Introduction

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

A remnant colony of about 50 sea otters survived in California. Taxonomists identified this population as the southern sea otter, *Enhydra lutris nereis*, distinguishing it from other remnant populations remaining in Russia and Alaska. On January 14, 1977, we, the Fish and Wildlife Service, listed the southern sea otter as a threatened species under the Endangered Species Act [16 U.S.C 1531 et seq.] on the basis of its small population size, its greatly reduced range, and the potential risk of oil spills [42 FR 2968]. We established a recovery team for the species in 1980, and we approved a recovery plan for the species on February 3, 1982 (USFWS 1982). In the recovery plan, we identified the translocation of southern sea otters as an effective and reasonable recovery action, acknowledging that a translocated southern sea otter population could impact shellfish fisheries that had developed in areas formally occupied by southern sea otters.

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

In the course of planning for the translocation of southern sea otters, we identified a conflict between the Endangered Species Act and the Marine Mammal Protection Act. Both acts provided protection for the southern sea otter, but at the time the Marine Mammal Protection Act did not allow for the establishment of experimental populations. The matter was brought before the U.S. Congress and resulted in the passage of Public Law 99-625. Public Law 99-625 allowed us to develop and implement a southern sea otter translocation plan that included provisions to minimize conflict between sea otters and shellfish fisheries.

We completed a final environmental impact statement for southern sea otter translocation in May 1987 and published a final rule and record of decision in August of the same year (Appendix D). Our 1987 environmental impact statement evaluated the environmental impacts of several potential translocation sites. We selected San Nicolas Island, a small island off the southern California coast, as the preferred site and began to capture and move sea otters to the island in August of the same year.

Eighteen years have passed since the first translocations of sea otters to San Nicolas Island were undertaken, during which time we have gained considerable information. However, contrary to initial expectations,

we have failed to achieve the recovery objectives of the program. We concluded in a biological opinion in 2000 that implementation of the containment component of the program would likely jeopardize the continued existence of the species (Appendix B). In this supplement to our 1987 final environmental impact statement, we summarize what we have learned regarding sea otter translocation and evaluate the biological and socioeconomic effects of several alternatives, including the program's termination.

Comments expressed during the scoping process indicate that there are widely divergent views on whether sea otters should be allowed to recolonize their historic range. Our translocation plan attempted to balance multiple needs while implementing a recovery action for sea otters. Our experience in implementing the translocation plan over the past 18 years, which has differed significantly from what we anticipated under the 1987 plan, has prompted our reevaluation of the plan and consideration of alternatives to it, including termination. Success or failure of our next course of action will depend on our ability to effect change in the context of sea otters' natural behaviors.

Chapter 1. Purpose and Need

1.1 Purpose for Action

The purpose of this supplement is to assess options for the future of the southern sea otter translocation program that will ultimately result in recovery of the species, including revisions to the program or termination of it. This assessment includes a reevaluation of impacts of the southern sea otter translocation plan, as described in our 1987 environmental impact statement, based on current information obtained over the 18 years since the plan's inception. It also includes an evaluation of impacts of alternatives for the future of the translocation program.

1.2 Need for Action

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

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

Several overarching needs also help to define the alternatives considered here. These include the need to meet our mandate under the Endangered Species Act to bring the southern sea otter to recovery; the need to implement recovery actions as specified in the southern sea otter recovery plan (USFWS 2003); the need to comply with Public Law 99-625; and the need to bring the southern sea otter population to its

optimum sustainable population (OSP) level by the Marine Mammal Protection Act.

Chapter 2. Background

2.1 History of the Translocation Program

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

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

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

If the Secretary of the Interior chose to develop a translocation plan under P.L. 99-625, the plan was to include: (1) the number, age, and sex of southern sea otters proposed to be relocated; (2) the manner in which southern sea otters were to be captured, translocated, released, monitored, and protected; (3) specification of a zone into which the experimental population would be introduced (translocation zone); (4) specification of a zone surrounding the translocation zone that did not include range of the parent population or adjacent range necessary for the recovery of the species

(management zone); (5) measures, including an adequate funding mechanism, to isolate and contain the experimental population; and (6) a description of the relationship of the implementation of the plan to the status of the species under the Endangered Species Act and determinations under section 7 of the Endangered Species Act. The purposes of the management zone were to: (1) facilitate the management of southern sea otters and the containment of the experimental population within the translocation zone; and (2) prevent, to the maximum extent feasible, conflicts between the experimental population and shellfish fisheries within the management zone. Any sea otter found within the management zone was to be treated as a member of the experimental population. We were required to use all feasible non-lethal means to capture sea otters in the management zone and to return them to the translocation zone or the range of the parent population.

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

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

Between August 1987 and March 1990, we released 140 southern sea otters at San Nicolas Island. As of March 1991, approximately 14 sea otters (10 percent) were thought to remain at the island. Some sea otters died as a result of translocation; many swam back to the parent population; and some moved into the management zone. The fate of more than half the sea otters taken to San Nicolas Island was never determined. In 1991, we stopped translocating sea otters to San Nicolas Island due to high rates of dispersal and poor survival. However, we continued monitoring the sea otters remaining in the translocation zone.

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

In February 1993, two sea otters that had been recently captured in the management

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

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

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

We distributed a draft section 7 consultation on the southern sea otter containment program to interested parties for comment on March 19, 1999, and issued a final biological opinion on July 19, 2000. Our reinitiation of consultation was prompted by the receipt of substantial new information on the population status, behavior, and ecology of the southern sea otter that revealed adverse effects of containment that were not previously considered. In the biological opinion, we cited the following information and circumstances as prompting reinitiation: (1) in 1998 and 1999, southern sea otters moved into the management zone in much greater numbers than in previous years; (2) analysis of carcasses indicated that southern sea otters were being exposed to environmental contaminants and diseases that could be affecting the health of the population throughout California; (3) range-wide counts of southern sea otters indicated that numbers were declining; (4) recent information, in particular the observed effects of the Exxon Valdez oil spill, indicated that southern sea otters at San

Nicolas Island would not be isolated from the potential effects of a single large oil spill; and (5) the capture and release of large groups of southern sea otters could result in substantial adverse effects on the parent population. The biological opinion concluded with our assessment that continuation of the containment program would likely jeopardize the continued existence of the species on the grounds that: (1) reversal of the southern sea otter's population decline was essential to the survival and recovery of the species, whereas continuation of containment could cause the direct deaths of individuals and disrupt social behavior in the parent range, thereby exacerbating population declines; and (2) expansion of the southern sea otter's distribution was essential to the survival and recovery of the species, whereas continuation of the containment program would artificially restrict the range to the area north of Point Conception, thereby increasing the vulnerability of the species to oil spills, disease, and stochastic events.

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

2.2 Scoping and Issues

On July 27, 2000, we published in the *Federal Register* a notice of intent to prepare a supplement to our 1987 environmental impact statement on the southern sea otter translocation program [65 FR 46172]. The notice of intent announced that public scoping meetings would be held on August 15, 2000 in Santa Barbara, California and on August 17, 2000 in Monterey, California. On July 27, 2000, we distributed a press release that identified the scoping meeting dates, times, and locations to wire services at *Associated Press* (San Francisco) and *Bay City News*, reporters in coastal counties of California, local radio and television stations, and other interested parties. We posted formal notices of the meetings in the *Santa Barbara News Press*, *The Independent* (Santa Barbara), *The Coast Weekly* (Monterey) and the *Monterey Herald*.

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

We met with the technical consultants to the southern sea otter recovery team to discuss scoping of the supplement on September 26, 2000. We reviewed comments received during the scoping meetings and solicited

additional information from the group. In April 2001, we published a scoping report and distributed it to scoping meeting participants and other interested parties (Appendix E).

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

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

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Chapter 3. Alternatives Including the Proposed Action

3.1 Introduction

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

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

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

Several alternatives were proposed during scoping but are not evaluated in this supplement because they do not meet our purpose and need for action. They include the following: place a moratorium on shellfisheries; establish no-take zones for fisheries; develop educational programs to encourage people to use alternative food sources and reduce seafood consumption; petition the U.S. Navy to include San Nicolas Island within the Channel Islands National Park; establish a captive breeding program and reintroduce sea otters to other sites in California and Mexico; and move sea otters north or translocate sea otters to a location closer to the parent population. At the end of this chapter, we explain why we

do not perform a detailed analysis of these alternatives.

3.2 Description and Comparison of Alternatives

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

3.2.1 Baseline (Status Quo)—The No Action Alternative

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

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

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

3.2.2 Alternative 1—Resume Implementation of 1987 Translocation Plan

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

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

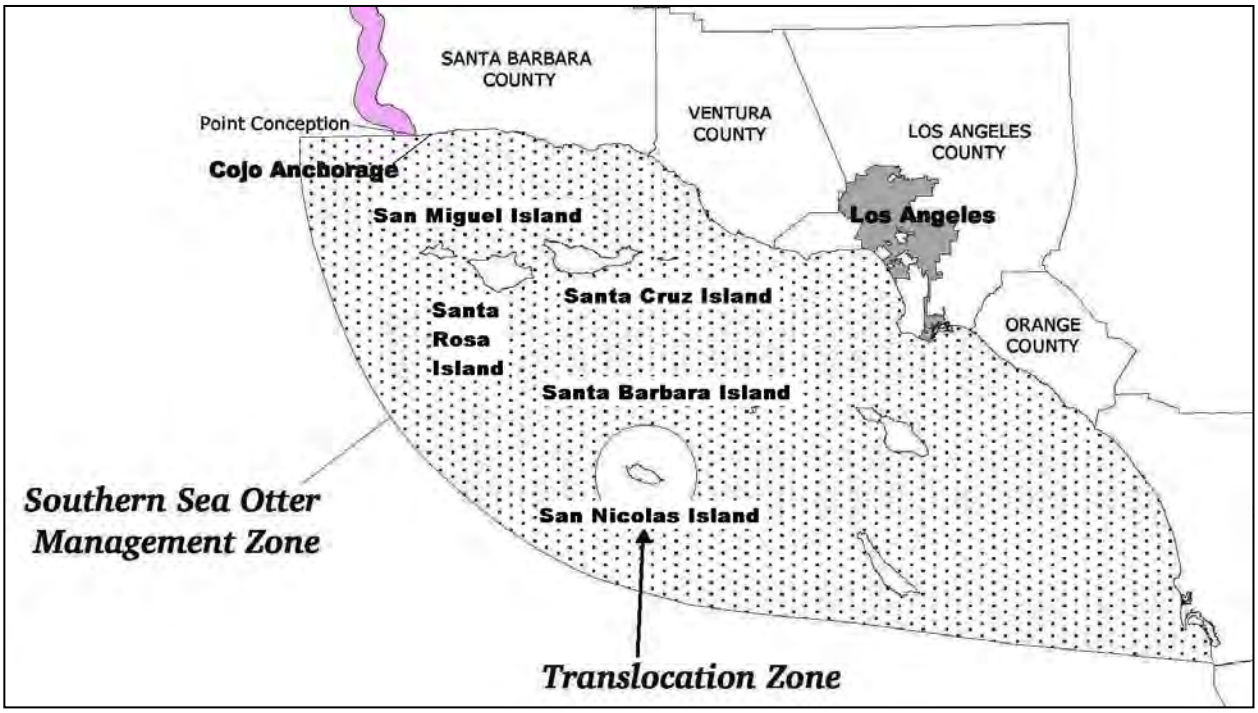

FIGURE 3-1. MANAGEMENT ZONE (ALTERNATIVE 1).

requisite core population size of 70 sea otters (due to high rates of dispersal), we discontinued efforts to move sea otters to San Nicolas Island in 1991, effectively ending the transplant phase at that time. The colony is currently in the growth and reestablishment stage as defined in the plan. While monitoring of the experimental colony at San Nicolas Island and conducting research on related ecosystem changes on the island have continued to the present as envisioned under the 1987 plan (with the exception that far fewer sea otters than expected are present at the island to cause such changes), full implementation of the southern sea otter translocation program would also require containing the colony within the translocation zone and maintaining the designated management zone from Point Conception to the Mexican border (Figure 3-1) free of sea otters. Given the small founding size of the colony and the fact that renewed maintenance of the management zone would preclude the possibility of genetic exchange with the parent population in perpetuity, we would likely need to consider additional translocations of sea otters to ensure adequate genetic diversity within the island colony.

Selection of Alternative 1 would require that we resume capturing and removing sea otters found in the management zone. The management zone includes about 96 percent of the nearshore area of the Southern California Bight. Before this alternative could be implemented, we would need to reinitiate consultation under section 7 of the Endangered Species Act to assess the effects of containment on southern sea otters. For a summary of specific actions to be taken under this alternative, see Table 3-1.

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

Alternative 2 is similar to Alternative 1, but with an important difference. Under Alternative 2, the southern sea otter translocation plan would be implemented as

originally written, but the designated management zone would be reduced in size.

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

The new designation would reflect recognized biogeographic boundaries and allow for limited sea otter range expansion. The reduction in size of the management zone would provide additional habitat for the recovery of the species (relative to Alternative 1) while retaining a modified management zone to minimize conflicts with existing fisheries. The modified management zone includes about 78 percent of the nearshore area of the Southern California Bight. Sea otter containment would resume in the newly designated management zone.

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

3.2.4 Alternatives 3A-3C—Terminate Translocation Program

Specific failure criteria are defined in the southern sea otter translocation plan and may be found at 50 CFR §17.84(d)(8). Alternatives 3A-3C would require finalization of the draft evaluation of the translocation program (addressing established failure criteria) in consultation with the California Department of Fish and

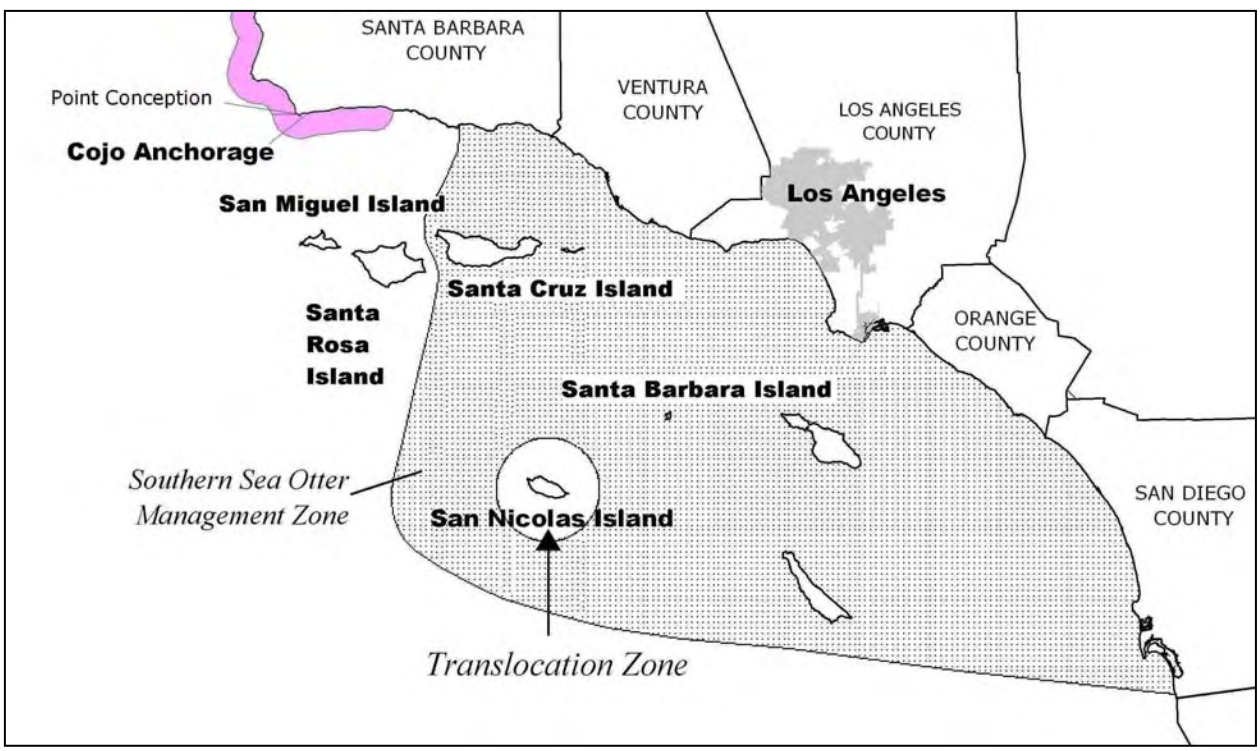

FIGURE 3-2. MODIFIED MANAGEMENT ZONE (ALTERNATIVE 2).

Game and the Marine Mammal Commission and a rulemaking to delete the regulations at 50 CFR 17.84(d). A draft evaluation, in which we conclude that the translocation plan has failed, is included as Appendix C. We are seeking comments on the draft evaluation as well as on this draft supplement. If the program were terminated, all southern sea otters, regardless of their physical location, would be treated as members of the same population for the purposes of the Endangered Species Act and the Marine Mammal Protection Act. The standard prohibitions and authorizations under the Endangered Species Act and the Marine Mammal Protection Act would once again apply, and the special rule governing the translocation plan [50 CFR §17.84(d)] would no longer apply.

To mitigate conflicts with commercial fisheries, we would propose to work with the California Department of Fish and Game and affected fishers to develop fishery management strategies that will minimize the effects of sea otter range expansion on individuals in the affected fisheries. One possibility could be to retire (rather than reissue) permits for fisheries affected by sea otters when current permit-holders voluntarily relinquish them, thereby reducing competition between permit-holders remaining in those fisheries.

To mitigate effects of the change in consultation requirements at San Nicolas Island on the U.S. Navy, we would propose to develop a programmatic Biological Opinion for activities that may affect sea otters there.

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

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

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

Under Alternative 3B, subject to the outcome of a future section 7 consultation, all sea otters remaining within the translocation zone at San Nicolas Island would be captured and placed in the range of the parent population. Efforts to maintain the management zone free of sea otters would not be reinitiated. For a summary of

specific actions to be taken under this alternative, see Table 3-1.

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

No sea otters within the translocation zone or management zone would be removed following the decision to declare the translocation program a failure. Efforts to maintain the management zone free of sea otters would not be reinitiated. For a summary of specific actions to be taken under this alternative, see Table 3-1.

3.3 Alternatives Identified During Scoping but Not Analyzed Further in This Supplement

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

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

2. *Establish no-take zones for fisheries.* Twelve new Marine Protected Areas at the Channel Islands went into effect on April 9, 2003. Maps and descriptions of the 10 State Marine Reserves and 2 State Marine Conservation Areas and their associated regulations are available at the California Department of Fish and Game, Marine Resources Division website: http://www.dfg.ca.gov/mrd/channel_islands/index.html. We address the Channel Islands Marine Protected Areas in our effects analysis; however, we do not have the legal authority to propose no-take zones for fisheries. Additionally, as noted above, we have no evidence that competition with fisheries is limiting growth of the sea otter population at San Nicolas Island or limiting potential range expansion into southern California.

3. *Develop educational programs to encourage people to use alternative food sources and reduce seafood consumption.* We believe that the intent of this suggested alternative is to address the global issue of marine resource allocation. As such, this alternative is beyond the scope of this supplement and does not meet the purpose and need for action we have identified. The purpose of this supplement is to assess options for the future of the southern sea otter program based on new information gained over the past 18 years, not to address marine resources *per se*.

4. *Petition the U.S. Navy to allow inclusion of San Nicolas Island within the Channel Islands National Park.* We believe that the intent of

this suggested alternative is to provide additional protection to the translocated population of southern sea otters. Under the existing translocation program, sea otters within the boundaries of the Channel Islands National Park receive less protection than do those found in the translocation zone at San Nicolas Island. This alternative would not result in a significant modification to the translocation program.

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

6. *Move sea otters north or translocate sea otters to a location closer to the parent population.* The purpose of this supplement is to assess options for the future of the southern sea otter program based on new information gained over the past 18 years. We are not considering alternate translocation sites. Therefore, this alternative is beyond the scope of this supplement and does not meet our purpose and need for action.

TABLE 3-1. SUMMARY OF ACTIONS BY ALTERNATIVE

	No Action	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C (Proposed Action)
Decision on translocation program	None	Resume implementation as described in original plan	Resume implementation with modification	Declare failure		
Translocation zone and associated regulations	Translocation zone exists; no prohibition of incidental take of sea otters for defense-related activities in translocation zone; standard prohibitions and authorizations under ESA and MMPA, including those applicable to incidental take of sea otters, apply to other activities			No translocation zone; standard prohibitions and authorizations under ESA and MMPA, including those applicable to incidental take of sea otters, apply to all activities		
Management zone and associated regulations	Management zone exists; standard prohibitions and authorizations under ESA and MMPA apply to all activities, except no prohibition against incidental take of sea otters in management zone		Modified management zone exists; standard prohibitions and authorizations under ESA and MMPA apply to all activities, except no prohibition against incidental take of sea otters in modified management zone	No management zone; standard prohibitions and authorizations under ESA and MMPA, including those applicable to incidental take of sea otters, apply to all activities		
Management of sea otters at San Nicolas Island	Continue monitoring	Continue monitoring; if needed, supplement colony to ensure genetic diversity		Remove sea otters from SNI (short-term)		Do not remove sea otters from SNI; continue monitoring
Management of sea otters in management zone	None (maintenance remains suspended)	Remove all sea otters in management zone in perpetuity	Redefine management zone; remove all sea otters from modified management zone in perpetuity	Remove sea otters in management zone at time of decision (short-term)	Do not remove sea otters in management zone	
Mitigation measures	None	No additional measures proposed		Work with CDFG to develop fishery management plan for affected fisheries to minimize effects of sea otter range expansion on individual fishers		
						Develop programmatic BO with U.S. Navy for activities that may affect sea otters at SNI
Regulatory actions needed to implement	N/A	Consult under section 7 of ESA for sea otters				No consultation required for sea otters because no sea otters moved
		Consult under section 7 of ESA for white abalone and confer on black abalone				
		No change to regulations at 50 CFR 17.84(d)	Amend regulations at 50 CFR 17.84(d)4 to re-delineate management zone	Amend regulations at 50 CFR 17.84(d)		

SNI=San Nicolas Island
SCB=Southern California Bight
CDFG=California Department of Fish and Game
BO=biological opinion
ESA=Endangered Species Act
MMPA=Marine Mammal Protection Act

Chapter 4. Description of the Affected Environment

4.1 Introduction

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

Measurements here and elsewhere in this supplement are given in metric units, with the exception of fishery information, which is given in U.S. customary measurements in accordance with convention.

4.2 Physical Environment

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

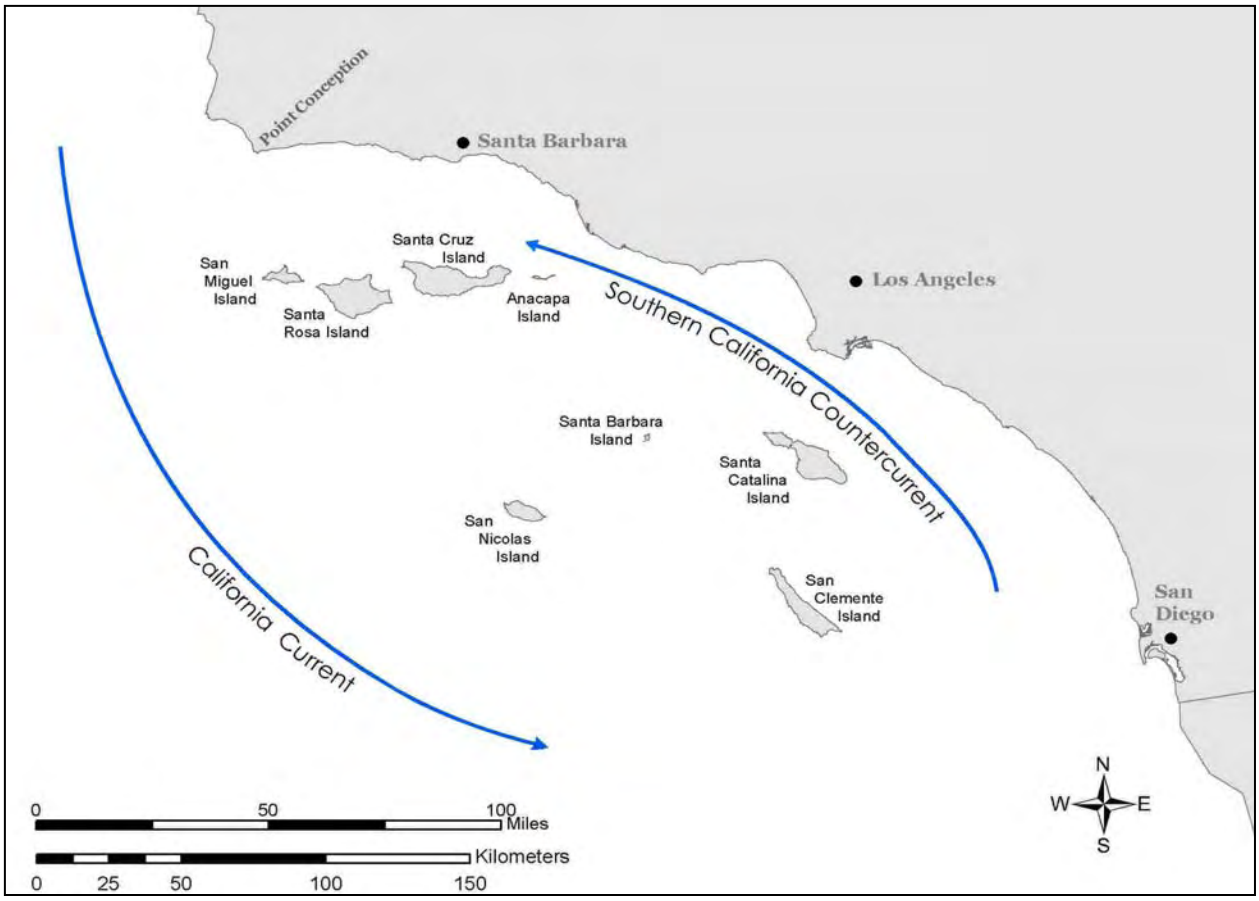

FIGURE 4-1. MAIN SURFACE CURRENTS OF THE SOUTHERN CALIFORNIA BIGHT.

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

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

4.3 Biological Environment

4.3.1 Overview

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

4.3.1.1 Shallow Water Marine Communities

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

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

are associated with characteristic communities of organisms.
Common organisms in rocky intertidal areas include various species of algae (*e.g.*, *Enteromorpha* spp., *Egregia menziesii*, *Eisenia arborea*), surfgrass (*Phyllospadix* spp.), barnacles (*e.g.*, *Chthamalus* spp., *Balanus glandula*, *Tetraclita rubescens*), littorines and limpets (*e.g.*, *Littorina planaxis*, *Collisella digitalis*), mussels (*e.g.*, *Mytilus californianus*), anemones (*e.g.*, *Anthopleura elegantissima*), snails (*e.g.*, *Nucella emarginata*, *Acanthina spirata*), sea stars (*e.g.*, *Pisaster ochraceous*), and purple sea urchins (*Strongylocentrotus purpuratus*) (Thompson *et al.* 1993). Black abalone (*Haliotis cracherodii*), formerly a spatial dominant in lower rocky intertidal areas, have been devastated by withering syndrome (a disease that causes atrophy of the foot muscle and other symptoms) and have now become rare throughout much of their former range in southern California (*e.g.*, Richards 2000).

Rocky subtidal areas provide anchorage for kelp species (Murray and Bray 1993) and habitat for sea urchins (*Strongylocentrotus* spp., *Centrostephanus coronatus*, *Lytechinus anamesus*), sea stars (*e.g.*, *Pisaster giganteus*), crabs (*e.g.*, *Cancer* spp.), spiny lobsters (*Panulirus interruptus*), several species of abalone (*Haliotis* spp.), and octopus (*Octopus* spp.) (Thompson *et al.* 1993, CINMS 2002c).

Kelp forest fishes are numerous but include blacksmith (*Chromis punctipinnis*), garibaldi (*Hypsypops rubicunda*), opaleye (*Girella nigricans*), kelp bass (*Paralabrax clathratus*), California sheephead (*Semicossyphus pulcher*), kelp surfperch (*Brachyistius frenatus*), and rockfish (*Sebastes* spp.) (Foster and Schiel 1985, CINMS 2002c).

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

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

4.3.1.2 Southern Sea Otter Prey Consumption

Southern sea otters forage in shallow waters, usually in depths of 25 meters or less, and only rarely in depths exceeding 40 meters (Riedman and Estes 1990). As a group they consume a wide variety of prey, but the majority of their diet is composed of sessile macroinvertebrates. A list of potential sea otter prey species known to be present at San Nicolas Island is given in our final environmental impact statement (USFWS 1987), and a list of observed prey items for southern sea otters statewide is given in

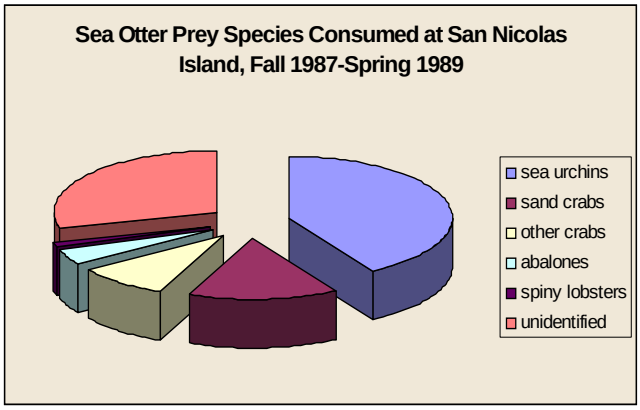

FIGURE 4-2. SPECIES CONSUMED BY SEA OTTERS AT SAN NICOLAS ISLAND, 1987-1989.

Riedman and Estes (1990). In newly reoccupied areas in central California, southern sea otters are known to have consumed primarily abalone (*Haliotis* spp.), rock crabs (*Cancer* spp.), and large red sea urchins (*S. franciscanus*) (reviewed in Riedman and Estes 1990). Diversity in prey selection increases as populations of preferred prey items decline (Riedman and Estes 1990, Bodkin and Ballachey 1996). Prey selection depends also on the individual sea otter (dietary preferences are highly individualized) and on the habitat (Riedman and Estes 1990). In sandy habitats, for instance, sea otters prey substantially on bivalve mollusks (Riedman and Estes 1990).

Data on prey consumption by southern sea otters in southern California waters are limited. We are aware of no information on the prey composition of southern sea otters before their extirpation from the Southern California Bight. Observations made during the early years of the translocation program at San Nicolas Island may provide the best available predictor of sea otter prey preferences if they recolonize their former southern California range (Figure 4-2). These observations revealed that sea otters consumed sea urchins (39.8%), mole (sand) crabs (14.4%), other crabs (8.8%), abalones (3.8%), snails (3.3%), and spiny lobsters (1.2%) (USFWS 1990).[2] Some prey items (28.0%) were unidentified (USFWS 1990).

4.3.2 Nearshore Marine Ecosystem

4.3.2.1 Giant Kelp

Giant kelp (*Macrocystis pyrifera*), in its large sporophyte phase, is a fleshy brown macroalgae that plays a major role in the nearshore marine ecosystems of southern California (Foster and Schiel 1985). Forests of giant kelp are composed of numerous individual kelp plants, each with a well-developed holdfast that serves as an anchor and up to 100 fronds. Fronds consist of a stem-like stipe and multiple leaf-like blades. The blades have gas-filled pneumatocysts at their base, which buoy the fronds to the water's surface (Figure 4-3). Under ideal

FIGURE 4-3. DEVELOPING PNEUMATOCYSTS ON KELP FROND. Photo © Garry McCarthy. www.underwater-photos.com Used by permission.

[2] Data are based on shore observations of 586 dives (58% of which were successful) at San Nicolas Island between Fall 1987 and Spring 1989 (USFWS 1990).

growing conditions (high nutrient levels and temperatures between 50 and 60 degrees Fahrenheit), giant kelp can elongate up to two feet per day, reaching more than 150 feet in length (Bedford 2001). The fronds from multiple plants can combine to form extensive floating surface canopies.

Giant kelp forests support complex communities of organisms (Figure 4-4). Invertebrates, fishes, and many species of birds and marine mammals, both resident and migratory, use kelp forests in a variety of ways: as feeding grounds, nurseries, or cover from predators. Non-resident communities of organisms make use of the kelp detritus that results when pieces detach during storms (Foster and Schiel 1985). Individual kelp plants may shelter hundreds of invertebrate species, with numbers of

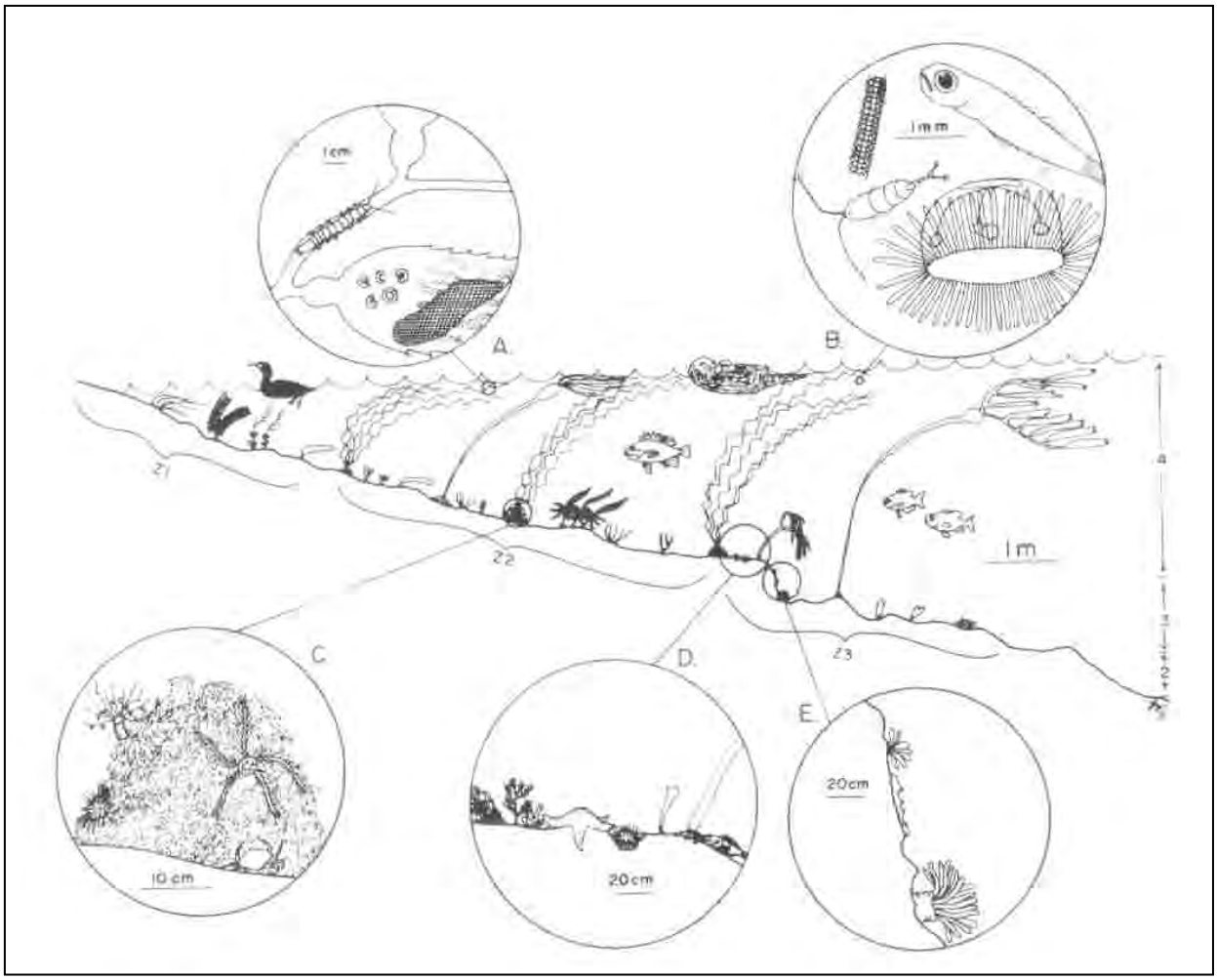

FIGURE 4-4. GENERALIZED KELP FOREST COMMUNITY.
Z1, Z2, and Z3 represent general zonal associations along a depth gradient (inshore, within, and offshore of the kelp forest, respectively). Circular diagrams represent the following associations:
A: Animals associated with the surface of *Macrocystis* and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

individuals reaching tens of thousands (Duggins 1988). Giant kelp provides an important food source for many invertebrates (such as sea urchins and abalone) and fishes (such as opaleye and halfmoon [*Medialuna californiensis*]), which may consume live plants or detritus (Foster and Schiel 1985, Bedford 2001).

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

FIGURE 4-5. GIANT KELP FOREST
Photo © Kip F. Evans. Used by permission.

Even in areas with suitable substrate, the distribution of giant kelp can fluctuate dramatically as a result of wave motion, silting, turbidity and light availability, high temperature/low nutrient conditions, and grazing by herbivores (Foster and Schiel 1985). El Niño events, which bring warm water conditions northward along the coast, can dramatically affect kelp distribution through damage to plants from the increased wave action associated with storms and through increases in warm, nutrient-poor water (Bedford 2001). Sedimentation, pollution, and disease can also affect the survival of kelp forests (Bedford 2001).

Engle (1994) documents the relative distribution of kelp canopy among the eight Channel Islands based on aerial surveys conducted in 1978. San Nicolas Island had the greatest area of kelp beds (30%), while Santa Catalina Island had the least (about 2%) (Engle 1994). A statewide aerial kelp survey, conducted in 1999, recorded 11.4 square miles of kelp off southern California, with 3.7 square miles along the mainland and 7.7 square miles along the Channel Islands (Bedford 2001). Although aerial assessments of kelp coverage are not definitive because the method (infrared photography) used to quantify kelp is subject to error in strong wave and current conditions, the amount of canopy coverage recorded in 1999 reflects a notable decline in kelp abundance since the late 1960s (Bedford 2001). The Kelp Forest Monitoring Program of the Channel Islands National Park has collected detailed annual data on kelp forests around Santa Barbara, Anacapa, Santa Cruz, Santa Rosa, and San Miguel Islands since 1982. These data are available online at http://www.nature.nps.gov/im/units/chis.

4.3.2.2 Sea Urchins

Sea urchins are marine invertebrates belonging to the phylum Echinodermata.[3] Largely herbivorous, they occupy low-intertidal or subtidal depths and play a key role in southern California kelp communities.

Sea urchins are characterized by a hard test, or shell, with radiating spines that are used for locomotion, burrowing, or defense (Figure 4-6). Interspersed with the spines are pedicellariae (small pinchers) and tube feet, which are used for respiration, locomotion, and grasping. The mouth, located on the lower surface of the body, is equipped with a complex jaw apparatus called "Aristotle's lantern," which is used for grazing or scraping food and (in purple urchins) for excavating burrows (Durham *et al.* 1980). Urchins may be rare in one area and abundant in another, but overall, red (*Strongylocentrotus franciscanus*) and purple (*S. purpuratus*) urchins are common in the Southern California Bight. White (*Lytechinus anamesus*) urchins are also common in the Southern California Bight, though they have a patchy distribution. The warm-water diadematid urchin *Centrostephanus coronatus* has increased dramatically in abundance in southern California waters in the last 15 years and is now common in the southern portions of the Southern California Bight to about mid-Santa Cruz Island (Kushner pers. comm. 2002).

FIGURE 4-6. RED SEA URCHIN SURROUNDED BY PURPLE SEA URCHINS.
Photo by Sherry Ballard, © California Academy of Sciences. Used by permission.

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

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

urchins reach the age of 50 (Ebert and Southon 2003).

Sea urchins are generally viewed as the subtidal grazers having the greatest impact on macrophytes in the Southern California Bight (Murray and Bray 1993). In food-rich conditions, when there is an abundance of drift kelp (in southern California, primarily pieces of *Macrocystis pyrifera* that break off live plants and drift down to the bottom), sea urchins tend to remain stationary. However, when food is scarce, hungry sea urchins may aggregate and go in search of food, feeding on the holdfasts and other parts of live kelp plants, thereby denuding areas of kelp and ultimately replacing them with urchin "barrens" (reviewed in Thompson *et al.* 1993). The ecological relationship between sea urchins and kelp abundance is addressed in greater detail in section 6.2.2.

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

The distribution of sea urchins in southern California falls roughly along a depth gradient, with purple urchins occurring shallowest (in the low intertidal and upper subtidal zones); red urchins predominating at intermediate depths; and *C. coronatus* occurring in subtidal waters deeper than 10 meters (Thompson *et al.* 1993). White urchins often occur on sandy or muddy bottoms and at depths of 2 to 300 meters (Durham *et al.* 1980). No estimate of absolute sea urchin abundance is available for the Southern California Bight, but the Kelp Forest Monitoring Program of the Channel Islands National Park gives a year-to-year picture of the relative abundance of these species at sixteen sites throughout five of the Channel Islands (San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara). In the latest available results (for 2001), 4 of the 16 sites were dominated by kelp, and the remainder were dominated by echinoderms: 2 by purple sea urchins; 1 by red sea urchins; 5 by purple and red sea urchins; 1 by purple and white sea urchins; 1 by purple and red sea urchins and brittle stars (*Ophiothrix spiculata*); and 1 by purple sea urchins, aggregated red sea cucumbers (*Pachythyone rubra*), and cup coral (*Astrangia lajollaensis*) (Kushner *et al.* 2004). The 2001 results reflected a decline in sea urchin abundance overall when compared to recent years, although it remains extremely high (Kushner *et al.* 2004). This pattern of sea urchin population growth and decline is believed to reflect the "aftereffects" of the strong 1997-8 El Niño event because of similarities with trends in the late 1980s following the strong 1982-3 El Niño event (Kushner *et al.* 2004).

4.3.2.3 California Spiny Lobsters

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

California spiny lobsters have long antennae and, like other crustaceans, a hard exoskeleton. Growth requires regular molting, during which spiny lobsters are particularly vulnerable to predators. Growth rates of California spiny lobsters are variable and depend on size and sex of the lobster as well as on food availability. Larger animals grow more slowly, and sick or injured animals can stop growing entirely until they have recovered. California spiny lobsters generally reach maturity at five or six years of age and may live to age 20 (females) or 30 (males). During mating, which occurs between November and May, the male attaches a sperm packet to the underside of the female's carapace, which she uses to fertilize eggs that are attached to the underside of her tail (generally in May and June). Tiny pelagic larvae hatch from the eggs and are carried in ocean currents to distances of 560 kilometers offshore and to depths of more than 120 meters. After five to nine months, the larvae become juveniles that resemble tiny adults. Assisted by eddies, juveniles swim inshore and settle in shallow vegetated reefs, especially subtidal surfgrass beds (Engle 1979). Mature lobsters move to rocky habitat.

FIGURE 4-7. CALIFORNIA SPINY LOBSTER.
Photo by Shane Anderson. Used by permission.

California spiny lobsters play an important role in subtidal ecosystem dynamics. Hiding by day in rocky crevices, usually in groups, these predators and scavengers emerge at night to feed on a variety of marine organisms, including algae, snails, mussels, clams, sea urchins, fish, and injured or vulnerable (newly molted) lobsters. At a marine reserve at Anacapa Island (closed to lobster fishing) lobsters substantially reduced sea urchin densities (Lafferty and Kushner 2000). Predators of California spiny lobsters include octopuses (*Octopus* spp.), several species of large fishes (including sheephead, cabezon [*Scorpaenichthys marmoratus*], kelp bass, rockfishes, and giant sea bass [*Stereolepis gigas*]), California moray eels

[4] The phylum Arthropoda includes a great variety of organisms that abound in the sea as well as in fresh water and on land. Arthropods are characterized by the possession of a supporting exoskeleton, jointed appendages, and a segmented body. The majority of arthropods in the sea today belong to the Subphylum Crustacea. Crustaceans include shrimps, prawns, lobsters, hermit crabs, and true crabs, among others (Abbott and Haderlie 1980b).

(*Gymnothorax mordax*), horn sharks (*Heterodontus francisci*), leopard sharks (*Triakis semifasciata*), and sea otters. Commercial fishing and sport fishing represent an additional source of mortality for California spiny lobsters, with commercial landings for California ranging from 400,000 to 950,000 pounds annually during the 1980s and 1990s. Human harvest is addressed further in section 4.4.2.3

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

4.3.2.4 Sand Crabs

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

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

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

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

4.3.2.5 Rock and Sheep Crabs

Rock and sheep crabs are marine arthropods of the Subphylum Crustacea. Unless

otherwise noted, the following information is derived from Morris *et al.* (1980).

Many brachyurans, or "true" crabs, occur in the nearshore waters of southern California, including rock crabs (*Cancer* spp.) and sheep crabs (*Loxorhynchus grandis*) (Figure 4-8). Rock crabs belong to the family Cancridae, whereas sheep crabs are the largest member of the spider crab family, the Majidae. Rock and sheep crabs generally occur in rocky areas, but some occur in sandy areas. Dungeness crabs (*Cancer magister*) are considered rare south of Point Conception (Hankin and Warner 2001) and will not be considered here.

FIGURE 4-8. SHEEP CRAB
Photo by Shane Anderson. Used by permission.

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

Rock crabs are predators and scavengers, preying on snails, clams, abalone, barnacles, and oysters (Parker 2001). In turn, they serve as food for such fishes as cabezon, barred sand bass (*Paralabrax nebulifer*), a number of species of rockfish, octopus, sea stars, and sea otters (Parker 2001). Humans are also a significant predator on rock crabs. The commercial rock crab fishery has had localized effects on rock crab size and abundance (Parker 2001).

