing the human health risks associated with consuming fish, this information provides limited guidance regarding what is safe to eat, largely because the basis of the information is limited to DDTs and PCBs and species that are particularly highly contaminated by DDTs and PCBs.

A2.3 PROJECT DESCRIPTION AND METHODS

Public outreach and education is a key strategy of the MSRP on a number of levels. The MSRP already employs outreach and education activities as a means of involving the public in restoration planning and plans to use these activities to keep the public informed and involved as restoration implementation proceeds (see Section 5.4.1 of the Restoration Plan). Under the category of fishing and fish habitat restoration, public outreach and education is proposed as a specific action for restoring lost natural resource services by providing information to people that allows them to make knowledgeable choices about where to fish, and what to fish for. This information differs from, and will complement, the critical information generated by the EPA regarding fish species and locations to avoid.

The program to provide public information to restore lost fishing services would be designed in close coordination with the existing FCEC organization, with the goal of integrating contributions from both MSRP and the EPA into a common and complete message. MSRP would continue to work in close partnership with FCEC and take advantage of many of the existing programs, points of contact, outreach materials, and other aspects of the FCEC. This approach would reduce public confusion, reduce the potential for these agencies to send out mixed messages, and potentially result in substantial cost sharing.

As natural resource agencies, the agencies that serve as the Trustees will also develop outreach materials that provide a link between fish as living marine resources and the risks and benefits they provide to their consumers. Contaminant bioaccumulation rates largely depend on the specific ecological and life-history strategies of a fish. Factors such as habitat use, migratory behavior, age, size, foraging mode, and preferred prey all play a critical role in the level of health risk that a fish imposes on its consumer. Thus, if anglers learn about the ecology and life history of the fish that they typically encounter, they can enable themselves to make more informed decisions about what to eat and what to throw back.

Gathering updated and accurate information on the levels of contamination in the fishes inhabiting the coastal waters of the Southern California Bight is essential if the Trustees are to provide public information on the species that are safe to target for fishing. This gathering process includes continuing to identify and investigate the species that may not impose significant human health risks. Updated information will enable the Trustees to distribute better information to anglers about the species and the locations for fishing that offer minimal contaminant-related threats. Also, if contamination levels have changed since the data for the current advisories were gathered (1987), some advisories my need to be revised or eliminated.

In collaboration with the EPA, the Trustees have already implemented a survey of fish contamination levels for 23 species or species groups in the area from Point Dume to Dana Point.

This data set, once analyzed, will provide a context for the development of restoration projects and highlight the areas that need additional sampling to better understand where restoration activities may be implemented or where the contamination levels are particularly dynamic (e.g., at the edges of the highly contaminated areas).

The specific activities and products of the public information program on fishing will be developed in a work plan once this Restoration Plan has been approved. Although the Trustees will not provide funds to construct specific facilities or support specific staff positions, the budget for the project mentioned above will include a portion to fund the design and production of outreach materials, including stationery or traveling graphic exhibits for learning centers and associated literature for dissemination, signage, advertising spots, public service announcements, pier outreach, or other such activities to dispense information to the public. The Trustees hope to cooperate with the following groups in this endeavor:

- Palos Verdes Peninsula Land Conservancy (PVPLC): PVPLC submitted a proposal requesting supplemental funding to construct an interpretive center at the White Point Nature Preserve. Although MSRP will not fund the construction of specific facilities, the Trustees agree that because this center will be located near the wastewater outfalls where the contaminants of the Montrose case originally entered the marine environment, this center would be a prime location for an educational exhibit. Another reason why the center would be a prime location for an exhibit is the potentially large number of people affected by the Montrose contaminants that the center would be able to reach.
- Marine Mammal Care Center (MMCC)/Center for Marine Studies (CMS) at Ft. MacArthur: MMCC and CMS submitted several proposals for funding for educators and for transportation to expand their current outreach and education programs. Although MSRP will not fund specific staff positions or transportation, the Trustees feel that the location and missions of the MMCC and CMS make Ft. MacArthur another well-suited place for educational exhibits.
- Other groups: The following list shows groups the Trustees currently work with and other groups that the Trustees hope to work with in the future to develop and disseminate additional outreach materials:
    - FCEC
    - Cabrillo Marine Aquarium
    - Long Beach Aquarium of the Pacific
    - EALab
    - Channel Islands National Park
    - Channel Islands Marine Sanctuary

This list is by no means exhaustive and will grow to include other groups as outreach opportunities are identified and expanded.

A2.4 ENVIRONMENTAL BENEFITS AND IMPACTS

A2.4.1 Biological

Benefits

Because this action involves public outreach and education rather than directly affecting biological habitat or organisms, the Trustees do not anticipate any direct benefits to biological resources. However, as part of their message, the Trustees intend to encourage conservation-minded fishing (including the careful handling and release of fish that are not retained by anglers for consumption), which may provide benefits to fish populations.

Impacts

Because this action involves public outreach and education, the Trustees do not anticipate any direct adverse impacts to biological resources. Should the public information lead to changes in fishing practices in the region, it is possible that fishing exploitation of certain cleaner species of fish would increase. It is also possible that the public information that the action provides may lead to increased exploitation of fish populations in locations identified as having fish lower in contamination. The degree to which this public information program would result in increased fishing mortality of certain species and/or at certain locations is not expected to be significant. However, the Trustees will consider both contamination levels and vulnerability to over-fishing as factors when they provide fishing advice to anglers. The Trustees will not advise anglers to focus fishing activity on any species that is currently over-fished or at risk of future over-fishing due to population status or specific life-history characteristics that might make that species more vulnerable to over-fishing. Also, the Trustees will encourage anglers to comply with all state fishing size and bag limits that are established to ensure sustainable fishing.

A2.4.2 Physical

Benefits

This action will not have benefits with regard to geology/earth resources, water resources, oceanographic and coastal processes, air quality, or noise.

Impacts

This action will not have negative impacts on geology/earth resources, water resources, oceanographic and coastal processes, air quality, or noise.

A2.4.3 Human Use

Benefits

The development and dissemination of better data on fish contamination (including information on the locations and species of fish that offer reduced contaminant-related risk) will lead to improved recreational benefits for anglers and could potentially lead to improved human use of ocean fish resources. By clarifying the current state of contamination in fish and providing advice to anglers about locations and species that do not trigger health advisories, this action directly addresses the loss of natural resource services caused by elevated levels of contamination that have led to the issuance of directives to limit or ban consumption of several species of marine fish.