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

Rock crabs inhabit the low intertidal zone to depths of more than 90 meters and range from Alaska to Baja California, Mexico, with yellow rock crabs (*C. anthonyi*) preferring sandy areas and brown (*C. antennarius*) and red (*C. productus*) rock crabs preferring rocky habitat (Parker 2001). Yellow rock crabs are most abundant off southern California; brown and red rock crabs are more abundant in central and northern California, respectively (Parker 2001). Rock crab stock sizes are unknown (Parker 2001). Sheep crabs occur in waters from 6 to 122 meters deep between Marin

County, California and Baja California, Mexico, but their greatest numbers occur off southern California (Culver and Kuris 2001). Large populations occur off Los Angeles and San Diego (Culver and Kuris 2001).

4.3.2.6 Abalone

Abalone are marine invertebrates of the Phylum Mollusca.[5] Unless otherwise noted, the following information is derived from Haaker *et al.* 2001.

Abalone are typically sedentary herbivorous marine snails of the genus *Haliotis* (Morris *et al.* 1980). These gastropods are characterized by the possession of an enlarged, muscular foot and a flattened spiral shell with a row of holes over the mantle cavity that allows for the expulsion of waste materials and water from the gills (Morris *et al.* 1980). Seven species of abalone occur in California: black (*Haliotis cracherodii*), red (*H. rufescens*), pink (*H. corrugata*), green (*H. fulgens*), white (*H. sorenseni*), flat (*H. walallensis*), and pinto (*H. kamtschatkana*. Threaded abalone (*H. assimilis*) were formerly considered to be a distinct species but are now considered to be a southern subspecies of pinto abalone. Flat and pinto abalone are generally restricted to the cooler waters north of Point Conception and will not be considered further here. Black abalone were designated a candidate species under the Endangered Species Act in 1999 [64 FR 33466], and white abalone were listed as endangered under the Endangered Species Act in 2001 [66 FR 29046] due to human over-exploitation. Black abalone and white abalone are addressed further under "Candidate, Threatened, and Endangered Species."

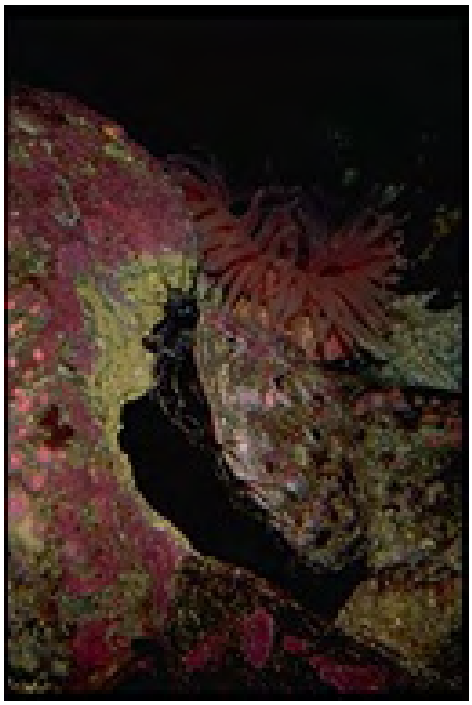

FIGURE 4-9. RED ABALONE (PICTURED WITH SEA ANEMONE). Photo by Gerald and Buff Corsi, © California Academy of Sciences. Used by permission.

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

[5] Mollusks as a group are named for their soft bodies and are characterized by extreme diversity of form. Mollusks generally have a three-part body structure consisting of a head, a foot, and a visceral mass (although one or more of these elements may be scarcely identifiable as such in some organisms). Additionally, many have a shell, and most have hard mouthparts. The phylum consists of seven classes, including the gastropods (snails, slugs, and allies), bivalves (clams, mussels, oysters), cephalopods (octopus, squid), and others. Gastropods are by far the most numerous representatives of the phylum, accounting for over 80 percent of living molluscan species, and are further divided into three subclasses. The subclass Prosobranchia of the Gastropoda consists of the marine snails, such as abalone, limpets, turban snails, and top snails (Abbott and Haderlie 1980c; Abbott and Haderlie 1980d).

centimeters; and black at about 5 centimeters.

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

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

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

4.3.2.7 Clams and Mussels

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

Clams and mussels are bilaterally symmetrical mollusks of the class Bivalvia. Numerous species of clams and mussels occur in southern California waters. Sandy or muddy substrates in the low intertidal and subtidal zones are habitat for littleneck (*Prothothaca staminea*), Washington (*Saxidomus nuttallii*), jackknife (*Tagelus californianus*), Pacific gaper (*Tresus nuttallii*) and Pismo (*Tivela stultorum*) clams, among others. California mussels (*Mytilus californianus*) are some of the most common invertebrates on rocky shores and sometimes occur in mixed beds with Mediterranean mussels

(*M. galloprovincialis*, formerly thought to be *M. edulis*) in more protected areas (Richards and Trevelyan 2001) (Figure 4-10). Clams and mussels are generally sedentary, but some species can use their muscular foot to burrow into soft sediment, bore into hard substances, or glide along substrates much like snails. Many bivalves attach to solid substrates by means of byssal threads, organic threads secreted by glands near the base of the foot. Siphons in some bivalves facilitate the circulation of water, which is crucial to respiration and feeding.

Littleneck, Washington, jackknife, Pacific gaper, and Pismo clams have a planktonic larval period, after which they settle to the substrata and lead a relatively sedentary existence. Littleneck clams usually spawn in southern California between March and July and can reach a maximum shell length of 7 to 8 centimeters (Reilly 2001). Washington clams spawn between spring and fall and grow to a length of almost 18 centimeters (Moore 2001a). Jackknife clams spawn year round, with an apparent peak in early spring, and reach maturity at a shell length of 6 to 12 centimeters (Emmett *et al.* 1991). Gaper clams spawn beginning in spring at 2-3 years of age and may attain a length of 25 centimeters (Moore 2001b). Pismo clams spawn generally from June to September and grow continuously throughout their lives, reaching a shell length of about 11 centimeters in five to nine years (Pattison 2001). California and Mediterranean mussels spawn year round, producing free-swimming larvae that metamorphose and settle onto substrates within a few weeks (Richards and Trevelyan 2001). The growth rate of mussels depends primarily on food availability rather than temperature, and they can reach a shell length of about five centimeters in six to eight months (Richards and Trevelyan 2001).

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

FIGURE 4-10. MUSSELS (PICTURED WITH GOOSENECK BARNACLES).
Photo by Sherry Ballard, © California Academy of Sciences. Used by permission.

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

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

4.3.2.8 Fishes

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

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

More than 125 fish species utilize rocky reefs and associated kelp forest habitat in the Southern California Bight (Figure 4-11). The abundance of some fishes, such as kelp surfperch (*Brachyistius frenatus*), kelp bass (*Paralabrax clathratus*), giant kelpfish (*Heterostichus rostratus*), and kelp rockfish (*Sebastes atrovirens*), is directly related to kelp density. Kelp forests provide important habitat for some juvenile fishes, including kelp bass, giant kelpfish, and kelp surfperch.

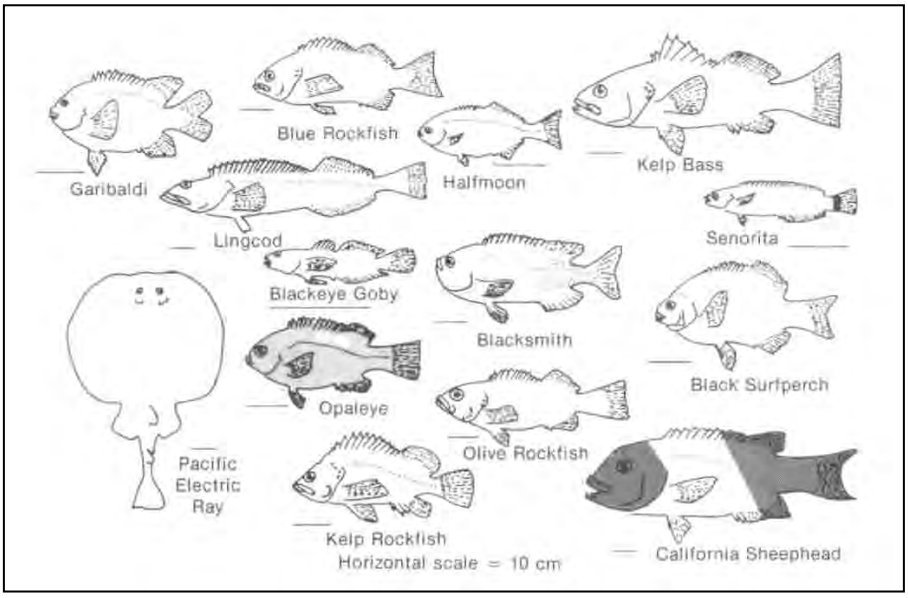

FIGURE 4-11. COMMON KELP FOREST FISHES. Source: Foster and Schiel 1985 (redrawn from Miller and Lea 1972).

Other common kelp forest fishes include blacksmith (*Chromis punctipinnis*), garibaldi (*Hypsypops rubicundus*), senorita (*Oxyjulis californica*), halfmoon, opaleye, blue rockfish (*Sebastes mystinus*), California sheephead, and the surfperches (Family Embiotocidae) (Foster and Schiel 1985).

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

4.3.3 Candidate, Threatened, and Endangered Species

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

4.3.3.1 White Abalone

Unless otherwise noted, the following information is derived from Haaker *et al.* (2001).

White abalone (Figure 4-12) are the deepest living of *Haliotis* species that occur along the west coast of North America (Hobday and Tegner 2000). They have a high, oval shell with a row of pores (the largest three to five of which are open) spiraling to the highest part of the shell. They may live 35 or 40 years, with a growth rate (based on observations of a few individuals in the laboratory) of about 2.5 centimeters per year for the first five years of life and slower growth thereafter. White abalone shell lengths of almost 25 centimeters have been reported in California (Hobday and Tegner 2000). Spawning occurs in winter with the simultaneous release of gametes by male and female individuals, although the trigger remains unknown. As with other abalone, reproductive success depends on the density of individuals, the period of spawning, the quantity of gametes produced, and good settlement conditions for the larvae.

White abalone are herbivorous, feeding on bacterial and diatom films as juveniles and deep-water kelp (both attached and drift) as adults. They have been observed at the borders between rocky and sandy substrate, where drift kelp is easier to capture.

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

	Species	Status	Year Listed
Invertebrate	White abalone (*Haliotis sorenseni*)	Endangered	2001
	Black abalone (*Haliotis cracherodii*)	Candidate	1999
Bird	Western snowy plover (*Charadrius alexandrinus nivosus*)	Threatened	1993
	California least tern (*Sterna antillarum browni*)	Endangered	1970
	Bald eagle (*Haliaeetus luecocephalus*)	Threatened	1966
	Brown pelican (*Pelecanus occidentalis*)	Endangered	1970
Mammal	Steller sea lion (*Eumetopias jubatus*)	Threatened	1990
	Guadalupe fur seal (*Arctocephalus townsendi*)	Threatened	1985
	Southern sea otter (*Enhydra lutris nereis*)	Threatened	1977

FIGURE 4-12. WHITE ABALONE
Photo courtesy of Channel Islands National Marine Sanctuary. Used by permission.

Predators of white abalone include sea stars, octopus, crabs, lobsters, and fishes such as sheephead, cabezon, and bat rays. Sea otters are not believed to be an important predator of white abalone because of the depths at which white abalone typically occur. Human harvest, which began commercially in the late 1960s after the serial depletion of red, pink, and green abalone populations, has affected white abalone significantly and is believed to be the primary cause of dramatic declines in white abalone abundance. Annual white abalone landings totaled 144,000 pounds in 1972 but subsequently declined, reaching very low levels by the early 1980s.

White abalone occupy rocky substrata at depths of 18 to 60 meters from Point Conception to mid-Baja California, Mexico. Although individuals may occasionally be found in shallower waters, they are typically found at depths greater than about 25 meters. Currently, white abalone have been reduced to remnant populations in the deepest areas (below 33 meters) of their range (CDFG 2002c). Abundance is believed to have declined by 99 percent from numbers existing 25 years ago (Hobday and Tegner 2000). Total abundance throughout the range of the species is estimated at about 1,600 animals (based on survey data from 1997) (Hobday and Tegner 2000). In contrast, the estimated baseline abundance (based on commercial landings data from 1969-1978) was 363,000 animals (Hobday and Tegner 2000).

White abalone were federally listed as endangered in May 2001 because of dramatic declines in abundance due primarily to overharvesting for human consumption [66 FR 29046]. Currently, white abalone are nearly extirpated, with no appreciable recruitment having occurred since the late 1960s or early 1970s and most individuals likely reaching the end of their life spans. Even in the absence of human harvest, which has been illegal since the closure of the abalone fishery in 1996, remaining white abalone are at risk because of severe Allee effects (animals may be too far apart for successful fertilization to occur) due to reduced concentrations of individuals and because of natural mortality (from old age and predators such as fishes, octopuses, and sea stars) (CDFG 2002c).

4.3.3.2 Black Abalone

Unless otherwise noted, the following information is derived from Haaker *et al.* (2001).

Black abalone (Figure 4-13) have a smooth bluish-black or gray shell, generally with 5 to 9 (but sometimes as many as 14) open pores flush with the shell surface. They are relatively long-lived and can reach an age of 25 years or more. Growth is believed to vary with stress, food availability, and climate but is most rapid during the first 5 to

10 years of life. Although maximum shell lengths can exceed 20 cm (Morris *et al.* 1980), most individuals are sexually mature at less than 5 cm. Black abalone spawn in spring and early summer and may spawn again in the fall. Newly settled larvae, juveniles, and abalone up to 10 cm in length usually remain cryptic, inhabiting deep fissures or areas beneath rocks. When not subject to harvesting or predation pressure, larger abalone can aggregate in large numbers on rocks or in tidepools.

The primary food of adult black abalone is drift algae, whereas juveniles consume bacterial films. Predators of black abalone include sea stars, octopus, crabs, and sea otters. Because sea otters effectively restrict abalone to cryptic habitat by preying on emergent animals, the extirpation of sea otters from their former range in southern California is believed to be responsible for the large aggregations of black abalone (as well as other abalone) that were evident in California and Mexico during the nineteenth and twentieth centuries. Black abalone were fished during the second half of the nineteenth century until the fishery was closed in 1900. Twentieth-century commercial harvests began in the late 1960s at the Channel Islands and reached a zenith of almost 2 million pounds statewide in 1973. By 1990, however, landings had declined to 13 percent of the average annual catch of the 1970s and early 1980s (687,000 pounds). The collapse of black abalone stocks was the most recent in the series of serial depletions that characterized the California abalone fishery before its closure in 1996.

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

Black abalone generally occur in rocky intertidal habitat to depths of approximately 6 meters, often in areas heavily pounded by surf. Their range extends as far north as Oregon, but most occur between the San Francisco Bay and southern Baja California, Mexico, including the offshore islands. Once abundant, black abalone are now rare, due in part to the catastrophic effects of withering syndrome. Near Point Conception, mortalities of 39 to 97 percent have been observed (CDFG 2002c). Near Point Arguello (in Santa Barbara County), densities declined after withering syndrome was first detected and remained at low levels ($0.1/m^2$) through 2000, increasing slightly thereafter but remaining far below historic densities of up to $100/m^2$ (Davis 1993, CDFG 2002c).

Black abalone were listed as a candidate species under the Endangered Species Act in June 1999 [64 FR 33466]. Withering syndrome was first observed in individuals at the Channel Islands in 1985, and the disease has eliminated black abalone from large areas of their former range, including

the mainland coast of southern California. By the mid-1990s, only remnant populations persisted at the Farallon Islands and the Channel Islands and at locations along the mainland of northern and central California. Infected individuals manifest such symptoms as weight loss, atrophy of the foot, weakness, and lethargy.

4.3.3.3 Southern Sea Otters

Introduction

Southern sea otters (Figure 4-14) presently occupy the Southern California Bight only in relatively small numbers. About 30 animals reside year-round at San Nicolas Island, and seasonal movements bring groups of sea otters from the parent range into and out of areas to the southeast of Point Conception. In this section, we address sea otters in the parent range as well as those at San Nicolas Island because both the parent population and the island colony will be affected by the alternatives under consideration.

Listing History

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

General Ecology

Unless otherwise noted, the following information on the ecology of the southern sea otter is from Riedman and Estes (1990). The sea otter is the second largest member of the family Mustelidae and the second smallest marine mammal. The only marine mammal that is smaller is the South American marine sea otter (*Lutra felina*). Southern sea otters can weigh up to 40 kilograms and attain lengths of 140 centimeters. Males are larger than females. Southern sea otters have a typical life span of 11-15 years.

FIGURE 4-14. SOUTHERN SEA OTTERS.
Credit: Jeff Foott. Used by permission.

FIGURE 4-15. SOUTHERN SEA OTTER EATING CRAB.
Credit: Jeff Foott. Used by permission.

FIGURE 4-16. SOUTHERN SEA OTTER SURFACING WITH RED SEA URCHIN AND ROCK TOOL.
Credit: Jeff Foott. Used by permission.

Unlike most other marine mammals, sea otters have little subcutaneous fat. They depend on their clean, dense, water-resistant fur for insulation against the cold. Sea otters also maintain a high level of internal heat production to compensate for their lack of blubber. Consequently, their energetic requirements are high, and they are estimated to consume an amount of food equivalent to 23 to 33 percent of their body weight per day.

Contamination of the fur by oily substances can destroy its insulating properties and lead to hypothermia and death. The loss of the insulating properties of the fur greatly heightens the adverse effects of oil spills on southern sea otters and is one of the reasons that increased tanker traffic and the potential for oil spills was considered in the listing of the species.

Most southern sea otters reside within two kilometers of shore. The density of southern sea otters within most of the population's range is most likely related to substrate type. Rocky bottom habitats support an average density of five individuals per square kilometer, whereas areas with sandy bottoms support an average of 0.8 individuals per square kilometer.

Southern sea otters generally forage in both rocky and soft-sediment communities in water depths of 25 meters or less, although individuals occasionally move into deeper water. Rocky habitats that are topographically heterogeneous and support kelp forests are likely to support the greatest diversity and abundance of sea otter food resources, which include abalone, rock crabs, sea urchins, kelp crabs, clams, turban snails, mussels, octopus, barnacles, scallops, sea stars, and chitons. Because of their ability to eat large quantities of marine invertebrates, sea otters play an extremely important role in the nearshore marine community. Their mobility, forelimb dexterity, and ability to crush large invertebrates, either with their teeth or rocks, enable sea otters to prey on most invertebrates (Figures 4-15 and 4-16). The best refuges for invertebrates from predation by sea otters appear to be in deep holes and crevices in rocky areas or deep

water. The energetic inefficiency of consuming small prey items may also protect invertebrates of small size. Shallow water may also provide refuge for invertebrates; southern sea otters failed to find an "unusually dense concentration of Pismo clams [that occupied a very narrow band of habitat in the high intertidal (zone)] ... for several years" (CDFG 1999a).

Numerous reports exist of sea urchin, crab, and clam populations declining after sea otters inhabit an area. Generally, only more widely scattered, well-hidden, and smaller individuals remain after sea otters become established. Other studies have shown that populations of invertebrates begin to rebound once sea otters have left a site.

Although other factors are also likely to be involved, kelp forests appear to grow profusely in suitable areas where sea otters reduce the number and size of sea urchins. In turn, kelp forests provide shelter and food for various species of fish, which become established in areas where kelp forests regenerate.

The annual patterns in which southern sea otters move along the coast are complicated and vary between males and females. Generally, the home ranges of southern sea otters consist of several heavily used areas with travel corridors between them. Animals often remain in an area for a long period of time and then suddenly move long distances; these movements can occur at any time of the year.

Male southern sea otters have larger home ranges than females. Compared to males, most female southern sea otters are more sedentary. Occasionally, females travel long distances; 3 tagged adult females routinely moved between Monterey and Santa Cruz, a distance of 40 to 50 kilometers, for over 4 years. Juvenile males move further from natal groups than do juvenile females. Aggressive behavior exhibited towards the juvenile males by older males may be partially responsible for their more extensive travels. Most male southern sea otters leave the central portion of the range and travel to its ends during the pupping season, which occurs in the winter and spring (Riedman and Estes 1990).

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

Jameson (1998) notes that adult male sea otters are territorial and exclude juvenile and subordinate males from their territories. However, females move freely across these territories. Generally, southern sea otters occupy territories on a seasonal basis. During the winter and spring, males leave their territories and join male groups that also include juvenile and subordinate males. Maintaining territories during the winter and spring may not be profitable for male southern sea otters because of the reduced chance of encountering estrous females.

Additionally, winter storms may reduce the availability of resting sites in kelp. Males that are not defending territories are able to seek shelter in other areas with females or to move to new areas, such as at the edges of the range, where food resources may not be as limiting. The early results of research with sea otters in Washington show that testosterone levels in territorial males are three to four times higher than in non-territorial males. Consequently, the absence of females and the presence of greater food resources at the southern edge of the range may seasonally reduce stress between members of the species. This pattern of movement may not be universal throughout the southern sea otter's range. Some territorial males near Monterey appear to maintain their territories year-round (Riedman and Estes 1990). This disparity may be due to environmental differences between the study areas.

Reproduction

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

Distribution and Population Trends

Unless otherwise noted, the following information on distribution and population trends is summarized from USFWS (2003). Sea otters once ranged along the North Pacific rim from the northern Japanese islands to mid-Baja California, Mexico. Southern sea otters occupied the southern portion of this range, but the historical northern range limit of the subspecies is somewhat in question. Authors have placed it in northern California or Oregon or as far north as Prince William Sound in Alaska (Riedman and Estes 1990, Wilson *et al.* 1991). The California population prior to exploitation is thought to have numbered about 16,000 animals (CDFG 1976).

Following near-extinction because of exploitation during the 18th and 19th centuries, sea otters were legally protected from take in 1911 through the International Fur Seal Treaty. Subsequently, northern sea otters (*E. l. kenyoni*) recolonized most of the available habitat through the Kuril Islands, Kamchatka Peninsula, and across the North Pacific rim to about Prince William Sound. Populations had recovered to levels at or near carrying capacity throughout much of this region by the late 1980s but declined precipitously over large areas of western Alaska during the 1990s (Estes *et al.* 1998). The average rate of decline in this region has been about 17 percent per year, for a total population reduction of perhaps 80 to 90 percent in many areas (Doroff *et al*. 2003). The likely cause of these declines is predation by killer whales. Whereas the world population of sea otters was thought until recently to be well in excess of 100,000 individuals, the current total is probably much less. The most recent information indicates that the population has declined to a low density throughout its range, at least through the Aleutian archipelago (Doroff *et al.* 2003).

Figure 4-17 shows the historic and current distribution of sea otters throughout the species' range. The historic range of the species southeastward from Prince William Sound to central Baja California, Mexico remains uninhabited except for translocated colonies in southeast Alaska, British Columbia, and Washington (which grew at rates of 17 to 20 percent annually through the 1990s [Estes 1990]); the remnant

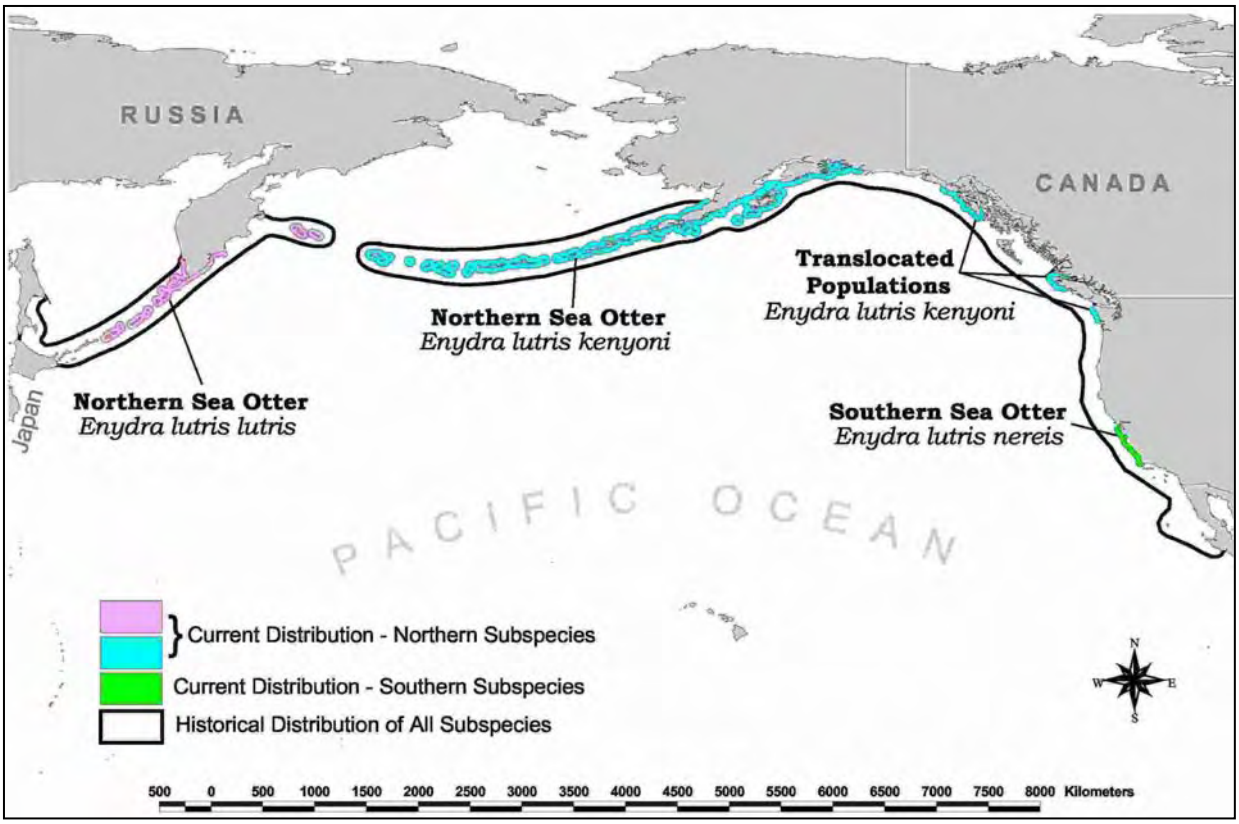

FIGURE 4-17. HISTORIC AND CURRENT RANGE OF THE SEA OTTER.

population of southern sea otters in central California; and the translocated colony at San Nicolas Island (which has grown at an average annual rate of about 9 percent since declining to its minimum size in 1992 and 1993).

Information on the distribution and abundance of sea otters in California prior to 1990 is summarized by Riedman and Estes (1990). Although both range and numbers have increased during the 20th century, these variables are not well correlated. In particular, whereas population abundance has declined during several periods, distribution evidently has not retracted during these periods.

Range delineation is somewhat arbitrary because individuals frequently wander well beyond the distributional limits of most of the rest of the population. Still, it is clear that the geographic range of the southern sea otter has expanded considerably since 1938, at which time most individuals occurred from about Bixby Creek in the north to Pfeiffer Point in the south. As the southern sea otter population increased during the following decades, range expansion to the south was always more rapid than it was to the north. By 1995, sea otters were commonly seen as far south as Point Arguello, and in 1998 a substantial number of sea otters dispersed southward beyond Point Conception.

Standardized range-wide counts of southern sea otters were initiated in 1982. Until 1995, when 2,377 otters were counted, the annual growth rate averaged about five percent. However, in each of four successive years (1996, 1997, 1998, and 1999), the total number of animals counted progressively declined, to a low of 2090 in

1999. This declining trend was evident in both the yearly counts and in the same data plotted as 3-year running averages, which are generally used for trend analysis to reduce the influence of anomalously high or low counts (USFWS 2003). Recent spring surveys (conducted in 2000, 2001, 2002, 2003, and 2004) counted 2,317, 2,161, 2,139, 2,505, and 2,825 sea otters, respectively. The 2004 count represents an increase of about 13 percent over the 2003 count, and the 3-year running average for 2003 represents an increase of about 9.8 percent over the 3-year running average for 2002 (Figure 4-18).

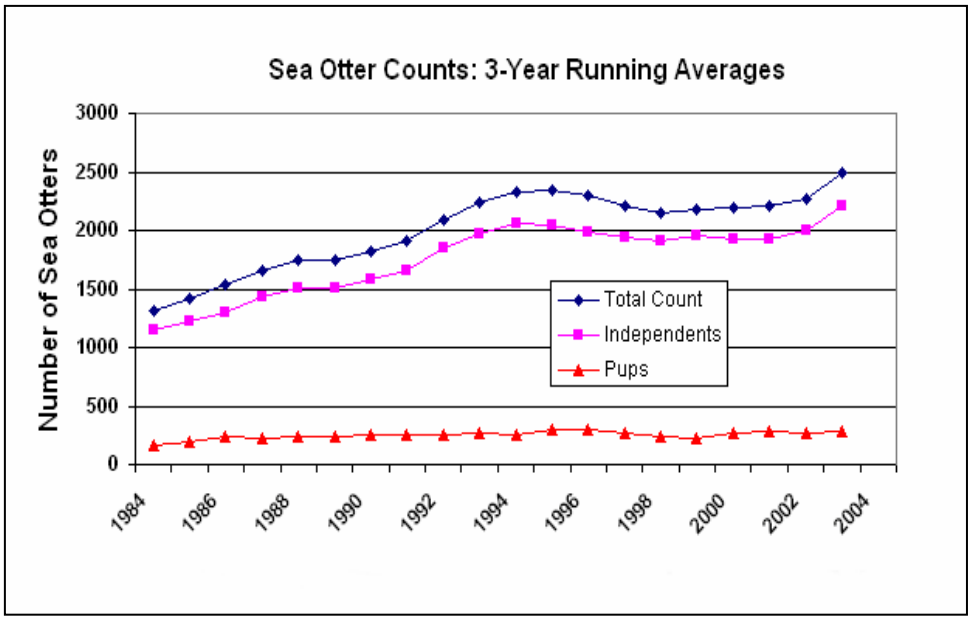

FIGURE 4-18. TOTAL NUMBER OF SOUTHERN SEA OTTERS COUNTED DURING SPRING SURVEYS (1983-2004) PLOTTED AS 3-YEAR RUNNING AVERAGES.
Source: U.S. Geological Survey (2005). http://www.werc.usgs.gov/otters/

MORTALITY

Unless otherwise noted, the following information on mortality is summarized from USFWS (2003).

An effort to document all southern sea otter strandings (live and dead sea otters that wash ashore) has been underway since 1968. While most stranded sea otters are found dead, some live sea otters are also retrieved and are included in the stranding database. Assessment of sea otter mortality in recent years is based almost exclusively on information obtained from beach-cast carcasses (Estes *et al.* 2003). Two measures are available: 1) the number of carcasses retrieved, and 2) the cause of death in fresh carcasses. The number of carcasses recovered through time shows an overall pattern that is roughly consistent with population growth (Figure 4-19). However, the relative mortality (measured by dividing the number of carcasses retrieved in a given year by the number of otters counted in the spring survey of that same year) suggests several departures from a time-constant relationship (Figure 4-20). These data suggest that mortality was roughly constant at about 5 percent during the period when the population was growing (from about 1985 through 1995) but was somewhat higher during periods of apparent decline (*i.e.*, the early 1980s and from 1996 through 1999).

Net entanglement is estimated to have caused an average of 80 deaths per year (Wendell *et al.* 1985) from at least the mid-1970s to the early 1980s. Entanglement mortality appears to have caused the population to decline during that period because restrictions on the use of gill and trammel nets were followed by a resumption

of population growth (Estes 1990). There is also evidence that the rate of pre-weaning mortality in central California is higher than it is in growing populations in Alaska (Siniff and Ralls 1991, Riedman *et al.* 1994, Monson *et al.* 2000), perhaps explaining, in part, the comparatively low growth rate in the southern sea otter population. However, the age composition of beach-cast sea otters in California demonstrates that prime-age adults also have experienced elevated mortality rates.

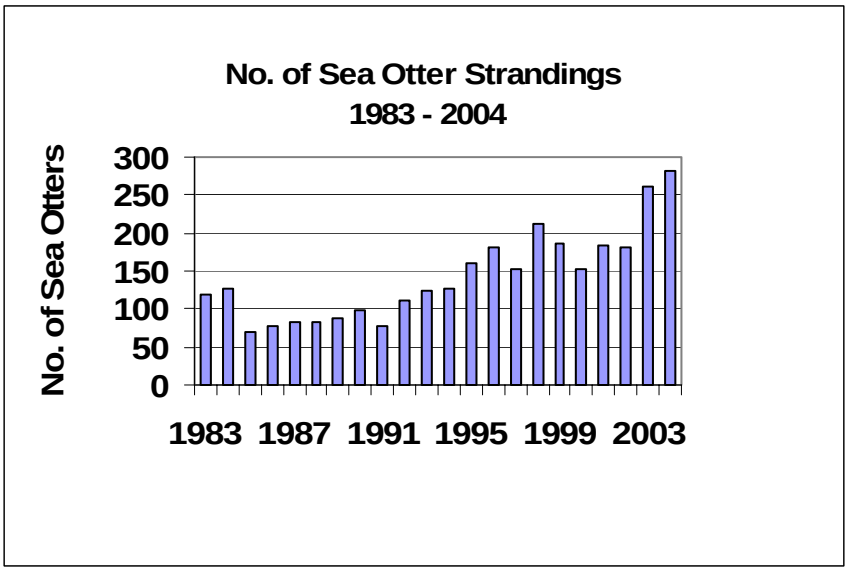

FIGURE 4-19. NUMBER OF SOUTHERN SEA OTTER STRANDINGS, 1983-2004.
Source: U.S. Geological Survey (2005). http://www.werc.usgs.gov/otters/

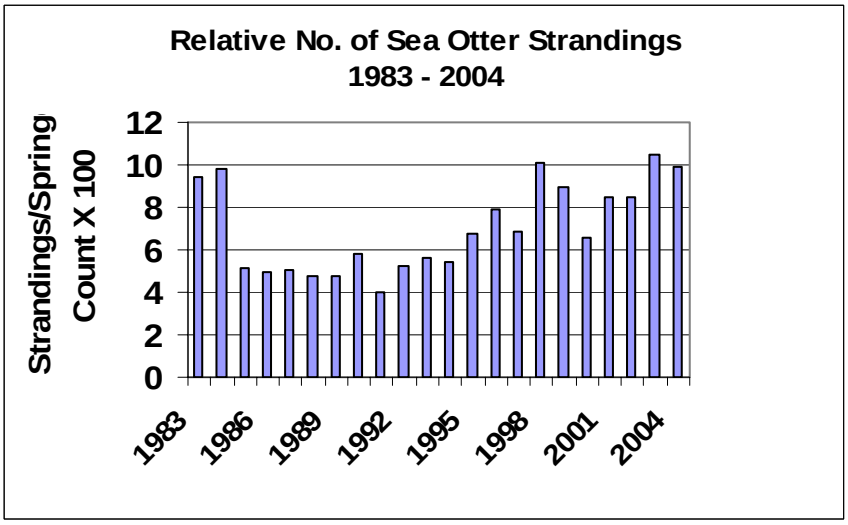

FIGURE 4-20. RELATIVE NUMBER OF SOUTHERN SEA OTTER STRANDINGS, 1983-2004.
Source: U.S. Geological Survey (2005). http://www.werc.usgs.gov/otters/

Three possible explanations for the recently increased mortality and reduced population abundance of the southern sea otter have been suggested: increases in the rate of infectious disease; incidental losses in coastal fishing gear; and decreases in food abundance. It should be recognized that two or more of these factors may affect the dynamics of the southern sea otter at a given time. Disease is responsible for roughly 40 percent of the deaths in animals obtained from the salvage program. Infectious diseases in the southern sea otter are almost entirely the consequence of parasites and microbes for which the sea otter is not a natural host (USFWS 2003). While coastal live trap fisheries are known to have intensified in recent years, and there are unconfirmed reports of otters having been incidentally drowned, sufficient information to evaluate this potential source of mortality is not presently available.

Research on sea otter foraging behavior and movements is ongoing. The data being collected will be useful in determining what role food availability plays in the recovery of the southern sea otter.

4.4 Socioeconomic Environment

4.4.1 Overview: Use Value, Non-Use Value, and Regional Economic Context

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

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

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

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

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

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

Non-rivalrous uses of the Southern California Bight that occur *onsite* include marine mammal and bird watching, tidepooling, kayaking, observational diving, and photography. Although these activities are not intended to cause harm to the organisms being observed, they may sometimes have such effects, and in these cases they cannot be considered to be strictly non-rivalrous. The value derived from non-rivalrous onsite activities is somewhat difficult to estimate because the goods derived are not generally traded on markets, but it can be quantified (with varying degrees of reliability) in terms of the time and travel costs people are willing to pay to perform these activities.

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

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

A third kind of non-use value is pure existence value: the belief that animals, plants, and environments have intrinsic worth regardless of their utility for humans. Pure existence value is "biocentric" rather than "anthropocentric," in that living organisms and their habitats are valued for their own sake. Biocentric values are becoming increasingly important to many people's views about how humans should interact with nature. Non-use values are notoriously difficult to quantify, but they are an important part of the social environment of the Southern California Bight.

Because of the difficulty and speculative nature of attempts to quantify offsite non-rivalrous consumption and all types of non-use value (including existence value), we do not explicitly address these values as socioeconomic impact topics. However, we implicitly address some of these values in our discussion of agency activities, some of which are focused on preserving and enhancing ecosystems and environments for their intrinsic value.

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

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

County	Total Personal Income for 2003 (thousands of 2004$)	Per Capita Income
Santa Barbara County	$13,904,248	$34,519
Ventura County	$28,602,282	$36,179
Los Angeles County	$319,574,990	$32,410
Orange County	$119,333,549	$40,314
San Diego County	$107,400,198	$36,795
Total	$588,815,266	

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

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

4.4.2 COMMERCIAL FISHERIES

4.4.2.1 Overview

Commercial fishing occurs at various locations throughout the Southern California Bight. Numerous species of fish and shellfish are commercially taken in nearshore waters using a variety of gear types. The best information on commercial catch comes from the California Department of Fish and Game, which establishes and regulates fishery seasons and collects information on the amounts, types, locations, and ex-vessel values of fish caught each year. These data are organized by numbered statistical blocks (Figure 4-21). Landings (the number of pounds of fish caught and delivered to shore) are recorded by statistical block in pounds and dollar amount received.

Ex-vessel values represent the best available measure of the value of commercial fisheries, but certain deficiencies of this measure should be borne in mind. Ex-vessel value is a measure of the gross revenues taken in by commercial anglers and does not account for operating costs. Because operating costs vary among fisheries, ex-vessel values for different fisheries are not strictly comparable. Additionally, operating costs are often not available for the calculation of net revenues. Because ex-vessel values reflect gross rather than net revenues, they overestimate the gain to commercial fishers (Thomson 2001).

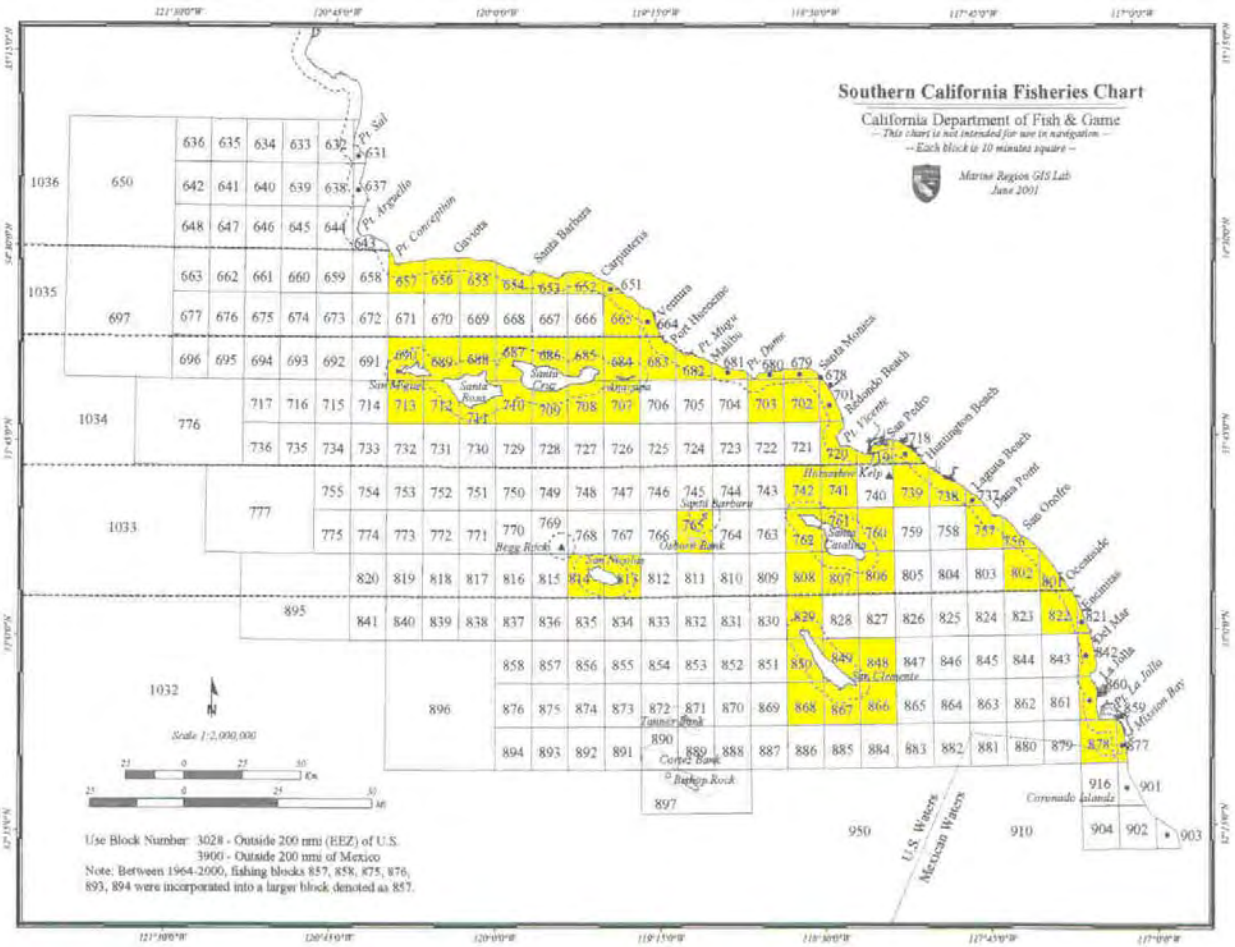

FIGURE 4-21. CALIFORNIA DEPARTMENT OF FISH AND GAME STATISTICAL BLOCK MAP, WITH NEARSHORE BLOCKS HIGHLIGHTED. Source: CDFG (2001).

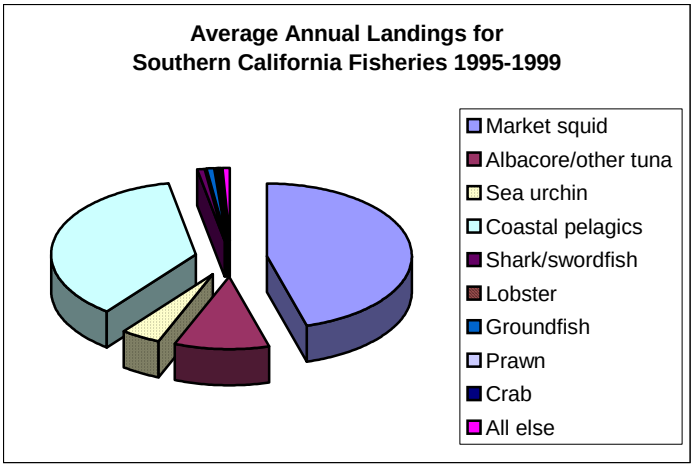

FIGURE 4-22. AVERAGE ANNUAL LANDINGS FOR SOUTHERN CALIFORNIA, 1995-1999. Source: Thomson (2001).

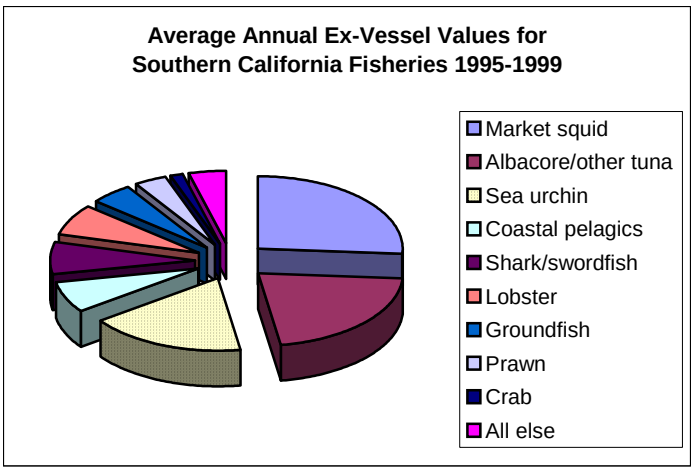

FIGURE 4-23. AVERAGE ANNUAL EX-VESSEL VALUES FOR SOUTHERN CALIFORNIA 1995-1999. Source: Thomson (2001).

Landings and ex-vessel values given in this chapter come from two different sources. Those for 1995-1999, which compare the proportional contributions of different fisheries, are from the latest available status report on the marine ecosystems and fisheries of California, *California's Living Marine Resources*, issued by the California Department of Fish and Game (Leet *et al.* 2001).[6] Other data presented in this overview section are from landings data provided by the California Department of Fish and Game for the blocks highlighted in Figure 4-21. These data are used for the analysis in Chapter 6 and are cited throughout this supplement as CDFG 2002a and 2005a.

A review of the top commercial landings in recent years provides a picture of the proportional significance of the fisheries that will likely be affected by the alternatives under consideration: sea urchin, lobster, crab, and (if attempts are made to reopen the fishery in the future) abalone. The proportional annual contribution of each fishery by pounds landed and ex-vessel revenue is shown in Figures 4-22 and 4-23, respectively.

From 1995-1999, southern California landings were dominated by market squid (45%), coastal pelagic fish (36%), and to a much lesser extent albacore and other tuna (11%), which together accounted for more than 90 percent of total landings. Ex-vessel values for these years were proportionally highest for market squid (26%), albacore and other tuna (21%), and sea urchins (18%). When combined, squid, tuna, and sea urchins accounted for 65 percent of the average annual ex-vessel receipts in these years. Revenues from lobster (7%) and crab (1%) were less significant.

[6]Landings data and ex-vessel values presented in Leet *et al.* (2001) are generally grouped into three regions: northern, central, and southern California. Southern California in this context includes not only the Southern California Bight but a portion of mainland coastline north of the Southern California Bight to just past Point Sal. Because this area is slightly larger than our area of consideration, landings and ex-vessel value totals taken from this source likely overestimate landings and ex-vessel values for the Southern California Bight. However, these data provide a good picture of the proportional contribution of each fishery to the southern California fishery as a whole.

TABLE 4-4. AVERAGE ANNUAL LANDINGS, EX-VESSEL VALUE, AND VESSEL PARTICIPATION IN MAJOR SOUTHERN CALIFORNIA FISHERIES 1995-1999

Major Southern California Fishery	Landings	Value (Base Year=1999)	Number of Participating Vessels	Number Participating as Principal Fishery
Squid seine/other net	129,556,200	$19,150,200	87	70
Urchin dive	13,007,900	$12,835,500	223	207
Tuna seine	23,001,500	$9,644,100	21	10
Tuna H&L	7,473,200	$5,736,900	115	65
Coastal pelagics seine	115,869,400	$5,671,800	46	23
Lobster trap	680,700	$5,157,500	202	168
Shark/swordfish gillnet	1,053,900	$2,548,200	80	50
Groundfish H&L	1,588,500	$2,193,800	205	157
Shark/swordfish H&L	795,600	$1,875,900	42	27
Prawn trawl	745,300	$1,679,900	27	19
Groundfish/misc. net	810,800	$1,232,300	58	31
Crab trap	900,400	$1,097,200	76	25
Prawn trap	135,100	$1,011,900	28	18
Abalone dive	87,600	$877,000	33	13
Groundfish/misc. trap	219,100	$663,200	66	19
Shark/swordfish dive	119,300	$632,000	24	20
Groundfish trawl	255,000	$525,300	32	20
Cucumber dive	398,600	$244,300	22	21

Source: Thomson (2001)

TABLE 4-5. AVERAGE ANNUAL LANDINGS AND EX-VESSEL VALUE PER BOAT FROM THE PRINCIPAL SOUTHERN CALIFORNIA FISHERY, 1995-1999

Major Southern California Fishery	Landings/boat/year from Principal fishery		Ex-Vessel Revenue/Boat/Year from Principal fishery (Base Year=1999)	
	Pounds	%	$	%
Squid seine/other net	1,516,900	69	226,000	82
Urchin dive	60,200	88	58,800	92
Tuna seine	1,882,100	59	806,400	88
Tuna H&L	105,000	67	70,500	63
Coastal pelagics seine	2,475,800	84	132,000	60
Lobster trap	3,700	49	28,200	81
Shark/swordfish gillnet	16,400	34	42,900	62
Groundfish H&L	8,900	82	12,200	88
Shark/swordfish H&L	26,800	73	62,800	78
Prawn trawl	32,500	33	79,400	77
Groundfish/misc. net	17,500	58	28,100	72
Crab trap	15,100	92	18,300	80
Prawn trap	6,100	66	47,400	83
Abalone dive	2,100	18	21,400	68
Groundfish/misc. trap	4,600	61	14,000	66
Shark/swordfish dive	5,200	81	27,300	94
Groundfish trawl	9,000	36	20,900	71
Cucumber dive	2,600	37	15,100	61

Source: Thomson (2001)

Revenues from all other species combined amounted to 4 percent of the total ex-vessel value for these years.

Table 4-4 gives the average annual landings, ex-vessel value, and number of vessels participating in the major fisheries of southern California for 1995-1999, with fisheries of particular interest (sea urchin, lobster, and crab) highlighted.

Table 4-5 gives landings and ex-vessel revenues *per boat* for vessels having a southern California fishery as a principal fishery. Fisheries of particular interest (sea urchin, lobster, and crab) are again highlighted.

Table 4-6 compares ex-vessel revenues for the commercial sea urchin, lobster, and crab fisheries in southern California to the total personal income for the coastal counties bordering the Southern California Bight. To be properly compared to total personal income, ex-vessel values should be adjusted upwards with a multiplier (appropriate to the county where the catch was landed) that translates ex-vessel value into income. Leeworthy and Wiley (2002) give multipliers of 2.1 for sea urchins, 2.0 for spiny lobsters, and 2.8 for crab landed and processed in Ventura County, but multipliers are different for each fishery and county where catch is landed. While multipliers differ somewhat for each fishery and county, it is clear that each of these fisheries accounts for only a small proportion of the regional economy, on the order of thousandths of one percent.

The following sections describe the commercial fisheries for sea urchin, lobster, crab, and abalone. Although the abalone fishery was closed entirely in southern California in 1997, we address it because efforts to reestablish abalone populations (and eventually the abalone fishery) are underway (CDFG 2002c).

TABLE 4-6. REVENUES OF POTENTIALLY AFFECTED SOUTHERN CALIFORNIA FISHERIES AND TOTAL PERSONAL INCOME, SOUTHERN CALIFORNIA COASTAL COUNTIES (THOUSANDS OF 2004$)

Fishery	Average Annual Ex-Vessel Fishery Revenue for SCB 1994-2003	Total Personal Income for 2003 Southern California Coastal Counties
Sea Urchin	$12,148	$588,815,266
Lobster	$5,023	$588,815,266
Crab	$1,136	$588,815,266

Data source: U.S. Department of Commerce, Bureau of Economic Analysis (www.bea.gov), California Department of Fish and Game (2002a, 2005a). See Tables 6-2, 6-5, 6-8 of this supplement for annual ex-vessel revenues by fishery for 1994-2003.

4.4.2.2 Sea Urchin Fishery

Unless otherwise noted, the following information is derived from Kalvass and Rogers-Bennett (2001).

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

Landings are dependent on a variety of factors, especially because the urchin's market value is in the gonads, not the body. Roe quality is primarily dependent on an urchin's access to kelp, which is its primary

food source. If there is a food shortage (usually due to an El Niño event), urchins go into a "starvation mode," where nutrients are allocated for survival, thereby causing atrophy and discoloration of the gonads. While urchin populations may persist at high densities, fishers will not expend fishing effort if the quality of the roe is low. Roe is extremely perishable, and short transport times are essential to the maintenance of quality (Kato and Schroeter 1985 in Price and Tom 1995).

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

The average annual sea urchin harvest in southern California between 1995 and 1999 was just over 13 million pounds, which resulted in an ex-vessel value of almost 13 million (1999) dollars (see Table 4-4). An average of 223 vessels participated in the fishery during these years. For 207 of these vessels, the sea urchin fishery in southern California was the principal fishery (see Table 4-4). These vessels derived 88 percent of their landings and 92 percent of their ex-vessel revenue from the southern California sea urchin fishery and the remainder from fisheries elsewhere (see Table 4-5).

4.4.2.3 Spiny Lobster Fishery

Unless otherwise noted, the following information is derived from Barsky (2001), hereby incorporated by reference.

Spiny lobsters have been commercially fished in southern California waters since the late nineteenth century. Currently, they are caught in traps constructed of wire mesh, which are baited with fish and weighted with cement, steel, or bricks. Lobster traps are required to have an approved destruct-device to ensure that they do not continue to capture marine organisms if lost or abandoned, and they must also have escape ports to facilitate the escape of undersize lobsters (those with a carapace length of less than 3 1/4 inches). Buoys bearing the trapper's license number followed by the letter P mark trap locations. Lobster traps are placed in relatively shallow, rocky areas from Point Conception south to Mexico and off the islands and banks of southern California. Some areas at Santa Catalina Island and in Santa Monica and Newport bays are closed to lobster fishing, as are

some marine life refuges and reserves. The largest numbers of lobsters are taken at the beginning of the season, which starts in early October; effort and catch decline sharply in January through mid-March, when the season ends. Landings are usually highest in San Diego County, followed by Los Angeles/Orange and Ventura/Santa Barbara counties. Since 1997, a formal restricted access program has been in place for the commercial fishery. All lobster fishers must have an operator permit ($285), and all deckhands must have a lobster crewmember permit ($125). Most of the lobster catch has been destined for Asian and French markets in recent years, although efforts to reestablish domestic markets have been undertaken because of depressed economies overseas.

Commercial landings of spiny lobsters for the state of California have been marked by fluctuations that reflect a number of factors, including market influences, weather patterns, the health of the population, and harvest regulations. Landings reached a high of 1.05 million pounds in the 1949-50 season. This record catch was followed by a quarter century of general decline. Landings remained between 400,000 and 500,000 pounds during much of the 1980s and between 600,000 and 800,000 pounds through much of the 1990s. Landings for the state of California reached a peak of 950,000 pounds in 1997-1998 but dropped thereafter.

The average annual lobster harvest in southern California between 1995 and 1999 was almost 700,000 pounds, which resulted in an ex-vessel value of just over 5 million (1999) dollars (Table 4-4). An average of 202 vessels participated in the fishery during these years. For 168 of these vessels, the lobster fishery in southern California was the principal fishery (Table 4-4). These vessels derived 49 percent of their landings and 81 percent of their ex-vessel revenue from the southern California lobster fishery and the remainder from fisheries elsewhere (Table 4-5).

4.4.2.4 Crab Fishery

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

Unless otherwise noted, the following information on rock crabs is derived from Parker (2001).

Rock crabs of three species are fished along the coast of California: yellow rock crab (*Cancer anthonyi*), brown rock crab (*C. antennarius*), and red rock crab (*C. productus*). Yellow rock crabs, which prefer soft-bottom habitat, are most abundant in southern California, whereas brown and red rock crabs are most abundant in central and northern California, respectively. More than 85 percent of the rock crab landings in California come from Morro Bay and south. Rock crabs are caught in traps made from either wire mesh or molded plastic. Most traps are set at depths of 90 to 240 feet in open sandy areas or near rocky substrate and are left submerged for 48 to 96 hours. Vessels are generally small, and 200 or more traps may be fished by a single boat. Current regulations require traps to have escape rings of 3.5 inches in diameter and require crabs kept to have a minimum

carapace length of 4.25 inches. Rock crab landings for the entire state of California steadily increased from 1950 to 1986, when they totaled over 2 million pounds. Statewide landings for 1999 were 790,000 pounds and have averaged 1.2 million pounds annually since 1991.

Unless otherwise noted, the following information on sheep crabs is derived from Culver and Kuris (2001).

Sheep crabs (*Loxorhynchus grandis*) are fished primarily over sandy bottoms, with effort concentrated in the Santa Barbara Channel and off the northern Channel Islands. Crabs are caught for the live whole crab market using traps. Traps are set in waters 30 to 70 feet deep in spring and summer and in depths of 120 to 240 feet in the fall and winter. Claws for the claw fishery come from set gill-nets, where the crab is usually killed in the claw removal process. Sheep crabs were not a significant fishery before 1984, when they were landed primarily as by-catch. Landings peaked in 1988 at over 100,000 pounds of live crabs and an additional nearly 400,000 pounds of claws (combined with rock crab claws). Claw landings decreased dramatically to 5,000 pounds annually after a ban on gill nets in shallow waters was phased in between 1990 and 1994. Whole crab landings remained at about 75,000 pounds annually during this period. In 1999, the retail value of the sheep crab fishery for the state of California was approximately $310,000.

Total crab landings in southern California waters averaged almost 900,000 pounds annually between 1995 and 1999, resulting in an ex-vessel value of over 1 million (1999) dollars (Table 4-4). An average of 76 vessels participated in the fishery during these years. For 25 of these vessels, the crab fishery in southern California was the principal fishery (Table 4-4). These vessels derived 92 percent of their landings and 80 percent of their ex-vessel revenue from the southern California crab fishery and the remainder from fisheries elsewhere (Table 4-5).

4.4.2.5 Gill and Trammel Net Fishery

Gill and trammel nets were used increasingly from the 1960s to the mid-1980s to catch rockfish, California halibut, white seabass, California barracuda, soupfin shark, angel shark, white croaker, and other nearshore species. At the peak of gill and trammel net use in 1985, 1,122 permits were issued (Schultze 2001). Because of conflicts with sport fisheries and mortality to seabirds and marine mammals due to entanglement in the nets, California citizens voted in a 1990 initiative to ban gill-net fishing in shallow waters, resulting in the Marine Resources Protection Act of 1990 (California Constitution Article 10B). This ban took full effect in 1994. With respect to southern California, it prohibits the use of gill and trammel nets in waters less than 70 fathoms or within one mile of the Channel Islands, whichever is less, and generally prohibits the use of gill and trammel nets within three nautical miles offshore of the mainland coast from Point Arguello to the Mexican border (Marine Resources Protection Act 1990). Because the use of gill and trammel nets is prohibited in the nearshore waters of the Southern California Bight, we do not consider gill and trammel net fishing further in this supplement.

4.4.2.6 Live-Fish Trap Fishery

The live-fish trap fishery emerged during the late 1980s in southern California waters, targeting shallow-water species, including California sheephead, cabezon, kelp greenling (*Hexagrammos decagrammus*), rock greenling (*Hexagrammos*

lagocephalus), California scorpionfish, a number of species of nearshore rockfish, and moray eels. Since then, the trap fishery has expanded northward and has targeted greater numbers of fish species. Numbers of trap fishery participants have also increased. In 1999, live-fish trap landings accounted for 7 percent of live/premium fish landings statewide. Since 1996, the southern California trap fishery has operated on a limited entry basis (Schultze 2001). A regulation requiring the use of 5-inch sea otter-exclusion rings in live fish traps went into effect for waters north of Point Conception in January 2002, but no regulations requiring such rings are in effect for southern California waters (Pattison pers. comm. 2002). The effectiveness of exclusion rings has not been documented. Despite continuing concerns about possible interactions between sea otters and trap fisheries, there are insufficient data to determine the effects that these traps could have on sea otters in the context of the alternatives under consideration. Therefore, we do not address the live-fish trap fishery further in this supplement.

4.4.3 Aquaculture

Aquaculture is the process of culturing, growing, and harvesting marine species in a controlled setting. Commercial aquaculture facilities in California are primarily focused on the production of shellfish such as abalone, oysters, and mussels (Wendell 2001). Abalone are grown in tanks on land or in cages suspended in the water column (Ebert 2001). Oysters are grown out in bays at privately owned or leased sites, with most oyster production occurring in areas north of Point Conception (Conte and Moore 2001). Much of the statewide mussel harvest comes from offshore platforms in the Santa Barbara Channel, with cultured mussels coming primarily from Tomales Bay and Agua Hediona Lagoon near Carlsbad (Richards and Trevelyan 2001). In April, 2002, 11 marine aquaculture facilities were registered with the state in southern California (in Santa Barbara, Ventura, Orange, and San Diego counties) (Moore pers. comm. 2002). Of these, five were growing abalone exclusively; two were growing abalone and other species of shellfish, finfish, or algae; three were growing mussels, rock scallops, and other shellfish species; and one was growing shrimp and prawns (Moore pers. comm. 2002).

Most commercial shellfish production in aquaculture operations has recently declined. Production of oysters, abalones, and mussels in California declined after peaking in 1994, 1996, and 1997, respectively (Wendell 2001). From 1992-1997, statewide mussel production grew from 187,000 pounds to 471,000 pounds but then dropped by almost 50 percent in 1998 due to El Niño conditions (Richards and Trevelyan 2001). Statewide mussel production returned about $500,000 annually in 1996 and 1997 but dropped to $280,000 in 1998 (Richards and Trevelyan 2001). Recent colder water regimes have improved mussel recruitment (Richards and Trevelyan 2001).

4.4.4 Seafood Processing Industry (Sea Urchins)

Information on the income earned from processing or marketing commercial fish and shellfish landings is usually not available, but ex-vessel value is equal to the cost to dealers of procuring fish and provides the best available measure of value (Thomson 2001).

Sea urchins require fairly intensive processing and packaging before their roe reaches Japanese markets (Price and Tom 1995). Fourteen sea urchin processing facilities are located in California, 12 of which are in southern California (Sea Urchin Harvesters Association-California 2003).

For the 10 southern California sea urchin processing facilities for which information could be found, 9 qualified as "small" processing groups (producing estimated group annual sales of $1 million to $5 million), and 1 qualified as "very small" (producing estimated group annual sales of $100,000 to $1 million) (Radtke and Davis 2000). The estimated value of finished pounds of sea urchin roe sold by primary processors throughout the entire state of California in 1996 was about $23 million (Radtke and Davis 2000).

4.4.5 Kelp Harvest

Giant kelp is harvested commercially for the production of algin, which is used as an additive in food, plaster and cement, textiles, paper, cosmetics, and pharmaceuticals. It is also used in aquaculture operations as food for abalone and for the production of herring-roe-on-kelp in the San Francisco Bay. Giant kelp supports a major industry in California. During the mid-1980s, the kelp industry was valued at more than $40 million per year (Bedford 2001).

Kelp harvest occurs along the coast from San Diego to Monterey Bay, but the vast majority of kelp is harvested from southern California waters by the San Diego based company ISP Alginates, Inc. (formerly Kelco). Figure 4-24 shows administrative kelp beds in the Southern California Bight.

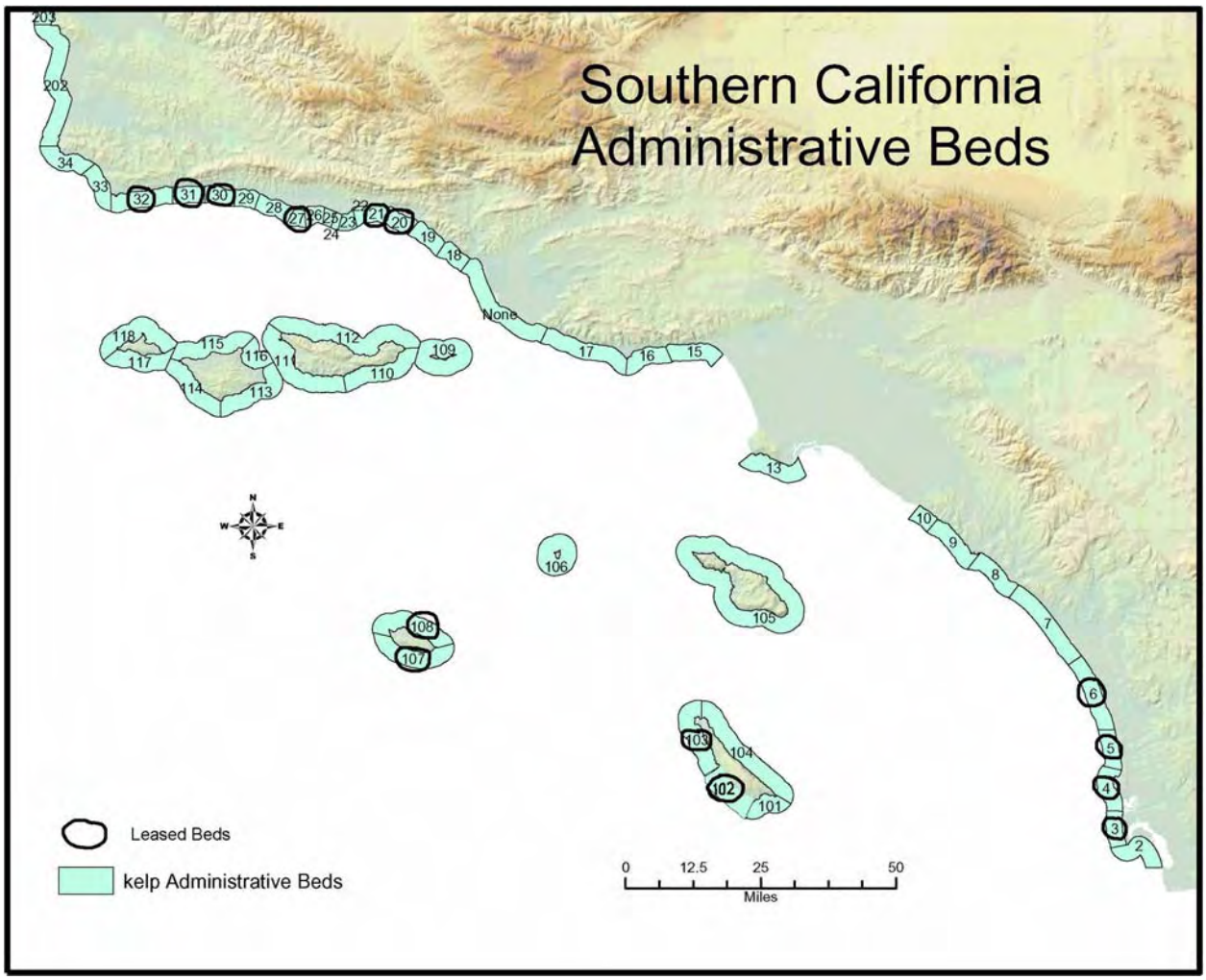

FIGURE 4-24. KELP LEASES IN SOUTHERN CALIFORNIA BIGHT. Currently leased beds are circled. Source: CDFG.

Annual kelp harvests fluctuate because of climate and growth cycles as well as market conditions of supply and demand. During the 1970s, the California harvest averaged almost 157,000 tons annually, whereas during the 1980s, the average annual harvest amounted to only about half that because of damage to kelp beds resulting from El Niño conditions and storm activity. By 1989 and 1990, statewide harvests had climbed again to more than 130 thousand tons and 150 thousand tons, respectively. International competition brought harvest levels down again during the 1990s to about 70 thousand tons annually. An annual California harvest of 80 thousand tons is expected during the coming decade (Bedford 2001).

The Southern California Bight has historically had the highest levels of giant kelp canopy when compared to the central and northern regions of the state because of favorable environmental conditions (periodic upwelling, the broad, shallow continental shelf, good bottom substrate, and the protection from storms afforded by Point Conception and the Channel Islands) (CDFG 2000a). From 1989-1999, the area near Cojo Anchorage (bed 32) was the second-highest-producing kelp bed in the state, with more than 100 thousand tons harvested (CDFG 2000a). The beds surrounding San Nicolas Island (107 and 108) are also important kelp harvesting areas, yielding between 10 and 80 thousand tons from 1989-1999 (CDFG 2000a). As of May 2005, 6 of the 12 kelp beds along the coastline from Point Conception to Santa Barbara and at San Nicolas Island were leased (kelp beds 27, 30, 31, 32, 107, 108) (Bedford pers. comm. 2005).

4.4.6. Recreational Fishing and Diving

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

Although there is no sport fishery for sea urchins, there is an economically significant sport fishery for lobsters. As with commercial lobster trapping, recreational diving for lobsters is most intensive and most successful during October (Barsky 2001). During 1995-1998, an average of 470,506 trips were taken on CPFVs in southern California waters each year, of which 39,542 (8.4 percent) were dive trips (Thomson 2001). From 1995 to 2001, an average of 9,625 recreational lobster dive trips were taken annually in southern California, including an average of 594 to San Nicolas Island and 11 to the coastline area between Point Conception and Santa Barbara (CDFG 1995, 1996, 1997, 1998, 1999b, 2000b, 2001).

4.4.7 Abalone Fishery Restoration

Unless otherwise noted, the information presented here is derived from Haaker *et al.* (2001), hereby incorporated by reference.

Abalone have been exploited in southern California since pre-colonial times. Archaeological evidence indicates significant use of abalone by California Indians along the mainland and at the Channel Islands before the arrival of

European settlers. During the 1850s, Chinese immigrants developed an intertidal abalone fishery that targeted black (*Haliotis cracherodii*) and green (*H. fulgens*) abalone. In 1900, shallow waters were closed to commercial harvest, and the intertidal fishery ended. Japanese free-divers and hard-hat divers began exploitation of deeper water abalone in the first few decades of the twentieth century. This fishery reached a peak in landings in 1935. By 1942, the fishery had declined significantly with the wartime relocation of Japanese-Americans to camps. In southern California, commercial abalone fishing was prohibited between 1913 and 1943, but the fishery was opened thereafter to increase food production during the war. In the post-war years, the abalone fishery was managed as a single entity, which had the effect of obscuring the serial depletion of individual abalone species.

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

The abalone fishery was closed in 1997, with the exception of a sport-only fishery for red abalone that continues north of San Francisco County. According to Thomson (2001), who gives abalone landings as a five-year average for purposes of comparison, Southern California abalone landings averaged 87,000 pounds annually between 1995 and 1999, resulting in an ex-vessel value of 877,000 (1999) dollars. An average of 33 vessels participated in the abalone dive fishery during these years. For 13 of these vessels, the abalone fishery in southern California was the principal fishery (Thomson 2001). These vessels derived 18 percent of their landings but 68 percent of their ex-vessel revenue from the southern California abalone dive fishery and the remainder from fisheries elsewhere (Thomson 2001).

4.4.8 ECOTOURISM

Tourism is the 3rd largest employer in the state of California and the 5th largest contributor to the gross state product (California Tourism 2003). Among ocean-dependent industries in California, coastal tourism is the most economically significant. Coastal tourism spending was the largest economic component among seven ocean-dependent industries studied by the Resources Agency of California, contributing $9.9 billion to the California economy in 1992 (Burroughs *et al.* 1997).[7] Expenditures for wildlife-watching activities in the state of California are the highest of any state and totaled about 2.6 billion dollars in 2001 (USFWS 2001). For comparison, expenditures for recreational fishing in California totaled about 2.0 billion dollars in 2001 (USFWS 2001).

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

[7] Seaports and shipbuilding contributed about $6.0 billion; offshore oil, gas, and mineral production contributed $852 million; and commercial fishing, aquaculture, and kelp harvesting contributed $554 million (Burroughs *et al*. 1997).

4.4.9 FEDERAL AND STATE AGENCY PROGRAMS

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

4.4.9.1 U.S. Fish and Wildlife Service

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

4.4.9.2 Channel Islands National Park

The Channel Islands National Park includes five of the eight Channel Islands and spans 249,353 acres, half of which are underwater. The park is home to more than 2,000 species of terrestrial plants and animals, a wide range of marine life, and archaeological and cultural resources dating back 10,000 years.

According to the *Strategic Plan for Channel Islands National Park*, the park's mission is to "protect and interpret the natural ecosystems and cultural values of the Channel Islands and adjacent marine waters […]." The park lies within a United Nations Biosphere Reserve, designated in 1976, which includes all eight Channel Islands (www.unesco.org/mab). The "Park Mission Goals" specify that natural, scenic, and cultural resources should be "protected, restored, understood, and maintained and managed within their broader ecosystem and cultural context" (CINP n.d.).

4.4.9.3 Channel Islands National Marine Sanctuary

The Channel Islands National Marine Sanctuary is one of 12 National Marine Sanctuaries in the United States. Completely surrounding Channel Islands National Park, the Channel Islands National Marine Sanctuary extends from mean high tide to six nautical miles offshore San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara Islands (Figure 4-25).

FIGURE 4-25. CHANNEL ISLANDS NATIONAL MARINE SANCTUARY

The sanctuary lies within a United Nations Biosphere Reserve, designated in 1976, which includes all eight Channel Islands (www.unesco.org/mab). Sanctuary waters host more than 27 species of cetaceans (dolphins and whales), 5 species of pinnipeds (seals and sea lions), 60 species of birds, and 23 species of sharks (CINMS 2002b). The mission of the National Marine Sanctuary Program is "to conserve and enhance biodiversity, ecological integrity and cultural legacy of areas of special national significance through comprehensive long term management and outreach" (CINMS 2002a).

4.4.9.4 California Department of Fish and Game

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

Marine Protected Areas (MPAs) are areas of the ocean that are reserved for the protection and restoration of habitats and ecosystems, the conservation of

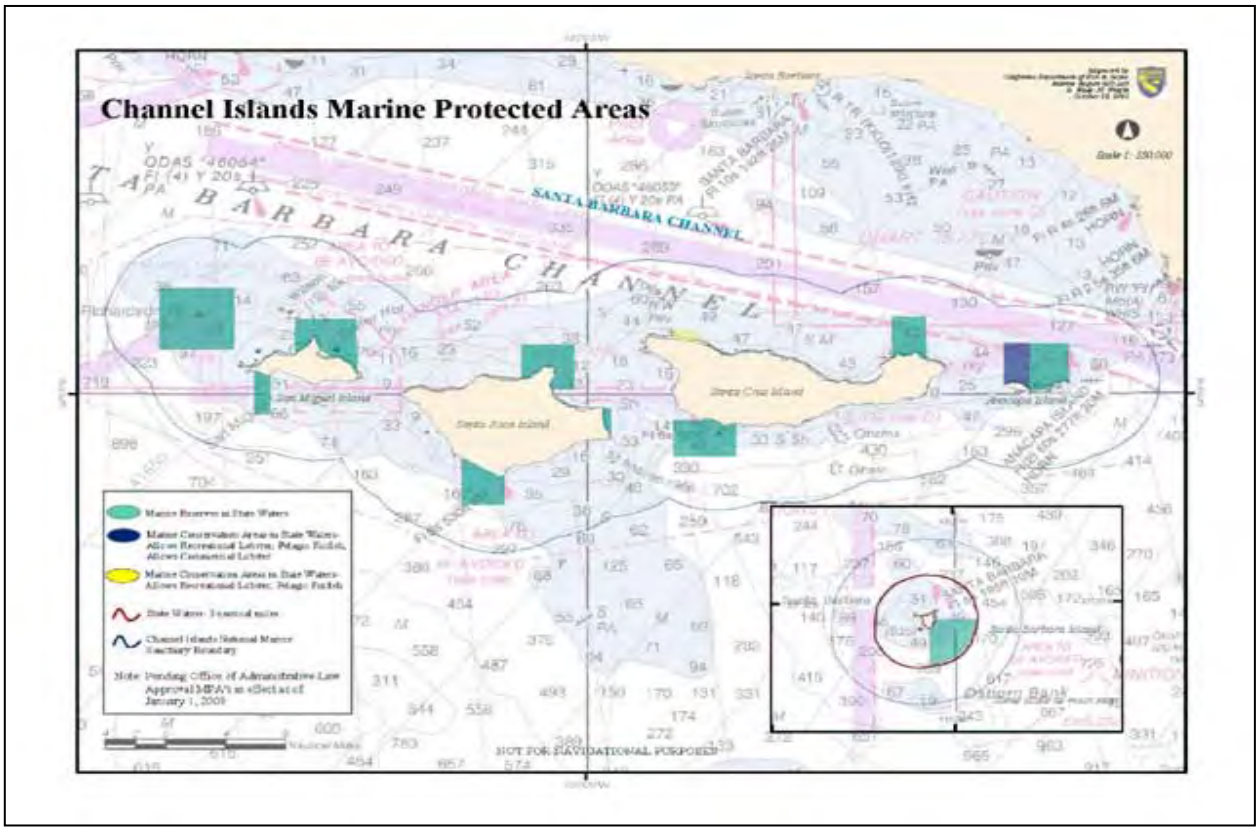

FIGURE 4-26. CHANNEL ISLANDS MARINE PROTECTED AREAS.

biological diversity, the protection of ocean life, the enhancement of recreational and educational opportunities, the establishment of a reference point against which changes in the environment elsewhere can be measured, and the rebuilding of depleted fisheries (McArdle *et al.* 2003). Twelve new MPAs at the Channel Islands were designated by the California Fish and Game Commission in October of 2002 (Figure 4-26). These new MPAs are all located in state waters within the boundaries of Channel Islands National Marine Sanctuary. Ten of these are "marine reserves," where no fishing or kelp harvesting is allowed. Two of these are "conservation areas," in which limited recreational fishing and lobster trapping are allowed. As described in the *Final Environmental Document for Marine Protected Areas in NOAA's Channel Islands National Marine Sanctuary* (Ugoretz 2002), the Channel Islands MPAs are intended to meet multiple objectives. These objectives include an ecosystem biodiversity goal, a socio-economic goal, a sustainable fisheries goal, a natural and cultural heritage goal, and an education goal (Ugoretz 2002). The Channel Islands MPAs are also intended to meet the requirements of recent state legislation emphasizing ecosystem management, such as the Marine Life Management Act (Chap. 1052, Stats. 1998) and the Marine Life Protection Act (Chap. 1015, Stats. 1999) (Ugoretz 2002).

4.4.9.5 U.S. Navy

The waters and airspace of the Southern California Bight are used intensively for military-related operations. The U.S. Navy and U.S. Air Force conduct military operations throughout the Pt. Mugu Sea Range (Figure 4-27), which extends over 36,000 square miles (93,240 sq. km), including San Nicolas Island and portions of

FIGURE 4-27. PT. MUGU SEA RANGE.

the northern Channel Islands but excluding most of the Santa Barbara Channel. The Naval Air Warfare Center Weapons Division at Pt. Mugu carries out extensive operations in the sea range, as does Vandenberg Air Force Base.

The Navy uses the Pt. Mugu Sea Range to test guided missiles and other weapons systems as well as the ships and aircraft that serve as platforms to launch them. The sea range supports fleet training exercises, small-scale amphibious warfare training, and special warfare training. In addition to the current test and training operations conducted on the sea range, the Naval Air Warfare Center Weapons Division at Pt. Mugu proposes to accommodate Theater Missile Defense test and training activities and an increase in the current level of fleet training exercises and special warfare training. The Navy intends to modernize facilities at Pt. Mugu and San Nicolas Island to increase the capacity of the sea range to support existing and future operations. The Navy submitted a final environmental impact statement/overseas environmental impact statement to this effect in 2002 (U.S. Department of Defense 2002).

4.4.9.6 U.S. Minerals Management Service

The Pacific Outer Continental Shelf (OCS) extends offshore from the California-Mexico border to the Washington-Canada border. In the past, the Minerals Management Service issued Federal leases for oil and natural gas exploration and development off Washington, Oregon, and California. However, only 79 leases remain, plus 4 leases that are under appeal,[8] and all are located off southern California. Seventy-five of the leases (plus the 4 leases under appeal) are located off San Luis Obispo, Santa Barbara, and Ventura Counties, while 4 leases lie off Los Angeles and Orange Counties. Currently, 43 of these leases are developed and producing about 80,000 barrels of oil and 154 million cubic feet of natural gas per day from 23 OCS platforms. Four of the platforms are located in the Santa Maria Basin north of Point Conception, 15 are located in the Santa Barbara Channel, and 4 are located in San Pedro Bay off Long Beach (Figures 4-28 and 4-29) (MMS pers. comm. 2005).

Thirty-six of the 79 Federal leases off southern California are undeveloped, as are the 4 leases under appeal. The undeveloped leases, for which unproven reserves are estimated to be over 1 billion barrels of oil and over 500 billion cubic feet of natural gas, are organized into nine units and one non-unitized lease. These leases are

[8] On August 16, 1999, four leases expired after the Minerals Management Service determined that the geological/geophysical/petroleum engineering interpretations of the leases no longer supported their inclusion within their respective units. The lessees have appealed this decision to the Interior Board of Land Appeals.

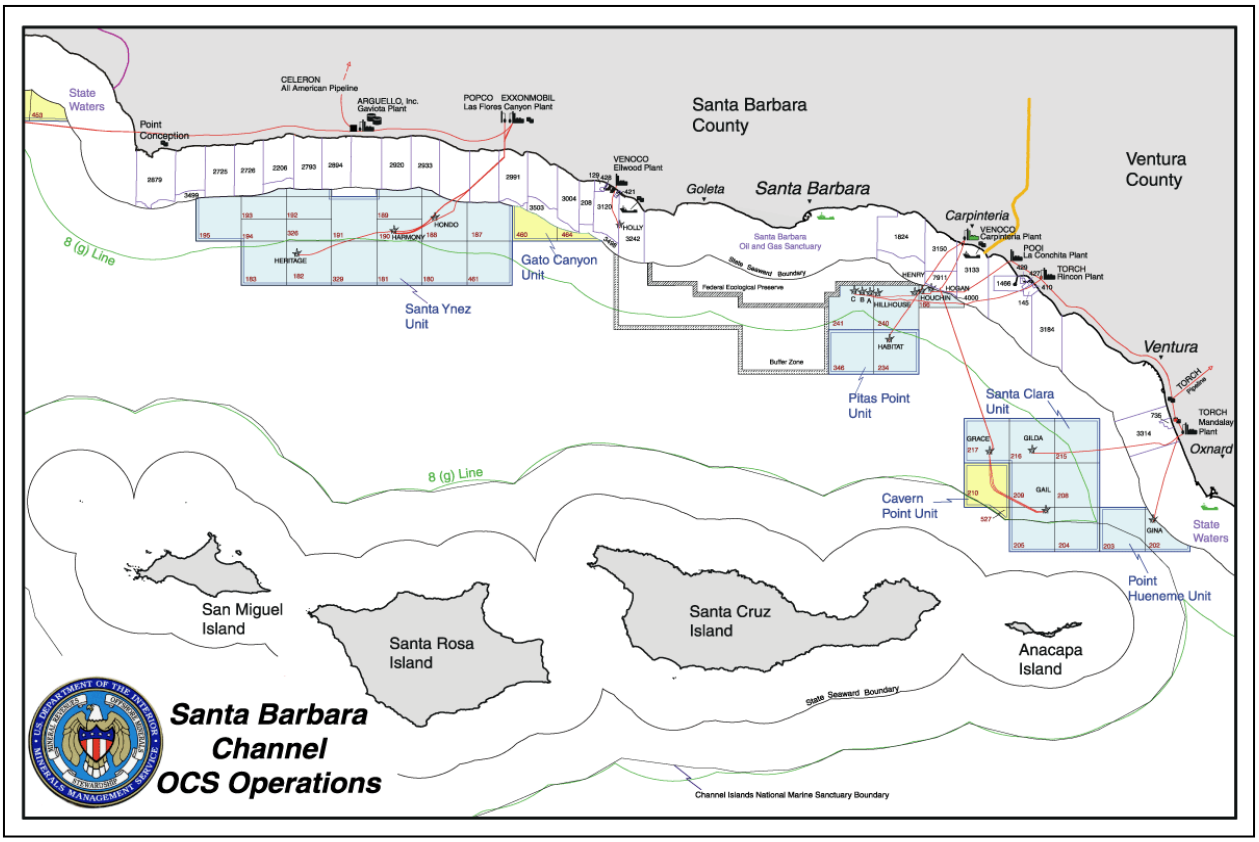

FIGURE 4-28. OIL LEASES OFF SANTA BARBARA AND VENTURA COUNTIES.

generally dispersed through an area in which production has been occurring for over 30 years and development of the producing leases is continuing. In 1999, the Minerals Management Service granted the operators suspensions on the units/lease. A suspension is defined in 30 CFR §250.105 as "a granted or directed deferral of the requirement to produce [Suspension of Production (SOP)] or to conduct leaseholding operations [Suspension of Operations (SOO)]." Consequently, two lawsuits were filed: California v. Norton, in the Northern District of California, and Amber Resources et al. v. United States (Amber), in the Court of Federal Claims (MMS pers. comm. 2005).

As a result of the ruling against the Department of the Interior in California v. Norton, the Minerals Management Service produced documents under the National Environmental Policy Act (NEPA) that reviewed the decisions proposed by the Minerals Management Service on the suspensions and developed documents under the Coastal Zone Management Act determining if the Minerals Management Service's granting of the suspensions was consistent with the California Coastal Management Plan. The Minerals Management Service released Draft Environmental Assessments (EAs) for public comment in November 2004 and finalized the EAs and their associated Findings of No Significant Impact (FONSIs) in February 2005. Subsequent to the release of the EAs, in March 2005, a third lawsuit concerning the undeveloped leases was filed, League for Coastal Protection, et al. v. Norton in the Northern District of California, asserting, in part, that the

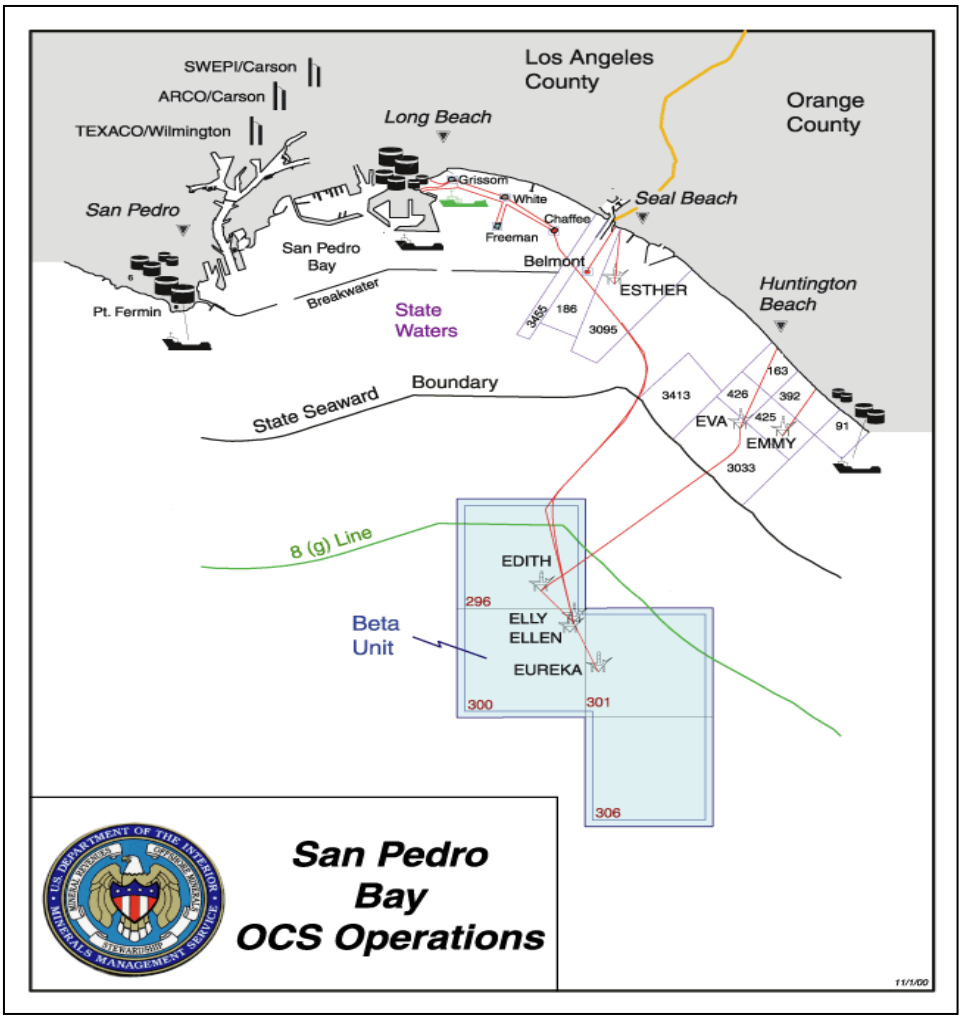

FIGURE 4-29. OIL LEASES OFF LOS ANGELES AND ORANGE COUNTIES.

Minerals Management Service should have produced an Environmental Impact Statement rather than FONSIs on the suspensions. The Minerals Management Service prepared 10 separate consistency determinations (one for each unit and one for the non-unitized lease) and a supporting Environmental Information Document and filed them with the California Coastal Commission in April 2005. The Coastal Commission is scheduled to vote on the consistency determinations in August 2005 (MMS pers. comm. 2005).

In Amber Resources et al. v. United States, lessees of the undeveloped Federal leases sued the U.S. Government for breach of contract, stating that they have not been permitted to proceed with development of their leases. Resolution or settlement has not yet been achieved, despite mediated discussions in May 2004 in San Francisco, CA (MMS pers. comm. 2005).

The physical presence of the oil industry offshore California will diminish over the next several decades. Some of the OCS platforms are approaching the end of their productive life, and the lengthy permit application process for decommissioning could begin within the next 5 to 10 years. Any proposed actions (development or decommissioning) will undergo rigorous environmental review by the Minerals Management Service under NEPA and, for those actions that may affect threatened or endangered species, consultation under Section 7 of the Endangered Species Act (MMS pers. comm. 2005).

4.4.10 Regulatory Environment

The southern sea otter is listed as a threatened species under the Endangered Species Act of 1973, as amended, and is therefore considered a depleted species under the Marine Mammal Protection Act of

1972, as amended. The state of California also recognizes the southern sea otter as a fully protected mammal in Fish and Game Code section 4700 and as a protected marine mammal under Fish and Game Code section 4500. Under all of these laws, intentional take of southern sea otters is prohibited. There are provisions under the Endangered Species Act and the Marine Mammal Protection Act for permitting certain types of incidental take upon consultation with the Fish and Wildlife Service; however, California's designation of southern sea otters as a fully protected species prohibits any form of take with narrow exceptions for scientific research.

As a free-standing act of Congress, Public Law 99-625 changed the status of sea otters residing in certain areas with respect to the Endangered Species Act and the Marine Mammal Protection Act. Intentional take of sea otters residing in the designated translocation zone (San Nicolas Island) and management zone (the Southern California Bight) is prohibited. With the exception of defense-related activities, incidental take within the translocation zone is subject to consultation requirements under the Endangered Species Act and the Marine Mammal Protection Act. In the designated management zone, take incidental to otherwise legal activities, including commercial fisheries, is not subject to consultation requirements and is not considered a violation of either the Endangered Species Act or the Marine Mammal Protection Act.