Impacts

Because this action focuses on providing information that will tend to promote fishing rather than restrict fishing, the action will not have negative impacts on human use. The action may have minor impacts to aesthetics depending on the design, size, and placement of signs. The designs of the program signage would be adopted from the previous designs developed and employed by the State of California and the county health departments in the study area. The signs would be placed in consultation with appropriate local authorities and in coordination with groups conducting outreach activities (such as the FCEC) in such a way as to minimize any impacts to the aesthetics of the surrounding area and avoid duplication of signage and/or message.

A2.5 LIKELIHOOD OF SUCCESS/FEASIBILITY

Education and awareness programs, through their display signs and brochures, nearly always attract public attention. Successful public educational programs instill knowledge and appreciation of the subject considered. This approach has a high probability of increasing human use and enjoyment of fishing resources in the targeted areas.

A2.6 PERFORMANCE CRITERIA AND MONITORING

Public feedback and reaction will be the primary means of monitoring the success of the outreach and educational activities of this action. The action will require the periodic updating and replacement of outreach materials to be effective over time due to the dynamic nature of contamination levels in the fish and changes in state fish consumption advisories.

A2.7 EVALUATION

Lack of public awareness about where fish contamination is a problem along the Southern California coast has significantly contributed to the loss of the natural resource services that fishing provides. Current outreach efforts spearheaded by the EPA provide critical information regarding the risks imposed by DDTs and PCBs, but do little to restore the faith in the resource itself, in general due to the EPA’s inability to seek out fish that provide minimal human health risks. The Trustees have evaluated this action against the screening and evaluation criteria developed to select restoration actions and have concluded that this action is consistent with these criteria. The Trustees have determined that this action will provide immediate benefits to human uses of injured natural resources and will be a cost-effective means of restoring the lost fishing services that have resulted from the contamination at issue in the Montrose case.

A2.8 ESTIMATED BUDGET

The Trustees will develop a work plan for public outreach and education efforts on fishing that addresses the specific components of the action and assumes close collaboration with the FCEC. For planning purposes, the Trustees have initially assumed that approximately $1 million would be used to conduct outreach, develop and produce materials, obtain and review additional contamination data, and perform other activities related to this restoration action.

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Appendix A3

Restore Full Tidal Exchange Wetlands

A3.1 GOALS AND NEXUS TO INJURY

The objective of this restoration action is to contribute to the restoration of coastal wetland/estuarine habitats that have direct tidal links to the ocean and serve as nursery habitats for fish, especially species that are targeted by ocean anglers. This action has nexus to the restoration objective of improving fish and the habitats on which they depend, as described in Section 4 of this Restoration Plan. The nexus between this action and the restoration objective of improving fishing impacted by state consumption advisories is not as direct or measurable. To the extent that wetlands restoration increases the production of recreationally valuable species that are lower in contamination and that eventually inhabit ocean fishing sites, then the restoration goal of "improving fishing" would also be met.

A3.2 BACKGROUND

A3.2.1 Importance of Wetlands as Nurseries

Coastal wetlands serve as nursery habitat for a diverse assemblage of marine fishes. The importance of wetlands/estuaries as nurseries is generally attributed to their higher productivity and warmer water temperatures (which promote fast growth rates in juvenile fish) as well as to the protection they provide from physical disturbance and larger ocean-resident predators (McHugh 1967, Boesch and Turner 1984). Examples of wetland-nursery- or estuarine-nursery-dependent species come from both the east and west coasts of the United States and from all around the world. In the Southern California Bight (SCB), wetlands are limited in size and many have been eliminated or otherwise filled in by coastal development However, those wetlands that still exist harbor juveniles of a suite of species that depend on wetlands for nursery habitat (Horn and Allen 1981).

The California halibut *(Paralichthys californicus)* uses wetlands as nurseries throughout its range. Wetlands in California have been reduced to a small fraction of what was historically present on the coast, and it has been speculated that this reduction limits the production potential for species like California halibut, and that declines in landings of this species in Southern California are associated with the dredging and filling of bays and wetlands (CDFG 2001). Although it is apparent that California halibut are currently fished at a sustainable level, some speculate that the fishery could sustain much higher levels of fishing mortality if wetland nursery habitat was increased. A study of the early growth, development, and survival of California halibut (Kramer 1991) found that juvenile halibut settled in both bays and the open coast, but juvenile survival was much higher for those that settled in the bays. The author further concludes that those California halibut that settled in the open coast either moved into the bays after settlement or died, suggesting that California halibut are highly dependent on bays for nurseries.

A3.2.2 Importance of Wetland-Dependent Species to Anglers

Some wetland-dependent fish species are highly desired by local sport and subsistence anglers across most fishing modes. For example, in a recent survey of fishing practices and preferences in the SCB conducted by the Natural Resource Trustees for the Montrose case (Trustees) and the U.S. Environmental Protection Agency (EPA), anglers were asked which species of fish they were "trying to catch" (MSRP and USEPA 2004). In the anglers' replies, California halibut or barred sand bass, two species that use coastal wetland habitats, were consistently included in the top three species desired by anglers for all modes of fishing. White croaker, a species subject to consumption advisories and fishing restrictions in the region, was not included in the top three most-sought-after fish species for any fishing mode. However, when responding to a question on what species they typically catch, anglers collectively identified white croaker as being among the most commonly caught species, and California halibut was not. Furthermore, contaminant analysis of halibut collected in the SCB indicates that California halibut may contain lower concentrations of DDTs, PCBs, and mercury than other fish commonly caught by pier anglers, such as white croaker. Thus, if the Montrose Settlements Restoration Program (MSRP) were to contribute to an existing wetland restoration project that would improve the viability of the restored wetland as a nursery habitat, MSRP could potentially increase the availability of halibut and potentially other species for both shore-based and boat-based anglers in the areas affected by the Montrose contaminants.

A3.3 PROJECT DESCRIPTION AND METHODS

This restoration action is described at a non-site-specific, conceptual level for this Restoration Plan and programmatic Environmental Impact Statement/Environmental Impact Report. The Trustees will further develop the design details of the action as described below. Additional National Environmental Policy Act (NEPA) and/or California Environmental Quality Act (CEQA) documentation will be required prior to any final site selection and construction.