To accommodate Public Law 99-625 and to support the southern sea otter translocation program, the state of California added Section 8664.2 to the Fish and Game Code. This section provides additional protection for translocated sea otters in the form of gill/trammel net restrictions and prohibitions on the discharge of firearms at San Nicolas Island. This section also allows for incidental take of sea otters found in the management zone by means of specific exemptions from Fish and Game Code section 4700. Unlike Public Law 99-625, Section 8664.2 does not provide an exemption from section 4700 for defense-related activities within the translocation zone.

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Chapter 5. Significance Criteria and Definitions of Levels of Impact

This supplement determines, where possible, whether biological entities or socioeconomic activities would be subject to significant or insignificant impacts from the alternatives under consideration. The determination of significance takes into consideration both the context and intensity of the potential impact [40 CFR 1508.27].

Significance criteria and definitions of levels of impact are given only for those impact topics where the effects can be predicted with some reasonable certainty. Levels of significance are not defined for aquaculture because the effects of sea otter foraging on offshore oil platform mussel production (the primary form of aquaculture in the Santa Barbara Channel that may potentially be affected by sea otters within the next 10 years) are likely to be localized and sporadic (see section 6.2.5). Levels of significance are not defined for kelp harvest and finfishing because: 1) the abundance of kelp and finfish is influenced by a number of biotic and abiotic factors in the ocean environment, some of which cannot be predicted with any reasonable accuracy; 2) the development of kelp in areas recolonized by sea otters would likely take 10 or more years (see section 6.2.7), whereas significance criteria are defined only for effects occurring within 10 years; and 3) the expected enhancement of finfish abundance is dependent on the change in abundance of kelp. Levels of significance are not defined for abalone fishery restoration because of the uncertain baseline for abalone fishery restoration; the Abalone Recovery and Management Plan (CDFG 2002c) does not provide projections of when the abalone fishery might be reopened (beyond the suggestion that it might take decades), citing any such projections as "speculative" (see section 6.2.9). Levels of significance are not defined for ecotourism because we have insufficient information to predict the correlation between numbers and location of sea otters and the additional revenue that would potentially accrue to ecotourism operations. Finally, effects on agency programs are not defined because these effects and programs are various and cannot be meaningfully compared with a single set of criteria. While we have not assigned levels of significance to these topics, we do address each of them qualitatively under each alternative discussed in Chapter 6.

Where significance criteria have been defined, a term is included in text and tables to describe the severity of the impact. This impact may be either adverse or beneficial and is identified as such when the term is used. Definitions of these terms are provided in Table 5-1. Generally, the term Very Low is used to describe the level to which an impact would need to be reduced by mitigation to be considered insignificant. Other terms (Low to Very High) indicate the severity of impacts that are determined to be significant.

The percentages associated with each term describing a level of significance (*e.g.*, a change of less than 1% = Very Low; a change of between 1% and 10% = Low, etc.) are generally based on those used in reference to effects on commercial fishing in our 1987 final environmental impact statement. However, that document defined the regional context as San Luis Obispo, Santa Barbara, and Ventura Counties, while acknowledging that effects were probably distributed over a larger southern California area. Because the alternatives under consideration directly concern the nearshore waters of the Southern California Bight, we

define the regional context as the Southern California Bight.

The significance criteria and definitions of levels of impact given in Table 5-1 are used only in reference to effects projected to occur within 10 years. Because of the number of independent factors and uncertainty involved in predictions beyond 10 years, possible long-term effects are described in qualitative terms only and are not described in terms of levels of impact. Effects of the alternatives under consideration are described in detail in Chapter 6 and are summarized at the end of that chapter in Tables 6-43 and 6-44.

TABLE 5-1. DEFINITIONS OF LEVELS OF IMPACT REPRESENTED BY TERMS USED IN THIS DOCUMENT

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

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

Chapter 6. Environmental Consequences

6.1 Overview

Effects of the alternatives under consideration are described in detail in this chapter and are summarized in Tables 6-43 and 6-44. Table 6-43 gives a summary of biological impacts by alternative. Table 6-44 gives a summary of socioeconomic impacts by alternative. For impact topics for which significance criteria have been defined (see Chapter 5 for definitions of significance), Tables 6-43 and 6-44 also give the level of significance of each of the anticipated effects.

6.1.1 Direct, Indirect, and Cumulative Effects

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

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

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

Cumulative effects are those resulting from the incremental effects of an action when added to the effects of other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR §1508.7). The effect of sea otter predation on abalone populations in the Southern California Bight, when combined with the effects of past actions that have already driven these populations to low levels, is one example of a cumulative effect considered in this supplement. Throughout this document, we do not discuss cumulative effects separately but rather address them in the contexts in which they arise.

6.1.2 Background

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

To establish a baseline for our analysis, we assume that, absent efforts to remove them from the management zone, southern sea otters will continue to expand their range into southern California. At San Nicolas Island, a small colony of sea otters (32 independent animals as of the end of 2004) persists. To establish a baseline for our analysis with respect to sea otters at the island, we assume that this colony will survive and grow at a rate comparable to what has been observed since 1993.

6.1.3 Timeline for Analysis

In this supplement, we use a 10-year time horizon for the quantitative analysis of effects. The rationale for using 10 years is based in part on the uncertainty of economic projections beyond 10 years and in part on the extent of uncertainty involved in predicting sea otter range expansion. However, not all effects that are expected to occur within 10 years are quantified. Some effects are speculative in nature, depend on numerous independent factors, or will occur at unknown magnitudes; these effects are described in qualitative terms only.

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

6.1.4 Predicting Mainland Range Expansion and Colony Growth at San Nicolas Island

The mainland southern sea otter population is currently distributed over roughly 500 kilometers of coastline from Half Moon Bay to just south of Point Conception. Over the past several decades, sea otter range expansion along the mainland coastline has been monitored. These historical data, in combination with spatially-explicit demographic and movement information, serve as the basis for projections of future range expansion into the Southern California Bight. Because extension of the southern sea otter's range along the mainland coastline is essentially linear, this range expansion is expressed in terms of linear sections of coastline. In contrast, at San Nicolas Island, sea otter foraging is limited to a relatively small area surrounding the island, which sea otters are easily capable of circumnavigating. Because of these differences, predictions of the effects of sea otter range expansion and population growth require different strategies for the two different areas. Projections of the likely speed and extent of range expansion along the mainland and colony growth at San Nicolas Island follow.

6.1.4.1 Sea Otter Range Expansion into Southern California

The results of a simulation model (Tinker *et al.* 2004, included as Appendix F) afford the best available projection of sea otter range expansion into the Southern California Bight. In a 10-year scenario, this simulation model predicts that approximately 117 (median number) independent sea otters will reside year-round along a stretch of the mainland coastline between Point Conception and the Santa Barbara harbor mouth (Figure 6-1). While the model provides a mathematical basis for the estimation of future impacts associated with sea otter range expansion, it should be noted that the range end predicted by the model under this scenario is a *median* value and that there is considerable unavoidable uncertainty surrounding the estimate.

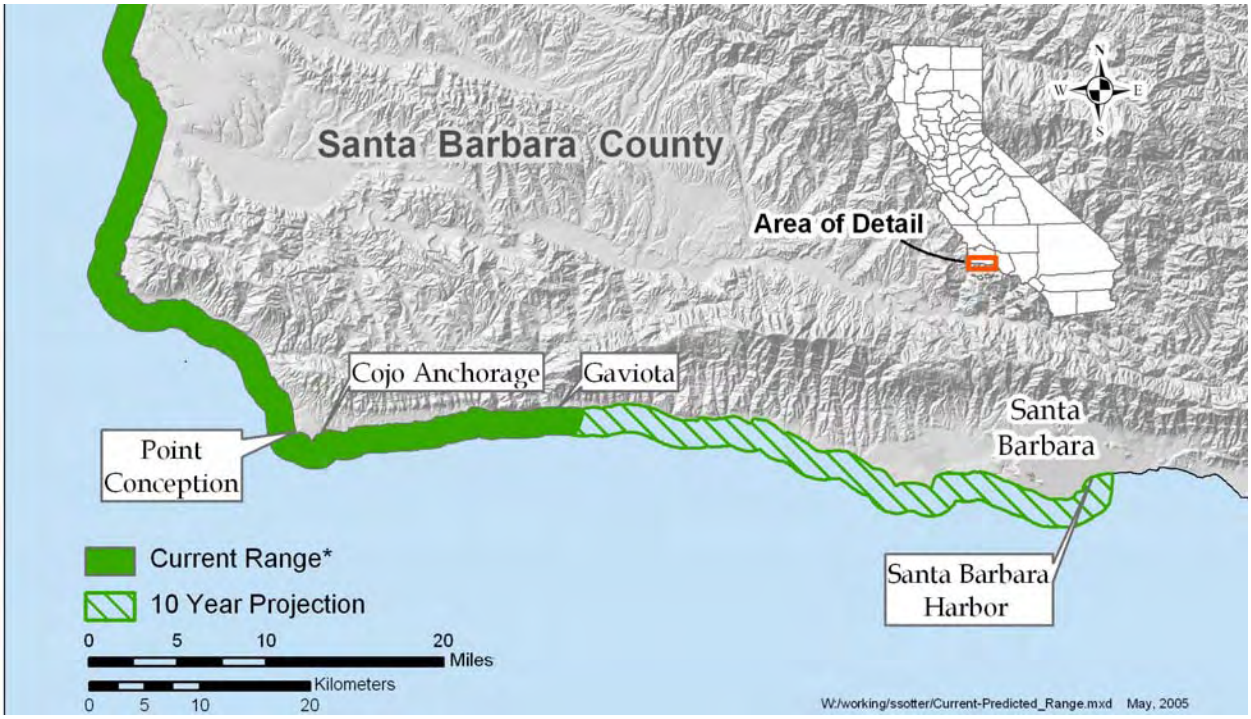

FIGURE 6-1. COASTAL AREA PROJECTED TO BE AFFECTED BY SEA OTTER PREDATION WITHIN 10 YEARS. *The southern range boundary is defined as in Tinker et al. (2004).

Moreover, individual sea otters could and likely would travel further into the Southern California Bight during this 10-year period. Sporadic movements of individual sea otters are impossible to predict, however, and the effects of their foraging activities would not likely be measurable in an environmental or fishery context. Therefore, we do not attempt to quantify the effects of individual far-ranging sea otters.

6.1.4.2 San Nicolas Island Colony Growth

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

The impacts to fisheries at San Nicolas Island projected in our 1987 environmental impact statement have not been realized. Even with the translocation of 140 animals to San Nicolas Island, we were unable to achieve and maintain the core population size of 70 sea otters that was to have been the seed of subsequent sea otter population growth. Instead, the colony of sea otters has remained small (13-32 independent animals) for many years. Nevertheless, we assume that if the colony persisted at San Nicolas

Island, fishery impacts would likely occur at some time in the future.

Despite the uncertainty involved in predicting population growth, particularly of a small colony (which may not follow expected general growth trends because of the effects of demographic and environmental stochasticity[9]), it is necessary for the purposes of our analysis to estimate the potential effects of the existing colony of sea otters on the island's nearshore environment. The determination of impacts at San Nicolas Island used in this supplement is a modification of the approach used in the 1987 final environmental impact statement. While we assume the same direct relationship between percent occupation of habitat and percent loss of shellfish fisheries, we use a spatial rather than linear approach to quantifying the available habitat at San Nicolas Island. We use a geographic information system (GIS)-based estimation of the area of nearshore habitat surrounding San Nicolas Island and a more-recently-derived estimate of equilibrium density for sea otters in rocky habitat than the one used in the 1987 environmental impact statement. Additionally, we recalculate the population projection using the highest number of independent sea otters counted at San Nicolas Island during 2004 (32) and the observed average annual growth rate of the sea otter colony over an 11-year period (1993-2004), approximately 9 percent.

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

In the absence of detailed demographic data for the colony at San Nicolas Island, we use a simple exponential model of population growth: $N_t = N_0e^{rt}$, where N_t is the numbers of sea otters at time t, N_0 is the initial number of sea otters, e is the base of the natural logarithm (a constant, 2.718…), r is the per capita growth rate, and t is the amount of time that has elapsed. For N_0, we use 32, the highest count of independent animals at San Nicolas Island in 2004. For r, we use the observed average annual rate of increase of the colony during the period 1993-2004 (the time between the smallest observed population size of the colony and the present), or about 9 percent. Table 6-1 shows the observed number of sea otters in 2004 and the number of sea otters expected each year for ten years (2005-2014); it also gives an estimate of the percentage of carrying capacity that each number represents. Although fishery impacts may

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

not be detectable until some unknown population threshold is reached, we assume, in the absence of more complete information, that these impacts correspond directly to the percent occupation of available habitat.

TABLE 6-1. PROJECTED NUMBER OF SEA OTTERS AND PERCENT OF CARRYING CAPACITY AT SAN NICOLAS ISLAND

Year	Projected Number of Sea Otters (9% growth rate)	Estimated Percent of Carrying Capacity
2004	32*	6
2005	35	7
2006	38	8
2007	42	8
2008	46	9
2009	50	10
2010	55	11
2011	60	12
2012	66	13
2013	72	14
2014	79	16

*Actual high count of independent sea otters for 2004; all other numbers are projections.

6.1.5 Biological and Socioeconomic Impact Topics

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

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

6.2 Baseline (Status Quo)—The No Action Alternative

6.2.1 Introduction

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

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

6.2.2 Nearshore Marine Ecosystem

6.2.2.1 Overview

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

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

Sea otters reoccupying the nearshore marine environment are expected to enhance biodiversity and the stability and persistence of kelp forest habitat. The marine environment of southern California has been dramatically affected by human activities, such as the direct removal of many of the animal components of the community and the input of pollution, making it difficult to determine the “natural” functioning of the community (Dayton *et al.* 1998). The return of sea otters, top carnivores that were historically present in the ecosystem, is expected to enhance ecosystem functioning and to bring the nearshore marine ecosystem

to a state more closely resembling its historic (pre-fur-trade), or "natural," condition. Over the next 10 years, if sea otters recolonized the coastline to Santa Barbara and the San Nicolas Island colony expanded in size as projected, sea otters would occupy a total of about 1.7 percent of the nearshore habitat area within the 40 meter isobath in the Southern California Bight. The following discussion provides a more detailed description of the role that sea otters play in the nearshore marine environment and the changes expected to occur in areas of the Southern California Bight reoccupied by sea otters.

6.2.2.2 Sea Otters and the Nearshore Marine Ecosystem

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

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

Sea Urchins and Kelp Abundance

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

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

Schiel 1985, Engle 1994). Monitoring at sixteen sites throughout the Channel Islands National Park from 1992-8 revealed that percent cover of algae declined with purple sea urchin density, suggesting that purple sea urchins can structure kelp forest communities (Lafferty and Kushner 2000).

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

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

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

Additionally, human harvest has considerably reduced densities of red sea urchins in many areas of the northern Channel Islands (Kalvass and Rogers-Bennet 2001), and it has been suggested by some that human harvest has filled the niche historically occupied by the sea otter. However, commercial fisheries focus harvest effort on commercially valuable species (*i.e.*, red sea urchins) (Kalvass and Rogers-Bennett 2001), whereas sea otters are less selective and prey on a variety of sea urchin species (Riedman and Estes 1990). The selective harvest of red sea urchins may in turn encourage the growth of white and purple sea urchin populations by releasing them from competition (reviewed in Foster and Schiel 1985), allowing them to reach high densities and to maintain some areas as sea urchin barrens. Sea urchins, when starving (as is often the case in the wake of warm-water El Niño episodes, which adversely affect giant kelp) are of little value to the commercial fishery due to

the atrophy of their gonads (the consumable portion of the sea urchin). Due to the resulting fluctuations in harvest effort, these sea urchins tend to remain in their established barrens unless removed by some other form of predation, eliminated by disease (Ebeling and Laur 1988), or removed abiotically, such as by a severe storm (Ebeling *et al.* 1985).

Densities of sea urchins are currently high in the Southern California Bight. In 2001, 12 of the 16 sites monitored by the Channel Islands National Park were dominated by echinoderms rather than by kelp: 2 by purple sea urchins; 1 by red sea urchins; 5 by purple and red sea urchins; 1 by purple and white sea urchins; 1 by purple and red sea urchins and brittle stars (*Ophiothrix spiculata*); and 1 by purple sea urchins, aggregated red sea cucumbers (*Pachythyone rubra*), and cup coral (*Astrangia lajollaensis*) (Kushner *et al.* 2004).

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

Rate of Change in Kelp Abundance

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

One such biotic factor, which may affect the rate of macroalgal establishment even in the presence of sea otters, is the regularity of sea

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

Kelp Forests and Biodiversity

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

Sea Urchin–Abalone Interactions

Because there are complex interactions between the species preyed on by sea otters, the effects of sea otter predation on these species are not necessarily unidirectional. Sea urchins have a dual relationship of competition and dependence with abalone, all species of which are currently at low levels in the Southern California Bight due to human overexploitation, disease, and other factors (Haaker *et al.* 2001). Sea urchins and abalone have similar food and habitat preferences and thus compete for these resources. Because adult abalone subsist mainly on live and drift algae, sea urchins have a detrimental effect on abalone when drift kelp is limited because of the tendency of sea urchins to overgraze (Lowry and Pearse 1973). However, abalone may out-compete sea urchins for space when food is plentiful (Lowry and Pearse 1973). On the other hand, several instances have been identified where abalone benefit from the presence of sea urchins. Juvenile abalone may depend on the spine canopy of adult sea urchins for protection from predation where other cover is limited (Tegner and Dayton 1981, Day 1998). Sea urchins also maintain densities of coralline algal turf on kelp forest substrates that are appropriate for the post-larval settlement of abalone (CDFG 2002c).

Abalone and sea urchins share several predators and may indirectly derive benefits from them if predation reduces competition or other forms of predation. Like sea urchins, abalone are preyed on by spiny

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

The low population levels that currently characterize all species of abalone in southern California (Haaker *et al.* 2001) raise the question of whether the effects of sea otter predation, when added to the past influences that have driven abalone populations to low levels, would preclude the survival and recovery of abalone species. Because sea otters and abalone have coexisted for thousands of years, and because healthy abalone populations are currently found within the range of sea otters along the central coast (Bergen and Raimondi 2001), it is unlikely that sea otter predation poses an extinction threat to abalone species in the Southern California Bight. Currently, white abalone are listed as endangered, and black abalone are listed as a candidate species. The potential effects of sea otters on white and black abalone recovery efforts are discussed in greater detail in section 6.2.3, "Candidate, Threatened, and Endangered Species."

Establishing the Baseline for the Nearshore Marine Environment

If sea otters reoccupied areas of the Southern California Bight as predicted, community level changes in the nearshore marine ecosystem would take place gradually. Over the next 10 years, an expanding mainland sea otter population would affect invertebrate populations from Point Conception to Santa Barbara, considerably reducing their densities and restricting individuals to cryptic and inaccessible habitat. Changes in giant kelp abundance in this area of the coast would likely take a decade or more to become noticeable and would occur only in areas where invertebrate herbivory is limiting kelp recruitment and survival. Species dependent on kelp canopy would likely benefit from any increases in kelp abundance.

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

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

6.2.3 Candidate, Threatened, and Endangered Species

Table 4-1 in Section 4.3.3 includes a list of candidate, threatened, and endangered species found in the Southern California Bight. White abalone (*Haliotis sorenseni*), black abalone (*Haliotis cracherodii*), and the southern sea otter are the only candidate, threatened, or endangered species that are

likely to be affected by the alternatives under consideration in this supplement. These species are discussed below.

6.2.3.1 White Abalone

White abalone are now rare in California. The National Marine Fisheries Service listed this species as endangered in 2001 [66 FR 29046], citing overharvesting for human consumption as the primary factor in its dramatic decline in abundance. Recovery efforts for white abalone have recently been initiated. The California Department of Fish and Game has identified key locations for white abalone recovery, which include portions of the southern Channel Islands (Santa Barbara, Santa Catalina, and San Clemente) and offshore banks (Tanner and Cortez). The National Marine Fisheries Service has convened a recovery team to identify recovery criteria and tasks for the recovery of white abalone and is now considering the outplanting of captive-reared individuals.

Establishing the Baseline for White Abalone

Because abalone are a common prey item for sea otters, the degree to which sea otter predation poses an increased risk of extinction for white abalone must be assessed. In light of the evolutionary history shared by the two species, it is clear that sea otters and white abalone are able to coexist. The question raised by the endangered status of white abalone is whether the effects of sea otter predation, when added to the factors that have already adversely affected white abalone in southern California, would preclude the survival and recovery of the species.

The primary problems facing white abalone are low density, lack of recruitment, and the advanced age of remaining animals (Hobday *et al.* 2001). As broadcast spawners, abalone (including white abalone) must maintain sufficiently high densities for successful fertilization to occur (Hobday *et al.* 2001). Although sea otter range expansion along the central California coast is known to have reduced abalone population levels and size distributions (Wendell 1994), there are several reasons why it is unlikely that the gradual expansion of sea otters into the Southern California Bight would pose a substantial additional extinction risk to white abalone:

1) The depths at which white abalone occur and the typical foraging depths of southern sea otters overlap only marginally. Historically, white abalone were reported to occur at depths from 20 to 60 meters, and were most abundant at depths of 25 to 30 meters. Recent surveys indicate that most white abalone are now found at depths from 30 to 65 meters, with a median depth of 48 meters (reviewed in Hobday *et al.* 2001). Southern sea otters usually forage in waters shallower than 25 meters (Riedman and Estes 1990);

2) The stretch of coastline that sea otters are expected to reoccupy within the next 10 years is at the northernmost end of the white abalone's historic range (the historic range extends from Point Conception in the north to Punta Abreojos, Baja California, Mexico in the south). White abalone population centers and key recovery areas are in the southern half of the Southern California Bight (CDFG 2002c), more than 200 kilometers from areas of the coast where sea otter range expansion is likely to occur within the next 10 years. If the sea otter

colony at San Nicolas Island persists, it is predicted to grow by about 9 percent annually. Because the colony appears stable and the number of sea otters at San Nicolas Island would remain well below the estimated carrying capacity of the island over the next 10 years, substantial dispersal of sea otters from the island is unlikely;

3) Offshore banks likely provide refuge for white abalone from sea otter predation. Cortez Bank and Tanner Bank have the highest population densities of white abalone among areas surveyed (Hobday *et al.* 2001) and have been identified as key recovery areas (CDFG 2002c). We are aware of no evidence of the historical occupation of these banks by sea otters, and telemetry studies indicate that even the furthest-foraging of southern sea otters (juvenile males) tend to remain within 1-2 kilometers of shore (Ralls *et al.* 1988a, 1988b);

4) White abalone are capable of reproducing at sizes small enough to allow them to take advantage of cryptic and inaccessible habitat. If white abalone make use of cryptic and inaccessible habitat as do other species of abalone, reproductively mature white abalone can successfully evade sea otter predation even in the areas and depth ranges where the two species may overlap as long as a sufficient amount of this habitat is available. Tutschulte and Connell (1981) reported that white abalone become sexually mature at 4 to 6 years of age at a typical size of 88-134 millimeters. Although the age and size at which white abalone become reproductively mature depend on a range of environmental conditions, including food availability, recent evidence suggests that white abalone are capable of reproducing at a younger age and much smaller size than previously thought, about 22 millimeters (in captivity) (McCormick and Brogan 2003).

Under the baseline, sea otters are expected to expand their range gradually along the coastline between Point Conception and Santa Barbara and to increase in number at San Nicolas Island. We know that the abalone fishery was active in these areas, and fishery data collected from 1955-1997 indicate that less than one half of one percent of all white abalone landings came from these areas (Hobday *et al.* 2001). Because relatively low numbers of white abalone occur (both presently and historically) in areas expected to be reoccupied by sea otters over the next 10 years, we do not expect sea otters to affect the white abalone population, as a whole, substantially during this period.

The rate at which sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. Under the baseline, we would not expect sea otters to expand their range into key white abalone recovery areas for many decades. During this time, a continued ban on the harvest of white abalone, combined with white abalone recovery efforts, may be sufficient to ameliorate conditions brought about by human overexploitation of the species and to dampen concern that the added cumulative effect of sea otter predation would cause the extinction of the species. Given the relative scarcity of white

abalone and their preference for deep water habitats, opportunities for sea otter and white abalone interaction would be limited and likely minor in the context of white abalone recovery.

6.2.3.2 Black Abalone

The extirpation of sea otters from their former range in southern California is believed to have been responsible for aggregations of large black abalone evident in California and Mexico during the nineteenth and twentieth centuries (Haaker *et al.* 2001). In 1999, the National Marine Fisheries Service added black abalone to its list of candidate species [64 FR 33466]. Although this species was formerly harvested for human consumption, its value compared to other abalone species was relatively low. As a consequence, the collapse of black abalone stocks occurred late in the serial depletion that characterized the abalone fishery before its closure in 1997 (Haaker *et al.* 2001). Annual landings of black abalone peaked in 1973 at almost 2 million pounds but declined by 1990 to only 13 percent of previous levels (which averaged about 700,000 pounds annually between 1972 and 1984) (Haaker *et al.* 2001).

The dramatic decline in abundance of black abalone has been exacerbated by a disease called withering syndrome. Withering syndrome began affecting black abalone populations in southern California in the mid-1980s, and the disease has spread northward in recent years to areas of the coast north of Point Conception (Figure 6-2). The disease has eliminated black abalone from large areas of their former range, including the mainland coast of southern California (Haaker *et al.* 2001). Elevated seawater temperature, while not believed to be necessary for the occurrence of withering syndrome and the onset of mass mortality, is thought to promote these conditions (Bergen and Raimondi 2001).

Like other abalone species, black abalone may be preyed upon by sea otters. Black abalone inhabit water depths well within the range of sea otter predation (generally rocky intertidal areas), although cryptic and inaccessible habitats provide refuge for the species. Newly settled larvae, juveniles, and sexually mature individuals up to 100 millimeters in length usually remain cryptic, inhabiting deep fissures or areas beneath rocks (Haaker *et al.* 2001). Because black abalone generally become sexually mature at about 50 millimeters in length (Haaker *et*

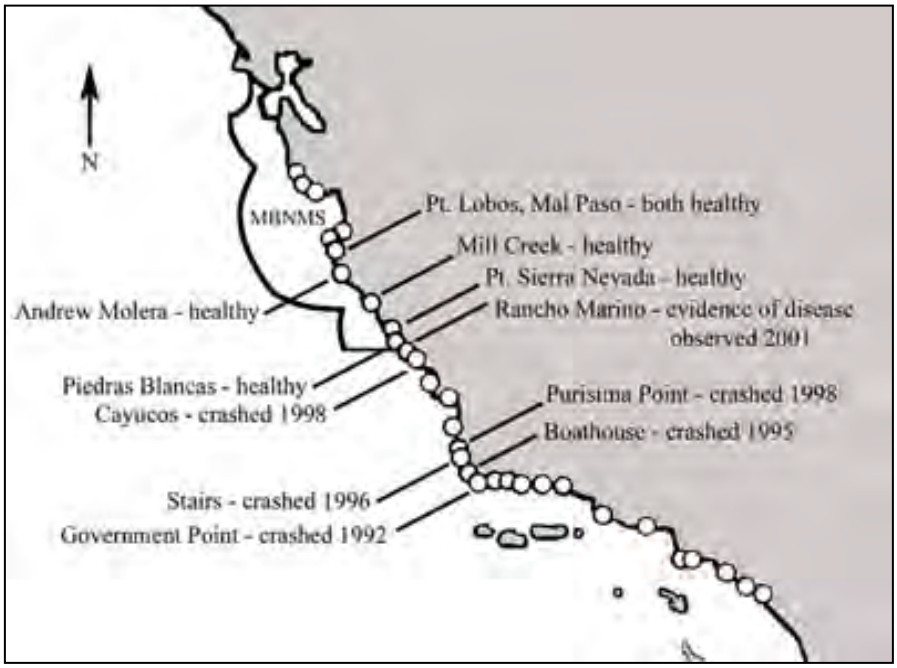

FIGURE 6-2. INCIDENCE OF WITHERING SYNDROME, 1992-2001.
Source: Bergen and Raimondi (2001).

al. 2001), they are capable of sustaining reproductively viable populations in the presence of sea otters.

A considerable portion of the black abalone's range overlaps the current range of the southern sea otter. The fact that southern California stocks have been severely reduced by disease (in the general absence of sea otter predation), whereas the healthiest populations of black abalone are currently found within the sea otter's established range along the central California coast, suggests that disease is far more detrimental to black abalone populations than sea otter predation (Figure 6-3). Although black abalone populations along the central California coast are considered healthy (in terms of numbers of individuals and low prevalence of disease), these populations cannot support a sustainable fishery because the large individual abalone on which fisheries depend represent a relatively small portion of the overall population. Where sea otters and black abalone coexist, abalone are restricted to cryptic and inaccessible habitats that afford protection from sea otter predation, and abalone of the size historically harvested for human consumption (greater than 150 millimeters) are reduced in numbers.

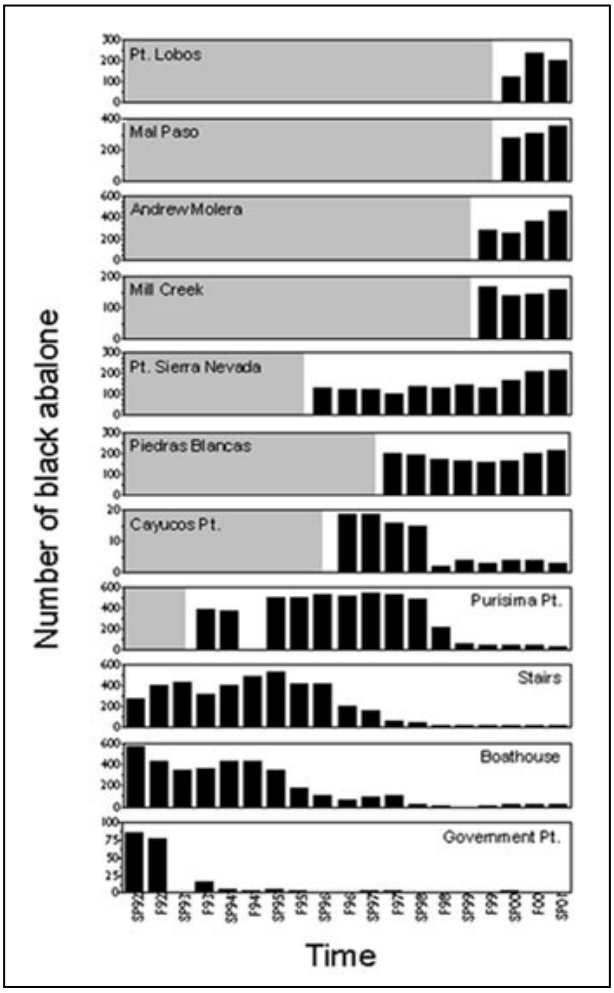

FIGURE 6-3. ABUNDANCE OF BLACK ABALONE, 1992-2001. Source: Bergen and Raimondi (2001).

Establishing the Baseline for Black Abalone

Under the baseline, sea otters are expected to expand their range gradually along the coastline between Point Conception and Santa Barbara and to increase in number at San Nicolas Island. The coastline between Point Conception and Santa Barbara, which sea otters are expected to affect through predation within the next 10 years, has not been identified as an important area for black abalone recovery because intertidal habitat along much of this section of coastline does not support black abalone. However, San Nicolas Island has been identified by the California Department of Fish and Game as 1 of 10 key locations for the recovery of black abalone (CDFG 2002c).

The effect that a persistent colony of sea otters would have on black abalone at the island is uncertain, but the fact sea otters and black abalone historically co-occurred at the island suggests that black abalone populations would have sufficient refuge from sea otter predation to maintain viable populations there.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. The effect that sea otters may have on severely depleted black abalone stocks throughout the area is uncertain, but if sea otters do recolonize the Southern California Bight, the process would likely occur gradually over the course of several decades, allowing time for black abalone populations to recover from the effects of human harvest and disease in the absence of predation pressure from sea otters. Ultimately, in areas of the Southern California Bight with sufficient cryptic and inaccessible habitat, black abalone populations would likely persist and have the opportunity to recover in the presence of sea otters. However, in areas with insufficient cryptic and inaccessible habitat, into which black abalone populations may have expanded in the absence of sea otters, abalone would be more vulnerable to predation resulting from sea otter range expansion.

6.2.3.3 Southern Sea Otter

In 1977, the U.S. Fish and Wildlife Service listed the southern sea otter as a threatened species under the Endangered Species Act. This listing was based on the southern sea otter's small population size, its greatly reduced range, its vulnerability to oil spills, and the potential risk of oil spills [42 FR 2965]. Our original recovery plan (USFWS 1982) for the species sought to encourage range expansion, and the translocation program, which is under reevaluation in this supplement, was an integral part of that plan. Unfortunately, the translocation program appears to have failed to meet its objectives (Appendix C). Our revised recovery plan for the southern sea otter (USFWS 2003) continues to focus on efforts to increase the size of the southern sea otter's population; however, it no longer recommends the translocation of sea otters as a means to achieve this goal. Furthermore, the recovery plan acknowledges the recovery team's recommendations to declare the translocation program a failure, to allow natural range expansion to occur, and to allow the colony at San Nicolas Island to remain at the island rather than capturing these sea otters and releasing them in the mainland range (USFWS 2003).

Establishing the Baseline for the Southern Sea Otter

Under baseline conditions, sea otters would likely continue to expand their range into the Southern California Bight. Over the next 10 years, the southern sea otter's range is predicted to expand gradually along the coastline to Santa Barbara (Appendix F). Although there is much uncertainty surrounding the estimates, range expansion of the mainland population is expected to result in a median number of 117 independent sea otters (95% confidence interval range of 57-207) permanently residing south of Point Conception in 10 years. If the colony at San Nicolas Island persists, it is predicted to grow at a rate similar to that observed at the island over the past 11 years, about 9 percent annually (from 32 independent animals in 2004 to 79 in 2014). Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If recolonization occurs, it is expected to occur gradually.

The marine habitat in the Southern California Bight has been degraded by a multitude of human activities. In spite of this degradation, the southern sea otter range is naturally expanding into this area.

Allowing natural range expansion to occur maximizes habitat available for southern sea otter recovery and would reduce the species' vulnerability to widespread catastrophic events.

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

6.2.4 Commercial Fisheries

For a discussion of the regulatory environment (including as it pertains to commercial fisheries) see section 6.2.12.

Our analysis of commercial fisheries in this document is based largely on commercial fisheries data organized by species, year, and statistical block (Figure 6-4), which is reported by participants in the commercial fishery and collected by the California Department of Fish and Game. Other data used in our analysis are derived from the

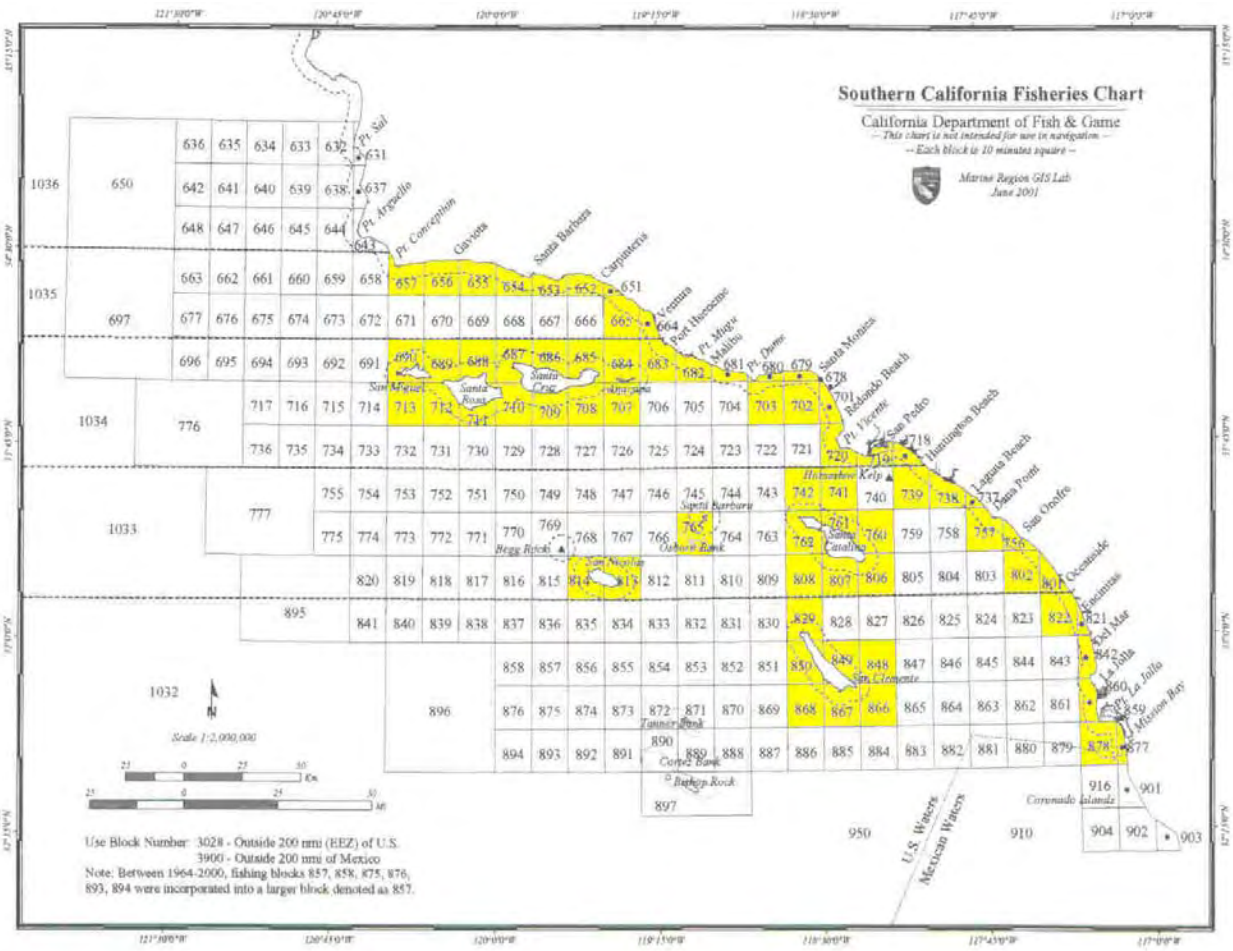

FIGURE 6-4. CALIFORNIA DEPARTMENT OF FISH AND GAME STATISTICAL BLOCK MAP, WITH NEARSHORE BLOCKS HIGHLIGHTED. Source: CDFG (2001).

2001 status report produced by the California Department of Fish and Game, *California's Living Marine Resources* (Leet *et al.* 2001). The analysis that follows focuses on species that are important commercially and that coincide with the sea otter's primary diet, namely sea urchins (*Strongylocentrotus franciscanus*), spiny lobsters (*Panulirus interruptus*), and crabs (*Cancer* spp.). The southern California fishery for abalone (*Haliotis* spp.) is currently under a moratorium and is discussed in a separate section entitled "Abalone Fishery Restoration." For additional background information on California fisheries, please refer to section 4.4.2

6.2.4.1 Baseline Assumptions for Impacts to Fisheries

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

1. Over the next 10 years, southern sea otters are expected to extend their range and approach equilibrium densities along the coastline from Point Conception to Santa Barbara (Appendix F). We assume that shellfish fisheries will be eliminated from Point Conception to Santa Barbara during this period. The affected area corresponds to CDFG statistical blocks 654, 655, 656, and 657 (see Figure 6-4).

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

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

4. We assume that when sea otters permanently reside in a given area, the commercial fisheries for lobster, crab, and sea urchin will no longer be viable in that area.[10] Although it is unknown whether the presence of sea otters would eliminate the lobster sport fishery entirely, we make the conservative assumption that the sport fishery would also be adversely

[10] Interactions between sea otters and shellfish fisheries are described in Estes and Van Blaricom (1985). They conclude that some shellfish fisheries (*e.g.*, rock crabs, northern razor clams, butter clams, littleneck clams, and mussels) can persist in the presence of sea otters, whereas others (commercial sea urchin and abalone fisheries) cannot. Because there has not been a considerable overlap in the range of southern sea otters and spiny lobsters in the recent past, Estes and Van Blaricom do not draw a conclusion regarding the effects of sea otters on lobster fishing. We conservatively assume that sea otters will eliminate crab and lobster fisheries (in addition to precluding sea urchin and abalone fisheries) in the areas they reoccupy. However, we do not know the level of harvest at which a commercial fishery would become non-viable. In our analysis, we employ zero landings as a non-viable fishery, with the understanding that in reality the commercial fishery could collapse earlier.

affected at the same rate as the commercial fishery in areas where sea otters become established. Thus, commercial and recreational fisheries are assumed to be mutually exclusive with, and equally affected by, sea otter predation.

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

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

7. We assume that the sea otter population at San Nicolas Island will increase at a 9 percent annual growth rate over the next 10 years.

8. At San Nicolas Island, we assume that changes in shellfish fisheries are inversely proportional to changes in the percentage of carrying capacity occupied by the colony. If the colony increased by 9 percent annually, it would grow from 32 animals in 2004 to 79 animals in 2014. With an estimated carrying capacity of about 500 animals, the sea otter population at San Nicolas Island would increase from 6 percent of carrying capacity in 2004 to 16 percent of carrying capacity in 2014, resulting in a 10 percent decrease in commercial shellfish harvests over 10 years.

6.2.4.2 Sea Urchin Fishery

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

Southern California Sea Urchin Fishing Effort

From 1995 to 1999, an annual average of 223 vessels participated in the sea urchin fishery. Two hundred and seven (207) of these vessels identified southern California as their principal fishing area. These vessels derived 88 percent of their landings and 92 percent of their ex-vessel revenue from the southern California sea urchin fishery. During this period, sea urchin diving permits averaged approximately 490 annually, and sea urchin crewmember permits averaged 324 annually (Thomson 2001).

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

PAST LANDINGS AND EX-VESSEL REVENUES

Table 6-2 summarizes landings and ex-vessel revenues for the southern California sea urchin fishery from 1986-2003.[11] This table also includes specific information for the two areas that would likely be affected by sea otter predation over the next 10 years: 1) the coastline from Point Conception to Santa Barbara, and 2) San Nicolas Island. These areas are discussed in greater detail below.

TABLE 6-2. COMMERCIAL SEA URCHIN HARVEST: LANDINGS AND EX-VESSEL REVENUE BY AREA.

Year	Commercial Landings (pounds)			Ex-Vessel Revenue (thousands of 2004 dollars)		
	SCB	Point Conception to Santa Barbara	San Nicolas Island	SCB	Point Conception to Santa Barbara	San Nicolas Island
1986	12,155,209	355,480	2,649,764	$4,364	$93	$992
1987	7,193,837	398,639	3,395,431	$2,256	$169	$1,088
1988	6,006,438	283,237	2,335,082	$2,250	$190	$577
1989	5,309,415	535,282	356,974	$2,513	$395	$234
1990	10,402,343	587,996	2,184,513	$6,967	$381	$1,271
1991	16,340,679	388,237	2,323,093	$8,475	$54	$1,053
1992	13,628,097	634,107	1,504,035	$10,251	$370	$1,083
1993	14,897,618	382,220	1,372,737	$11,799	$225	$842
1994	16,196,547	391,110	1,715,937	$21,647	$576	$2,057
1995	16,714,982	450,369	2,971,561	$19,888	$564	$3,182
1996	15,776,375	354,662	1,291,148	$17,247	$435	$1,291
1997	13,199,317	415,713	1,359,738	$12,435	$421	$1,227
1998	7,001,081	183,186	942,818	$6,167	$160	$751
1999	10,378,689	44,211	1,675,293	$11,127	$44	$1,737
2000	9,947,301	19,290	546,048	$10,628	$20	$516
2001	8,271,694	22,812	293,539	$8,266	$22	$266
2002	8,286,564	8,504	337,618	$7,123	$7	$257
2003	8,660,645	54,770	389,698	$6,954	$41	$311

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

Southern California Bight

Figure 6-5 shows commercial sea urchin landings and numbers of sea urchin diving permits for the southern California fishery. The annual sea urchin harvest in southern California peaked at 16.7 million pounds in 1995 but declined to a low of about 7 million pounds in 1998. In the late 1990s, a strong El Niño event (1997/1998) affected the quality of sea urchins available for harvest, and a weak Japanese economy (the primary market for harvested sea urchins) reduced demand and forced downward pressure on prices (Kalvass and Rogers-Bennett 2001).

[11] All references to the southern California fishery cited as CDFG (2002a) and CDFG (2005a) in this document include landings for coastal areas and islands but exclude landings for offshore banks.

Coastline, Point Conception to Santa Barbara

Sea urchin landings along the coastline from Point Conception to Santa Barbara are depicted in Figure 6-6. Sea urchin landings in this area peaked at 634,000 pounds in 1992 but have since declined by 95 percent. During the 1997-1998 El Niño event, landings dropped from 415,000 pounds in 1997 to 183 thousand pounds in 1998. Landings along this stretch of coastline continued to decline after the 1997-1998 El Niño event and averaged 24,000 pounds annually from 1999 through 2002.

However, landings increased in 2003 to about 55,000 pounds.

San Nicolas Island

Sea urchin landings at San Nicolas Island peaked at over 3 million pounds in 1987 but have since declined by 90 percent. During the 1997-1998 El Niño event, landings dropped from over 1 million pounds in 1997 to about 943,000 pounds in 1998. In 1999, landings at the island increased to pre-El Niño levels, but subsequently (in 2001) they dropped again to 294,000 pounds. Landings increased to 390,000 pounds in 2003.

Percentages of Fishery

From 1994 to 2003, annual commercial sea urchin landings along the coastline from Point Conception to Santa Barbara accounted for two percent of southern California sea urchin landings (CDFG 2002a). During the same period, annual commercial sea urchin landings at San Nicolas Island accounted for 10 percent of southern California sea urchin landings (Table 6-3).

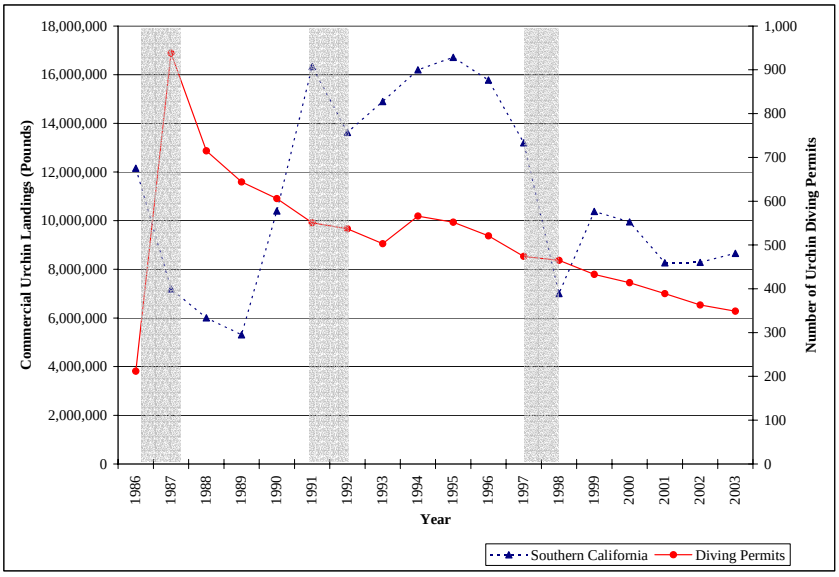

FIGURE 6-5. COMMERCIAL SEA URCHIN LANDINGS AND SEA URCHIN DIVING PERMITS FOR THE SOUTHERN CALIFORNIA BIGHT, 1986-2003. Shaded areas indicate El Niño events. Data source: California Department of Fish and Game (2002a, 2005b).

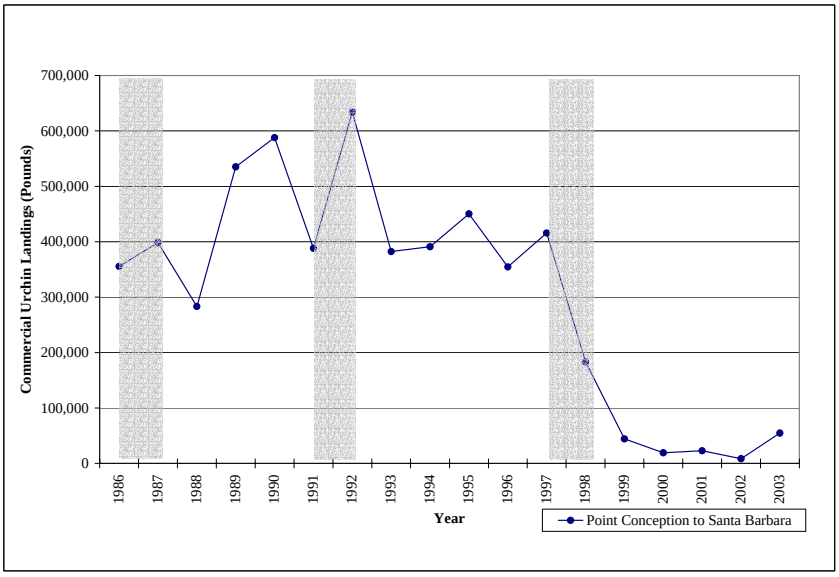

FIGURE 6-6. ANNUAL SEA URCHIN LANDINGS: POINT CONCEPTION TO SANTA BARBARA, 1986-2003. Shaded areas indicate El Niño events. Data source: California Department of Fish and Game (2002a, 2005a)

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

Under the baseline (no attempt to remove sea otters), changes in the southern California sea urchin fishery would likely occur over time. Based on simulations by Tinker *et al.* (2004) (Appendix F), the southern sea otter's range is expected to expand along the mainland coastline towards the city of Santa Barbara over the next 10 years. For the purposes of analysis, we assume that sea otter predation would eliminate all commercial sea urchin harvest from Point Conception to Santa Barbara

TABLE 6-3. AVERAGE ANNUAL SEA URCHIN LANDINGS, 1994-2003.

	Average Annual Landings (pounds)	Percentage of Southern California Bight Landings
Point Conception to Santa Barbara (coastline)	194,463	2%
San Nicolas Island	1,152,340	10%
SCB (excluding landings from the above two areas)	10,096,517	88%
Total Annual Landings	11,443,319	100%

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

(CDFG statistical blocks 654, 655, 656, and 657) by the year 2014.

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

The colony of sea otters at San Nicolas Island (CDFG statistical blocks 813 and 814) is predicted to increase from 6 percent of carrying capacity at present (2004) to 16 percent of carrying capacity in 10 years. Assuming a perfect inverse relationship between the percentage of carrying capacity attained by sea otters and the commercial sea urchin catch (more sea otters = fewer sea urchins), sea urchin landings would decrease approximately 10 percent by the year 2014.

Establishing the Baseline for the Southern California Sea Urchin Fishery

To establish a landings baseline, we employ a 10-year average (1994-2003) for each area to mitigate the effects of cyclic variations in populations, adverse weather, market demand, and other factors that influence catch from one year to the next. From the 10-year average, we project sea urchin harvest impacts as a direct function of sea otter occupation in each area. Along the affected coastline (Point Conception to Santa Barbara), the 10-year landings average is 194,463 pounds. We assume that once an area is permanently occupied by sea otters, the commercial sea urchin fishery would no longer be viable in that area. Thus, we assume that sea urchin landings along the affected coastline would decrease 10 percent (19,446 pounds) each year, from 194,463 pounds to 175,016 pounds in 2005 to 155,170 pounds in 2006, and so forth to zero landings in 2014. Around San Nicolas Island, the 10-year landings average is 1,152,340 pounds. We assume that the commercial sea urchin fishery in this area would decrease by approximately 10 percent over 10 years. Thus, we assume that sea urchin landings from San Nicolas Island would decrease by approximately 1 percent (11,523 pounds) each year, from 1,152,340 pounds to 1,140,816 pounds in 2005 to 1,129,293 pounds in 2006, and so forth to 1,037,106 pounds in 2014.

Table 6-4 depicts the baseline for sea urchin landings that will be employed in this analysis. Note that commercial landings across areas are not additive. Rather, the Point Conception to Santa Barbara coastline and San Nicolas Island represent a portion of the entire southern California sea urchin fishery.

While this baseline represents a reasonable estimation of potential trends over time,

there are several problems inherent in the approach used here. Because we employ a 10-year average as our starting point, the projected landings for almost all years of the series are extremely high compared to current actual landings (in 2003, sea urchin harvest along the coastline from Point Conception to Santa Barbara was less than 55,000 pounds, and sea urchin harvest at San Nicolas Island was less than 390,000 pounds). When compared to current landings, the baseline appears to predict an immediate recovery of sea urchin landings to a level equivalent to the ten-year average. Because of our use of the 10-year average, our projected decreases in landings due to anticipated sea otter predation are correspondingly high. Therefore, our analysis likely overestimates the baseline effects of sea otters on the sea urchin fishery.

TABLE 6-4. PROJECTED BASELINE FOR COMMERCIAL SEA URCHIN LANDINGS

Year	Commercial Landings (pounds)*		
	Southern California Bight**	Point Conception to Santa Barbara Coastline	San Nicolas Island
10-year average (1994-2003)	11,443,319	194,463	1,152,340
2005	11,412,350	175,016	1,140,816
2006	11,381,380	155,570	1,129,293
2007	11,350,410	136,124	1,117,770
2008	11,319,441	116,678	1,106,246
2009	11,288,471	97,231	1,094,723
2010	11,257,501	77,785	1,083,199
2011	11,226,532	58,339	1,071,676
2012	11,195,562	38,892	1,060,153
2013	11,164,592	19,446	1,048,629
2014	11,133,622	0	1,037,106

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

6.2.4.3 Spiny Lobster Fishery

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

California Lobster Fishing Effort (Commercial)

From 1995 to 1999, an annual average of 202 vessels participated in California's commercial lobster fishery. One hundred sixty eight (168) of these vessels identified the lobster fishery as their principal fishery. These vessels derived 49 percent of their landings and 81 percent of their ex-vessel revenue from this fishery (Thomson 2001).

Since 1997, the California Department of Fish and Game has restricted access to the fishery by limiting the number of permits issued. All lobster fishers must have an operator permit, and all deckhands must have a lobster crewmember permit. From 1996 to 1999, the number of lobster operator permits averaged 300 annually, and the number of lobster crewmember permits averaged about 135 annually (CDFG 2002b).

Past Landings and Ex-Vessel Revenues

Table 6-5 summarizes landings and ex-vessel revenues for the southern California lobster fishery from 1986-2003. This table also includes specific information for the two areas that would likely be affected by

sea otter predation over the next 10 years: 1) the coastline from Point Conception to Santa Barbara, and 2) San Nicolas Island. These areas are discussed in greater detail below.

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

Year	Commercial Landings (pounds)			Ex-Vessel Revenue (thousands of 2004 dollars)		
	SCB	Point Conception to Santa Barbara	San Nicolas Island	SCB	Point Conception to Santa Barbara	San Nicolas Island
1986	250,553	10,751	16,113	$1,817	$79	$116
1987	199,852	7,526	19,783	$1,344	$52	$136
1988	193,813	3,015	22,076	$1,297	$17	$159
1989	256,900	7,533	26,369	$1,924	$63	$209
1990	226,089	18,336	25,166	$1,715	$143	$201
1991	324,244	25,340	36,393	$2,792	$228	$317
1992	329,660	29,831	31,640	$2,736	$275	$280
1993	350,318	20,045	24,350	$2,929	$175	$235
1994	416,533	24,528	27,317	$3,894	$239	$289
1995	567,727	28,901	30,276	$5,346	$283	$317
1996	631,728	27,999	29,934	$6,073	$276	$314
1997	859,118	58,810	44,143	$7,342	$519	$445
1998	665,966	38,730	56,411	$4,699	$284	$416
1999	452,651	18,659	33,129	$3,532	$153	$268
2000	679,440	18,621	36,524	$4,682	$133	$275
2001	681,767	23,853	29,506	$4,697	$164	$209
2002	669,486	23,813	39,577	$4,888	$169	$292
2003	672,210	29,170	50,408	$5,072	$208	$381

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

Southern California Bight

Commercial landings of spiny lobsters in the state of California have been marked by fluctuations that reflect a number of factors, including market influences, weather patterns, population health, and harvest regulations (Barsky 2001). Figure 6-7 shows commercial lobster landings and the annual number of operator permits for the southern California fishery. Lobster landings for southern California steadily increased from 250,000 pounds in 1986 to 860,000 pounds in 1997. Landings decreased by almost 50 percent from 1997 to 1999 but have since increased to about 670,000 pounds in 2002 and 2003.

Coastline, Point Conception to Santa Barbara

Lobster landings along the coastline from Point Conception to Santa Barbara are depicted in Figure 6-8. From 1986 to 1997, lobster landings along this stretch of coastline increased four-fold, from 10,751 pounds to 58,810 pounds. Landings sharply decreased after 1997, steadying at 18,621 pounds in 2000, but they have since increased to about 29,000 pounds in 2003.

San Nicolas Island

Lobster landings at San Nicolas Island varied from 1994 to 2003, ranging from approximately 27,000 pounds to approximately 50,000 pounds.

Percentages of Fishery

The lobster fishery is clearly a high-value industry, with an average price per pound of $7.98 (1994-2003). This price is over five times greater than that of crab and over seven times greater than that of sea urchin. Although the lobster fishery is of high-value, it contributed less than one percent of southern California's total fishery landings and represented about seven percent of southern California's ex-vessel fishery revenue between 1995 and 1999 (Thomson

2001). For comparison, the sea urchin fishery contributed 18 percent of southern California's ex-vessel fishery revenue (Thomson 2001).

From 1994 to 2003, annual commercial lobster landings on the coastline from Point Conception to Santa Barbara represented 5 percent of southern California lobster landings, while annual commercial lobster landings at San Nicolas Island accounted for 6 percent of southern California lobster landings (Table 6-6).

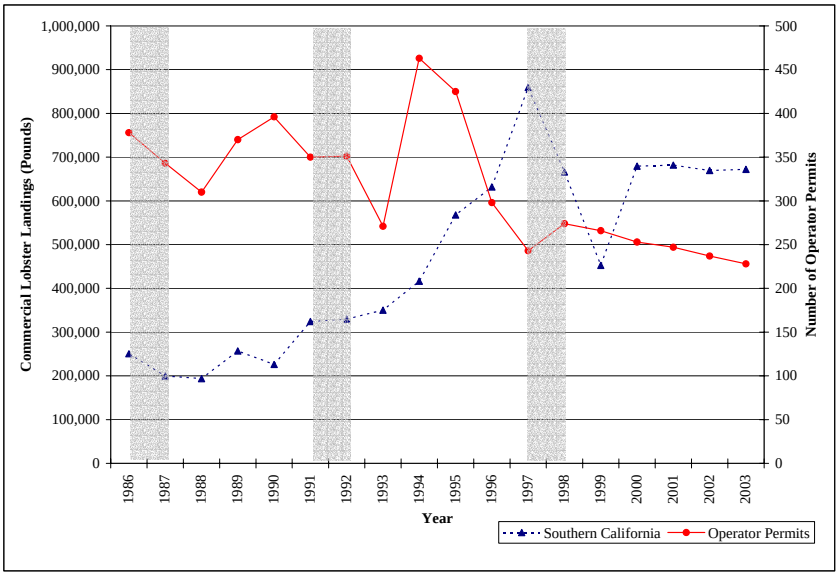

FIGURE 6-7. COMMERCIAL LOBSTER LANDINGS AND NUMBER OF OPERATOR PERMITS FOR SOUTHERN CALIFORNIA, 1986-2003. Shaded areas indicate El Niño events. Data source: California Department of Fish and Game (2002a, 2005a, 2005b).

SEA OTTER RANGE EXPANSION AND EFFECT ON THE CALIFORNIA LOBSTER FISHERY

Under the baseline (no attempt to remove sea otters), changes in the California lobster fishery would likely occur over time. Based on simulations by Tinker *et al.* (2004) (Appendix F), the southern sea otter's range is expected to expand along the mainland coastline towards the city of Santa Barbara over the next 10 years. Although there is little or no evidence of sea otters adversely affecting lobster fisheries (sea otters have only recently recolonized range inhabited by California spiny lobsters), sea otters have been observed consuming lobsters in captivity and in the wild. To be conservative (*i.e.*, to make sure we fully capture potential effects on the lobster fishery),

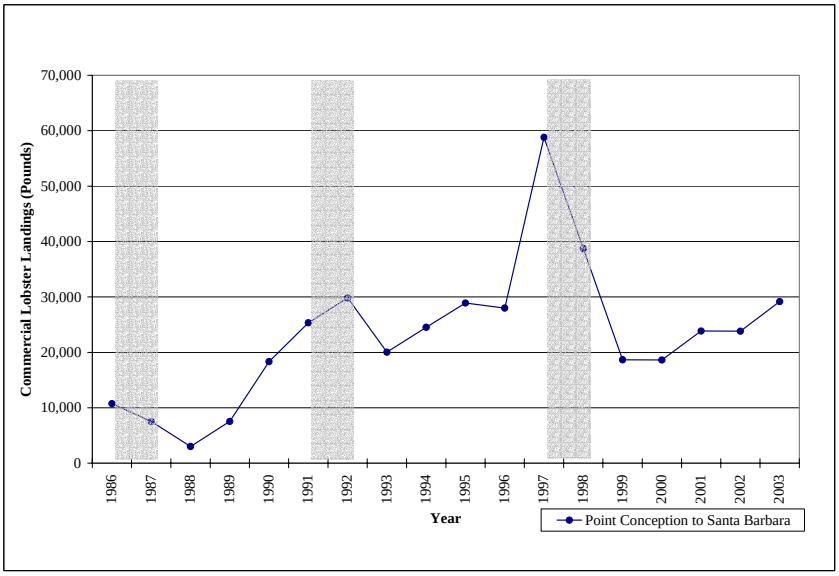

FIGURE 6-8. ANNUAL LOBSTER LANDINGS: POINT CONCEPTION TO SANTA BARBARA. Shaded areas indicate El Niño events. Data source: California Department of Fish and Game (2002a, 2005a).

TABLE 6-6. AVERAGE ANNUAL LOBSTER LANDINGS, 1994-2003.

	Average Annual Landings (pounds)	Percentage of Southern California Bight Landings
Point Conception to Santa Barbara (coastline)	29,308	5%
San Nicolas Island	37,722	6%
SCB (excluding landings from the above two areas)	562,632	89%
Total Average Annual Landings	629,662	100%

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

we assume that sea otter predation would eliminate all commercial lobster harvest from Point Conception to Santa Barbara (CDFG statistical blocks 654, 655, 656, and 657) by the year 2014.

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

The colony of sea otters at San Nicolas Island (CDFG statistical blocks 813 and 814) is predicted to increase from 6 percent of carrying capacity at present (2004) to 16 percent of carrying capacity in 10 years. Assuming a perfect inverse relationship between the percentage of carrying capacity attained by sea otters and the commercial lobster catch (more sea otters = fewer lobsters), lobster landings would decrease approximately 10 percent by the year 2014.

Establishing the Baseline for the California Lobster Fishery

To establish a landings baseline, we employ a 10-year average (1994-2003) for each area to mitigate the effects of cyclic variations in populations, adverse weather, market demand, and other factors that influence catch from one year to the next.

From the 10-year average, we project lobster harvest impacts as a direct function of sea otter occupation in each area. Along the affected coastline (Point Conception to Santa Barbara), the 10-year landings average is 29,308 pounds. We assume that once an area is permanently occupied by sea otters, the commercial lobster fishery would no longer be viable in that area. Thus, we assume that lobster landings along the affected coastline would decrease 10 percent (2,931 pounds) each year, from 29,308 pounds to 26,378 pounds in 2005 to 23,447 pounds in 2006, and so forth to zero landings in 2014.

Around San Nicolas Island, the 10-year landings average is 37,722 pounds. We assume that the commercial lobster fishery in this area would decrease by approximately 10 percent over 10 years. Thus, we assume that lobster landings from San Nicolas Island would decrease by 1 percent (377 pounds) each year, from 37,722 pounds to 37,345 pounds in 2005 to 36,968 pounds in 2006, and so forth to 33,950 pounds in 2014.

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

TABLE 6-7. PROJECTED BASELINE FOR COMMERCIAL SPINY LOBSTER LANDINGS

Year	Commercial Landings (pounds)*		
	Southern California Bight**	Point Conception to Santa Barbara Coastline	San Nicolas Island
10-year average (1994-2003)	629,662	29,308	37,722
2005	626,354	26,378	37,345
2006	623,046	23,447	36,968
2007	619,738	20,516	36,591
2008	616,430	17,585	36,213
2009	613,122	14,654	35,836
2010	609,814	11,724	35,459
2011	606,506	8,793	35,082
2012	603,198	5,862	34,705
2013	599,890	2,931	34,327
2014	596,582	0	33,950

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

6.2.4.4 Crab Fishery

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

Southern California Crab Fishing Effort

From 1995 to 1999, an annual average of 76 vessels participated in the southern California crab fishery. Twenty five (25) of these vessels identified the crab fishery as their principal fishery. These vessels derived 92 percent of their landings and 80 percent of their ex-vessel revenue from southern California (Thomson 2001).

Past Landings and Ex-Vessel Revenues

Table 6-8 summarizes landings and ex-vessel revenues for the southern California crab fishery from 1986-2003. This table also includes specific information for the two areas that would likely be affected by sea otter predation over the next 10 years: 1) the coastline from Point Conception to Santa Barbara, and 2) San Nicolas Island. These areas are discussed in greater detail below.

Southern California Bight

Figure 6-9 shows commercial crab landings for the entire southern California fishery. Crab harvests in southern California have more than doubled in the last 15 years, from 400,000 pounds in 1986 to more than 1 million pounds in 2001. Harvests tend to decline slightly after each El Niño event but recover quickly.

Coastline, Point Conception to Santa Barbara

Crab landings along the coastline from Point Conception to Santa Barbara are depicted in Figure 6-10. Over the last 15 years, commercial annual crab landings along this stretch of coastline have fluctuated greatly, decreasing by 36 percent between 1988 and 1989 and increasing by 200 percent between 1989 and 1990. From 1997 to 2000, crab landings decreased by 47 percent before steadying at 135 thousand pounds in 2001. In 2003, landings decreased by 50 percent to about 99,000 pounds.

San Nicolas Island

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

Percentages of Fishery

From 1994 to 2003, commercial crab landings along the coastline from Point Conception to Santa Barbara accounted for 18 percent of southern California crab landings. During the same period, annual crab landings at San Nicolas Island accounted for one percent of southern California's annual crab landings (Table 6-9).

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

Under the baseline (no attempt to move sea otters), changes in the southern California crab fishery may occur over time. Based on simulations by Tinker *et al.* (2004) (Appendix F), the southern sea otter's range is expected to expand along the mainland coastline towards the city of Santa Barbara over the next 10 years. For the purposes of our analysis, we assume that sea otter predation would eliminate all commercial crab harvest from Point Conception to Santa Barbara (CDFG statistical blocks 654, 655, 656, and 657) by the year 2014. Whether sea otters would reoccupy other areas of the Southern California Bight in subsequent years would be a function of sea otter demographic rates, food supply, and other variables. Those areas reoccupied by sea otters would likely cease to support commercial crab fishing, but the magnitude and timing of this potential change is unknown.

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

Year	Commercial Landings (Pounds)			Ex-Vessel Revenue (thousands of 2004 dollars)		
	SCB	Point Conception to Santa Barbara Coastline	San Nicolas Island	SCB	Point Conception to Santa Barbara Coastline	San Nicolas Island
1986	398,933	147,768	1,526	$586	$221	$2
1987	366,168	114,750	16,550	$459	$154	$22
1988	246,334	117,595	2,876	$312	$162	$4
1989	161,344	75,310	0	$226	$114	$0
1990	361,468	230,418	672	$513	$345	$1
1991	600,046	161,681	7,507	$802	$235	$10
1992	503,753	134,369	0	$651	$181	$0
1993	488,108	110,312	1,053	$627	$141	$1
1994	484,180	79,093	737	$623	$106	$1
1995	621,210	98,467	619	$870	$145	$1
1996	802,058	185,984	1,253	$1,136	$254	$8
1997	958,960	249,106	1,675	$1,265	$330	$2
1998	990,563	232,035	22,851	$1,273	$286	$31
1999	651,729	175,589	4,545	$870	$238	$6
2000	931,467	133,092	1,453	$1,222	$181	$2
2001	1,042,774	134,615	4,852	$1,432	$185	$10
2002	1,082,491	148,289	7,047	$1,451	$194	$8
2003	954,515	99,183	18,468	$1,221	$118	$25

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

The colony of sea otters at San Nicolas Island (CDFG statistical blocks 813 and 814) is predicted to increase from 6 percent of carrying capacity at present (2004) to 16 percent of carrying capacity in 10 years. Assuming a perfect inverse relationship between the percentage of carrying capacity attained by sea otters and the commercial crab catch (more sea otters = fewer crabs), crab landings would decrease by approximately 10 percent by the year 2014.

ESTABLISHING THE BASELINE FOR THE SOUTHERN CALIFORNIA CRAB FISHERY

To establish a landings baseline, we employ a 10-year average (1994-2003) for each area to mitigate the effects of cyclic variations in populations, adverse weather, market demand, and other factors that influence catch from one year to the next. From the 10-year average, we project crab harvest

impacts as a direct function of sea otter occupation in each area. Along the affected coastline (Point Conception to Santa Barbara), the 10-year landings average is 153,545 pounds. We assume that once an area is permanently occupied by sea otters, the commercial crab fishery would no longer be viable in that area. Thus, we assume that crab landings along the coastline would decrease 10 percent (15,355 pounds) each year, from 153,545 pounds to 138,191 pounds in 2005 to 122,836 pounds in 2006, and so forth to zero landings in 2014. Around San Nicolas Island, the 10-year landings average is 6,350 pounds. We assume that the commercial crab fishery in this area would decrease by approximately 10 percent over 10 years. Thus, we assume that crab landings from San Nicolas Island would decrease by 1 percent (64 pounds) each year, from 6,350 pounds to 6,287 pounds in 2005 to 6,223 pounds in 2006, and so forth to 5,715 pounds in 2014.

Table 6-10 depicts the baseline for crab landings that will be employed in this analysis. Note that commercial landings across areas are not additive. Rather, the Point Conception to Santa Barbara coastline and San Nicolas Island

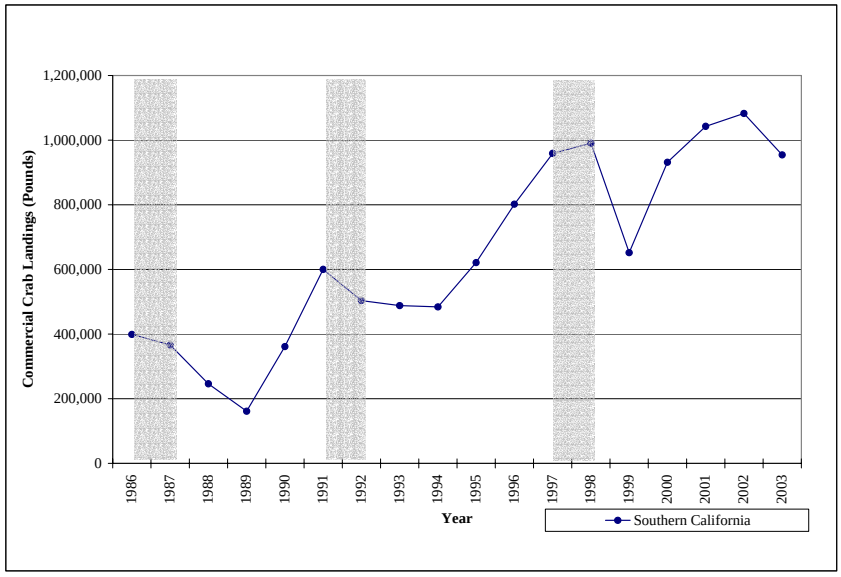

FIGURE 6-9. COMMERCIAL CRAB LANDINGS FOR SOUTHERN CALIFORNIA, 1986-2003. Shaded areas indicate El Niño events. Data source: California Department of Fish and Game (2002a, 2005a).

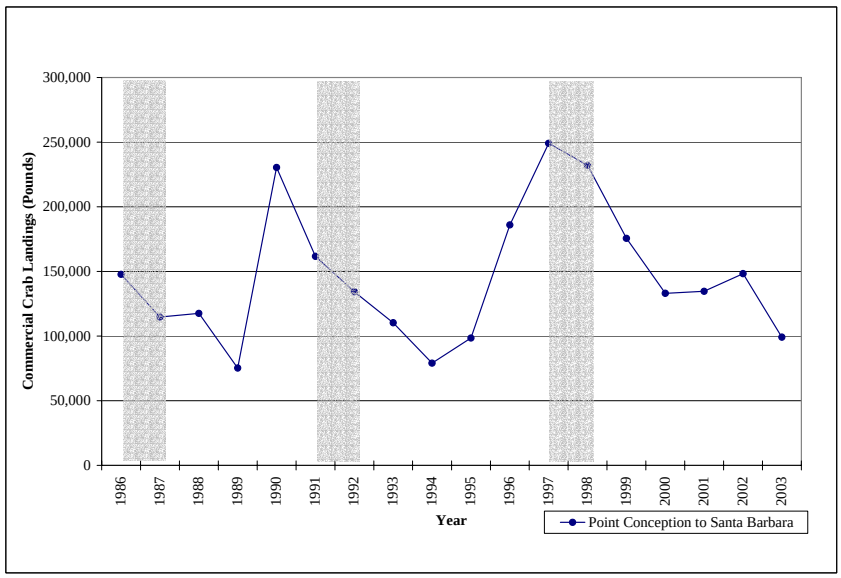

FIGURE 6-10. ANNUAL CRAB LANDINGS: POINT CONCEPTION TO SANTA BARBARA. Shaded areas indicate El Niño events. Data source: California Department of Fish and Game (2002a, 2005a).

TABLE 6-9. AVERAGE ANNUAL CRAB LANDINGS, 1994-2003.

	Average Annual Landings (pounds)	Percentage of Southern California Bight Landings
Point Conception to Santa Barbara (coastline)	153,545	18%
San Nicolas Island	6,350	1%
SCB (excluding landings from the above two areas)	692,099	81%
Total Average Annual Landings	851,995	100%

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

represent a portion of the entire southern California crab fishery.

6.2.5 AQUACULTURE

Most commercial shellfish production in aquaculture operations has recently declined. Production of oysters, abalones, and mussels in California declined after peaking in 1994, 1996, and 1997, respectively (Wendell 2001). From 1992-1997, statewide mussel production grew from 187,000 pounds to 471,000 pounds but then dropped by almost 50 percent in 1998 due to El Niño conditions (Richards and Trevelyan 2001). Statewide mussel production returned about $500,000 annually in 1996 and 1997 but dropped to $280,000 in 1998 (Richards and Trevelyan 2001). Recent colder water regimes have improved mussel recruitment (Richards and Trevelyan 2001).

ESTABLISHING THE BASELINE FOR AQUACULTURE

In April 2002, nine registered aquaculture facilities were in operation in the Southern California Bight (Moore pers. comm. 2002).

TABLE 6-10. PROJECTED BASELINE FOR COMMERCIAL CRAB LANDINGS

Year	Commercial Landings (pounds)*		
	Southern California Bight**	Point Conception to Santa Barbara Coastline	San Nicolas Island
10-year average (1994-2003)	851,995	153,545	6,350
2005	836,577	138,191	6,287
2006	821,159	122,836	6,223
2007	805,741	107,482	6,160
2008	790,323	92,127	6,096
2009	774,905	76,773	6,033
2010	759,487	61,418	5,969
2011	744,069	46,064	5,906
2012	728,651	30,709	5,842
2013	713,233	15,355	5,779
2014	697,815	0	5,715

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

Five of these leases are located in the Santa Barbara Channel between Point Conception and Santa Barbara, with most production deriving from the harvest of mussels from offshore oil platforms. There are currently no active aquaculture operations at San Nicolas Island. Several aquaculture facilities grow abalone in land-based tanks or in cages suspended in the water column (Ebert 2001). These abalone are inaccessible to sea otters and are therefore not expected to be affected by sea otter range expansion.

Over the next 10 years, sea otters are expected to extend their range along the coastline between Point Conception and

Santa Barbara and to increase in number by about nine percent annually at San Nicolas Island. Sea otters reoccupying the mainland coastline could travel to offshore oil platforms in the Santa Barbara Channel and consume mussels. The potential effect of sea otters on mussel aquaculture operations is unclear. Sea otters are capable of locally reducing mussel densities, but regional depletion of harvestable mussel stocks may not occur (Estes and Van Blaricom 1985). Because the local clearing of patches in mussel beds by sea otter predation is episodic, it is not possible to predict or quantify impacts. At the regional level, it is probable that mussel aquaculture operations can persist within the range of sea otters because the consumption of mussels in California is patchy and sporadic (Estes and Van Blaricom 1985); however, the combination of sea otter predation and other factors that may adversely affect these operations could result in cumulative effects on mussel aquaculture.

Beyond 10 years, aquaculture operations located in other portions of the Southern California Bight may be affected by sea otters. In April 2002, there were two registered aquaculture leases in Ventura County (producing a variety of shellfish and finfish) and two in San Diego County (producing exclusively abalone). Effects on aquaculture operations overall would likely be limited to sporadic losses at open water aquaculture leases where the harvested species is unprotected from sea otter foraging.

6.2.6 Seafood Processing Industry (Sea Urchins)

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

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

Approximately 12 sea urchin processing facilities are located in southern California (Sea Urchin Harvester's Association-California 2003). These facilities process between 7 and 10 million pounds of sea urchin annually. While some of these facilities process only sea urchins, others process other shellfish and fish.

Establishing the Baseline for the Sea Urchin Processing Industry

Under the baseline (no attempt to manage sea otters), changes in the southern California sea urchin processing industry may occur. Based on simulations by Tinker *et al.* (2004) (Appendix F), the southern sea otter's range is expected to expand along the coastline towards the city of Santa Barbara over the next 10 years. Sea otter predation is projected to reduce the total commercial sea urchin harvest in the Southern California Bight, and thus inputs to southern California sea urchin processing facilities, by 3 percent over the next 10 years due to (1) the elimination of the commercial sea urchin fishery along the coastline from Point Conception to Santa Barbara, and (2) the 10 percent decline of the commercial sea urchin harvest at San Nicolas Island. Whether sea

otters would reoccupy other areas of the Southern California Bight in subsequent years would be a function of sea otter demographic rates, food supply, and other variables. Those areas reoccupied by sea otters would cease to be a source of sea urchin inputs to the seafood processing industry, but the magnitude and timing of this potential future change is unknown.

6.2.7 Kelp Harvest

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

Establishing the Baseline for Kelp Harvest

Harvesting of giant kelp (*Macrocystis pyrifera*), the algal species most important to the kelp industry, occurs throughout much of the section of coastline that sea otters are expected to recolonize over the next 10 years. The area from Point Conception to Santa Barbara corresponds to CDFG administrative kelp beds 23-32 (see figure 4-24), of which bed 32, near Cojo Anchorage, produced the second-highest kelp yields in the state from 1989-1999 (more than 100,000 tons) (CDFG 2000a). Beds are also currently leased at San Nicolas Island, which is another important area for kelp harvest. Bed 108, along the northern side of San Nicolas Island, produced the eighth-highest kelp yields in the state from 1989-1999 (almost 50,000 tons) (CDFG 2000a).

Sea otter predation on herbivores is generally expected to promote the growth of dense beds of giant kelp (for a more detailed discussion of the relationship between sea otters, sea urchins, and kelp, see section 6.2.2). However, because kelp distribution in areas of suitable substrate is not strictly correlated with grazing pressure (storms, pollution, water temperature, and other factors can also limit kelp), the magnitude of impact to this industry cannot be reasonably predicted.

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

The impact around San Nicolas Island is likely to be minimal over the next 10 years because the sea otter population is expected to reach only 16 percent of the estimated carrying capacity for the island. Although some increased predation on invertebrate herbivore populations at the island is expected, San Nicolas Island presently has extensive kelp forests. The predicted increase in sea otter numbers would not likely result in noticeable effects, but the persistence and density of these kelp beds may be enhanced.

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

6.2.8 Recreational Fishing and Diving

For a description of recreational fishing and diving, see section 4.4.6. Recreational fishing and diving activities that may be affected by sea otters include lobster diving, abalone diving, and finfish fishing. Lobster diving and finfish fishing are addressed

below. Abalone diving is included under "Abalone Fishery Restoration" (section 6.2.9).

Southern California is a leading recreational fishing area along the west coast. Recreational fisheries in the Southern California Bight access nearshore and offshore areas, targeting both finfish and shellfish. Recreational fishing may occur from human-made structures, such as jetties and piers; from beaches; from commercial passenger fishing vessels; or from private boats. The top recreational landings for California during 1998-1999 were rockfish, sea basses/tuna/mackerel, smelt, surfperch, croakers, and Pacific barracuda. Based on 1998-99 data, annual expenditures related to all marine recreational fishing trips in southern California are estimated to total $202 million. This estimate, combined with an additional $128.4 million in expenditures for license, fishing gear, and boat-related items, results in a total annual expenditure of $330.4 million for recreational fishing in southern California (Thomson 2001).

Recreational fishing may be affected by the presence of sea otters in two ways: 1) direct competition between recreational divers and sea otters for recreationally targeted species consumed by sea otters, or 2) indirect habitat enhancement that could benefit recreational fishing through increased production of targeted finfish species. Because southern sea otters predominantly consume shellfish, the only potential for direct competition with a current southern California recreational fishery is recreational lobster diving (and the potential for future abalone diving). Sea otter predation would also reduce the abundance of herbivorous invertebrates, which would in turn promote the development, stability, and persistence of the nearshore kelp forest ecosystem in areas where herbivores are limiting kelp production. A healthy kelp forest ecosystem is important for a wide range of finfish species harvested by the recreational fishery. See section 6.2.2.

The California Department of Fish and Game has collected data on commercial passenger fishing vessels (recreational) since 1995. From 1997 to 2001, the number of commercial passenger fishing vessels submitting data averaged about 22 boats per year in southern California (Thomson 2001).

6.2.8.1 Lobster Diving

From 1995 to 2003, recreational lobster dive trips in southern California averaged 8,983 trips annually, ranging from about 11,700 trips in 1996 to about 7,300 trips in 2003 (Table 6-11). The ratio of person-trips to lobster catch in southern California averaged 1.3:1 from 1995 to 2003. This ratio was slightly lower (0.9) for San Nicolas Island. There are too few data points for the stretch of coastline from Point Conception to Santa Barbara to estimate a similar ratio.

Between 1995 and 2003, the majority of lobster fishing trips was concentrated around the Northern Channel Islands, where 6 percent of trips occurred (Figure 6-11). Although the coastline from Point Conception to Santa Barbara is located near the Northern Channel Islands, virtually no dive trips were reported in this region, and it is therefore not included in Figure 6-11. Approximately 5 percent of the dive trips occurred in the nearshore waters around San Nicolas Island. The coastline from Santa Barbara to the Mexican border also had very few dive trips.

Establishing the Baseline for Lobster Diving

Under the baseline (no attempt to manage sea otters), changes in recreational lobster diving may occur. Based on simulations by

TABLE 6-11. NUMBER OF RECREATIONAL LOBSTER FISHING TRIPS AND CATCH VIA COMMERCIAL PASSENGER FISHING VESSELS DISTRIBUTED BY AREA

Year	Recreational Lobster Dive Trips			Number of Lobsters Caught		Ratio of Trips to Catch	
	Southern California Bight	Point Conception to Santa Barbara	San Nicolas Island	Southern California Bight	San Nicolas Island	Southern California Bight	San Nicolas Island
1995	10,094	33	742	5,633	783	1.8	0.9
1996	11,698	0	1,398	6,143	1,583	1.9	0.9
1997	11,514	45	933	7,148	925	1.6	1.0
1998	7,910	0	274	5,446	182	1.5	1.5
1999	9,164	1	342	5,782	373	1.6	0.9
2000	9,880	0	352	9,098	624	1.1	0.6
2001	7,118	0	120	6,830	243	1.0	0.5
2002	6,163	0	346	7,270	441	0.8	0.8
2003	7,309	0	183	9,032	177	0.8	1.0
9-year average	8,983	9	521	6,931	592	1.3	0.9

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

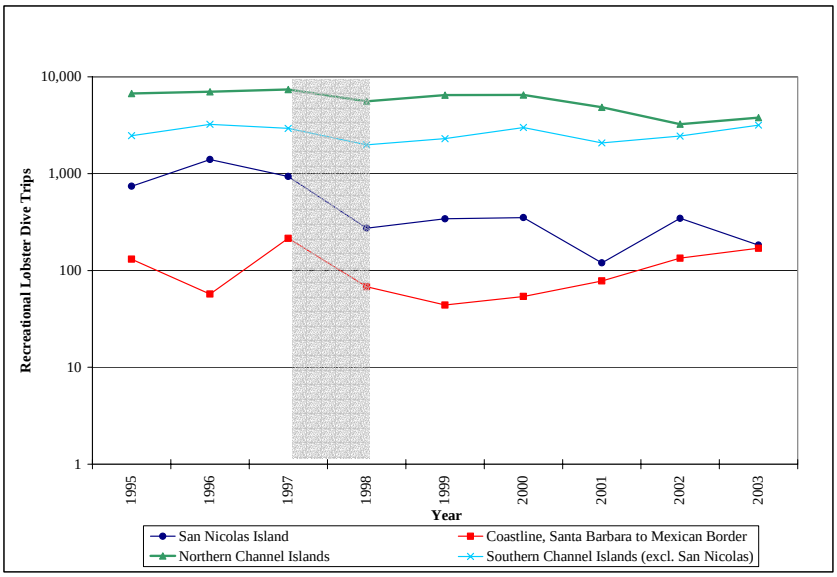

FIGURE 6-11. ANNUAL DISTRIBUTION OF RECREATIONAL LOBSTER FISHING TRIPS VIA COMMERCIAL PASSENGER FISHING VESSELS BY AREA IN SOUTHERN CALIFORNIA. Shaded area indicates El Niño event. Data source: California Department of Fish and Game (2002a, 2005a).

Tinker *et al.* (2004) (Appendix F), the southern sea otter's range is expected to expand along the coastline towards the city of Santa Barbara over the next 10 years. For the purposes of our analysis, we assume that sea otter predation would eliminate lobster dive trips along the coast from Point Conception to Santa Barbara (CDFG statistical blocks 654, 655, 656, and 657) during this period. Recreational lobster fishing trips around San Nicolas Island could also be affected. Over the next 10 years, sea otters at San Nicolas Island (CDFG statistical blocks 813 and 814) are expected to increase from 6 percent of carrying capacity in 2004 to 16 percent of carrying capacity in 2014. We assume that lobster dive trips would decrease accordingly, by 10 percent over 10 years at the island. Whether sea otters would reoccupy other areas of the Southern California Bight in subsequent years would be a function of sea otter demographic rates, food supply, and other variables. Those areas reoccupied by sea otters would likely exhibit declines in the number of lobsters available to recreational lobster divers, but the magnitude and timing of this potential future change is unknown.

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

To establish the recreational lobster fishing baseline, we project that the elimination of lobster fishing trips along the coastline from Point Conception to Santa Barbara would be distributed evenly across 10 years so that lobster dive trips would decrease 10 percent (about 1 trip) each year from 9 trips (9-year average) to 8 trips in 2005, and so forth to zero trips in 2014.

TABLE 6-12. PROJECTED BASELINE FOR RECREATIONAL LOBSTER FISHING TRIPS

Year	Recreational Lobster Fishing Trips*		
	Southern California Bight	San Nicolas Island	Point Conception to Santa Barbara Coastline
9-year average (1995-2003)	8,983	521	9
2005	8,977	516	8
2006	8,971	511	7
2007	8,965	506	6
2008	8,959	500	5
2009	8,953	495	4
2010	8,947	490	3
2011	8,941	485	2
2012	8,935	480	2
2013	8,928	474	1
2014	8,922	469	0

*Rounded to the nearest trip.

Around San Nicolas Island, the average number of annual trips is 521. Using this approach, trips around San Nicolas Island are predicted to decrease 1 percent per year over 10 years from 521 trips (9-year average) to 516 trips in 2005 to 511 trips in 2006, and so forth to 469 trips in 2014 (Table 6-12). Because the data represent only commercial passenger fishing vessels (no private dive trips are included), the number of dive trips may be underestimated.

6.2.8.2 Finfish Fishing

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

6.2.9 Abalone Fishery Restoration

For additional background on the commercial and recreational abalone fishery, see section 4.4.7. From 1995 to 1997, recreational abalone trips in southern California decreased by 83 percent, while

TABLE 6-13. NUMBER OF RECREATIONAL ABALONE FISHING TRIPS AND CATCH VIA COMMERCIAL PASSENGER FISHING VESSELS DISTRIBUTED BY AREA

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

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

trips at San Nicolas Island decreased by 50 percent (Table 6-13). The California abalone fishery was closed in 1997 (with the exception of a sport-only fishery for red abalone north of San Francisco County) due to the depletion of multiple species of abalone caused by commercial and recreational harvest. Advances in diving equipment and boats increased the efficiency of commercial abalone exploitation, contributing to the depletion of stocks and the continual expansion of fishing grounds. During this same period, sea otter reoccupation of historic range along the central coast of California resulted in the displacement and concentration of fishing pressure to other areas of California (CDFG 2002c).

In December 2002, the California Department of Fish and Game published a draft Abalone Recovery and Management Plan (ARMP) for five species of abalone (red, black, green, pink, and white) in southern California. If abalone populations recover to sufficient levels, the ARMP proposes various management alternatives that will "…initially apply to the northern California red abalone fishery, but ultimately will apply to any fully recovered species in central and southern California, *outside of the sea otter range*" (CDFG 2002c, emphasis added). As indicated here and elsewhere in the ARMP, areas of southern California that are reoccupied by sea otters would not be considered for the development of commercial or recreational abalone fisheries.

The ARMP projects recovery times and key recovery areas for each species of abalone considered in the plan (Table 6-14). According to these projections, abalone populations will require 6 to 20 (or more) years to meet Criterion 1, which will be achieved when abalone reach a broad size distribution over their former range. Only when abalone have met Criterion 3 (an average density of 6,600 abalone per hectare) would they be considered for recreational or commercial harvest. The ARMP does not estimate the time required to meet Criteria 2 or 3 because such estimates would be purely "speculative," but the plan does state that achievement of these criteria may take decades.

ESTABLISHING THE BASELINE FOR ABALONE FISHERY RESTORATION

The southern sea otter's range is expected to expand along the coastline towards the city of Santa Barbara over the next 10 years (Appendix F). It does not appear that there is any potential for reopening the abalone fishery for any species during this 10-year time frame, regardless of the presence or absence of sea otters. We assume that extension of the southern sea otter's range from Point Conception to Santa Barbara would preclude reestablishment of abalone fishing along this stretch of coastline.