Through this action, the Trustees will use a portion of the Montrose settlements to contribute to one or more coastal wetlands restoration projects in Southern California. Several such projects are at various stages of planning. Given the high costs of sizable wetlands restoration actions in California and the existing multi-agency framework for regional planning, the Trustees do not propose that MSRP fund and implement such a habitat restoration project in its entirety. Providing improved wetland habitat for fish may be more cost-effective and within the range of funding available under MSRP if the action were to cover the incremental costs of incorporating improved fish habitat into existing plans for restoration.

Several potential opportunities exist for MSRP to participate in restoration projects in Southern California without having to bear the total cost of the restoration. The Trustees have preliminarily reviewed a list of projects compiled by the Southern California Wetlands Recovery Project (WRP) (www.coastalconservancy.ca.gov/scwrp). The list of potential projects in the WRP inventory covers a larger geographic area and includes a larger variety of wetland types than would be suitable for MSRP objectives. Nevertheless, this list may be screened to identify the projects that contain open water and salt marshes and are in the study area.

The Trustees consider the following to be the fundamental characteristics required for restored wetlands to function as marine fish nurseries: full tidal exchange over the majority of the year, suitable water depth, substrate, food sources, and cover. The components of wetland restoration projects that apply to the Trustees' objectives would likely relate to acquiring land, sediment removal or reducing sediment input, opening or protecting channels to the ocean that provide full tidal exchange, creating deeper areas or channels that provide refuge for juveniles during low tides, and establishing eelgrass beds, which have been shown to be an important nursery-habitat characteristic for marine fishes. To accomplish this restoration action, the Trustees will develop a comprehensive set of evaluation criteria, review potential projects with WRP representatives and others, and potentially request the submission of proposals from existing project proponents for MSRP review and selection. As an additional selection criterion, priority will be given to projects whose plan includes an agreement among the participating agencies to allow for the continued protection of the restored wetland in perpetuity. Such an agreement would preferably state the agency that will be responsible for the long-term maintenance of the site, as in the Batequitos Lagoon project description, where the California Department of Fish and Game is designated as being responsible for long-term maintenance (Merkel and Associates 2003).

This restoration action will likely entail MSRP partnering with agencies or groups that are leading the planning, design, and implementation of large wetland restoration efforts that still have incomplete commitments for funding and that offer opportunities to affect the final design and function of the site identified for habitat restoration. Although proximity to the Palos Verdes site will be included as a selection criterion, the Trustees believe that restricting site selection to wetlands local to the Palos Verdes Shelf (i.e., within the boundaries of the Palos Verdes peninsula) may limit opportunities too severely and lead to the elimination of projects that might provide significant fish habitat benefits. Also, because halibut and other coastal species dependent on wetlands are highly mobile, the Trustees believe that the effects of wetland restorations on fish habitat are likely to provide regional benefits. Thus, projects located within the boundaries of the Southern California Bight will be considered to have sufficient geographic nexus to the injured fish habitats on the Palos Verdes Shelf to satisfy this criterion. At present, it is not clear whether greater benefits may be derived from identifying areas for land acquisition for new restoration or from contributing to ongoing restoration in areas that are most likely to result in nursery habitat for the California halibut and other sport fishes.

A3.4 ENVIRONMENTAL BENEFITS AND IMPACTS

The environmental consequences of wetland restoration actions are addressed at a broad conceptual level, as no specific sites have been proposed or evaluated for this action. Subsequent NEPA and/or CEQA documentation will address site-specific environmental considerations.

A3.4.1 Biological

Benefits

The restoration of full tidal exchange wetlands along the Southern California coast will have numerous ecological benefits and, more specifically, will provide increased and/or improved habitat for several species of marine fishes that depend on such habitat for portions or all of their life histories. Wetlands have been studied extensively to document their numerous functions and values (USEPA 2001, Greeson et al 1979). Once wetlands are restored, they have the potential to serve as nursery habitat for multiple fish species for a period that could span decades or more provided the wetlands are protected from development or other forms of impacts.

Primary sport fish species that rely on wetlands as nurseries include spotted sand bass, California halibut, and, to some extent, barred sand bass. Spotted sand bass experience population boom and bust fluctuations that appear to be linked El Niño–driven fluctuations in sea surface temperature (Allen, et. al. 1995). This species is dependent on wetlands for its entire life history, so the quantity and quality of available wetland habitat will directly affect the overall abundance of this species. California halibut utilize wetland habitats (among other coastal habitats) as nurseries during their juvenile period. Although California halibut populations are currently considered to be stable and managed at a sustainable level, their abundances are not considered to be at historical levels. An analysis of the California halibut population suggests that historical fluctuations in abundance occur over an approximate 20-year time scale, but that landings declined during the 1970s and appear now to be maintained at a level far below their historical levels, possibly due to reductions in available wetland habitat. Presumably, as wetland habitats are restored, population abundance and therefore the level of sustainable fishing mortality will increase. Juvenile barred sand bass use subtidal wetlands as nurseries along with other shallow nearshore waters (CDFG 2001)

Fully functioning estuarine wetlands and embayments provide several benefits to the species of fish sought by coastal anglers. These wetlands not only serve as habitat during critical life stages for halibut and other species, but also increase primary production and promote production of forage fish that are prey for other marine species of fish. Specific wetland restoration benefits may be evaluated at two levels that reflect the two fish-related MSRP restoration objectives: (1) restore fish and the habitats on which they depend and (2) restore lost fishing services.

Impacts

The biological consequences of wetlands restoration projects are largely beneficial, but such projects usually involve trade-offs between different and sometimes competing biological resources and uses. Analysis of specific impacts is beyond the scope of this Restoration Plan, as the Trustees have not identified a specific project or projects toward which they would contribute funding. It is anticipated that the lead agencies for the wetlands restoration work to which MSRP funds are contributed will conduct the NEPA/CEQA analysis at a later date.

A3.4.2 Physical

Benefits

Intertidal wetlands have been credited as providing a broad benefit to a variety of resources (USEPA 2001, USEPA 2005a). These benefits include biological diversity, water quality improvement and biogeochemical cycling, atmospheric maintenance, hydrologic cycle roles (including groundwater replenishment), flood control (including storage and flow reduction), shoreline erosion control, and recreation. Specific analysis is beyond the scope of this Restoration Plan, as the Trustees have not identified a specific project or projects toward which they would contribute funding. It is anticipated that the lead agencies for the wetlands restoration work to which MSRP funds are contributed will conduct the NEPA/CEQA analysis at a later date.