Over the next 10 years, sea otters at San Nicolas Island (CDFG statistical blocks 813 and 814) are expected to increase from 6 percent of carrying capacity in 2004 to 16 percent of carrying capacity in 2014. Abalone populations at San Nicolas Island are expected to persist as sea otter predation increases. However, densities of large individual abalone would likely eventually be reduced to a point that would preclude reestablishment of an abalone fishery at the island. If the colony at San Nicolas Island persisted as projected, the area surrounding the island would likely be disqualified from abalone fishery consideration on the grounds that it is not "outside of the sea otter range" (CDFG 2002c).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. Whether or when an abalone fishery could be reestablished in the absence of sea otters is also uncertain, but it is clear that sea otter range expansion would preclude the possibility of recreational or commercial abalone fishing in reoccupied areas.

TABLE 6-14. PROJECTED ABALONE RECOVERY TIMES AND KEY RECOVERY AREAS.

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

Source: Draft Abalone Recovery and Management Plan (CDFG 2002c).

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

6.2.10 ECOTOURISM

HISTORY AND PAST TRENDS

Tourism is the 3rd largest employer in the state of California and the 5th largest contributor to the gross state product (California Tourism 2003). Among ocean-dependent industries in California, coastal tourism is the most economically considerable. Coastal tourism spending was the largest economic component among seven ocean-dependent industries studied by the Resources Agency of California, contributing $9.9 billion to the California economy in 1992 (Burroughs *et al.* 1997).[12] Expenditures for wildlife-watching activities in the state of California are the highest of any state and totaled about 2.6 billion dollars in 2001. For comparison, expenditures for recreational fishing for all of California totaled about 2.0 billion dollars in 2001 (USFWS 2001).

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

Like whales, sea otters can be a considerable draw for tourists. Sea otters in Monterey Bay and Morro Bay attract visitors who contribute to the local economies through spending on accommodations, meals at restaurants, recreation, and retail purchases. However, it is difficult to estimate the economic importance of sea otters relative to other tourist attractions.[13] Sea otters have occurred only in very low numbers in the Southern California Bight in the recent past. At San Nicolas Island, the only area of the Southern California Bight where sea otters have been consistently present, the numbers of sea otters have also remained low. Trips directed toward ecotourism in the Southern California Bight would increase in quality if sea otters were observed.

ESTABLISHING THE BASELINE FOR ECOTOURISM

Over the next 10 years, southern sea otters are expected to recolonize the stretch of coastline from Point Conception to the Santa Barbara harbor mouth, with a median number of 117 sea otters residing year-round south of Point Conception by the end of the 10-year period. Tourism, based on sea otter watching, would be enhanced with sea otters residing along a coastline accessible by a well-traveled highway and near busy areas like the Santa Barbara harbor. Overall economic value of this tourism is difficult to quantify and would not necessarily result in increased economic activity. Rather, it would likely manifest itself as an added value to other tourist draws in the area.

The sea otter colony at San Nicolas Island is expected to increase by 9 percent annually,

[12] Seaports and shipbuilding contributed about $6.0 billion; offshore oil, gas, and mineral production contributed $852 million; and commercial fishing, aquaculture, and kelp harvesting contributed $554 million (Burroughs et al. 1997).

[13] Only one study of which we are aware attempts to quantify the impact of sea otters on tourism. Aldrich *et al.* (2001) performed a regression analysis to calculate a yearly added-value destination spending (in California) per sea otter of $69,700 +/- 39,300, which includes accommodation, eating-drinking, recreation, and retail spending.

resulting in an estimated population size of 79 in 2014. San Nicolas Island is not currently an important destination for ecotourism (U.S. Department of Defense 2002) relative to the other Channel Islands because of its isolation from other islands, its distance from the mainland, and the periodic closure of its surrounding waters for military operations. We do not expect ecotourism in this area to grow considerably (in terms of number of trips) due to the increased abundance of sea otters. Rather, the quality of recreational trips that do occur at San Nicolas Island would likely be enhanced due to increased opportunities to see sea otters.

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

6.2.11 Federal and State Agency Programs

For additional background on the activities of the Channel Islands National Park (CINP), the Channel Islands National Marine Sanctuary (CINMS), the California Department of Fish and Game (CDFG), the U.S. Minerals Management Service (Minerals Management Service) and the U.S. Navy, see section 4.4.9. For a discussion of the regulatory environment, see section 6.2.12.

6.2.11.1 U.S. Fish and Wildlife Service

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

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

Establishing the Baseline for Fish and Wildlife Service Programs

Under baseline conditions, sea otters may expand their range naturally into the Southern California Bight, maximizing the area available at the southern end of the

range for southern sea otter recovery and the potential for the eventual increase of southern sea otters to OSP. The carrying capacity of the Southern California Bight has been estimated as 6,441 sea otters, which accounts for about 40 percent of the carrying capacity of California as a whole (Laidre *et al*. 2001).

For a discussion of the regulatory provisions that apply to sea otters under the baseline, see section 6.2.12.

IMPLEMENTATION COSTS (10-YEAR PERIOD)

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

6.2.11.2 Channel Islands National Park

ESTABLISHING THE BASELINE FOR CHANNEL ISLAND NATIONAL PARK PROGRAMS

Based on simulations by Tinker *et al.* (2004) (Appendix F), the southern sea otter's range is expected to expand along the mainland coastline towards the city of Santa Barbara over the next 10 years. At San Nicolas Island, the sea otter population is expected to grow by about nine percent annually. Because both of these areas are outside the boundaries of the Channel Islands National Park, sea otters are not expected to have any effect on this agency within ten years.

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

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

6.2.11.3 Channel Islands National Marine Sanctuary

ESTABLISHING THE BASELINE FOR CHANNEL ISLANDS NATIONAL MARINE SANCTUARY PROGRAMS

Based on simulations by Tinker *et al.* (2004) (Appendix F), the southern sea otter's range is expected to expand along the mainland coastline towards the city of Santa Barbara over the next 10 years. At San Nicolas Island, the sea otter population is expected to grow by about nine percent annually. Because both of these areas are outside the boundaries of the Channel Islands National

Marine Sanctuary, sea otters are not expected to have any effect on this agency within ten years.

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

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

6.2.11.4 California Department of Fish and Game

Note: California Department of Fish and Game activities that may be affected by sea otters are diverse, and baseline effects on these activities are discussed separately. California Department of Fish and Game activities include general fisheries management or restoration, efforts to protect rare species (such as white and black abalone and southern sea otters), and the implementation of Marine Protected Areas. Effects on the recovery of white and black abalone and sea otters are discussed under "Candidate, Threatened, and Endangered Species" (section 6.2.3). Effects on existing commercial fisheries are discussed under "Commercial Fisheries" (section 6.2.4). Effects on attempts to restore an abalone fishery are discussed under "Abalone Fishery Restoration" (section 6.2.9). Effects on Marine Protected Areas are discussed here.

Establishing the Baseline for California Department of Fish and Game Programs

Twelve new Marine Protected Areas at the Channel Islands were designated by the California Fish and Game Commission in October of 2002. These special status areas are all located in state waters within the boundaries of Channel Islands National Marine Sanctuary. Under baseline conditions, sea otters are not expected to recolonize any currently designated Marine Protected Areas within 10 years. Therefore, there would be no effect within this period of time on the efforts of CDFG to implement and manage these areas.

At some point in the future, however, it is possible that sea otters would recolonize other areas of the Southern California Bight, which would likely include the Channel Islands. As described in the *Final Environmental Document for Marine Protected Areas in NOAA's Channel Islands National Marine Sanctuary* (Ugoretz 2002), the Channel Islands Marine Protected Areas are intended to meet multiple objectives. These objectives include an ecosystem biodiversity goal, a socio-economic goal, a sustainable fisheries goal, a natural and

cultural heritage goal, and an education goal (Ugoretz 2002). The Channel Islands Marine Protected Areas are also intended to meet the requirements of recent state legislation emphasizing ecosystem management, such as the Marine Life Management Act (Chap. 1052, Stats. 1998) and the Marine Life Protection Act (Chap. 1015, Stats. 1999) (Ugoretz 2002). Specifically, the Channel Islands Marine Protected Areas are intended to meet the following goals identified in the Marine Life Protection Act [Fish and Game Code Section 2853(b)]:

> 1) To protect the natural diversity and abundance of marine life, and the structure, function, and integrity of marine ecosystems;
>
> 2) To help sustain, conserve, and protect marine life populations, including those of economic value, and rebuild those that are depleted;
>
> 3) To improve recreational, educational, and study opportunities provided by marine ecosystems that are subject to minimal human disturbance, and to manage these uses in a manner consistent with protecting biodiversity;
>
> 4) To protect marine natural heritage, including protection of representative and unique marine life habitats in California waters for their intrinsic value;
>
> 5) To ensure that California's Marine Protected Areas have clearly defined objectives, effective management measures, and adequate enforcement, and are based on sound scientific guidelines; and
>
> 6) To ensure that California's Marine Protected Areas are designed and managed, to the extent possible, as a network. (Ugoretz 2002)

The gradual reoccupation of historic range by sea otters would be consistent with the goals set out for the Marine Protected Areas relating to: the maintenance of ecosystem biodiversity; the protection of the structure, function, and integrity of marine ecosystems; the protection of marine natural heritage; and the provision of recreational, scientific, and educational opportunities. With respect to the socio-economic goals set for the Marine Protected Areas, the presence of sea otters would likely enhance socio-economic activities related to all forms of non-consumptive recreation.

The presence of sea otters would also be compatible with state legislative mandates to practice ecosystem management. Specifically, the presence of sea otters is compatible with the objectives of state policy to conserve entire systems, to allow only sustainable uses of the marine environment, to recognize the importance of non-consumptive uses, and to encourage commercial fishing and aquaculture where it is consistent with marine living resource conservation policies. These objectives are expressed in Division 6, Part 1.7 of the Marine Life Management Act [7050(b)]:

> 1) Conserve the health and diversity of marine ecosystems and marine living resources.[14]

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

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

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

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

An assessment of the possible effects of sea otters on sustainable fisheries goals for the Marine Protected Areas is somewhat more complicated. Generally, sea otters can be expected to have a beneficial effect on the nearshore marine ecosystem, and thus to enhance the potential productivity of Marine Protected Areas overall (see section 6.2.2). Because 10 of the 12 Marine Protected Areas are closed to all fishing and kelp harvesting (designated "marine reserves"), there would be no direct effects on fishing or kelp harvesting activities within the boundaries of these 10 Marine Protected Areas. The two remaining areas are designated "conservation areas," which allow limited recreational fishing and lobster trapping. If sea otters occupied areas in and around these two "conservation areas," in numbers sufficient to cause a reduction in the densities of their invertebrate prey species, lobster trapping would likely be reduced or eliminated, but recreational finfish fishing could be enhanced as a result of increases in kelp, associated finfish, and other species (see section 6.2.2).

Most of the fishery benefits of Marine Protected Areas are expected to accrue outside of their boundaries. These benefits may occur as a result of the increased reproductive output and recruitment of fished species or as a result of the migration of legal-sized individuals out of Marine Protected Area boundaries (Ugoretz 2002). If sea otters reoccupied areas designated as Marine Protected Areas, the reproductive output of lobster, crab, and sea urchin populations in these areas would likely diminish as a result of sea otter predation. Dispersal of the highly mobile pelagic larvae produced by the remaining mature individuals in Marine Protected Areas could still occur, however. The potential for dispersal of larger individuals outside the boundaries of reserves depends on the mobility of the species in question (Ugoretz 2002). Whereas sea otter predation would have no impact on this form of "spillover effect" for sea urchins and abalone because mature individuals of these species are not highly mobile, sea otters would be expected to reduce the densities of lobsters and crabs and thus to reduce the number of legal-sized individuals that could potentially move out of Marine Protected Areas.

To the extent that the Channel Islands Marine Protected Areas are intended to enhance the prospect of a possible eventual reopening of the abalone fishery in southern California, the presence of sea otters in these areas would adversely affect such efforts. Sea otter predation can be expected to remove the larger, exposed individuals (which are more vulnerable to predation) from the abalone population and to restrict the remaining individuals to cryptic and inaccessible habitat. Abalone populations would likely be maintained at the densities typical for the area prior to the extirpation of sea otters, in whose absence the commercial abalone and sea urchin fisheries developed

(Estes and Van Blaricom 1985). The presence of sea otters in Marine Protected Areas would not eliminate the potential for persistent (cryptic) abalone populations but would rather diminish the fishery benefit anticipated from the exported reproductive output of protected large adults. Fanshawe *et al.* (2003) conclude from a study of red abalone in California "no take" areas with and without sea otters that sea otters restrict abalone to a subset of microhabitats adequate for population persistence but likely insufficient to contribute to regional fishery sustainability.

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

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

6.2.11.5 U.S. Navy

ESTABLISHING THE BASELINE FOR U.S. NAVY PROGRAMS

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

6.2.11.6 U.S. Minerals Management Service

ESTABLISHING THE BASELINE FOR U.S. MINERAL MANAGEMENT SERVICE PROGRAMS

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

6.2.12 REGULATORY ENVIRONMENT

The southern sea otter is federally listed as a threatened species under the Endangered Species Act of 1973, as amended, and is therefore a depleted species under the Marine Mammal Protection Act of 1972, as amended. The state of California additionally recognizes the southern sea otter as a fully protected mammal in Fish and Game Code section 4700 and as a protected marine mammal in Fish and Game Code section 4500. Among other restrictions, "take" of southern sea otters is prohibited under each of these laws.

Under the Endangered Species Act and the Marine Mammal Protection Act, there are provisions that allow certain types of take (*e.g.*, for scientific research or enhancement purposes, or incidental to specific legal activities) upon authorization of the Fish and Wildlife Service. However, state law

appears to be more restrictive. While California Fish and Game Code Section 4500 makes it unlawful to take a sea otter except in accordance with the Marine Mammal Protection Act of 1972, Fish and Game Code Section 4700 goes further and provides that "no provision of this code or any other law shall be construed to authorize the issuance of permits or licenses to take a fully protected mammal." Section 4700 contains a limited exception for scientific research and recovery efforts.

Establishing the Baseline for the Regulatory Environment

As a free-standing act of Congress, Public Law 99-625 changed the protections under the Endangered Species Act and the Marine Mammal Protection Act for sea otters residing in the translocation zone and management zone.

Under Public Law 99-625, sea otters within the translocation zone receive the standard protections of the Endangered Species Act for threatened species, except with respect to defense-related activities. Proposed actions other than defense-related activities that are carried out, authorized, or funded by a federal agency within the translocation zone and that may affect the southern sea otter are subject to the consultation requirements of section 7 of the Endangered Species Act. Under section 7 and its implementing regulations, a federal agency must consult with the Fish and Wildlife Service if a proposed action may affect the southern sea otter, and the agency may not proceed with the action if it is likely to jeopardize the continued existence of the southern sea otter. The standard prohibitions and authorizations (exceptions to the prohibitions) of the Marine Mammal Protection Act and state law also apply to southern sea otters within the translocation zone, with specific exemptions for incidental take of southern sea otters by defense-related agency actions.

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

Under Public Law 99-625, sea otters within the management zone are treated as members of a species that is proposed to be listed for the purposes of section 7 of the Endangered Species Act. Accordingly, federal agencies are not required to consult with the Fish and Wildlife Service under section 7 of the Endangered Species Act but only to conference with the Service if a proposed action is likely to jeopardize the continued existence of the species. In addition, any taking of sea otters within the management zone that is incidental to an otherwise legal activity (including commercial fishing) is not subject to the take authorization procedures of, and may not be considered a violation of, either the Endangered Species Act or the Marine Mammal Protection Act. To accommodate Public Law 99-625 and to support the

southern sea otter translocation program, the State of California enacted section 8664.2 of the California Fish and Game Code. Among other provisions, section 8664.2 allows for incidental take of sea otters in the management zone by means of specific exemptions from section 4700 of the Fish and Game Code.

6.3 Alternative 1—Resume Implementation of 1987 Translocation Plan

6.3.1 Introduction

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

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

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

6.3.2 Nearshore Marine Ecosystem

Alternative 1 would require the exclusion of sea otters from all areas of the Southern California Bight except the translocation zone surrounding San Nicolas Island. Any community changes that have occurred as a result of seasonal sea otter predation in the management zone during the last several years would likely be reversed, and none of the ecosystem changes predicted under baseline conditions would occur (see section 6.2.2). Conditions at San Nicolas Island would be the same as those projected for the baseline.

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

Significance criteria are not defined for effects on the nearshore marine ecosystem because of the extent of uncertainty involved.

6.3.3 Candidate, Threatened, and Endangered Species

To some extent, implementation of Alternative 1 may benefit existing white abalone and black abalone populations in the Southern California, unless sea otter containment efforts fail. Effects of

Alternative 1 on southern sea otters are considerable and strongly negative.

6.3.3.1 White Abalone

Resuming maintenance of the currently designated management zone, as required under Alternative 1, would minimize sea otter predation on white abalone populations in the Southern California Bight except in the translocation zone surrounding San Nicolas Island. However, this alternative differs little from the baseline condition with respect to white abalone because an expanding sea otter population is likely to have effects only on shallow-living individuals and is not expected to have effects at the local population or species level (see section 6.2.3.1).

Because Alternative 1 calls for only minor changes to the colony at San Nicolas Island relative to the baseline (including the possibility of continued translocation of small numbers of sea otters for the purposes of genetic enhancement), effects on white abalone in the vicinity of San Nicolas Island are essentially the same as for the baseline. Within 10 years, Alternative 1 is expected to have a beneficial effect of low significance.

In the long term, Alternative 1 would provide a probable benefit to shallow-living individuals in the management zone but would have no expected benefit at the species level.

6.3.3.2 Black Abalone

Maintenance of the currently designated management zone, as required under Alternative 1, would minimize sea otter predation on black abalone populations in the Southern California Bight except in the translocation zone surrounding San Nicolas Island. The area sea otters would likely reoccupy in the absence of zonal management (Point Conception to Santa Barbara) is not listed as a key recovery area for black abalone (CDFG 2002c), but because sea otters could have local population effects, over the next 10 years the exclusion of sea otters from the Southern California Bight is expected to have a beneficial effect of moderate significance.

Over the longer term, the exclusion of sea otters from the currently designated management zone could enhance black abalone recovery, but the magnitude of this potential benefit is unknown.

Despite the current presence of a sea otter colony at San Nicolas Island, the California Department of Fish and Game has identified San Nicolas Island as 1 of 10 key recovery areas for black abalone. Because Alternative 1 calls for only minor changes to the colony at San Nicolas Island relative to the baseline (including the possibility of continued translocation of small numbers of sea otters for the purposes of genetic enhancement), effects on black abalone in the vicinity of San Nicolas Island are the same as for the baseline.

6.3.3.3 Southern Sea Otter

Effects on Parent Population

Alternative 1 would require the resumption of zonal management (containment) of sea otters and the maintenance of the currently designated management zone in perpetuity. Under this alternative, sea otters found in the management zone (Point Conception to the Mexican border) would be captured and moved to other portions of the southern sea otter's range.

In 2000, the Service completed a biological opinion (USFWS 2000, included as Appendix B) on the southern sea otter containment program as described in our original southern sea otter translocation plan

(USFWS 1987). In this opinion, we concluded that continuing the containment program and restricting the southern sea otter to the area north of Point Conception (with the exception of the translocation zone at San Nicolas Island) would likely jeopardize the continued existence of the species. We based this conclusion on the assumption that reversal of southern sea otter population declines and expansion of the southern sea otter's range is essential to the survival and recovery of the species. Continuation of sea otter containment under Alternative 1 could result in increased mortality of sea otters and disrupt behavior throughout the range of the species. To implement Alternative 1, consultation under the Endangered Species Act would be reinitiated to consider any new information that is available. If the resulting opinion concludes that continuation of the program would not jeopardize the southern sea otter, Alternative 1 may be considered a viable option.

Continuation of zonal management of sea otters would limit natural range expansion and would eliminate about 37 percent of the carrying capacity (for sea otters) of California (see section 6.3.11.1, "U.S. Fish and Wildlife Service").

Moving sea otters from the management zone to the northern or central portion of the existing range would likely increase competition among sea otters, change natural behaviors, and may result in the deaths of otherwise healthy animals. Additionally, the incidental injury or death of sea otters removed from the management zone is likely unavoidable. Restriction of the southern sea otter's range may increase the vulnerability of the species to oil spills, disease, and stochastic events (relative to the baseline). In combination, these effects would slow the recovery of the species. In the revised southern sea otter recovery plan (USFWS 2003), the recovery team recommends that we discontinue zonal management and allow natural range expansion of sea otters to occur.

Effects on San Nicolas Island Colony

Alternative 1 would have little or no effect on the sea otter colony at San Nicolas Island compared to baseline conditions. Monitoring of the colony would continue, and protective measures in place would remain unchanged. Alternative 1 allows for the limited translocation of sea otters to San Nicolas Island for the purposes of maintaining genetic diversity; however, past experience indicates that dispersal of translocated sea otters would be high, possibly negating the intended effect of supplementing genetic diversity.

Because of the effects on key segments and behaviors of the southern sea otter, within 10 years Alternative 1 is expected to have an adverse effect of high significance on the southern sea otter and would likely change prospects for the recovery of the species.

6.3.4 Commercial Fisheries

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

6.3.4.1 Sea Urchin Fishery

Under Alternative 1, impacts to the commercial sea urchin fishery are expected to be limited to the coastline from Point Conception to just southeast of Gaviota (CDFG statistical blocks 655, 656, and 657). This area is henceforth referred to as Cojo Anchorage.

Maintenance of the management zone would theoretically eliminate sea otter predation on sea urchins that has been occurring in this area over the past several years, which could lead to a larger sea urchin population for commercial harvest. Benefits to the fishery accumulate for two reasons. First, newly settled or smaller sea urchins that escaped predation in the past would now potentially become available for future commercial harvest. Second, sea urchin landings would not be eliminated along the coastline from Point Conception to Santa Barbara, as projected under the baseline. Therefore, landings would not decrease the anticipated 1.1 million pounds over 10 years from 2005 to 2014. Thus, the analysis for the sea urchin fishery is divided into two sections: (1) increased harvests from the elimination of past predation, and (2) increased harvests due to elimination of the anticipated future decrease. Benefits are represented as increased landings and increased ex-vessel revenue.

REMOVAL OF PAST SEA OTTER PREDATION

Sea urchin landings from the Cojo Anchorage area peaked in the early 1990s (540,000 pounds in 1990), and steadied at about 300,000 pounds in the mid-1990s. Unlike other areas of southern California, Cojo Anchorage landings have not rebounded. In 1998, landings dropped to just over 100,000 pounds, and declined further in subsequent years, averaging 7,139 pounds between 1999 and 2003. In 2003, landings were about 17,000 pounds. The drop in landings is more severe than the average decrease for southern California and coincides with the seasonal movement of sea otters into the management zone.

To estimate the effects of sea otter predation in relation to other factors that have influenced sea urchin landings, we compare sea urchin landings from the Cojo Anchorage area with a similar (in terms of habitat and landings history) section of coast, Point Mugu to Point Dume (CDFG statistical blocks 680, 681, 682, and 703) (Figure 6-12). Prior to 1998, this section of the coastline exhibited peaks and troughs similar to those at Cojo Anchorage. However, beginning in 1998, Cojo Anchorage landings decreased, while landings along the coast from Point Mugu to Point Dume increased.

Figure 6-13 shows annual sea urchin landings on a logarithmic scale for five areas: southern California, the Northern Channel Islands, San Nicolas Island, Cojo Anchorage, and the coastline from Point Mugu to Point Dume. As shown in the figure, southern California and the Northern

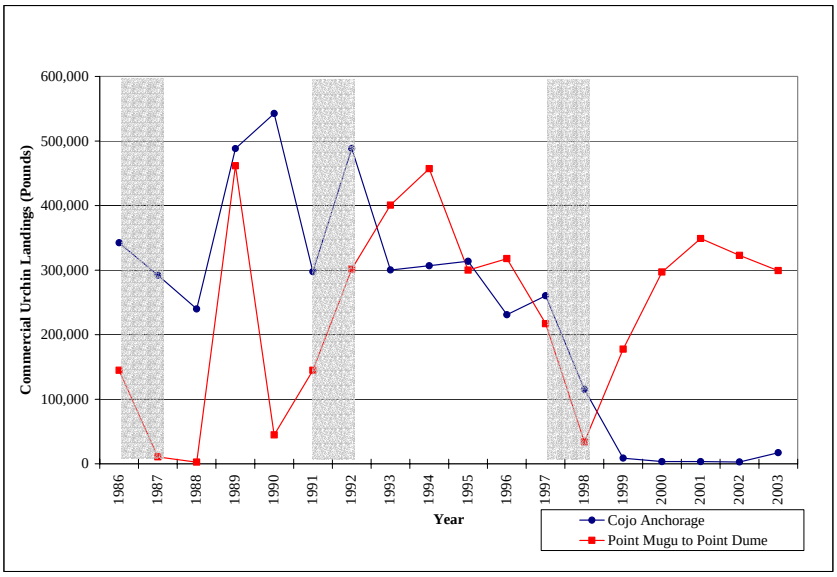

FIGURE 6-12. COMMERCIAL SEA URCHIN LANDINGS FOR COJO ANCHORAGE AREA (STATISTICAL BLOCKS 655, 656, AND 657) AND POINT MUGU-POINT DUME (STATISTICAL BLOCKS 680, 681, 682, AND 703). Shaded areas indicate El Niño events.
Data source: California Department of Fish and Game (2002a, 2005a).

Channel Islands follow similar trends over time. After the most recent El Niño event, southern California and northern Channel Islands landings dropped an average of 34 and 30 percent, respectively, compared to the peak year of harvest in 1997. Landings from Cojo Anchorage, however, exhibited a 90 percent decline after the 1997/98 El Niño event. Landings along the coastline from Point Mugu to Point Dume recovered to a pre- El Niño level (see Table 6-15).

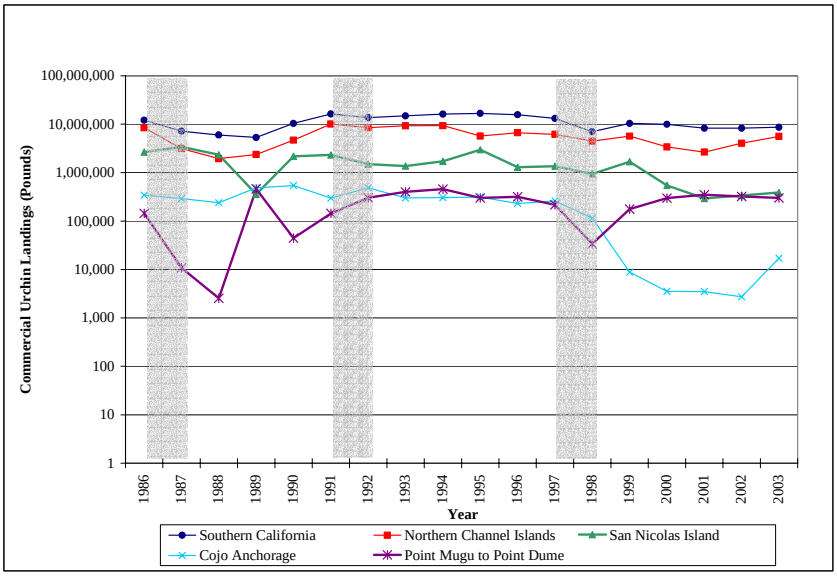

FIGURE 6-13. COMMERCIAL ANNUAL SEA URCHIN LANDINGS BY AREA, ON A LOGARITHMIC SCALE. Shaded areas indicate El Niño events. Data source: California Department of Fish and Game (2002a, 2005a).

Sea urchin landings in southern California are a function of a variety of factors, including (but not limited to) population variation, weather fluctuations, and market demand. Determining the exact composition of these factors for sea urchin landings is difficult. As a conservative approach, we assume that sea urchin landings are solely and equally dependent upon weather fluctuations (El Niño events) and sea otter predation. We further assume that southern California's average annual sea urchin landings are not representative of landings along the northern coastline of the management zone because landings in these areas have not followed similar historical trends. Rather, we assert that landings throughout the coastline from Point Conception to Point Dume should respond similarly to weather fluctuations and sea otter predation. Thus, we establish sea urchin landings fluctuations along the coastline from Point Mugu to Point Dume as a baseline for Cojo Anchorage landings fluctuations. Because little or no sea otter predation occurred southeast of Gaviota, we attribute the total percentage decrease from Point Mugu to Point Dume to the El Niño event (Table 6-16). Any Cojo Anchorage decrease above the baseline is, thus, attributed to sea otter predation. Since the

TABLE 6-15. CHANGE IN ANNUAL SEA URCHIN LANDINGS AFTER THE 1997/1998 EL NIÑO EVENT.

	Southern California	Northern Channel Islands	San Nicolas Island	Cojo Anchorage	Point Mugu to Point Dume
1997 Peak Landings	13,199,317	6,178,144	1,359,738	260,176	216,962
Average Landings (1998-2003)	8,757,662	4,304,917	697,502	25,194	246,551
Percentage Decrease after El Niño	-34%	-30%	-49%	-90%	+14%

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

El Niño event, landings have actually increased in the Point Mugu to Point Dume area. We therefore attribute a loss of 100 percent (260,176 pounds) of the Cojo Anchorage landings to sea otter predation.

If sea otters are removed from the management zone and the zone is successfully maintained, it is assumed that sea urchin populations would fully rebound from sea otter predation in five years.[15] We further assume that the landings increase would be equally distributed across the five years. Thus, sea urchin landings would increase by 20 percent (46,996 pounds) each year to stable landings of 234,982 pounds in 2009.

TABLE 6-16. AVERAGE ANNUAL SEA URCHIN LANDINGS IN COJO ANCHORAGE AREA AND RELATIVE CHANGE ATTRIBUTABLE TO EL NIÑO AND SEA OTTER PREDATION.

Year	Average Annual Landings (pounds)
1997 peak (pre-sea otter)	260,176
1998-2003	25,194
Decrease attributable to El Niño	0
Decrease attributable to sea otter predation	234,982
Total decrease	234,982

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

Avoided Future Loss

Sea urchin landings would not be eliminated along the coastline from Point Conception to Santa Barbara, as in the baseline, because maintenance would remove the sea otter population from this section of the coastline. Therefore, landings would not decrease an anticipated 1.1 million pounds over 10 years from 2005 to 2014.

Summary of Impacts

Table 6-17 shows the expected change in commercial landings and ex-vessel revenue in the Cojo Anchorage area if sea otters are removed from CDFG statistical blocks 655, 656, and 657. Over 10 years, landings would increase by 2.9 million pounds. Thus, the total non-discounted benefit to sea urchin fishing vessels for Alternative 1 would total about $3.1 million, and the total discounted 10-year benefit for this Alternative would be about $2.6 million (discounted at 3 percent) or $2.0 million (discounted at 7 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-6.

The expected increase in sea urchin landings resulting from implementation of Alternative 1 would be approximately 3 percent over 10 years (Table 6-18). On average in the southern California sea urchin fishery, 223 vessels participate and annually land 60,200 pounds each (Thomson 2001). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels and no new vessels entered the fishery, then each vessel would have increased landings of approximately 13,200 pounds and increased revenue between $9,100 (PV at 7 percent) and $11,600 (PV at 3 percent) per vessel total over 10 years.

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

TABLE 6-17. SEA URCHIN LANDINGS: BENEFITS OF ALTERNATIVE 1

Year	Commercial Landings (avoided future loss)	Commercial Landings (increase from removal of past predation)	Total Increase in Commercial Landings (pounds)	Ex-Vessel Revenue*	Ex-Vessel Discounted Revenue (3%)*	Ex-Vessel Discounted Revenue (7%)*
2005	19,447	46,996	66,443	$70,430	$68,378	$65,822
2006	38,893	93,993	132,886	$140,859	$132,773	$123,032
2007	58,339	140,989	199,328	$211,288	$193,359	$172,474
2008	77,785	187,986	265,771	$281,717	$250,302	$214,921
2009	97,232	234,982	332,214	$352,147	$303,765	$251,076
2010	116,678	234,982	351,660	$372,760	$312,180	$248,386
2011	136,124	234,982	371,106	$393,373	$319,848	$244,973
2012	155,571	234,982	390,553	$413,986	$326,804	$240,944
2013	175,017	234,982	409,999	$434,599	$333,084	$236,393
2014	194,463	234,982	429,445	$455,212	$338,720	$231,407
Total Benefits	1,069,549	1,879,856	2,949,405	$3,126,370	$2,579,214 (PV @ 3%)	$2,029,426 (PV @ 7%)

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price divers received for sea urchins (in shell) from 1994 to 2003, which is $1.06 per pound in 2004 dollars.

TABLE 6-18. SEA URCHIN LANDINGS BENEFITS OF ALTERNATIVE 1 COMPARED TO THE SOUTHERN CALIFORNIA BASELINE

Year	Southern California Baseline Landings	Southern California Baseline Ex-Vessel Discounted Revenue (3%)**	Southern California Baseline Ex-Vessel Discounted Revenue (7%)**	Expected Percentage Increase from Alternative 1
2005	11,412,350	$11,744,748	$11,305,692	1%
2006	11,381,380	$11,371,725	$10,537,394	1%
2007	11,350,410	$11,010,467	$9,821,235	2%
2008	11,319,441	$10,660,607	$9,153,680	2%
2009	11,288,471	$10,321,786	$8,531,435	3%
2010	11,257,501	$9,993,659	$7,951,429	3%
2011	11,226,532	$9,675,889	$7,410,799	3%
2012	11,195,562	$9,368,153	$6,906,874	3%
2013	11,164,592	$9,070,134	$6,437,166	4%
2014	11,133,622	$8,781,528	$5,999,355	4%
TOTAL	112,729,861	$101,998,697	$84,055,061	3%

**Ex-vessel revenue is based upon the average price divers received for sea urchins (in shell) from 1994 to 2003, which is $1.06 per pound in 2004 dollars.

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

Beyond 10 years, maintenance of the management zone would continue to prevent sea otters from expanding their range into southern California. As a result of this management, the long-term impacts that would have occurred under the baseline (the elimination of

commercial sea urchin harvests via competition with sea otters in recolonized areas) would not occur. The timing and magnitude of this potential benefit is uncertain, but it would likely accrue gradually over the course of many decades, if not hundreds of years.

6.3.4.2 Spiny Lobster Fishery

Under Alternative 1, impacts to the commercial lobster fishery are expected to be limited to the coastline from Point Conception to just southeast of Gaviota (CDFG statistical blocks 655, 656, and 657). This area is henceforth referred to as Cojo Anchorage. Maintenance of the management zone would theoretically eliminate sea otter predation on lobsters in this area, which could lead to a larger lobster population for commercial harvest.

The same assumptions applied to the commercial sea urchin fishery are also applied to the commercial spiny lobster fishery. Benefits to the fishery accumulate for two reasons. First, newly recruited lobsters or lobsters that escaped predation in the past would now potentially become available for future commercial harvest. Second, lobster landings would not be eliminated along the coastline from Point Conception to Santa Barbara, as projected by the baseline. Therefore, as an avoided future loss, landings would not decrease the anticipated 161,000 pounds over 10 years from 2005 to 2014. Thus, the analysis for the lobster fishery is divided into two sections: (1) increased harvests from the elimination of past predation, and (2) increased harvests due to elimination of the anticipated future decrease. Benefits are represented as increased landings and increased ex-vessel revenue.

Removal of Past Sea Otter Predation

Lobster landings within the Cojo Anchorage area peaked in 1997 (about 37 thousand pounds). In 1999, landings dropped by two-thirds to 11,826 pounds and have since averaged approximately 16,200 pounds between 2000 and 2003. This drop in landings is more severe than the decrease for southern California and coincides both with when sea otters were first sighted in the management zone and the most recent El Niño event. The decline in landings is similar to that along the coastline from Point Mugu to Point Dume, an area in which sea otters have not been sighted. Landings for these two sections of coastline are shown in Figure 6-14. Figure 6-15 shows annual lobster landings on a logarithmic scale for five areas: southern California, the Northern Channel Islands, San Nicolas Island, Cojo Anchorage, and the coastline from Point Mugu to Point Dume. As shown in the

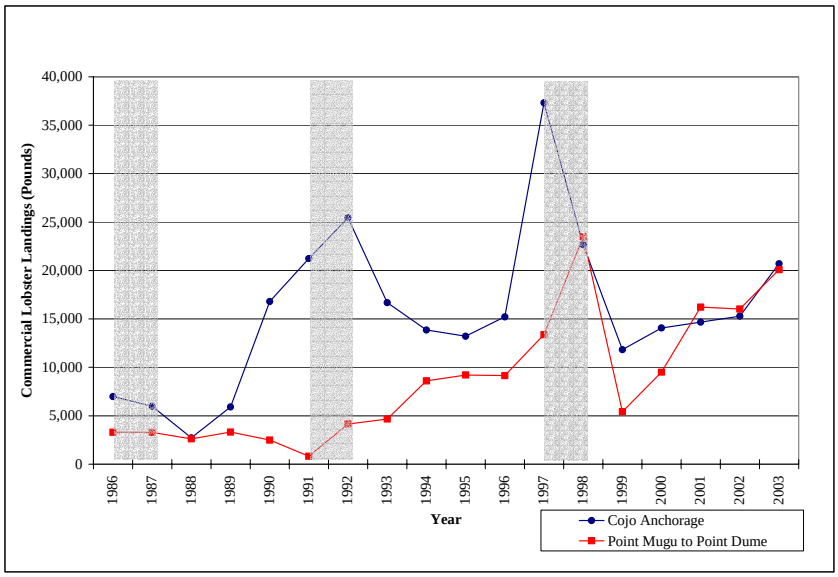

FIGURE 6-14. COMMERCIAL LOBSTER LANDINGS FOR THE COJO ANCHORAGE AREA (STATISTICAL BLOCKS 655, 656, AND 657) AND POINT MUGU-POINT DUME (STATISTICAL BLOCKS 680, 681, 682, AND 703). Shaded areas indicate El Niño events. Data source: California Department of Fish and Game (2002a, 2005a).

figure, southern California and the Northern Channel Islands follow similar trends over time. After the most recent El Niño event, southern California landings dropped 26 percent, while landings around Point Mugu to Point Dume and the Northern Channel Islands both increased. Landings at Cojo Anchorage declined by 56 percent, and those at San Nicolas Island decreased by 7 percent compared to landings made in 1997. Table 6-19 depicts this difference in landings between the areas.

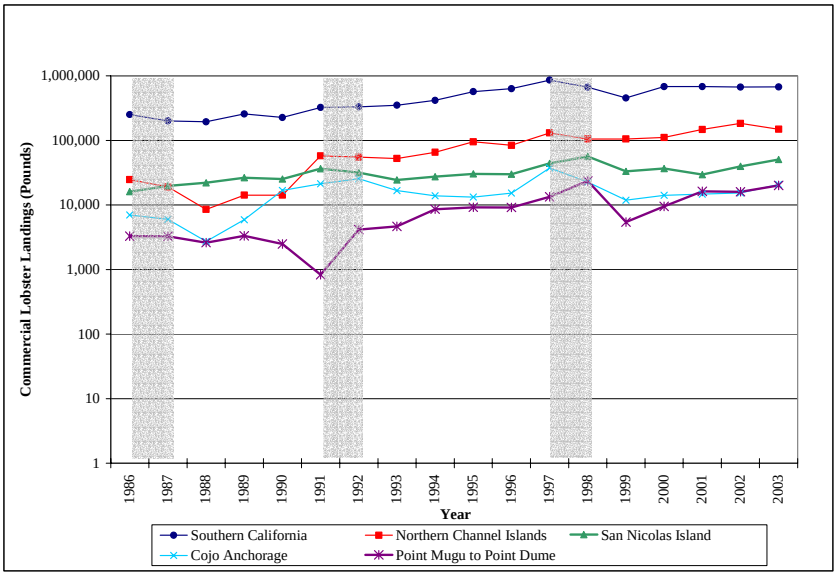

FIGURE 6-15. ANNUAL LOBSTER LANDINGS BY AREA, ON A LOGARITHMIC SCALE. Shaded areas indicate El Niño events. Data source: California Department of Fish and Game (2002a, 2005a).

Lobster landings in southern California are a function of a variety of factors, including (but not limited to) population variation, weather fluctuations, and market demand. Determining the exact composition of these factors for lobster landings is difficult. As a conservative approach, we assume that lobster landings are solely and equally dependent upon weather fluctuations (El Niño events) and sea otter predation. We further assume that southern California's average annual lobster landings are not representative of landings along the northern coastline of the management zone because landings in these areas have not followed similar historical trends. Rather, we assert that landings throughout the coastline from Point Mugu to Point Dume should respond similarly to weather fluctuations and sea otter predation. Thus, we establish lobster landings fluctuations along the coastline from Point Mugu to Point Dume as a baseline for Cojo Anchorage landings fluctuations. Because little or no sea otter predation occurred southeast of Gaviota, we attribute the total percentage decrease from Point Mugu to Point Dume to the El Niño event. Any Cojo Anchorage decrease above the baseline is, therefore, attributed to sea otter predation. In Table 6-20, we attribute 100 percent of the recent lobster landings decrease at Cojo Anchorage to sea otter predation (20,783 pounds).

If sea otters are removed from the management zone and the zone is

TABLE 6-19. CHANGE IN ANNUAL LOBSTER LANDINGS AFTER THE 1997/1998 EL NIÑO EVENT

	Southern California	Northern Channel Islands	San Nicolas Island	Cojo Anchorage Coastline	Point Mugu to Point Dume
1997 Peak Landings	859,118	130,321	44,143	37,316	13,378
Average Landings (1998-2003)	636,920	133,307	40,926	16,533	15,123
Percentage Change after El Niño	-26%	2%	-7%	-56%	13%

TABLE 6-20. AVERAGE ANNUAL LOBSTER LANDINGS IN COJO ANCHORAGE AND THE CHANGE ATTRIBUTABLE TO THE EL NIÑO EVENT AND SEA OTTER PREDATION

Year	Average Annual Landings (pounds)
1997 Peak (pre-sea otter)	37,316
1998-2003	16,533
Decrease Attributable to El Niño	0
Decrease Attributable to Sea Otter Predation	20,783
Total Decrease	20,783

successfully maintained, we assume that lobster populations would fully rebound from sea otter predation in seven years.[16] We further assume that the landings increase would be equally distributed across the seven years. Thus, lobster landings would increase by about 14 percent (2,969 pounds) each year from 2,969 pounds in 2005 to an annual increase of 20,783 pounds in 2011.

Avoided Future Loss

Lobster landings would not be eliminated along the coastline from Point Conception to Santa Barbara, as in the baseline, because maintenance of the management zone would remove sea otters from this area. Therefore, landings would not decrease an anticipated 161,000 pounds over 10 years from 2005 to 2014.

Summary of Impacts

Table 6-21 shows the expected change in commercial landings and ex-vessel revenue in the Cojo Anchorage area if sea otters are removed from CDFG statistical blocks 655, 656, and 657. Over 10 years, landings would increase by 307,000 pounds. Thus, the maximum non-discounted benefit to lobster fishing vessels for Alternative 1 would total about $2.5 million, and the maximum discounted 10-year benefit for this Alternative would be about $2.0 million (discounted at 3 percent) and $1.6 million (discounted at 7 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-6. The expected increase in lobster landings resulting from implementation of Alternative 1 would be about 5 percent of southern California lobster landings over 10 years (Table 6-22).

On average in the southern California lobster fishery, 202 vessels participate annually landing 3,700 pounds each (Thomson 2001). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be affected disproportionately. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels and no additional vessels entered the fishery, then each vessel would have increased landings of about 1,500 pounds and increased revenue between $7,700 (PV at 7 percent) and $9,900 (PV at 3 percent) per vessel total over 10 years.

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

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

TABLE 6-21. LOBSTER LANDINGS: BENEFITS OF ALTERNATIVE 1

Year	Commercial Landings (avoided future loss)	Commercial Landings (increase from removal of past predation)	Total Increase in Commercial Landings (pounds)	Ex-Vessel Revenue*	Ex-Vessel Discounted Revenue (3%)*	Ex-Vessel Discounted Revenue (7%)*
2005	2,930	2,969	5,899	$47,078	$45,707	$43,998
2006	5,861	5,938	11,799	$94,158	$88,753	$82,241
2007	8,792	8,907	17,699	$141,239	$129,253	$115,293
2008	11,723	11,876	23,599	$188,319	$167,319	$143,668
2009	14,654	14,845	29,499	$235,399	$203,058	$167,837
2010	17,584	17,814	35,398	$282,480	$236,572	$188,228
2011	20,515	20,783	41,298	$329,560	$267,963	$205,234
2012	23,446	20,783	44,229	$352,948	$278,620	$205,419
2013	26,377	20,783	47,160	$376,336	$288,430	$204,702
2014	29,308	20,783	50,091	$399,724	$297,432	$203,199
Total Benefits	161,191	145,481	306,672	$2,447,241	$2,003,107 (PV @ 3%)	$1,559,819 (PV @ 7%)

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price divers received for lobster from 1994 to 2003, which is $7.98 per pound in 2004 dollars.

TABLE 6-22. LOBSTER LANDINGS BENEFITS OF ALTERNATIVE 1 COMPARED TO THE SOUTHERN CALIFORNIA BASELINE

Year	Southern California Baseline Landings	Southern California Baseline Ex-Vessel Discounted Revenue (3%)**	Southern California Baseline Ex-Vessel Discounted Revenue (7%)**	Expected Percentage Increase from Alternative 1
2005	626,354	$4,852,726	$4,671,316	1%
2006	623,046	$4,686,502	$4,342,659	2%
2007	619,738	$4,525,844	$4,037,011	3%
2008	616,430	$4,370,569	$3,752,769	4%
2009	613,122	$4,220,500	$3,488,439	5%
2010	609,814	$4,075,465	$3,242,633	6%
2011	606,506	$3,935,298	$3,014,059	7%
2012	603,198	$3,799,839	$2,801,514	7%
2013	599,890	$3,668,932	$2,603,878	8%
2014	596,582	$3,542,427	$2,420,112	8%
TOTAL	6,114,683	$41,678,104	$34,374,390	5%

**Ex-vessel revenue is based upon the average price received for lobster from 1994 to 2003, which is $7.98 per pound in 2004 dollars.

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

6.3.4.3 Crab Fishery

Under Alternative 1, impacts to the commercial crab fishery are expected to be limited to the coastline from Point Conception to just southeast of Gaviota (CDFG statistical blocks 655, 656, and 657). This area is henceforth referred to as Cojo Anchorage. Maintenance of the management zone would theoretically

eliminate sea otter predation on crabs in this area, which could lead to a larger crab population for commercial harvest. Benefits to the fishery accumulate for two reasons. First, newly recruited crabs or crabs that escaped predation in the past would now potentially become available for future commercial harvest. Second, crab landings would not be eliminated along the coastline from Point Conception to Santa Barbara, as projected by the baseline. Therefore, as an avoided future loss, landings would not decrease an anticipated 844,000 pounds over 10 years from 2005 to 2014. Thus, the analysis for the crab fishery is divided into two sections: (1) increased harvests from the elimination of past predation, and (2) increased harvests due to elimination of the anticipated future decrease. Benefits are represented as increased landings and increased ex-vessel revenue.

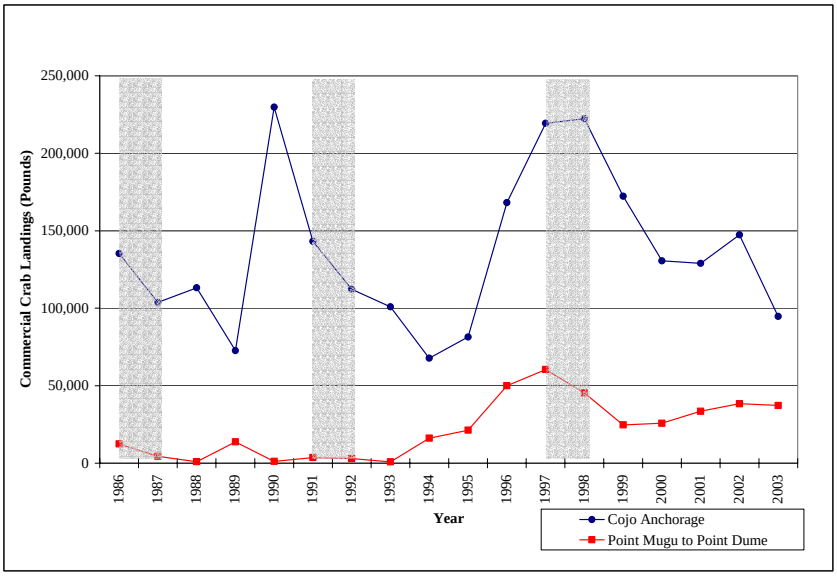

FIGURE 6-16. COMMERCIAL CRAB LANDINGS FOR COJO ANCHORAGE AREA (STATISTICAL BLOCKS 655, 656, AND 657) AND POINT MUGU-POINT DUME (STATISTICAL BLOCKS 680, 681, 682, AND 703). Shaded areas indicate El Niño events. Data source: California Department of Fish and Game (2002a, 2005a).

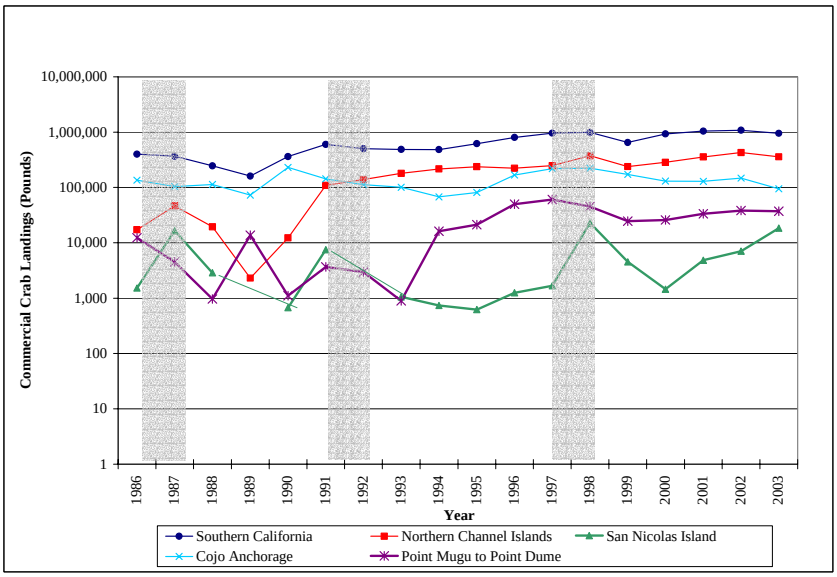

FIGURE 6-17. COMMERCIAL ANNUAL CRAB LANDINGS BY AREA, ON A LOGARITHMIC SCALE. Shaded areas indicate El Niño events. Data source: California Department of Fish and Game (2002a, 2005a).

Removal of Past Sea Otter Predation

Crab landings within the Cojo Anchorage area are cyclical and peak and trough roughly coincident with El Niño events (Figures 6-16 and 6-17). Crab landings peaked at about 220 thousand pounds in both 1990 and 1998. However, after each peak, landings declined by about 50 percent. The drop in landings after 1998 is more severe than the average decrease for southern California and coincides with the movement of sea otters into the management zone. However, past landings trends are similar to the neighboring coastline southeast from Point Mugu to Point Dume, along which sea otters have not been sighted (Figure 6-16).

TABLE 6-23. CHANGE IN ANNUAL CRAB LANDINGS AFTER THE 1997/1998 EL NIÑO EVENT.

	Southern California	Northern Channel Islands	San Nicolas Island	Cojo Anchorage Coastline	Point Mugu to Point Dume Coastline
1997 Peak Landings	958,960	248,117	1,675	219,333	60,442
Average Landings (1998-2003)	942,257	340,179	9,869	149,388	34,153
Percentage Decrease after El Niño	-2%	+37%	+489%	-32%	-43%

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

Figure 6-17 shows annual crab landings on a logarithmic scale for five areas: southern California, the northern Channel Islands, San Nicolas Island, Cojo Anchorage, and the coastline from Point Mugu to Point Dume. As shown in the figure, southern California and the northern Channel Islands follow similar trends over time. After the most recent El Niño event, southern California landings declined by 2 percent. Cojo Anchorage and the Point Mugu to Point Dume area declined by 32 percent and 43 percent, respectively (see Table 6-23).

Crab landings in southern California are a function of a variety of factors, including (but not limited to) population variation, weather fluctuations, and market demand. Determining the composition of these factors for crab landings is difficult. As a conservative approach, we assume that crab landings are solely and equally dependent upon weather fluctuations (El Niño events) and sea otter predation. We further assume that southern California's average annual crab landings are not representative of landings along the northern coastline of the management zone. Rather, we assert that landings throughout the coastline from Point Conception to Point Dume should respond similarly to weather fluctuations and sea otter predation. Thus, we establish crab landings fluctuations along the coastline from Point Mugu to Point Dume as a baseline for Cojo Anchorage landings fluctuations. Because little or no sea otter predation occurred southeast of Gaviota, we attribute the total percentage decrease from Point Mugu to Point Dume (see Figure 6-16) to the El Niño event. Any Cojo Anchorage decrease above the baseline is thus attributed to sea otter predation. In Table 6-24, we attribute 100 percent of the recent Cojo Anchorage landings decrease to El Niño (69,945 pounds).

AVOIDED FUTURE LOSS

Crab landings would not be eliminated along the coastline from Point Conception to Santa Barbara, as under the baseline, because maintenance of a management zone would

TABLE 6-24. AVERAGE ANNUAL CRAB LANDINGS IN COJO ANCHORAGE AND CHANGE ATTRIBUTABLE TO EL NIÑO AND SEA OTTER PREDATION

Year	Average Annual Landings (pounds)
1997 Peak (pre-sea otter)	219,333
1998-2003	149,388
Decrease Attributable to El Niño	69,945
Decrease Attributable to Sea Otter Predation	0
Total Decrease	69,945

TABLE 6-25. CRAB LANDINGS: BENEFITS OF ALTERNATIVE 1

Year	Commercial Landings (avoided future loss)	Commercial Landings (increase from removal of past predation)	Total Increase in Commercial Landings (Pounds)	Ex-Vessel Revenue*	Ex-Vessel Discounted Revenue (3%)*	Ex-Vessel Discounted Revenue (7%)*
2005	15,354	0	15,354	$20,421	$19,826	$19,085
2006	30,709	0	30,709	$40,843	$38,498	$35,673
2007	46,063	0	46,063	$61,264	$56,065	$50,010
2008	61,418	0	61,418	$81,686	$72,577	$62,317
2009	76,772	0	76,772	$102,107	$88,078	$72,801
2010	92,127	0	92,127	$122,528	$102,616	$81,646
2011	107,481	0	107,481	$142,950	$116,231	$89,022
2012	122,836	0	122,836	$163,371	$128,967	$95,084
2013	138,190	0	138,190	$183,793	$140,862	$99,971
2014	153,545	0	153,545	$204,214	$151,955	$103,812
Total Benefits	844,494	0	844,494	$1,123,177	$915,675 (PV @ 3%)	$709,422 (PV @ 7%)

Note: Benefits are rounded to the nearest dollar.
**Ex-vessel revenue is based upon the average price divers received for crabs from 1994 to 2003, which is $1.33 per pound in 2004 dollars.

remove sea otters from this section of the coastline. Therefore, landings would not decrease an anticipated 844,494 pounds over 10 years from 2005 to 2014.

SUMMARY OF IMPACTS

Table 6-25 shows the expected change in commercial landings and ex-vessel revenue in the Cojo Anchorage area if sea otters are removed from CDFG statistical blocks 655, 656, and 657. Over 10 years, landings would increase by about 844,000 pounds.

Thus, the maximum non-discounted benefit to crabbing vessels for Alternative 1 would total about $1.1 million, and the maximum discounted 10-year benefit for this Alternative would be between $709,000 (PV at 7 percent) and $916,000 (PV at 3 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-6.

The expected increase in crab landings resulting from implementation of Alternative 1 would be approximately 11 percent of southern California crab landings over 10 years (Table 6-26). On average in the southern California crab fishery, 76 vessels participate annually landing 15,100 pounds each (Thomson 2001). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels and no additional vessels entered the fishery, then each vessel would have increased landings of about 11,000 pounds and increased revenue between $9,300 (PV at 7 percent) and $12,000 (PV at 3 percent) total over 10 years.

As described in Chapter 5, we define levels of significance in this supplement by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 1 is expected to result in an increase in crab ex-

TABLE 6-26. CRAB LANDINGS BENEFITS OF ALTERNATIVE 1 COMPARED TO THE SOUTHERN CALIFORNIA BASELINE

Year	Southern California Baseline Landings	Southern California Baseline Ex-Vessel Discounted Revenue (3%)**	Southern California Baseline Ex-Vessel Discounted Revenue (7%)**	Expected Percentage Increase from Alternative 1
2005	836,577	$1,080,240	$1,039,857	2%
2006	821,159	$1,029,448	$953,918	4%
2007	805,741	$980,698	$874,774	6%
2008	790,323	$933,915	$801,902	8%
2009	774,905	$889,025	$734,820	10%
2010	759,487	$845,957	$673,084	12%
2011	744,069	$804,645	$616,280	14%
2012	728,651	$765,021	$564,028	17%
2013	713,233	$727,023	$515,975	19%
2014	697,815	$690,589	$471,796	22%
TOTAL	7,671,958	$8,746,560	$7,246,435	11%

**Ex-vessel revenue is based upon the average price divers received for crabs from 1994 to 2003, which is $1.33 per pound in 2004 dollars.

vessel revenues within the Southern California Bight over the next 10 years of 11 percent compared to the baseline, it qualifies as a beneficial effect of moderate significance (see Table 5-1 for definitions of levels of significance).

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

6.3.5 AQUACULTURE

Alternative 1 would require a resumption of zonal management (containment) of sea otters, which may result in the exclusion of sea otters from all areas of the Southern California Bight except the translocation zone surrounding San Nicolas Island. Over the next 10 years, aquaculture operations that grow mussels on oil platforms in the Santa Barbara Channel may benefit from zonal management of sea otters through a reduction in episodic predation on mussel beds.

Beyond 10 years, aquaculture facilities located in other portions of the Southern California Bight may benefit from the exclusion of sea otters, but these benefits are expected to be relatively minor for the following reasons: 1) in April 2002, there were only four registered aquaculture operations in the remainder of the Southern California Bight (*i.e.*, not in Santa Barbara Channel), two of which produce a variety of shellfish and finfish, and two of which produce exclusively abalone; 2) under baseline conditions, sea otter range expansion is predicted to occur gradually over the course of many decades; and 3) sea otters are not likely to affect abalone or finfish aquaculture operations and would likely affect mussel operations only locally and episodically.

There are no effects at San Nicolas Island because 1) there are currently no aquaculture operations at the island, and 2) there is no difference in management of the colony under Alternative 1 and the baseline.

Significance criteria are not defined for aquaculture because of the extent of uncertainty involved.

6.3.6 Seafood Processing Industry (Sea Urchins)

Under Alternative 1, impacts to the sea urchin processing industry would be a positive function of the change in sea urchin landings. If sea urchin landings increase according to the projections discussed above, then southern California landings would increase by approximately 1 percent in 2005 and increase by 4 percent in 2014 (an average increase of 3 percent over 10 years). Impacts to the sea urchin processing industry would be dependent upon whether individual companies are operating at capacity and whether they are capable of processing different seafood products. If companies are operating at capacity, then there may be room for growth in the industry for an additional company. If companies are not operating at capacity, then revenues may increase in relation to any increase in raw product. Companies receiving sea urchins harvested along the affected coastline would be disproportionately affected.

Because of the expected 3 percent increase in sea urchin inputs from the Southern California Bight, Alternative 1 is expected to have a beneficial effect of low significance on the seafood processing industry (see Table 5-1 for definitions of levels of significance).

6.3.7 Kelp Harvest

Alternative 1 would require the exclusion of sea otters from all areas of the Southern California Bight except the translocation zone surrounding San Nicolas Island. If kelp abundance or density has begun to be enhanced as a result of seasonal sea otter predation on invertebrate herbivores in the Cojo Anchorage area during the last several years, this effect would be eliminated (for a description of the relationship between sea otters and kelp abundance, see section 6.2.2). As a result of maintenance of the currently designated management zone, the potential increases in kelp along the coastline from Point Conception to Santa Barbara and eventually in other areas of the Southern California Bight (if they are reoccupied by sea otters) predicted under baseline conditions would not occur, representing a possible loss to the kelp industry. However, conditions at San Nicolas Island would be the same as those projected for the baseline.

Significance criteria are not defined for kelp harvesting because of the extent of uncertainty involved.

6.3.8 Recreational Fishing and Diving

Recreational fishing and diving activities that may be affected by sea otters include lobster diving, abalone diving, and finfish fishing. Lobster diving and finfish fishing are addressed below. Abalone diving is included under “Abalone Fishery Restoration” (section 6.3.9).

6.3.8.1 Lobster Diving

Under Alternative 1, impacts to recreational lobster diving are expected to be limited to the coastline from Point Conception to just southeast of Gaviota (CDFG statistical blocks 655, 656, and 657). From 1995 to 2003, recreational lobster dives near the affected coastline were less than one percent of all trips taken annually in southern California. For the coastline from Point Conception to Santa Barbara, there were only two observations to calculate an

average of nine trips. Because only 1 trip occurred in 1999 compared to 45 trips in 1997, the average is most likely an overestimate.

If Alternative 1 is selected, the removal of sea otters from the northern edge of the management zone may result in an increase in the lobster population. Benefits to the recreational sport fishery accumulate for two reasons. First, newly recruited lobsters or lobsters that escaped predation in the past would now potentially become available for future recreational harvest. Second, recreational lobster dives would not be eliminated along the coastline from Point Conception to Santa Barbara, as projected by the baseline. Thus, recreational dive trips in 10 years may increase along the coastline from Point Conception to Santa Barbara. These benefits are minimal (nine trips) and represent less than one percent of the total number of lobster dive trips in the Southern California Bight. Effects at San Nicolas Island are the same as for the baseline. Therefore, overall, Alternative 1 is expected to have a beneficial effect of very low significance on recreational lobster diving (see Table 5-1 for definitions of levels of significance).

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

6.3.8.2 Finfish Fishing

Alternative 1 would require the removal of any sea otters currently in the management zone and would prevent the expansion of the southern sea otter's range (along the coastline towards the city of Santa Barbara) that is expected to occur under baseline conditions within 10 years. It would also preclude the possibility of any further sea otter range expansion into the Southern California Bight in the more distant future.

As a consequence, Alternative 1 may have adverse effects, relative to the baseline, on the recreational finfish fishery in all nearshore areas of the Southern California Bight except in the translocation zone surrounding San Nicolas Island, where effects would be the same as for the baseline. A healthy kelp forest ecosystem is important for a wide range of finfish species harvested by the recreational fishery (a discussion of the long-term effects of sea otter predation on the kelp forest community, including finfish production, is given in section 6.2.2). However, any beneficial effects that would occur under the baseline (and would be prevented under Alternative 1) would likely require more than 10 years to become noticeable (because the reestablishment of giant kelp canopies in areas where sea urchin grazing is limiting kelp is expected to take at least 10 years) and could occur gradually over several decades. Therefore, it is not possible to reasonably quantify the effects of Alternative 1 on recreational finfish fishing.

Significance criteria are not defined for recreational finfish fishing because of the extent of uncertainty involved.

6.3.9 Abalone Fishery Restoration

The commercial and recreational abalone fishery in southern California was placed under a fishing moratorium in 1997 due to

the depletion of stocks. The moratorium is expected to be removed once the population reaches a level where sustainable harvesting can occur. Because it does not appear that there is any potential for reopening the abalone fishery (for any species) during the next 10 years, regardless of the presence or absence of sea otters (see section 6.2.9), the benefit that Alternative 1 may contribute during this time frame to efforts to restore the abalone fishery is essentially speculative.

It is conceivable, however, that an abalone fishery could be restored in the Southern California Bight at some point in the future. Abalone will be considered for recreational or commercial harvest when they have met Criterion 3 as defined in the draft Abalone Recovery and Management Plan (ARMP): an average density of 6,600 abalone per hectare (CDFG 2002c). The ARMP does not estimate the time needed to achieve Criterion 3, beyond stating that it would likely require several decades, because such an estimate would be "speculative." As stated in the ARMP, areas within the range of southern sea otters would not be considered for restoration of an abalone fishery (CDFG 2002c). Therefore, sea otter range expansion would preclude the reestablishment of an abalone fishery in the areas that are reoccupied.

Alternative 1 would require the removal of any sea otters currently in the management zone and would prevent the expansion of the southern sea otter's range (along the coastline towards the city of Santa Barbara) that is expected to occur under baseline conditions within 10 years. It would also preclude the possibility of any further sea otter range expansion into the Southern California Bight in the more distant future. As a consequence, Alternative 1 may benefit abalone fishery restoration. Although the coastline area northwest of Santa Barbara is not identified as a key location for abalone recovery (CDFG 2002c), if sea otters are consuming abalone in the Cojo Anchorage area, then the removal of this source of predation would enhance efforts to foster increases in abalone densities there. Additionally, the long-term removal of sea otters from the management zone would prevent areas within the zone from being eliminated from abalone fishery consideration due to the extension of the southern sea otter's range.

Impacts at San Nicolas Island are the same as for the baseline. Over the next 10 years, sea otters at San Nicolas Island (CDFG statistical blocks 813 and 814) are expected to increase from 6 percent of carrying capacity to 16 percent of carrying capacity. Abalone populations at San Nicolas Island are expected to persist as sea otter predation increases. However, densities of large individual abalone would likely eventually be reduced to a point that would preclude reestablishment of an abalone fishery at the island. Because San Nicolas Island would continue to be occupied by sea otters, it would likely be disqualified from abalone fishery consideration on the grounds that it is not "outside of the sea otter range of sea otters" (CDFG 2002c).

The magnitude of benefit provided by Alternative 1 to the restoration of an abalone fishery is difficult to determine for two reasons: 1) it is unknown whether or when an abalone fishery could be reopened even in the absence of sea otters; and 2) sea otter range expansion that would occur beyond 10 years if not prevented under Alternative 1 is uncertain (it would be a function of demographic rates, food supply, and other variables). Still, it is clear that sea otter range expansion would preclude the possibility of recreational or commercial abalone fishing in reoccupied areas.

Therefore, the prevention of range expansion under Alternative 1 can be expected to provide a benefit of unknown magnitude to efforts to restore an abalone fishery.

Significance criteria are not defined for abalone fishery restoration because of the extent of uncertainty involved.

6.3.10 ECOTOURISM

Under Alternative 1, ecotourism based on observing sea otters would decrease relative to the baseline because no sea otters would be allowed to remain in the management zone. Although ecotourism activity directed specifically at sea otter watching is now rare in the management zone, under the baseline, tourism is expected to be enhanced over the next 10 years as sea otters progressively reoccupy and begin to reside year-round along the stretch of mainland coastline between Point Conception and Santa Barbara. Alternative 1 would prevent this enhancement from occurring. Overall impacts are difficult to quantify, and implementation of Alternative 1 would not necessarily result in decreased economic activity. However, the quality of tourist trips may decrease relative to the baseline because sea otters would not be observed. Beyond 10 years, Alternative 1 would prevent, in perpetuity, the development of any tourism based on sea otter watching in the area currently designated as the management zone. Effects on ecotourism at San Nicolas Island are the same as for the baseline.

Significance criteria are not defined for ecotourism because of the extent of uncertainty involved.

6.3.11 FEDERAL AND STATE AGENCY PROGRAMS

Significance criteria are not defined for effects on agency programs because these effects and programs are various and cannot be meaningfully compared with a single set of criteria. For a discussion of the regulatory environment, see section 6.3.12.

6.3.11.1 U.S. Fish and Wildlife Service

The effects of Alternative 1 on southern sea otter recovery are also addressed in section 6.3.3.3 (“Southern Sea Otter”). Here we address our ability to meet our mandates under the Endangered Species Act and Marine Mammal Protection Act and give the implementation costs of Alternative 1.

ABILITY TO MEET MANDATE

Alternative 1 would require the exclusion of sea otters from all areas of the Southern California Bight except the translocation zone surrounding San Nicolas Island. If the colony at San Nicolas Island persists, it could conceivably reach the estimated carrying capacity of the island, which is about 500 animals (see section 6.1.4.2). Measured against the estimated carrying capacities given in Laidre *et al.* (2001) for areas of southern California and for California overall, San Nicolas Island accounts for about eight percent of the carrying capacity of the Southern California Bight and about three percent of the carrying capacity of California as a whole. The carrying capacity of the currently designated management zone (*i.e.*, the Southern California Bight minus San Nicolas Island) represents about 37 percent of the carrying capacity of California as a whole and about 92 percent of the carrying capacity of the Southern California Bight.

An OSP estimate has not been formally determined for sea otters, but if it were based on the 50-80 percent range of values proposed by Taylor and DeMaster (1993), and on the most recent estimate of carrying capacity for California of 15,941 sea otters

(Laidre *et al.* 2001), OSP for California would be between 7,971 and 12,753 sea otters. The final revised recovery plan for the southern sea otter estimates the lower bound of OSP as approximately 8,400 animals for the California coast (USFWS 2003). Alternative 1 would make it difficult, if not impossible, to reach OSP for sea otters in California, even under the most optimistic scenario (assuming that all remaining habitat could be successfully reoccupied).[17]

If sea otters were prevented from recolonizing the management zone as specified under Alternative 1, the remaining sea otter habitat in California would need to be sufficient to achieve OSP. Excluding the management zone, California could theoretically support about 10,000 sea otters (this number includes about 500 at San Nicolas Island). Therefore, Alternative 1 may or may not allow for the achievement of OSP. Failure to achieve OSP would ensure that southern sea otters remained "depleted" and would effectively prevent the Service from fulfilling our mandate under the Marine Mammal Protection Act to manage sea otters to their OSP.

Maintenance of the existing management zone, as required by Alternative 1, restricts the habitat available to the subspecies and subjects the entire population to a risky management scenario (see additional discussion in section 6.3.3.3, "Southern Sea Otter"). Alternative 1 would require the removal, in perpetuity, of all sea otters that enter the management zone. The potential effects of the continual introduction of sea otters into the mainland population on the subspecies as a whole have been previously evaluated by the Service in a biological opinion pursuant to section 7 of the Endangered Species Act (USFWS 2000, included as Appendix B). At that time we determined that the continuation of the program would likely jeopardize the survival and recovery of the southern sea otter. If Alternative 1 were chosen, its effects on sea otter recovery would have to be reevaluated through a reinitiation of consultation using the most current information available before it could be implemented. Because the management scenario under Alternative 1 is the same as that evaluated in the 2000 biological opinion, it is possible that Alternative 1 would preclude the survival and recovery of the species. Alternative 1 would not result in any changes in the regulatory provisions that apply to sea otters. For a discussion of these provisions, see section 6.3.12.

[17] For example, the remaining habitat includes the San Francisco Bay, which could theoretically sustain 1098 sea otters. However, given the intensity of the Bay's surrounding urbanization, its heavy human use, and its correspondingly poor water quality, it seems highly unlikely that the bay in its current condition could support such numbers of sea otters.

IMPLEMENTATION COSTS (10-YEAR PERIOD)

Under Alternative 1, funding would be necessary to resume maintenance of the management zone. Associated costs result from expenditures for personnel, transportation, and equipment (Table 6-27).

TABLE 6-27. PERSONNEL AND EQUIPMENT NEEDED TO IMPLEMENT ALTERNATIVE 1

Personnel	Transportation	Equipment
Program Manager	2 Vans	Boat Maintenance
Capture Teams	1 Tow Vehicle	Dive Gear and Maintenance
Transport Team	2 Monitor Vehicles	Tracking Equipment
Monitoring Team	Air Charters	Training
Veterinary Services	Boat Charters	
	Travel Costs	

TABLE 6-28. IMPLEMENTATION COSTS FOR MAINTENANCE OF THE MANAGEMENT ZONE AND MONITORING AT THE TRANSLOCATION ZONE OVER 10 YEARS

Year	Annual Cost			Discounted Cost (3% discount rate)	Discounted Cost (7% discount rate)
	Personnel	Transportation	Equipment		
2005	$535,000	$75,000	$75,000	$665,049	$640,187
2006	$535,000	$85,000	$66,000	$646,621	$599,179
2007	$535,000	$95,000	$68,000	$638,769	$569,776
2008	$535,000	$104,000	$70,000	$629,937	$540,893
2009	$535,000	$104,000	$70,000	$611,590	$505,507
2010	$535,000	$104,000	$70,000	$593,776	$472,437
2011	$535,000	$104,000	$70,000	$576,482	$441,530
2012	$535,000	$104,000	$70,000	$559,691	$412,644
2013	$535,000	$104,000	$70,000	$543,389	$385,649
2014	$535,000	$104,000	$70,000	$527,563	$360,420
Total	*$7,032,000*			*$5,992,867 (PV @ 3%)*	*$4,928,221 (PV @ 7%)*

Table 6-28 represents the estimated expenditures for the entire program over 10 years. Personnel costs to maintain the management zone comprise approximately 75 percent of the annual implementation costs listed here. Within the personnel costs, the capture teams represent the largest expense, at $300 thousand per year. The capture teams would patrol the management zone to ensure that no sea otters become established in the area. Most likely, effort would be concentrated at the northern border of the management zone boundary near Point Conception.

Based upon past and projected efforts, the annual implementation costs would stabilize at $709 thousand and would sum to about $7.0 million over 10 years. The 10-year discounted implementation costs would sum to about $6.0 million (discounted at 3 percent) or $5.0 million (discounted at 7 percent). Annual expenditures would continue in perpetuity.

6.3.11.2 Channel Islands National Park

Under Alternative 1, sea otters would be removed from the existing management zone in perpetuity. Therefore, they would be permanently prevented from establishing range within the boundaries of the Channel Islands National Park. Because sea otters are expected to recolonize only the mainland coastline to Santa Barbara within the next 10 years (and therefore would not be expected within Park boundaries during this period), the effects of Alternative 1 are effectively the same as under the baseline scenario within this 10-year period. However, in the long term, it is possible that sea otters would attempt to recolonize nearshore areas within the Channel Islands National Park. Alternative 1 would prevent this recolonization, which appears to be inconsistent with the Park's mission and mission-related goals to protect and restore natural ecosystems and to practice ecosystem management.

Alternative 1 would not result in any changes in the regulatory provisions that

apply to sea otters. For a discussion of these provisions, see section 6.3.12.

6.3.11.3 Channel Islands National Marine Sanctuary

Under Alternative 1, sea otters would be removed from the existing management zone in perpetuity. Therefore, they would be permanently prevented from establishing range within the boundaries of the Channel Islands National Marine Sanctuary. Because sea otters are expected to recolonize only the mainland coastline to Santa Barbara within the next 10 years (and therefore would not be expected within Sanctuary boundaries during this period), the effects of Alternative 1 are effectively the same as under the baseline scenario within this 10-year period. However, in the long term, it is possible that sea otters would attempt to recolonize nearshore areas that are within the boundaries of the Channel Islands National Marine Sanctuary. Alternative 1 would prevent this recolonization, which appears to be inconsistent with the Sanctuary's mission to conserve and enhance the biodiversity, ecological integrity, and cultural legacy of areas of special national significance.

Alternative 1 would not result in any changes in the regulatory provisions that apply to sea otters. For a discussion of these provisions, see section 6.3.12.

6.3.11.4 California Department of Fish and Game

Note: Effects on the recovery of white and black abalone and sea otters are discussed under "Candidate, Threatened, and Endangered Species" (section 6.3.3). Effects on existing commercial fisheries and the restoration of the abalone fishery are discussed under "Commercial Fisheries" (section 6.3.4) and "Abalone Fishery Restoration" (section 6.3.9). Effects on Marine Protected Areas are discussed here.

Under Alternative 1, sea otters would be removed from the existing management zone in perpetuity. Therefore, they would be permanently prevented from establishing range within any of the 12 newly designated Marine Protected Areas in the Channel Islands National Marine Sanctuary. Because sea otters are expected to recolonize only the mainland coastline to Santa Barbara within the next 10 years (and therefore would not be expected within MPA boundaries during this time), the effects of Alternative 1 are effectively the same as under the baseline scenario within this 10-year period.

However, in the long term, under baseline conditions, it is possible that sea otters would attempt to recolonize areas that are now designated as Marine Protected Areas. Alternative 1 would prevent this recolonization, thereby enhancing some goals established for the Marine Protected Areas but negatively affecting others. Preventing sea otters from recolonizing these areas would be consistent with the goal set for Marine Protected Areas to generate fishery benefits through increased reproduction and dispersal of shellfish larvae and the emigration of large-size individuals. However, it would eliminate possible benefits to finfish fisheries that could result from the presence of sea otters and would negatively affect the achievement of other goals set for the Channel Islands Marine Protected Areas relating to: the maintenance of ecosystem biodiversity; the protection of the structure, function, and integrity of marine ecosystems; the protection of marine natural heritage; and the provision of recreational, scientific, and educational opportunities. With respect to the non-consumptive socio-economic goals set for the Marine Protected Areas, preventing sea otters from recolonizing these areas would eliminate any potential increase in the quality of non-consumptive

recreation that would occur as a result of the presence of sea otters.

Alternative 1 would not result in any changes in the regulatory provisions that apply to sea otters. For a discussion of these provisions, see section 6.3.12.

6.3.11.5 U.S. Navy

No regulatory changes are associated with Alternative 1. Under Alternative 1, Endangered Species Act consultation and permitting requirements for the U.S. Navy under the Endangered Species Act, the Marine Mammal Protection Act, and state law would remain the same as those described for the baseline. For a discussion of these provisions, see section 6.3.12.

6.3.11.6 U.S. Minerals Management Service

No regulatory changes are associated with Alternative 1. Under Alternative 1, Endangered Species Act consultation and permitting requirements for the Minerals Management Service under the Endangered Species Act, the Marine Mammal Protection Act, and state law would remain the same as those described for the baseline. For a discussion of these provisions, see section 6.3.12.

6.3.12 REGULATORY ENVIRONMENT

Under Alternative 1, the regulatory environment in the Southern California Bight would remain unchanged.

In the translocation zone, with the exception of defense-related activities by a military department, the consultation requirements of section 7 of the Endangered Species Act would continue to apply to proposed federal actions, and take of sea otters would continue to be subject to the standard take authorization procedures for threatened species under the Endangered Species Act, depleted species under the Marine Mammal Protection Act, and fully protected species under Fish and Game Code section 4700 and 4500. With respect to defense-related activities, sea otters would continue to be treated (for the purposes of consultation and incidental take authorization) as a species that is proposed to be listed [50 CFR §17.84(d)(4)(iv)] under the Endangered Species Act.

In the management zone, the conference and not the consultation requirements of section 7 of the Endangered Species Act would apply to actions that may affect southern sea otters, and incidental take of southern sea otters resulting from otherwise legal activities would not be subject to take authorization procedures under the Endangered Species Act or Marine Mammal Protection Act or be considered a violation of either Act. As under the baseline, Section 8664.2 of the California Fish and Game Code would allow for incidental take of sea otters in the management zone by means of specific exemptions from section 4700.

Our biological opinion on sea otter containment, released in 2000, concluded that continued zonal management of the sea otter population would jeopardize the species' continued existence. Because of the potential effects of sea otter containment on sea otters found in the parent population, consultation under the Endangered Species Act would need to be reinitiated and a finding of no-jeopardy reached before we could proceed with implementation of Alternative 1.

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

6.4.1 Introduction

Alternative 2 modifies the southern sea otter translocation program from its original design, defined in 50 CFR §17.84(d). The size of the management zone would decrease, with its boundaries redrawn to exclude San Miguel Island, Santa Rosa Island, and the nearshore area between Point Conception and Santa Barbara from the zone. The new delineation would remove CDFG statistical blocks 654, 655, 656, 657, 688, 689, 690, 711, 712, 713, and the western half of block 710 from the management zone. This action would not increase or decrease projected sea otter range expansion compared to the baseline within 10 years. Sea otters are already expected to reach carrying capacity along the coastline from Point Conception to Santa Barbara (CDFG statistical blocks 654, 655, 656, and 657) but are not expected to recolonize San Miguel and Santa Rosa Islands within this period (see section 6.1.4). Therefore, there would be no impacts within the 10-year period of analysis from decreasing the size of the management zone except regulatory changes in the area excluded from the management zone under the new designation.

Under Alternative 2, translocations of sea otters to San Nicolas Island would not be reinitiated, beyond moving small numbers of sea otters to San Nicolas Island as necessary to improve genetic diversity in the colony. Instead, sea otters would be allowed to remain at San Nicolas Island, and the existing colony would be observed, protected, and contained. Because this action would not detectably increase or decrease the San Nicolas Island colony compared to the baseline, there would be no impacts except in terms of increased implementation costs.

The assumptions that apply to the analysis for Alternative 2 are the same as those described for the baseline. For a more detailed description of the baseline, to which each activity is compared, refer to section 6.2, “Baseline (Status Quo)—The No Action Alternative.”

6.4.2 Nearshore Marine Ecosystem

Alternative 2 would exclude sea otters from a smaller management zone than under Alternative 1, allowing sea otters to recolonize the coastline to Santa Barbara and the islands of San Miguel and Santa Rosa but preventing any further range expansion. Because sea otters are expected to reoccupy only the coastline area within 10 years, community changes under Alternative 2 are the same as those projected for the baseline within this 10-year period (see section 6.2.2). Changes at San Nicolas Island would also be the same as those projected for the island under baseline conditions because possible translocations of small numbers of animals for the purposes of maintaining genetic diversity are not expected to have a detectable effect.

Beyond 10 years, sea otters may attempt to recolonize other areas of the Southern California Bight. The redefined management zone would exclude sea otters from most of the Southern California Bight but allow them to recolonize the islands of San Miguel and Santa Rosa. If sea otters became re-established in these areas, the nearshore marine environment surrounding these islands would be subject to the kinds of changes described in section 6.2.2. However, maintenance of the modified management zone would prevent such ecosystem changes from occurring in the nearshore areas of the remainder of the Southern California Bight.

Significance criteria are not defined for effects on the nearshore marine ecosystem because of the extent of uncertainty involved.

6.4.3 Candidate, Threatened, and Endangered Species

6.4.3.1 White Abalone

Alternative 2 would require maintenance of a modified management zone. Sea otters would be captured and removed from all areas of the Southern California Bight except the coastline from Point Conception to the city of Santa Barbara and the waters surrounding San Nicolas, San Miguel, and Santa Rosa Islands. Within 10 years, the effects of Alternative 2 are the same as for the baseline (see section 6.2.3.1) because 1) sea otters are not expected to extend their range along the coastline beyond the city of Santa Barbara during this period, and 2) the translocated colony at San Nicolas Island is predicted to persist and to grow at a rate of nine percent annually just as under baseline conditions. As discussed for the baseline, sea otter and white abalone depth ranges overlap only marginally. The abalone fishery was active along the coastline between Point Conception and Santa Barbara and at San Nicolas Island, and fishery data collected from 1955-1997 indicate that less than one half of one percent of all white abalone landings came from these areas (Hobday *et al.* 2001). Because the effects of Alternative 2 on white abalone are the same as for the baseline within 10 years, these effects are not significant.

In the longer term, maintenance of the modified management zone under Alternative 2 would afford white abalone more protection from sea otter predation than the baseline but less than Alternative 1. However, because under baseline conditions natural sea otter range expansion is expected to have only minor negative effects on white abalone recovery (see section 6.2.3.1), the benefit to white abalone resulting from the exclusion of sea otters from the modified management zone is expected to be minor.

To a limited extent, implementation of Alternative 2 may benefit white abalone recovery; however, it is possible that sea otters would find and consume individual white abalone in areas outside the modified management zone. Therefore, we would request formal consultation with the National Marine Fisheries Service under section 7 of the Endangered Species Act and confer with the California Department of Fish and Game if this alternative were selected.

6.4.3.2 Black Abalone

Alternative 2 would require maintenance of a modified management zone. Sea otters would be captured and removed from all areas of the Southern California Bight except the coastline from Point Conception to the city of Santa Barbara and the waters surrounding San Nicolas, San Miguel, and Santa Rosa Islands. Within 10 years, the effects of Alternative 2 are the same as for the baseline (see section 6.2.3.2). The coastline between Point Conception and Santa Barbara, which sea otters are expected to affect through predation within the next 10 years, has not been identified as an important area for abalone recovery. However, San Nicolas Island has been identified by the California Department of Fish and Game as 1 of 10 key locations for the recovery of black abalone (CDFG 2002c). The sea otter colony at the island is predicted to persist and to grow by about nine percent annually under baseline conditions as well as under Alternative 2. Because the effects of Alternative 2 on the nearshore marine ecosystem are the same as

for the baseline within 10 years, these effects are not significant.
Over the longer term, the exclusion of sea otters from the modified management zone may afford black abalone more protection from sea otter predation when compared to the baseline but would offer less protection than Alternative 1. However, because black abalone can maintain reproductively viable populations where sufficient cryptic and inaccessible habitat exists, and because under baseline conditions sea otters would enter the Southern California Bight only gradually, the benefit to black abalone resulting from the exclusion of sea otters from the modified management zone is expected to be relatively minor.

Despite these considerations, the effect that sea otters may have on severely depleted black abalone stocks is uncertain. Therefore, we would confer with the National Marine Fisheries Service and the California Department of Fish and Game if this alternative is selected.

6.4.3.3 Southern Sea Otter

EFFECTS ON PARENT POPULATION

Alternative 2 would require the resumption of zonal management (containment) of sea otters and the maintenance, in perpetuity, of a modified management zone. Sea otters found in the modified management zone would be captured and moved to other portions of the southern sea otter's range.

Within 10 years, Alternative 2 would have no effect on sea otters relative to the baseline (see section 6.2.3.3). During this period, sea otters are expected to expand their range along the coastline towards Santa Barbara (Appendix F), and the modified management zone would allow this range expansion to occur unimpeded. Because the effects of Alternative 2 on the southern sea otter are the same as for the baseline within 10 years, these effects are not significant. However, if range expansion continues along the coastline after 10 years, sea otters may enter the modified management zone. Maintenance of the zone would result in the restriction of natural range expansion. The modified management zone would eliminate about 27 percent of the carrying capacity (for sea otters) of California (see section 6.4.11.1). Alternative 2 would allow sea otters more area for natural range expansion than would Alternative 1, but like Alternative 1, it would require resumption of a risky management strategy (removing sea otters from a management zone and placing them in the mainland range).

It is not possible to determine precisely what effects the maintenance of a modified management zone would have on the species 10 years from now and beyond. Our biological opinion on sea otter containment (USFWS 2000, included as Appendix B) concluded that continuing containment and restricting sea otters to the area north of Point Conception would jeopardize the continued existence of the species. While the modified management zone would allow more area for range expansion compared to the scenario evaluated in the 2000 biological opinion, maintenance of a modified management zone may disrupt behavior throughout the range of the species and cause the incidental injury or death of sea otters removed from the modified management zone. Range restriction would also increase the species' vulnerability to oil spills, disease, and stochastic events relative to the baseline. In the revised southern sea otter recovery plan (USFWS 2003), the recovery team recommends that the range expansion of sea otters be allowed to occur naturally.

EFFECTS ON SAN NICOLAS ISLAND COLONY

Alternative 2 would have little or no effect on the sea otter colony at San Nicolas Island compared to baseline conditions. Monitoring of the colony would continue, and protective measures in place would remain unchanged. Alternative 2 allows for the limited translocation of sea otters to San Nicolas Island for the purposes of maintaining genetic diversity; however, past experience indicates that the dispersal of translocated sea otters would likely be high, possibly negating the intended effect of supplementing genetic diversity.

6.4.4 COMMERCIAL FISHERIES

For a discussion of the regulatory environment (including as it pertains to commercial fisheries) see section 6.4.12.

6.4.4.1 Sea Urchin Fishery

Under Alternative 2, commercial sea urchin landings within 10 years would be (1) eliminated along the coastline from Point Conception to Santa Barbara and (2) unaffected at San Miguel and Santa Rosa Islands. The sea urchin fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Santa Barbara (CDFG statistical blocks 654, 655, 656, and 657). Therefore, there is no additional impact along the coastline compared to the baseline (see section 6.2.4.2 for the commercial sea urchin fishery baseline). Because the effects of Alternative 2 on the sea urchin fishery are the same as for the baseline within 10 years, these effects are not significant.

Whether sea otters would recolonize the nearshore areas around San Miguel and Santa Rosa Islands after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, the commercial sea urchin fishery in these areas would likely no longer be viable, and landings would approach zero because sea urchin divers would fish other areas where their catch per unit effort would be greater. However, there would be no additional impact from this expansion, compared to the baseline, because sea otters are equally likely to colonize these areas under baseline conditions.

Maintenance of the management zone southeast of Santa Barbara would prevent sea otters from further expanding their range. As a result of this management, the long-term impacts that would have occurred under the baseline (the elimination of commercial sea urchin harvests via competition with sea otters in recolonized areas) would not occur. This benefit is likely to accrue gradually over the course of many decades, if not hundreds of years.

6.4.4.2 Spiny Lobster Fishery

Under Alternative 2, commercial spiny lobster landings within 10 years would be (1) eliminated along the coastline from Point Conception to Santa Barbara and (2) unaffected at San Miguel and Santa Rosa Islands. The lobster fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Santa Barbara (CDFG statistical blocks 654, 655, 656, and 657). Therefore, there is no additional impact along the coastline compared to the baseline (see section 6.2.4.3 for the commercial lobster fishery baseline). Because the effects of Alternative 2 on the commercial lobster fishery are the same as for the baseline within 10 years, these effects are not significant.

Whether sea otters would recolonize the nearshore areas around San Miguel and Santa Rosa Islands after 10 years would be a function of their demographic rates, food

supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, the commercial lobster fishery in these areas would likely no longer be viable, and landings would approach zero because lobster fishers would fish other areas where their catch per unit effort would be greater. However, there would be no additional impact from this expansion, compared to the baseline, because sea otters are equally likely to colonize these areas under baseline conditions.

Maintenance of the management zone southeast of Santa Barbara would prevent sea otters from further expanding their range. As a result of this management, the long-term impacts that would have occurred under the baseline (the elimination of commercial lobster harvests via competition with sea otters in recolonized areas) would not occur. This benefit is likely to accrue gradually over the course of many decades, if not hundreds of years.

6.4.4.3 Crab Fishery

Under Alternative 2, sea otters are predicted to recolonize the northern fringe of the previously established management zone. Thus, commercial crab landings within one decade would be (1) eliminated along the coastline from Point Conception to Santa Barbara and (2) unaffected at San Miguel and Santa Rosa Islands. The crab fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Santa Barbara (CDFG statistical blocks 654, 655, 656, and 657). Therefore, there is no additional impact along the coastline compared to the baseline (see section 6.2.4.4 for the commercial crab fishery baseline). Because the effects of Alternative 2 on the commercial crab fishery are the same as for the baseline within 10 years, these effects are not significant.

Whether sea otters would recolonize the nearshore areas around San Miguel and Santa Rosa Islands after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, the commercial crab fishery in these areas would likely no longer be viable, and landings would approach zero because crab fishers would fish other areas where their catch per unit effort would be greater. However, there would be no additional impact from this expansion, compared to the baseline, because sea otters are equally likely to colonize these areas under baseline conditions.