Impacts

Wetlands restoration planning and design requires thorough analysis of a number of physical issues, including the hydrological the consequences of modifying landscapes, the identification of the disposal requirements for dredged material, and others. Specific analysis is beyond the scope of this Restoration Plan, as the Trustees have not identified a specific project or projects toward which they would contribute funding. It is anticipated that the lead agencies for the wetlands restoration work to which MSRP funds are contributed will conduct the NEPA/CEQA analysis at a later date.

A3.4.3 Human Use

Benefits

Wetlands provide numerous active and passive recreational use values, including birding, boating, fishing, and other uses. Specific analysis is beyond the scope of this Restoration Plan, as the Trustees have not identified a specific project or projects toward which they would contribute funding. It is anticipated that the lead agencies for the wetlands restoration work to which MSRP funds are contributed will conduct the NEPA/CEQA analysis at a later date.

The measurement of the direct benefits of any single wetland restoration project toward restoring the lost fishing services caused by the contamination at issue in the Montrose case may be difficult (Witting, in prep). The amount of restored halibut nursery habitat required to result in a measurable increases in the availability of California halibut can be roughly estimated using available catch data and the densities of juvenile California halibut in existing wetlands. Tagging studies indicate that adult halibut move long distances both up and down the coast and to offshore islands. This finding suggests that wetland restoration activity would have to result in a population-level increase in California halibut before specific benefits to anglers affected by fish consumption advisories at specific coastal sites could be measured. Given that the adult halibut population size and catch varies from year to year (one standard deviation is about 31 percent of the mean population size), it is likely that small increases in abundance would not be measurable.

Although no single wetland restoration effort would likely result in a measurable increase in the population size of California halibut, the collective beneficial impacts of many coastal wetland restoration projects in California may contribute significantly to increasing halibut abundance, to the extent that the projects involve the creation of wetland habitats that act as juvenile halibut nurseries. Thus, the MSRP contribution to coastal wetland restoration will contribute to this larger effort, but by itself may not increase fishing services for halibut to a degree that is readily measurable.

Impacts

Wetlands restoration may impact current recreational and other human uses of sites slated for restoration. Specific analysis is beyond the scope of this Restoration Plan, as the Trustees have not identified a specific project or projects toward which they would contribute funding. It is anticipated that the lead agencies for the wetlands restoration work to which MSRP funds are contributed will conduct the NEPA/CEQA analysis at a later date.

A3.5 LIKELIHOOD OF SUCCESS/FEASIBILITY

This action is, in concept, highly feasible because it entails contribution to existing wetland restoration efforts and will be incorporated as a portion of a broader design. The methods employed by this project will be standard, well-established methods that have been used for wetland restoration in many areas throughout the country.

Wetland restorations are likely to involve significant initial costs, including those associated with land acquisition, design, and engineering. However, the long-term costs are typically limited to monitoring and perhaps enforcement.

The Trustees will only consider contributing to wetland restoration efforts with plans that either already include or would be modified as a result of MSRP financial support to include the specific habitat components identified in this action. Thus, regulatory and public acceptance is likely to be high.

A3.6 PERFORMANCE CRITERIA AND MONITORING

The Trustees will adopt and contribute to the performance criteria and monitoring approach developed by the lead agency associated with the wetland restoration. The Trustees will limit their performance criteria to evaluating the restored wetlands ability to function as a nursery rather than evaluate the specific project's ability to change the fishing services in areas affected by fish consumption advisories.

A3.7 EVALUATION

The Trustees have evaluated this action against all the screening and evaluation criteria developed to select restoration projects and have concluded that this action is consistent with these selection factors. The Trustees have determined that this type and scale of action will provide long-term benefits to fish and the habitats on which they depend. This action will also provide broader ecological benefits and could contribute to improvements in coastal fisheries in areas currently affected by consumption advisories.

Further NEPA/CEQA analysis will be performed for this action prior to implementation. The lead agency or agencies for the overall wetlands restoration efforts to which MSRP funds are contributed will conduct the NEPA/CEQA analysis.

A3.8 BUDGET

The current work plan for the WRP identifies over $300 million in funding needs for the restoration of Southern California wetlands. Only a portion of these identified needs entail actions that restore full tidal exchange wetlands; however, the funding needs of this portion greatly exceed available MSRP restoration funds. For Phase 1 of restoration, the Trustees will contribute a portion of the $12 million allocated to restoration of fishing and fish habitat. Specific allocation of these funds between wetlands restoration and other fishing and fish habitat restoration work will depend on the funding partnerships identified and the specific needs of individual projects. The Trustees anticipate that funding for wetlands restoration will not exceed 25 percent of funding allocated to restoration of fishing and fish habitat as a category.

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Appendix A4

Augment Funds for Implementing Marine Protected Areas in California

A4.1 GOALS AND NEXUS TO INJURY

The goal of this action is to improve fish habitat function in Southern California by augmenting the funds needed to evaluate and implement Marine Protected Areas as part of an ecosystem-based management approach for fishery resources. The primary focus of this action will be to provide needed funds for the implementation of the recently established Channel Islands network of Marine Protected Areas (MPAs) to ensure that they provide the best possible basis for further implementations of MPA networks throughout California. Although this action provides specific benefits to fish habitats adjacent to the Northern Channel Islands, the action will also provide longer-term benefits for fish habitats and fishing throughout California by helping to generate sound empirical underpinnings for the site and design of future networks of MPAs. The recently established network of MPAs in the Channel Islands are currently the most appropriate area to direct such effort because they were specifically designed to evaluate the utility of using MPAs as a management tool. If mainland coastal MPA networks are established in the future, the Natural Resource Trustees for the Montrose case (Trustees) will consider directing additional funds to their implementation and/or evaluation during the next phase of restoration, particularly if the MPAs are established in Southern California.

There is growing recognition within California and throughout the world that existing fishing management practices should be expanded to include new methods that utilize an ecosystem approach. The Channel Islands network of MPAs was created in 2002 as a first step in implementing a California-wide network of MPAs as required by the California Marine Life Protection Act (MLPA) initiative. Collection of fish and other biota is prohibited in 10 of the 12 MPAs in this network and restricted in the remaining two MPAs. These protected areas enable fish to grow larger and have higher fecundity, leading to higher abundances within the MPA, and potentially to improvements in fish catches outside of the MPA. These “spillover” effects of MPAs are subject to an ongoing debate among scientists, managers, and commercial and recreational fishing interests. As a result, the degree to which commercial and recreational fishing interests are assured that MPAs networks result in a net increase catches will directly impact the level of resistance that the future implementation of these networks will receive.

This restoration action is considered to have a moderate relationship to the lost fishing services of the Montrose case because of the distance of the Channel Islands MPAs from areas with fishing advisories. However, MPAs may be areas of higher fish abundance, which may benefit eagles foraging along the coastlines of the Channel Islands. An evaluation of diet-based sources of DDTs to eagles demonstrated that even though fish constituted approximately 79 percent of the diet of bald eagles, only 8 percent of there total body burden of DDTs came from fish. Marine mammal tissue (principally sea lions) constituted approximately 5.8 percent of their diet, but contributed to approximately 59 percent of the eagles’ body burden of DDTs (Glaser and Connolly 2002). If fish abundances within and around the MPAs are sufficiently high to shift eagle foraging habits such that a larger proportion of their diet consists of fish rather than marine mammal carcasses, the possibility of the eagles producing viable eggs may be improved. Similarly, successfully implemented MPAs in the Channel Islands may also provide less disturbed foraging habitat with higher abundances of prey for seabirds that were impacted by DDTs.

This action has the highest nexus to injured fish habitats. Given that specific fish habitats (Palos Verdes Shelf sediments) are injured in a way that makes direct restoration difficult, this action is considered to be compensatory for the lost habitat function of the Palos Verdes Shelf. Further, if the Channel Islands MPAs are managed effectively and monitoring demonstrates improvements to adjacent fisheries, the use of MPAs as a management tool may be expanded by state and federal regulatory agencies to other areas along the California coast and eventually benefit anglers closer to the area impacted by Montrose-related contaminants.

A4.2 BACKGROUND

MPAs are sections of the ocean set aside to protect and restore habitats and ecosystems, conserve biological diversity, provide a sanctuary for sea life, enhance recreational and educational opportunities, provide a reference point against which scientists can measure changes elsewhere in the environment, and help rebuild depleted fisheries (McArdle 1997). Although MPAs may be established by federal, state, or local agencies, this action focuses on those established by the State of California, primarily because these are specifically designed to act as a stimulant of fish production and thereby create a more sustainable approach to fisheries management. The State of California is the primary agency involved in evaluating the effectiveness of the Channel Islands MPAs in increasing the abundances of fish beyond their borders.

The MPA concept spans a broad range of resource management options, ranging from limited to full protection. The State of California MPA classifications include:

- Marine Reserves: Also called no-take reserves, marine reserves prohibit all take of living, geological, or cultural resources.
- Marine Conservation Areas: Prohibit specific commercial and/or recreational take of resources on a case-by-case basis.
- Marine Parks: Prohibit commercial take but allow recreational fishing, though some restrictions may apply.

The wide variation in levels of protection and effectiveness of enforcement among the current array of MPAs in California creates "an illusion of protection while falling far short of its potential to protect living marine life and its habitat" (California Fish and Game Code, Section 2851). Prior to the establishment of the Channel Islands MPA network, only 14 of the 220,000 square miles of combined federal and state waters of California were set aside as genuine no-take reserves.

The Channel Islands MPA network was approved by the California Fish and Game Commission in 2002 and established by formal legislative rule in April 2003. The network consists of 12 MPAs covering 142 square nautical miles (487 square kilometers) (Figure 4A-1). Ten of the 12 MPAs (132 square nautical miles [453 square kilometers]) are no-take marine reserves, and the remaining two are marine conservation areas, which allow for limited recreational fishing and commercial lobster trapping. Thus, the establishment of the Channel Islands MPA network significantly expanded the total amount of area set aside as no-take marine reserves in California marine waters.

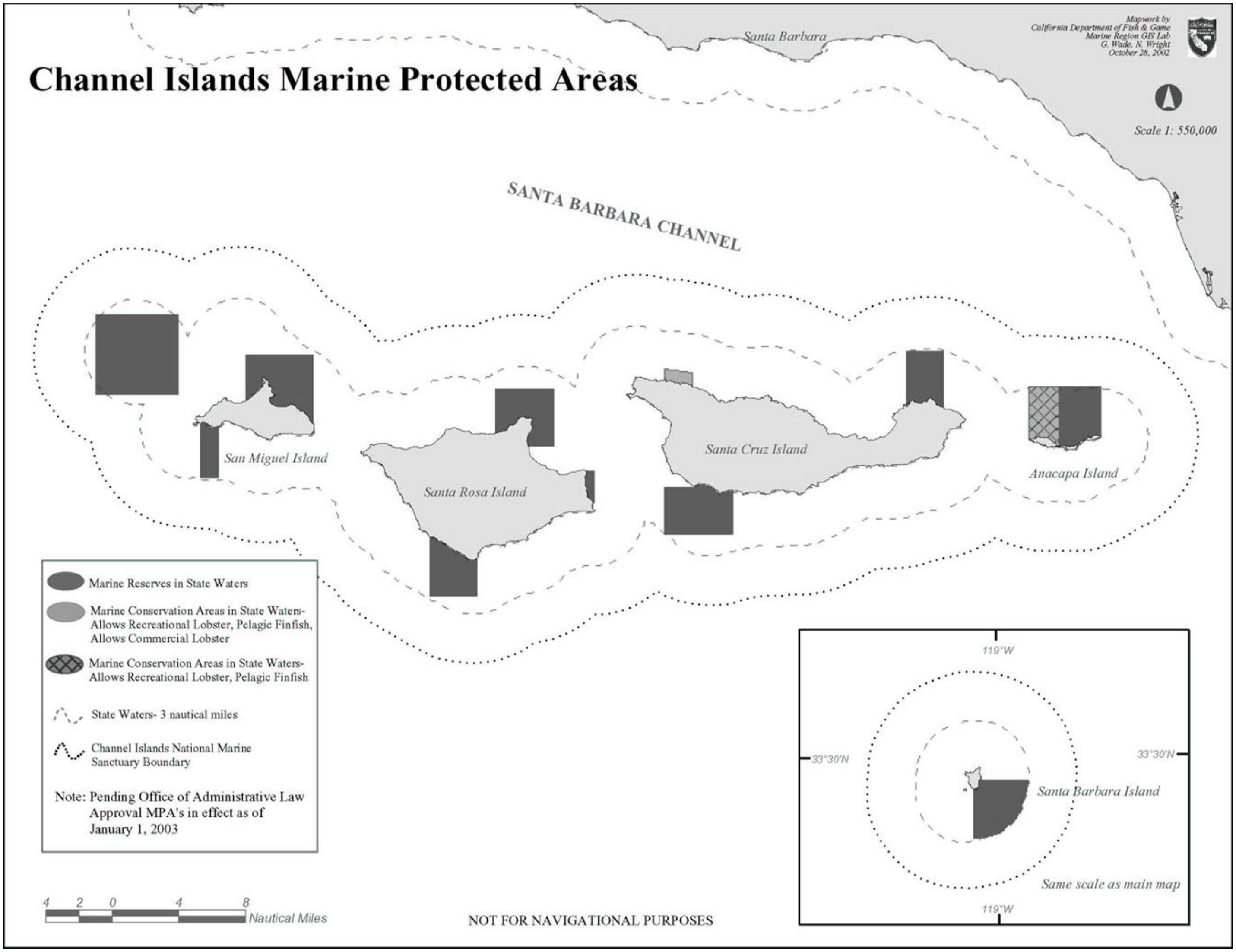

Figure A4-1. The Channel Islands network of Marine Protected Areas.

Several other MPAs exist in the Southern California Bight (a list may be found at www.dfg.ca.gov/mrd/mlpa/mpa.html). None of the other MPAs are as broad or comprehensive in scope as the Channel Islands MPAs, and most are designated as state marine parks rather than no-take reserves. Two marine parks, Abalone Cove State Marine Park and Point Fermin State Marine Park, are located in the Palos Verdes Shelf coastal region, an area associated with the most restrictive fishing advisories related to the Montrose case. The Point Fermin park serves primarily to prohibit the collection of invertebrates and does not restrict fin fishing; the Abalone Cove park imposes only limited restrictions pertaining to mode of fishing and does not regulate the species or quantity of fish caught. Neither of these sites has a management objective of enhancing fisheries outside of its boundaries.

Concurrent with the establishment of the Channel Islands MPAs is an expansion in the efforts to examine and reinvigorate ocean resource management in the United States and throughout the world in response to indicators of concern (e.g., depleted fish populations, lost nursery habitat, polluted coastal zones, or contaminated fish). At the national level, the Pew Oceans Commission published its findings and action recommendations in 2003, declaring that the oceans of the nation are in crisis (Pew Oceans Commission 2003). In September 2004, the U.S. Commission on Ocean Policy released its findings and recommendations for a new, coordinated, and comprehensive national ocean policy (U.S. Commission on Ocean Policy 2004). In 1999, the California State Legislature found that the marine habitat and biological diversity of the state's ocean waters were threatened by coastal development, water pollution, and other human activities and passed the MLPA. The MLPA mandates that the state design and manage an improved network of MPAs to, among other things, protect marine life and habitats, marine ecosystems, and marine natural heritage.

Under the MLPA, the state is required to develop a master plan for the integrated management of existing and new marine reserves for the entire state. The development of the MLPA master plan was placed on hold by the State of California in January 2004 due to lack of funding, but the program was revitalized later in 2004 through a combination of public and private funding. The evaluation of the Channel Islands MPAs has continued via collaboration between the California Department of Fish and Game (CDFG), the National Park Service (NPS), the National Oceanic and Atmospheric Administration (NOAA) National Marine Sanctuaries Program, and various universities. However, many components of the evaluation are currently operating with insufficient levels of funding (Table A4-1).

The success of an MPA, and therefore the degree to which information from it can be used to guide future MPAs, is strongly influenced by the effectiveness of its implementation. Insufficient financial and technical resources, lack of staff, or lack of data for management decisions can reduce the effectiveness of an MPA. Monitoring, public education, and enforcement play critical roles in providing for and demonstrating the long-term positive impacts of MPAs on biodiversity and the human communities that depend on these resources. (NOAA 2005a).

Monitoring programs for the Channel Islands MPAs provide information that is central to understanding the effectiveness of MPAs as a management tool for restoring depleted marine resources and sustainable fishing services. Biological monitoring of these MPAs includes a range of activities, is conducted by several groups and agencies (including NPS, CDFG, the

Partnership for Interdisciplinary Studies of Coastal Oceans [PISCO], University of California, Santa Barbara, and others), and is typically incompletely funded (Table A4-1). CDFG oversees

Table A4-1
Summary of Activities Associated with Monitoring, Evaluating, and Enforcing the Channel Islands MPAs

Agency	Progam	Annual Cost	Years	Total Cost (2005-2008)	Secured[3]	Funding Needs
CDFG[1]	**SCUBA Surveys**	N/A - $500,000	4	N/A - $2,000,000	$800,000	N/A - $1,200,000
	Groundfish tagging	N/A - $150,000	4	N/A - $600,000	$115,000	N/A - $485,000
	Trap/Fixed Gear Surveys	$100,000 - $300,000	4	$400,000 - $1,200,000	$0	$400,000 - $1,200,000
	Newly Settled Fish Surveys	N/A - $100,000	3	N/A - $300,000	$75,000	N/A - $225,000
	Aerial Monitoring of Kelp Canopy	N/A - $100,000	4	N/A - $400,000	$400,000	N/A - $0
	ROV Surveys	$150,000 - $200,000	4	$600,000 - $800,000	$40,000	$560,000 - $760,000
	Submersible Surveys	$60,000 - $100,000	4	$240,000 - $400,000	$0	$240,000 - $400,000
	Intertidal Monitoring	N/A - $200,000	4	N/A - $800,000	$800,000	N/A - $0
	Social Science Coordinator	$60,000 - $100,000	4	$240,000 - $400,000	$0	$240,000 - $400,000
	Social Science Surveys[4]	$325,000 - $500,000	4	$1,300,000 - $2,000,000	$600,000	$700,000 - $1,400,000
	Sanctuary Aerial Monitoring and Spatial Analysis Program (SAMSAP)	N/A - $100,000	4	N/A - $400,000	$400,000	N/A - $0
	Public Outreach	N/A - $50,000	4	N/A - $200,000	$200,000	N/A - $0
	Enforcement[5]	TBD	4	TBD	TBD	TBD
NPS	**Kelp Forest Monitoring Survey**	N/A - $280,000	4	N/A - $1,120,000	$920,000	N/A $200,000
	MPA evaluation/extention of	N/A - variable[2]	4	N/A - $904,711	$564,711	N/A $340,000
	Enforcement	$526,000	4	$2,104,000	$800,000	$1,304,000
Total[5]				$13,628,711		$7,914,000

[1] CDFG costs are estimates and some programs may vary in costs among years so a range of annual costs for these programs is presented.
[2] National Parks Service MPA project includes higher costs in the first two years due to the increased costs associated with setting up sites. Once sites are set up maintenance/monitoring costs are ~$170,000/year.
[3]Secured funding based on an assumption that current funding levels are maintained.
[4]Social science surveys includes knowledge perceptions and attitudes surveys as well as analysis of DFG commercial and recreational fisheries data.
[5]Total costs are based on maximun cost estimates only and should therefore be viewed as a "worst-case" scenario.
[5]TBD = To Be Determined

the evaluation of the MPAs. The goals of these monitoring programs are as diverse as the programs themselves, but the biological monitoring is primarily focused on evaluating productivity inside and outside the MPAs and the degree to which productivity (primarily in terms of fish biomass, eggs, or larvae) "spills over" into adjacent unprotected areas.

A4.3 PROJECT DESCRIPTION AND METHODS

The management and monitoring of the Channel Islands MPAs is a large effort involving state and federal agencies, academic institutions, and non-governmental organizations. Each component of this multi-faceted approach operates on different levels of funding with different funding sources. In examining the MPA concept as a potential means of restoring fish and their habitats in the Southern California Bight, the Trustees identified four specific actions for which Montrose Settlements Restoration Program (MSRP) funds could contribute to more effective implementation of the Channel Islands MPAs:

1. Subtidal fish monitoring: Much of the work associated with the Channel Islands MPA evaluation is labor intensive field work that requires significant training and knowledge of the biota. Over a 5-year period, MSRP could fund the salary of a technician working

for one of the existing MPA implementation groups (i.e., NPS, PISCO, or CDFG) during the field season to address key funding gaps in specific monitoring programs. This action will, for instance, improve the reliability of data collected to evaluate the spillover benefits of MPAs on adjacent fisheries.

2. NPS/CDFG enforcement: Inadequate enforcement of MPA restrictions on taking biota from the reserves would undermine the validity of the assessment of how well the MPA achieves its objectives. If the MPAs do not in fact function as a refuge from fishing due to lack of enforcement, the results of the MPA evaluation would not represent a protected area and would therefore not be an evaluation of the utility of MPAs as a management tool.
3. Support for CDFG ROV Surveys: Beyond the scuba-based survey work, CDFG also conducts regular remotely operated vehicle (ROV) surveys in the deeper regions of the reserve that are not easily monitored using scuba surveys. The CDFG boat that is available for these surveys is not adequately rigged to conduct these surveys, and other boats must be contracted to do the work (Ugoretz, pers. comm., 2004), leading to logistic constraints and higher operating costs.
4. Expansion of the groundfish tagging project: Through a private contractor, CDFG has been conducting a tagging program that specifically examines the abundance and movements of selected groundfish species inside and outside of MPAs, including, but not limited to, those that have been established in the Northern Channel Islands (Hanan, pers. comm., 2004). This effort has collateral benefits to commercial fishing boats impacted by fishery closures because the program employs these boats and crews for fish collections. The program also promotes the involvement of anglers over a 5-year period in the MPA evaluation process. Funding for this project was only sufficient to focus primarily on one species group: rockfishes. MSRP could fund this work for two additional years, allowing the techniques and infrastructure to be applied to species that are more directly relevant to MSRP restoration goals (e.g., kelp bass and surfperches). The results of this work would not only be relevant to the ongoing evaluation of the Channel Islands MPAs, but would also be relevant to MSRP artificial reef restoration projects by providing additional insights on the relationship between reef size and ability to sustain fishing pressure.

A4.4 ENVIRONMENTAL BENEFITS AND IMPACTS

A4.4.1 Biological

Benefits

The concept of using MPAs as a management tool is grounded in the concept that MPAs would be established in “source” habitats where the local population is protected and produces maximal numbers of eggs, larvae, and adults. This production would “refuel” areas depleted by fishing via spillover of adults and direct recruitment of juveniles, allowing for higher levels of fishing mortality than would be possible without the protected regions.

MPAs have been shown to increase fish abundance outside their boundaries via increased production of eggs by bigger, more abundant fish within the MPA and the spillover of fish from the MPA (e.g., Roberts et al. 2001). This effect is still much debated with no clear consensus in the literature (Willis et al. 2003). It is likely that the potential for spillover effects is system- and species-dependent and largely due to interspecies differences in often poorly understood life history parameters (e.g., larval survivorship, fecundity, home range, mobility, and size and age at reproduction) that affect the impacts of MPAs on abundance of fish outside their borders (Botsford et al. 2003, McClanahan and Mangi 2000). Recent work investigating maternal effects on offspring viability in rockfishes has shown that protecting larger older individuals in a population is an important component of the maintenance of a healthy population (Berkley et al. 2004a, 2004b). This work also suggests that many of the west coast groundfishes that are currently considered to be overfished are particularly sensitive to the loss of large, old individuals. The value of MPAs is that they present a solution to the problem of the loss of larger, older fish that typically occurs under conventional management strategies.

A fish population that consists of a diverse age/size distribution will likely spawn over a broader spawning period, with younger individuals spawning at different times than older individuals (Kjesbu et al. 1996). A broader spawning period can result in an increased potential for larvae to encounter conditions favorable for recruitment. Much of this work, however, is based on life-history-specific examinations, and to date there is a lack of comprehensive studies that examine the population-level impacts of these processes. The evaluation of the Northern Channel Islands MPAs may provide at least regional, if not population-level, data that will test the hypotheses that have been established based on the examination of specific life stages.

Although the impact of MPAs on surrounding fisheries is still a subject of debate, a growing body of literature has demonstrated the positive effects of MPAs on the size and abundance of fish and invertebrates within their boundaries (summarized in Halpern 2003). Although this effect by itself does not provide for additional fishing opportunities, it does provide important opportunities to monitor fish communities in a more pristine state. These opportunities are critical to pre-empt the tendency to allow ecological baselines to slide as marine resources become depleted (Dayton et al. 1998). These opportunities also provide chances for marine ecologists to investigate biological interactions in marine communities that are not impacted by fishing mortality, enabling a more clear separation of natural shifts in ecosystem processes (El Nińo, current regimes, etc.) and the impacts of fishing. Although these benefits do not directly result in increases in fishing opportunities, they relate directly to the process of improving the standards and methods with which fishery resources are managed.

The benefits of a successful evaluation of the utility of the Channel Islands MPAs as a fishery management tool may extend beyond the Northern Channel Islands if they improve the reliability of determinations of MPA effectiveness as a fishery management tool. Conventional resource management strategies are often ineffective for sustaining marine fisheries, and several important species commonly caught off the coast of California exhibit life-history characteristics that make them particularly vulnerable to the weaknesses of conventional management approaches (Berkley et al. 2004a, 2004b). Improved management strategies that incorporate the needs of species with vulnerable life history characteristics may be as vital a restoration activity to marine fisheries resources as the creation or restoration of critical habitat.

The Channel Islands MPA monitoring plan (CDFG 2004a) states that some resources may respond to MPAs quickly, whereas others may take many years to respond. The monitoring plan suggests that a major review be conducted 5 years after implementation (in the spring of 2008). The monitoring plan does not suggest that after 5 years there will be sufficient data to determine the outcome of the evaluation, but simply that 5 years will be sufficient time to determine if mid-course or adaptive corrections in the process need to be made. Given this expected time frame, the Trustees consider that a minimum period of involvement of 5 years is required to substantially improve the evaluation of the Northern Channel Islands MPAs.

Impacts

This action has no known biological impacts.

A4.4.2 Physical

Benefits

This action has no known benefits to the physical environment.

Impacts

This action has no known impacts to the physical environment.

A4.4.3 Human Use

Benefits

Several potential benefits to human use could occur from improved effectiveness of the implementation of the Channel Islands MPAs. Restoration of depleted resources within the boundaries of the reserves may provide recreational opportunities outside of the reserves. Although the MPAs generally prohibit the taking of biota within the MPA boundaries, effectively managed MPAs could potentially lead to the spillover of fish to adjacent areas and thus improve fishing uses outside their boundaries. The specific benefits of this action will relate to the design and location of the future MPAs on which the results of this action would be based. Only through a detailed understanding of the ecological value of currently established MPAs can future MPAs be designed that maximize the potential benefits to human use.

Impacts

By their nature, MPAs restrict several types of human uses within their boundaries. This impact was addressed in the environmental documentation that supported the original establishment of the Channel Islands MPAs (CDFG 2002). The most seriously debated impact of the Channel Islands MPAs related to the question of their contribution to commercial and recreational catches. Opponents of these MPAs suggest that even though MPAs may increase the abundance of fish within their boundaries, they exclude fishermen from the most productive fishing areas, concentrating them in the less productive areas and causing an overall reduction of catch. This issue was addressed during the development of the Channel Islands MPAs through extensive collaboration with the fishing community to avoid restrictions to fishing in already-established, favored fishing locations. In addition, the Channel Islands MPA evaluation plan calls for extensive socioeconomic impact studies designed to address the potential negative impacts of MPAs on human uses (CDFG 2002).

The specific MSRP action proposed here, augmenting funding for existing management and monitoring efforts, does not establish new MPAs and does not modify the boundaries or human use restrictions already established for the Channel Islands MPAs. Thus, potential impacts to human uses are not considered to be significant.

A4.5 LIKELIHOOD OF SUCCESS/FEASIBILITY

The success of this restoration action does not depend on actual monitoring outcomes (e.g., whether these MPAs improve fisheries in adjacent areas), but on whether MSRP contributions improve the validity and reliability of the findings emerging out of MPA implementation and increase the credibility of those findings before the public and affected user groups.

Because this restoration action will entail supplementing current enforcement and monitoring programs already designed and being carried out by CDFG, NPS, and PISCO, the operational feasibility of the action is high. The tagging program has been established and has already developed a working relationship with commercial charter boat captains along the Southern California coast. These agencies have also developed the protocols and initiated outreach to fishermen to increase recapture potential. Thus, the Trustees will not need to fund concept development, only implementation.

It is unlikely that any of the projects described above will encounter significant regulatory hurdles. However, the establishment of MPAs in the Northern Channel Islands has not had universal public support. The objective of this restoration action will be to contribute to enforcement and monitoring efforts that aim to resolve questions about the specific and realized benefits of MPAs.

A4.6 PERFORMANCE CRITERIA AND MONITORING

This action will be nested within the broader scope of the ongoing evaluation of the Northern Channel Islands MPAs being carried out by CDFG, which has developed specific performance criteria (CDFG 2004a). The Trustees will adopt these criteria.

A4.7 EVALUATION

The Trustees have evaluated this restoration action against all screening and evaluation criteria developed to select restoration actions and concluded that this action is consistent with these selection factors. Because the Channel Islands MPAs are distant from the areas affected by the fish consumption advisories related to the Montrose case, this action is not likely to significantly restore the lost human uses (fishing services) related to the case. Also, given the lack of regional data on the spillover of fish to fishing areas adjacent to MPAs, the potential that establishing new

MPAs nearer the Los Angeles coast would restore fishing services is uncertain. Nevertheless, this action will address the MSRP goal of restoring fish and the habitats on which they depend within the Southern California Bight and for this reason has been found to meet the selection factors. Also, the findings that come from improved management and monitoring of the Channel Islands MPAs may ultimately be used to improve fishery resources elsewhere, including the areas more severely impacted by the Montrose contamination.

A4.8 BUDGET

Under this action, MSRP funds will be provided to support MPA implementation in the Northern Channel Islands (Table A4-1). The Trustees propose to provide up to $500,000 toward implementation and evaluation of the Channel Islands MPAs from the $12 million allocated for all fishing and fish habitat restoration actions under the MSRP. The specific projects that will be funded will be determined via a review process that will respond to the dynamic nature of the funding for this program and will therefore seek to avoid duplicating funding for projects and maximize the degree to which funds may be matched with funding from other sources.