Maintenance of the management zone southeast of Santa Barbara would prevent sea otters from further expanding their range. As a result of this management, the long-term impacts that would have occurred under the baseline (the elimination of commercial crab harvests via competition with sea otters in recolonized areas) would not occur. This benefit is likely to accrue gradually over the course of many decades, if not hundreds of years.

6.4.5 AQUACULTURE

Alternative 2 would require a resumption of zonal management (containment) of sea otters, which may result in the exclusion of sea otters from all areas of the Southern California Bight except the coastline from Point Conception to the city of Santa Barbara and the waters surrounding San Nicolas, San Miguel, and Santa Rosa Islands.

Within 10 years, the effects of Alternative 2 on aquaculture operations are the same as for the baseline (see section 6.2.5) because sea otters are not expected to extend their range along the coastline beyond Santa Barbara during this period.

Beyond 10 years, aquaculture facilities located in other portions of the Southern California Bight may benefit from the exclusion of sea otters, but these benefits are expected to be relatively unimportant for the following reasons: 1) in April 2002, there were only four registered aquaculture operations in the remainder of the Southern California Bight (*i.e.*, not in Santa Barbara Channel), two of which produce a variety of shellfish and finfish, and two of which produce exclusively abalone; 2) under baseline conditions, sea otter range expansion (if it continues to occur) would occur gradually over the course of many decades; and 3) sea otters are not likely to affect abalone or finfish aquaculture operations and would likely affect mussel operations only locally and episodically.

There are no effects at San Nicolas Island because 1) there are currently no aquaculture operations there, and 2) there is no difference in management of the colony under Alternative 2 and the baseline. Significance criteria are not defined for aquaculture because of the extent of uncertainty involved.

6.4.6 Seafood Processing Industry (Sea Urchins)

Under Alternative 2, impacts to the sea urchin processing industry are a function of the change in sea urchin landings. Alternative 2 would exclude sea otters from a smaller management zone than the one currently designated, allowing sea otters to recolonize not only the coastline to Santa Barbara but also the islands of San Miguel and Santa Rosa. However, within 10 years, sea otters are expected to reoccupy only the coastline area. Therefore, there are no impacts to commercial sea urchin landings, relative to the baseline, and correspondingly, the sea urchin processing industry would not be affected (see section 6.2.6 for the seafood processing industry baseline). Because the effects of Alternative 2 on the seafood processing industry are the same as for the baseline within 10 years, these effects are not significant.

Maintenance of the management zone southeast of Santa Barbara would prevent sea otters from further expanding their range. As a result of this management, the long-term impacts that would have occurred under the baseline (the elimination of sea urchin processing inputs via competition with sea otters in recolonized areas) would not occur. This benefit is likely to accrue gradually over the course of many decades, if not hundreds of years.

6.4.7 Kelp Harvest

Alternative 2 would exclude sea otters from a smaller management zone than the one currently designated, allowing sea otters to recolonize not only the coastline to Santa Barbara but also the islands of San Miguel and Santa Rosa. However, within 10 years, sea otters are expected to reoccupy only the coastline area. Thus, the effects on kelp abundance under Alternative 2 are the same as those projected for the baseline within this 10-year period (for a description of the relationship between sea otters and kelp abundance, see section 6.2.2). Changes at San Nicolas Island would also be the same as those projected for the island under baseline conditions.

Beyond 10 years, however, sea otters may attempt to recolonize other areas of the Southern California Bight. The redefined management zone would exclude sea otters from most of the Southern California Bight but allow them to recolonize the islands of San Miguel and Santa Rosa. If sea otters established their range in these areas, the distribution and abundance of kelp would likely increase in the vicinity of these islands where invertebrate herbivores are limiting kelp. However, as a result of

maintenance of the modified management zone, the long-term benefits that may have accrued under the baseline (possible increase in kelp available for harvest) would not occur throughout the remainder of the Southern California Bight.

Significance criteria are not defined for kelp harvesting because of the extent of uncertainty involved.

6.4.8 Recreational Fishing and Diving

Recreational fishing and diving activities that may be affected by sea otters include lobster diving, abalone diving, and finfish fishing. Lobster diving and finfish fishing are addressed below. Abalone diving is included under "Abalone Fishery Restoration" (section 6.4.9).

6.4.8.1 Lobster Diving

Under Alternative 2, recreational lobster dive trips within 10 years would be (1) eliminated along the coastline from Point Conception to Santa Barbara and (2) unaffected at San Miguel and Santa Rosa Islands. Recreational lobster dives under the baseline are projected to be eliminated along the coastline from Point Conception to Santa Barbara (CDFG statistical blocks 654, 655, 656, and 657). Therefore, there is no additional impact along the coastline compared to the baseline (see section 6.2.8 for the recreational lobster diving baseline). Because the effects of Alternative 2 on lobster diving are the same as for the baseline within 10 years, these effects are not significant.

Whether sea otters would recolonize the nearshore areas around San Miguel and Santa Rosa Islands after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, recreational lobster dive trips in these areas would likely no longer be viable, and trips to these areas would likely approach zero. However, there would be no additional impact from this expansion, compared to the baseline, because sea otters are equally likely to colonize these areas under baseline conditions.

Maintenance of the management zone southeast of Santa Barbara would prevent sea otters from further expanding their range. As a result of this management, the long-term impacts that would have occurred under the baseline (the elimination of recreational lobster diving in other areas of the Southern California Bight recolonized by sea otters) would not occur. This benefit is likely to accrue gradually over the course of many decades, if not hundreds of years.

6.4.8.2 Finfish Fishing

Alternative 2 proposes a modified management zone, which would allow sea otters to recolonize the mainland coastline to Santa Barbara and the islands of San Miguel and Santa Rosa. Under Alternative 2, effects on recreational finfish fishing are the same as for the baseline (see section 6.2.8.2) over the next 10 years because during this period sea otters are not expected to extend their range along the mainland beyond Santa Barbara. As under the baseline, recreational finfish fishing may be enhanced as sea otters progressively reoccupy and begin to reside year-round along this stretch of mainland coastline.

A healthy kelp forest ecosystem is important for a wide range of finfish species harvested by the recreational fishery (a discussion of the long-term effects of sea otter predation on the kelp forest community, including finfish production, is given in section 6.2.2). However, any beneficial effects associated with sea otter range expansion along the coastline toward Santa Barbara would likely

require more than 10 years to become noticeable (because the reestablishment of giant kelp canopies in areas where sea urchin grazing is limiting kelp is expected to take at least 10 years) and could occur gradually over several decades. Therefore, it is not possible to reasonably quantify the effects of Alternative 2 on recreational finfish fishing.

Whether sea otters would attempt to recolonize other areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters became established at San Miguel and Santa Rosa Islands, recreational finfish fishing may be enhanced, as it would under the baseline. However, maintenance of the management zone southeast of Santa Barbara would prevent sea otters from recolonizing the mainland coastline southeast of Santa Barbara or any additional islands. As a consequence, Alternative 2 would prevent the possible enhancement of the recreational finfish fishery in these areas. Effects on recreational finfish fishing at San Nicolas Island in both the short term and long term are the same as for the baseline.

Significance criteria are not defined for recreational finfish fishing because of the extent of uncertainty involved.

6.4.9 Abalone Fishery Restoration

Within 10 years, the effects of Alternative 2 on abalone fishery restoration are the same as for the baseline (see section 6.2.9), both along the coastline between Point Conception and Santa Barbara and at San Nicolas Island.

Sea otter range expansion along the coastline towards Santa Barbara would preclude the reestablishment of abalone fishing in this area. Because it does not appear that there is any potential for reopening the abalone fishery (for any species) during the next 10 years, regardless of the presence or absence of sea otters (see section 6.2.9), effects projected for the baseline, as for Alternative 2, along the coastline during this time period are essentially speculative. At San Nicolas Island (CDFG statistical blocks 813 and 814) sea otters are expected to increase from 6 percent of carrying capacity in 2004 to 16 percent of carrying capacity in 2014. Abalone populations at San Nicolas Island are expected to persist as sea otter predation increases. However, densities of large individual abalone would likely eventually be reduced to a point that would preclude reestablishment of an abalone fishery at the island. Because San Nicolas Island would continue to be occupied by sea otters, it would likely be disqualified from abalone fishery consideration on the grounds that it is not “outside of the sea otter range” (CDFG 2002c).

Whether sea otters would recolonize the nearshore areas around San Miguel and Santa Rosa Islands after 10 years would be a function of their demographic rates, food supply, and other variables. San Miguel and Santa Rosa Islands are identified as key recovery areas for red and black abalone in the draft Abalone Management and Recovery Plan (CDFG 2002c). If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, their presence would likely preclude the restoration of an abalone fishery there. However, there would be no additional impact from this expansion, compared to the baseline, because sea otters are equally likely to colonize these areas under baseline conditions.

Maintenance of the management zone southeast of Santa Barbara would prevent sea otters from further expanding their

range. As a result of this management, the long-term impacts that would have occurred under the baseline (elimination of the possibility that an abalone fishery might be reopened in areas that are reoccupied by sea otters) would not occur. Thus, restoration of an abalone fishery may occur in the future. The magnitude of benefit provided by Alternative 2 to the restoration of an abalone fishery is difficult to determine for two reasons: 1) it is unknown whether or when an abalone fishery could be reopened even in the absence of sea otters; and 2) sea otter range expansion that would occur beyond 10 years if not prevented under Alternative 2 is uncertain. Still, it is clear that sea otter range expansion would preclude the possibility of recreational or commercial abalone fishing in reoccupied areas. Therefore, the prevention of range expansion under Alternative 2 can be expected to provide a benefit of unknown magnitude (within the modified management zone) to efforts to restore an abalone fishery.

Significance criteria are not defined for abalone fishery restoration because of the extent of uncertainty involved.

6.4.10 ECOTOURISM

Alternative 2 proposes a modified management zone, which would allow sea otters to recolonize the mainland coastline to Santa Barbara and the islands of San Miguel and Santa Rosa. Under Alternative 2, effects on ecotourism based on sea otter watching are the same as for the baseline (see section 6.2.10) over the next 10 years because during this period sea otters are not expected to extend their range along the mainland beyond Santa Barbara. As under the baseline, tourism is expected to be enhanced as sea otters progressively reoccupy and begin to reside year-round along this stretch of mainland coastline. Whether sea otters would attempt to recolonize other areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters established range at San Miguel and Santa Rosa Islands, ecotourism would be enhanced, as it would under the baseline. However, maintenance of the management zone southeast of Santa Barbara would prevent sea otters from recolonizing the mainland coastline southeast of Santa Barbara or any additional islands. Overall impacts are difficult to quantify and would not necessarily result in decreased economic activity in the modified management zone. However, the quality of tourist trips within the modified management zone may decrease because sea otters would not be observed. Effects on ecotourism at San Nicolas Island are the same as for the baseline (see section 6.2.10).

Significance criteria are not defined for ecotourism because of the extent of uncertainty involved.

6.4.11 FEDERAL AND STATE AGENCY PROGRAMS

Significance criteria are not defined for effects on agency programs because these effects and programs are various and cannot be meaningfully compared with a single set of criteria. For a discussion of the regulatory environment, see section 6.4.12.

6.4.11.1 U.S. Fish and Wildlife Service

The effects of Alternative 2 on southern sea otter recovery are also addressed in section 6.4.3.3 (“Southern Sea Otter”). Here we address our ability to meet our mandates under the Endangered Species Act and Marine Mammal Protection Act and give the implementation costs of the alternative.

Ability to Meet Mandate

Under Alternative 2, sea otters would be removed from a modified management zone in perpetuity. The modified zone does not include the mainland coastline from Point Conception to Santa Barbara or the islands of San Miguel or Santa Rosa. Therefore, the habitat available to sea otters under Alternative 2 would include these areas and the translocation zone surrounding San Nicolas Island.

Within 10 years, sea otters are expected to recolonize only the coastline to Santa Barbara and to increase in number by about 9 percent annually at San Nicolas Island. Because the modified management zone is not expected to restrict range expansion within 10 years, the effects of Alternative 2 on the ability of the Service to meet our mandates under the Endangered Species Act and the Marine Mammal Protection Act are the same as under the baseline scenario during this time period.

Whether sea otters would attempt to recolonize other areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters established range at San Miguel and Santa Rosa Islands, their chances of attaining recovery and reaching their OSP level would be improved relative to today, but the same trend would be expected under the baseline. However, maintenance of the modified management zone southeast of Santa Barbara would prevent sea otters from recolonizing the mainland coastline southeast of Santa Barbara or any additional islands in the Southern California Bight.

San Miguel and Santa Rosa Islands have a large area of high quality habitat within the 40m bathymetric contour. Alternative 2 would provide additional habitat (relative to Alternative 1) to allow for the achievement of recovery and OSP, but it would still prevent sea otters from reoccupying most of the suitable habitat in the Southern California Bight. Specifically, the modified management zone would eliminate about 27 percent of the carrying capacity (for sea otters) of California. If the estimate of OSP is based on the total nearshore habitat of California, and if areas that theoretically could support large numbers of sea otters in northern California (such as the San Francisco Bay) were found to be unsuitable for recolonization by sea otters, Alternative 2 could hinder or prevent the achievement of OSP because of insufficient habitat.

The potential effects of the continual introduction of sea otters into the mainland population on the subspecies as a whole have been previously evaluated by the Service in a biological opinion (USFWS 2000, included as Appendix B), in which we determined that the continuation of the program (which forms the basis of Alternative 1) would likely jeopardize the survival and recovery of the southern sea otter. Although Alternative 2 proposes a modified management zone that would delay the restriction of range expansion and would presumably result in fewer removals, at least in the short term (relative to Alternative 1), the management requirement is essentially the same as that evaluated in the 2000 biological opinion. It is unknown what the population status will be and whether large numbers of sea otters will be seasonally entering the modified management zone 10 years from now, as they were when the biological opinion was written, so the specific effects on the southern sea otter cannot be predicted. However, it is likely that Alternative 2 would make it more difficult to achieve our mandate to bring southern sea otters to their OSP level under the Marine Mammal

Protection Act. Before Alternative 2 could be implemented, we would need to reinitiate consultation under section 7 of the Endangered Species Act and reach a non-jeopardy opinion.

The modified management zone under Alternative 2 would be smaller than the one currently designated. Any sea otters found in the areas newly excluded from the management zone would be subject to the same regulatory provisions that currently apply to the mainland population along the central California coast under the Endangered Species Act, Marine Mammal Protection Act, and applicable state laws. For a discussion of the regulatory provisions that would apply to sea otters under Alternative 2, see section 6.4.12.

IMPLEMENTATION COSTS (10-YEAR PERIOD)

The change in the regulatory provisions that apply to sea otters in the area excluded from the management zone under Alternative 2 may result, in the long term, in increased coordination and consultation between the Service and other parties regarding activities that may affect the southern sea otter. Costs resulting from an increased consultation workload are not included here because few or no activities requiring consultation presently occur or are expected to occur in the area that sea otters would likely reoccupy within the next 10 years.

Under Alternative 2, new implementation costs would result from a resumption of activities to support the southern sea otter translocation program. Associated costs result from expenditures for personnel, transportation, and equipment (Table 6-29).

Based upon past and projected efforts, the annual implementation costs would stabilize at $635 thousand by 2005 and would sum to about $6.4 million over 10 years. The 10-year discounted costs for implementation would sum to $5.4 million (discounted at 3 percent) or $4.5 million (discounted at 7 percent). Annual expenditures would continue for at least 15 years.

Table 6-30 shows the estimated expenditures for the entire program costs over 10 years. Personnel costs to maintain the management zone comprise approximately 83 percent of annual implementation costs. Within the personnel costs, the capture teams represent the largest expense at about $300,000 per year. The capture teams would patrol areas of the modified management zone where sea otters are likely to be found to ensure that sea otters that migrate into the area are removed. Most likely, effort would be concentrated around San Nicolas Island and the northern fringe of the management boundary near Santa Barbara.

TABLE 6-29. PERSONNEL AND EQUIPMENT NEEDED TO IMPLEMENT ALTERNATIVE 2

Personnel	Transportation	Equipment
Program Manager	2 Vans	Boat Maintenance
Capture Teams	1 Tow Vehicle	Dive Gear and Maintenance
Transport Team	2 Monitor Vehicles	Tracking Equipment
Monitoring Team	Air Charters	Training
Veterinary Services	Boat Charters	
	Travel Costs	

TABLE 6-30. IMPLEMENTATION COSTS FOR MAINTENANCE OF MANAGEMENT ZONE AND TRANSLOCATION ZONE OVER 10 YEARS

Year	Annual Cost			Discounted Cost (3% discount rate)	Discounted Cost (7% discount rate)
	Personnel	Transportation	Equipment		
2005	$535,000	$49,000	$61,000	$626,214	$602,804
2006	$535,000	$49,000	$56,000	$603,261	$559,001
2007	$535,000	$49,000	$51,000	$581,115	$518,349
2008	$535,000	$49,000	$51,000	$564,189	$484,438
2009	$535,000	$49,000	$51,000	$547,757	$452,746
2010	$535,000	$49,000	$51,000	$531,803	$423,127
2011	$535,000	$49,000	$51,000	$516,313	$395,446
2012	$535,000	$49,000	$51,000	$501,275	$369,576
2013	$535,000	$49,000	$51,000	$486,675	$345,398
2014	$535,000	$49,000	$51,000	$472,500	$322,802
Total	*$6,365,000*			*$5,431,101 (PV @ 3%)*	*$4,473,687 (PV @ 7%)*

6.4.11.2 Channel Islands National Park

Under Alternative 2, sea otters would be removed from a modified management zone in perpetuity. The modified management zone would exclude the islands of San Miguel and Santa Rosa, allowing their eventual colonization by sea otters, but would require the permanent exclusion of sea otters from the Park's three remaining islands. Because sea otters are expected to recolonize only the mainland coastline to Santa Barbara within the next 10 years (and therefore would not be expected within Park boundaries during this period), the effects of Alternative 2 are the same as under the baseline scenario within this 10-year period.

However, in the long term, it is possible that sea otters would attempt to recolonize island coastlines that are part of the Channel Islands National Park but are also within the modified management zone. Alternative 2 would prevent recolonization of three of the five islands of the Channel Islands National Park (Santa Cruz, Anacapa, and Santa Barbara Islands), which appears to be inconsistent with the Park's mission and mission-related goals to protect and restore natural ecosystems and to practice ecosystem management.

Under Alternative 2, a change in the regulatory provisions that apply to sea otters in the area excluded from the management zone under Alternative 2 would occur (see section 6.4.12). This regulatory change could result, in the long term, in increased coordination and consultation between the Service and Channel Islands National Park. The change would apply only to activities that may affect the southern sea otter at San Miguel and Santa Rosa Islands if sea otters eventually colonized these areas.

6.4.11.3 Channel Islands National Marine Sanctuary

Under Alternative 2, sea otters would be removed from a modified management zone in perpetuity. The modified management zone would exclude the islands of San Miguel and Santa Rosa, allowing their eventual colonization by sea otters, but would require the permanent exclusion of sea otters from the Sanctuary's three remaining islands. Because sea otters are

expected to recolonize only the mainland coastline to Santa Barbara within the next 10 years (and therefore would not be expected within Sanctuary boundaries during this period), the effects of Alternative 2 are the same as under the baseline scenario within this 10-year period.

However, in the long term, it is possible that sea otters would attempt to recolonize nearshore areas that are part of the Channel Islands National Marine Sanctuary but are also within the modified management zone. Alternative 2 would prevent recolonization of three of the five islands of the Channel Islands National Marine Sanctuary (Santa Cruz, Anacapa, and Santa Barbara Islands), which appears to be inconsistent with the Sanctuary's mission to conserve and enhance the biodiversity, ecological integrity, and cultural legacy of areas of special national significance.

Under Alternative 2, a change in the regulatory provisions that apply to sea otters in the area excluded from the management zone under Alternative 2 would occur. This regulatory change could result, in the long term, in increased coordination and consultation between the Service and Channel Islands National Marine Sanctuary. The change would apply only to activities that may affect the southern sea otter at San Miguel and Santa Rosa Islands if sea otters eventually colonized these areas.

6.4.11.4 California Department of Fish and Game

Note: Effects on the recovery of white and black abalone and sea otters are discussed under "Candidate, Threatened, and Endangered Species" (section 6.4.3). Effects on existing commercial fisheries and the restoration of the abalone fishery are discussed under "Commercial Fisheries" (section 6.4.4) and "Abalone Fishery Restoration" (section 6.4.9). Effects on Marine Protected Areas (Marine Protected Areas) are discussed here.

Under Alternative 2, sea otters would be removed from a modified management zone in perpetuity. Therefore, they would be permanently prevented from establishing range within 6 of the 12 newly designated Marine Protected Areas in the Channel Islands National Marine Sanctuary. Specifically, sea otters would be excluded from the Marine Protected Areas at Santa Cruz, Anacapa, and Santa Barbara Islands. Because sea otters are expected to recolonize only the mainland coastline to Santa Barbara within the next 10 years (and therefore would not be expected within MPA boundaries during this period), the effects of Alternative 2 are the same as under the baseline scenario within this 10-year period.

However, in the long term, it is possible that sea otters would attempt to recolonize areas that are now designated as Marine Protected Areas. Alternative 2 would prevent the recolonization of 6 of the 12 Marine Protected Areas, thereby enhancing some goals established for the Marine Protected Areas but negatively affecting others. Preventing sea otters from recolonizing these six areas would be consistent with the goal set for Marine Protected Areas to generate fishery benefits through increased reproduction and dispersal of shellfish larvae and the emigration of large-size individuals. However, it would eliminate possible benefits to finfish fisheries that could result from the presence of sea otters and would negatively affect the achievement of other goals set for the Channel Islands Marine Protected Areas relating to: the maintenance of ecosystem biodiversity; the protection of the structure, function, and integrity of marine ecosystems; the

protection of marine natural heritage; and the provision of recreational, scientific, and educational opportunities. With respect to the non-consumptive socio-economic goals set for the 6 Marine Protected Areas from which sea otters would be excluded, preventing sea otters from recolonizing these areas would eliminate any potential increase in the quality of non-consumptive recreation that would occur as a result of the presence of sea otters.

6.4.11.5 U.S. Navy

Effects on the U.S. Navy are regulatory. Under Alternative 2, consultation requirements for the U.S. Navy for actions that may affect southern sea otters would be the same as those described for the baseline, except that the management zone would be reduced in size. The U.S. Navy would continue to have no requirement to consult on actions that may affect sea otters found in either the management zone or the translocation zone, but actions that may affect sea otters found outside the newly defined management zone (*i.e.*, along the coastline to Santa Barbara or at San Miguel or Santa Rosa Islands) would be subject to consultation and permitting requirements under the Endangered Species Act, Marine Mammal Protection Act, and applicable state laws (see section 6.4.12). Past levels of interaction with sea otters in areas outside the current management zone (*i.e.*, north of Point Conception), indicate that the additional regulatory burden would be negligible.

6.4.11.6 U.S. Minerals Management Service

Effects on the Minerals Management Service are regulatory. Under Alternative 2, consultation requirements for the Minerals Management Service for actions that may affect southern sea otters would be the same as those described for the baseline, except that the management zone would be reduced in size. The Minerals Management Service would continue to be required to consult under section 7 of the Endangered Species Act and to comply with other applicable laws on actions that may affect sea otters in the translocation zone. The Minerals Management Service would continue to have no requirement to consult on actions that may affect sea otters found in the management zone, but actions that may affect sea otters found outside the newly defined management zone (*i.e.*, along the coastline to Santa Barbara or at San Miguel or Santa Rosa Islands) would be subject to consultation and permitting requirements under the Endangered Species Act, Marine Mammal Protection Act, and applicable state laws. The additional regulatory burden would be negligible because 1) it would apply only to the area excluded from the management zone under the modified management zone designation; 2) the physical presence of the oil industry is expected to diminish offshore of California over the next several decades (MMS pers. comm. 2005); 3) all proposed actions that may affect *other* threatened or endangered species or marine mammals are already subject to consultation and permitting requirements under the Endangered Species Act and Marine Mammal Protection Act in this area; and 4) the regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of this alternative, and requirements for consultations or permits related to the southern sea otter have been minimal.

6.4.12 Regulatory Environment

Under Alternative 2, the regulatory environment in the Southern California Bight would remain relatively unchanged.

In the translocation zone, with the exception of defense-related activities by a military

department, the consultation requirements of section 7 of the Endangered Species Act would continue to apply to proposed federal actions, and take of sea otters would continue to be subject to the standard take authorization procedures for threatened species under the Endangered Species Act, depleted species under the Marine Mammal Protection Act, and fully protected species under Fish and Game Code section 4700 and 4500. With respect to defense-related activities, sea otters would continue to be treated (for the purposes of consultation and incidental take authorization) as a species that is proposed to be listed [50 CFR §17.84(d)(4)(iv)] under the Endangered Species Act.

In the newly defined management zone (the city of Santa Barbara to the Mexican border, excluding San Miguel and Santa Rosa Islands), the conference and not the consultation requirements of section 7 of the Endangered Species Act would apply to actions that may affect southern sea otters, and incidental take of southern sea otters resulting from otherwise legal activities would not be subject to take authorization procedures under the Endangered Species Act or Marine Mammal Protection Act or be considered a violation of either Act. As under the baseline, Section 8664.2 of the California Fish and Game Code would allow for incidental take of sea otters in the new management zone by means of specific exemptions from section 4700.

In that portion of the former management zone excluded from the newly designated management zone (Point Conception to the city of Santa Barbara, including San Miguel and Santa Rosa Islands), sea otters would come under the standard protections of the Endangered Species Act (for threatened species), and the Marine Mammal Protection Act (for depleted species). Because California Fish and Game Code section 8664.2 specifically defines the management zone to include all areas seaward of mean high tide subject to the jurisdiction of the United States that are located south of Point Conception, the take exemption provided under section 8664.2 from section 4700, the state's fully protected mammal statute, would continue to apply to the former management zone until and unless section 8664.2 is amended. With the exception of California Fish and Game Code sections 8664.2 and 4700, the federal and state law provisions that would apply in the area outside the new management zone would be identical to those that currently apply in the remainder of the southern sea otter range (north of Point Conception). Incidental take of sea otters would be prohibited unless authorized under the Endangered Species Act, Marine Mammal Protection Act, and applicable state laws. Incidental take of southern sea otters by commercial fisheries could not be authorized under the Marine Mammal Protection Act because of specific provisions applicable to southern sea otters.

Our biological opinion on sea otter containment, released in 2000, concluded that continued zonal management of the sea otter population would jeopardize the species' continued existence. Because of the potential effects of sea otter containment on sea otters found in the parent population, consultation under the Endangered Species Act would need to be reinitiated and a finding of no-jeopardy reached before we could proceed with implementation of Alternative 2.

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

6.5.1 Introduction

Alternative 3 entails declaring the southern sea otter translocation program a failure and terminating the program, thereby eliminating the management zone and translocation zone established through Public Law 99-625 and 50 CFR §17(d). Sub-alternative 3A would require the removal of sea otters from both San Nicolas Island and the management zone as stipulated in the current regulations at 50 CFR §17(d)(8). All sea otters remaining within the translocation zone at San Nicolas Island would be captured and placed with the parent population. Reasonable efforts would also be made initially to remove sea otters from the management zone. However, no effort would be made to enforce a management zone once these two tasks are completed, effectively allowing sea otters from the parent population to recolonize historic range throughout the Southern California Bight.

This action would not increase or decrease the projected sea otter range, compared to the baseline, because sea otters are already expected to reach carrying capacity along the coastline from Point Conception to Santa Barbara in the next 10 years (CDFG statistical blocks 654, 655, 656, and 657) (Appendix F). However, the removal of sea otters from San Nicolas Island would impact the sea otter population compared to the baseline, and would, therefore, impact some socioeconomic activities around this island. The majority of the quantitative impacts, relative to the baseline, result from implementation costs.

The assumptions that apply to the analysis for Alternative 3A are the same as those described for the baseline. For a more detailed description of the baseline, to which each activity is compared, refer to section 6.2, "Baseline (Status Quo)—The No Action Alternative."

6.5.2 Nearshore Marine Ecosystem

Alternative 3A entails declaring the translocation program a failure (thereby abolishing the management zone and translocation zone) and removing sea otters present in these zones at the time of the final decision. Effects on the nearshore marine environment are the same as those described for the baseline, except for possible effects associated with the removal of sea otters from the management zone and translocation zone.

The removal of sea otters from the management zone would not have any discernible ecosystem effects compared to the baseline because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which is occupied generally on a seasonal basis, 2) sea otters are capable of returning rapidly to areas from which they have been removed, and 3) ecosystem effects occur gradually over extended periods of time, in which context a temporary fluctuation in sea otter predation would likely be undetectable.

The removal of animals from San Nicolas Island would eliminate or greatly reduce the colony, probably resulting in minor increases in invertebrate prey populations within a few years. Any changes to the nearshore marine ecosystem (see section 6.2.2) that would have been afforded by a colony persisting at San Nicolas Island as projected under the baseline would not occur. Elimination of the sea otter colony at San Nicolas Island would likely slow sea

otter recolonization of the Southern California Bight and thus would also delay associated ecosystem changes throughout the area.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

Significance criteria are not defined for effects on the nearshore marine ecosystem because of the extent of uncertainty involved.

6.5.3 Effects on Candidate, Threatened, and Endangered Species

In the following discussions, we assume that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight. Nevertheless, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

6.5.3.1 White Abalone

Effects on white abalone resulting from the implementation of Alternative 3A are essentially the same as for the baseline (see section 6.2.3.1, “Establishing the Baseline for White Abalone”) except for possible benefits that may result from the removal of sea otters from San Nicolas Island and the management zone.

The benefit to white abalone under Alternative 3A relates to the potential for the removal of sea otters to slow sea otter range expansion into the Southern California Bight. However, based on our analysis of baseline conditions (unrestricted movement of sea otters without removal) this potential benefit is likely minor. There is little overlap between the habitat utilized by sea otters and habitat used by white abalone. Deep water and offshore habitats provide refuge for white abalone from sea otter predation. In addition, if white abalone make use of cryptic and inaccessible habitat as do other species of abalone, this habitat can provide another form of refuge even where sea otter and white abalone habitats overlap.

Although Alternative 3A is not expected to have adverse effects on white abalone at the

local or species level, it is possible that sea otters, unrestricted by a management zone, may find and consume individual white abalone. Therefore, we would request formal consultation with the National Marine Fisheries Service under section 7 of the Endangered Species Act and confer with the California Department of Fish and Game if this alternative is selected.

Alternative 3A is expected to have a very low beneficial effect on white abalone, relative to the baseline, resulting from the removal of sea otters from San Nicolas Island. This effect is not significant.

6.5.3.2 Black Abalone

Effects on black abalone resulting from the implementation of Alternative 3A are essentially the same as for the baseline (see section 6.2.3.2, "Establishing the Baseline for Black Abalone") except for possible short-term benefits that may result from the removal of sea otters from San Nicolas Island and the management zone.

The benefit to black abalone under Alternative 3A relates to the potential for the removal of sea otters to slow sea otter range expansion into the Southern California Bight. However, this potential benefit is believed to be minor. In areas of the Southern California Bight with sufficient cryptic and inaccessible habitat, black abalone populations would likely persist and have the opportunity to recover in the presence of sea otters. In areas with less suitable habitat, which were occupied by black abalone subsequent to the local extirpation of sea otters, black abalone would be more vulnerable to sea otter predation.

If sea otters are unrestricted by a management zone, predation of black abalone is likely to occur. We would therefore confer with the National Marine Fisheries Service and the California Department of Fish and Game if Alternative 3A is selected.

Alternative 3A is expected to have a beneficial effect of moderate significance on black abalone resulting from the removal of sea otters from San Nicolas Island.

6.5.3.3 Southern Sea Otter

Effects on southern sea otters resulting from the implementation of Alternative 3A are essentially the same as those identified for the baseline with the exception of 1) negative effects on individual sea otters removed from San Nicolas Island and the management zone, 2) possible negative effects on the mainland southern sea otter population resulting from this short-term action, and 3) potential benefits resulting from regulatory changes if incidental take is affecting sea otters (see section 6.5.12).

Under Alternative 3A, sea otters are ultimately allowed to expand their range naturally into the Southern California Bight after the removal of sea otters from the management zone and San Nicolas Island. This scenario enhances the opportunity for southern sea otter recovery by allowing sea otters to recolonize historic habitat. Although the marine habitat in many areas of the Southern California Bight has been degraded by a multitude of human activities, the southern sea otter range has begun to expand into this region. Allowing natural range expansion over the long term maximizes the habitat available for southern sea otter recovery, avoids the potential threat to the species caused by capturing and releasing sea otters throughout the range, and avoids the potential for injuring or killing individual sea otters removed from the management zone.

Alternative 3A would require the removal of those sea otters that are in the management zone or the translocation zone at the time the program is declared a failure. Removal of the colony at San Nicolas Island may slow the recolonization of the Southern California Bight, and thereby slow recovery of the species. Capture and relocation efforts also inevitably cause stress to the sea otters subject to removal and may result in the deaths of some animals. In addition to the stress imposed by capture and transport, sea otters that have learned to forage in prey-rich environments may experience additional stress resulting from their inability to find adequate food in prey-limited areas of the mainland range. The inability of sea otters to find sufficient food could lead to starvation or attempts to return to the Southern California Bight. Overall, removing sea otters from San Nicolas Island and the management zone and placing them in the mainland range would likely be extremely disruptive, if not harmful, to the animals removed, and disruptive also to animals in the receiving population. Both the displaced animals and the receiving population would suffer disturbance to their social structure and encounter increased competition for food.

Alternative 3A partially reflects recommendations made in the Revised Recovery Plan for the Southern Sea Otter (USFWS 2003). The revised recovery plan continues to focus on efforts to increase the size of the southern sea otter's population; however, it no longer recommends translocating sea otters as a means to achieve this goal. Rather, the plan advises against additional translocations (USFWS 2003). Additionally, the recovery team recommended declaring the translocation program a failure, allowing natural range expansion to occur, and allowing the colony at San Nicolas Island (although it is small and its ability to persist is uncertain) to remain at the island rather than capturing these sea otters and releasing them in the mainland range (USFWS 2003). Alternative 3A generally implements these recommendations, with two exceptions: 1) range expansion into the Southern California Bight would be temporarily disrupted by removal of sea otters from the management zone at the time the program was declared a failure, and 2) the colony would be removed from San Nicolas Island.

The potential benefit of the reversion to "threatened" status for southern sea otters is difficult to estimate because its value can be realized only in reference to future actions that may affect members of the species found in the Southern California Bight. If, in the future, the incidental take of sea otters were shown to be hindering the recovery of the species, then the value of the regulatory change could be high. Based on current levels of activity in the Southern California Bight, we would expect that the regulatory change, viewed on its own, would result in a beneficial effect of low significance on southern sea otters. However, because Alternative 3A requires the temporary removal of sea otters from the management zone and removal of the colony at San Nicolas Island, overall Alternative 3A is expected to have an adverse effect of moderate significance on sea otters within 10 years relative to the baseline.

6.5.4 Commercial Fisheries

For a discussion of the regulatory environment (including as it pertains to commercial fisheries) see section 6.5.12.

In the following discussions of the commercial sea urchin, lobster, and crab fisheries, we assume that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades and that their

absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight. Nevertheless, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

The removal of sea otters found in the management zone would have little effect on natural range expansion into the Southern California Bight. Sea otter densities north of Point Conception would likely be sufficient to maintain expansion of the population, and sea otters moved out of the management zone would be capable of rapidly returning. Therefore, this removal would result in little or no benefit to fisheries.

6.5.4.1 Sea Urchin Fishery

Under Alternative 3A, commercial sea urchin landings within 10 years (1) would be eliminated along the coastline from Point Conception to Santa Barbara and (2) may increase around San Nicolas Island. If sea otters are removed from the managed coastline that they currently occupy, we do not anticipate the commercial sea urchin catch to increase before sea otters move back into the area. The sea urchin fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Santa Barbara (CDFG statistical blocks 654, 655, 656, and 657). Therefore, there is no impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island may result in a sea urchin harvest increase, compared to the baseline, for two reasons. First, sea urchin landings would not decrease the projected 10 percent as projected under the baseline because there would be no sea otter population at the island. Therefore, landings would not decrease the anticipated 634,000 pounds from 2005 to 2014. Second, newly recruited sea urchins and those sea urchins that escaped sea otter predation in the past would now potentially be available for commercial harvest. This potential increase follows the assumption that fishery impacts correspond directly to the sea otter's carrying capacity percentage. As of 2004, sea otters were at about 6 percent of their estimated carrying capacity at the island. Thus, sea urchin landings would increase by approximately 6 percent from the 10-year average of 1,152,340 pounds. We assume that the sea urchin population would rebound from sea otter predation in five years.[18] We further assume that the associated increase in landings would be equally distributed across five years, so that landings would rise by about 1 percent (about 14,750 pounds) annually between 2005 and 2009, stabilizing to an annual benefit of approximately 73,750 pounds after 2009 (Table 6-31). This landings increase is dependent upon the assumption that the catch per unit of effort (CPUE) at San Nicolas Island is not already at a maximum, so that the existing sea

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

TABLE 6-31. SEA URCHIN LANDINGS: BENEFITS OF ALTERNATIVE 3A

Year	Commercial Landings (no 10% decrease at SNI)	Commercial Landings (increase of 6% at SNI)	Total Increase in Commercial Landings (Pounds)	Total Ex-Vessel Revenue*	Total Ex-Vessel Discounted Revenue (3%)*	Total Ex-Vessel Discounted Revenue (7%)*
2005	11,524	14,750	26,274	$27,850	$27,039	$26,028
2006	23,047	29,500	52,547	$55,700	$52,502	$48,650
2007	34,570	44,250	78,820	$83,550	$76,460	$68,201
2008	46,094	59,000	105,094	$111,399	$98,977	$84,986
2009	57,617	73,750	131,367	$139,249	$120,117	$99,283
2010	69,141	73,750	142,890	$151,464	$126,849	$100,927
2011	80,664	73,750	154,414	$163,679	$133,086	$101,931
2012	92,187	73,750	165,937	$175,893	$138,852	$102,372
2013	103,711	73,750	177,461	$188,108	$144,169	$102,318
2014	115,234	73,750	188,984	$200,323	$149,059	$101,834
Total Benefits	633,790	589,998	1,223,788	$1,297,215	$1,067,110 (PV @ 3%)	$836,530 (PV @ 7%)

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price divers received for sea urchins (in shell) from 1994 to 2003, which is $1.03 per pound in 2004 dollars.
SNI=San Nicolas Island
PV=present value

urchin vessels have the ability to increase their catch.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial sea urchin fishing in these areas would likely no longer be viable, and landings in these areas would likely approach zero. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight. Therefore, there may be a slight benefit to the sea urchin fishery, compared to the baseline, as a result of some delay in sea otter predation.

The maximum non-discounted benefit to sea urchin fishing vessels for Alternative 3A would total $1.3 million. The discounted 10-year benefit for this alternative would be about $1.1 million (discounted at 3 percent) or $837,000 (discounted at 7 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-6.

On average in the southern California sea urchin fishery, 223 vessels participate annually, landing 60,200 pounds each (Thomson 2001). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels, then each vessel would have increased landings of approximately 5,500 pounds and increased revenue between $3,800 (discounted at 7 percent) and $4,800 (discounted at 3 percent) totaled over 10 years.

As described in Chapter 5, we define levels of significance in this supplement by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 3A is expected to result in an increase in sea urchin ex-vessel revenues within the Southern California Bight of 1 percent compared to the baseline (a total benefit of 1.2 million pounds over 10 years compared to the projected total for southern California of 112.7 million pounds), the benefit is of low significance (see Table 5-1 for definitions of levels of significance).

6.5.4.2 Spiny Lobster Fishery

Under Alternative 3A, commercial lobster landings within 10 years would (1) be eliminated along the coastline from Point Conception to Santa Barbara and (2) increase at San Nicolas Island. If sea otters are removed from the managed coastline that they currently occupy, we would not expect the commercial lobster catch to increase before sea otters move back into the area. The lobster fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Santa Barbara (CDFG statistical blocks 654, 655, 656, and 657). Therefore, there is no impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island may result in an increase in the lobster catch, compared to the baseline, for two reasons. First, lobster landings would not decrease the projected 10 percent as in the baseline because there would be no sea otter population at the island. Therefore, landings would not decrease the anticipated 21,000 pounds from 2005 to 2014. Second, newly recruited lobsters or lobsters that escaped predation in the past would now potentially be available for commercial harvest. This potential increase follows the assumption that fishery impacts correspond directly to the sea otter's carrying capacity percentage. As of 2004, sea otters were at about 6 percent of their estimated carrying capacity at San Nicolas Island. Thus, lobster landings would increase by approximately 6 percent from the 10-year average of 37,722 pounds. We assume that the lobster population would rebound from sea otter predation in seven years.[19] We further assume that the associated increase in landings would be equally distributed across seven years, so that landings would rise by almost 1 percent (about 345 pounds) annually between 2005 and 2011, stabilizing to an annual benefit of approximately 2,400 pounds after 2011 (Table 6-32).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial lobster fishing in these areas would likely no longer be viable, and landings in these areas would likely approach zero. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight. Therefore, there may be a slight benefit to the lobster fishery, compared to the baseline, as a result of some delay in sea otter predation.

Thus, the maximum non-discounted benefit to lobster vessels for Alternative 3A would total about $300,000. The discounted 10-

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

TABLE 6-32. LOBSTER LANDINGS: BENEFITS OF ALTERNATIVE 3A

Year	Commercial Landings (no 10% decrease at SNI)	Commercial Landings (increase of 6% at SNI)	Total Increase in Commercial Landings (Pounds)	Total Ex-Vessel Revenue*	Total Ex-Vessel Discounted Revenue (3%)*	Total Ex-Vessel Discounted Revenue (7%)*
2005	377	345	722	$5,760	$5,592	$5,383
2006	754	690	1,444	$11,523	$10,861	$10,064
2007	1,131	1,035	2,166	$17,285	$15,818	$14,110
2008	1,509	1,380	2,888	$23,047	$20,477	$17,583
2009	1,886	1,724	3,610	$28,810	$24,852	$20,541
2010	2,263	2,069	4,332	$34,572	$28,954	$23,037
2011	2,640	2,414	5,054	$40,335	$32,796	$25,118
2012	3,017	2,414	5,432	$43,345	$34,217	$25,227
2013	3,395	2,414	5,809	$46,355	$35,527	$25,214
2014	3,772	2,414	6,186	$49,365	$36,732	$25,095
Total Benefits	20,744	16,899	37,644	$300,398	$245,827 (PV @ 3%)	$191,373 (PV @ 7%)

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price fishers received for lobsters from 1994 to 2003, which is $7.98 per pound in 2004 dollars.
SNI=San Nicolas Island
PV= present value

year benefit for Alternative 3A would range between about $191,000 (discounted at 7 percent) and $246,000 (discounted at 3 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-6.

On average in the southern California lobster fishery, 202 vessels participate annually landing 3,700 pounds each (Thomson 2001). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels, then each vessel would have increased landings of approximately 190 pounds and increased revenue of between $900 (discounted at 7 percent) and $1,200 (discounted at 3 percent) totaled over 10 years.

As described in Chapter 5, we define levels of significance in this supplement by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 3A is expected to result in an increase in lobster landings within the Southern California Bight of 0.6 percent compared to the baseline (a total benefit of 38,000 pounds over 10 years compared to the projected total for southern California of 6.1 million pounds), the benefit is very low and therefore not significant (see Table 5-1 for definitions of levels of significance).

6.5.4.3 Crab Fishery

Under Alternative 3A, commercial crab landings within 10 years would (1) be eliminated along the coastline from Point Conception to Santa Barbara and (2) increase at San Nicolas Island. If sea otters are removed from the managed coastline that they currently occupy, we would not expect the commercial crab catch to increase before sea otters move back into the area.

TABLE 6-33. CRAB LANDINGS: BENEFITS OF ALTERNATIVE 3A

Year	Commercial Landings (no 10% decrease at SNI)	Commercial Landings (increase of 6% at SNI)	Total Increase in Commercial Landings (Pounds)	Total Ex-Vessel Revenue*	Total Ex-Vessel Discounted Revenue (3%)*	Total Ex-Vessel Discounted Revenue (7%)*
2005	63	102	165	$220	$213	$205
2006	127	203	330	$439	$414	$384
2007	190	305	495	$659	$603	$538
2008	254	406	660	$878	$780	$670
2009	317	406	724	$963	$830	$686
2010	381	406	787	$1,047	$877	$698
2011	444	406	851	$1,132	$920	$705
2012	508	406	914	$1,216	$960	$708
2013	571	406	978	$1,301	$997	$707
2014	635	406	1,041	$1,385	$1,031	$704
Total Benefits	3,492	3,454	6,947	$9,239	$7,625 (PV @ 3%)	$6,005 (PV @ 7%)

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price fishers received for crabs from 1994 to 2003, which is $1.33 per pound in 2004 dollars.
SNI=San Nicolas Island
PV=present value

The crab fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Santa Barbara (CDFG statistical blocks 654, 655, 656, and 657). Therefore, there is no impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island may result in a crab harvest increase, compared to the baseline, for two reasons. First, crab landings would not decrease the projected 10 percent as in the baseline because there would be no sea otter population at the island. Therefore, landings would not decrease the anticipated 3,500 pounds from 2005 to 2014. Second, newly recruited crabs or crabs that escaped predation in the past would now potentially be available for commercial harvest. This potential increase follows the assumption that fishery impacts correspond directly to the sea otter's carrying capacity percentage. As of 2004, sea otters were at about 6 percent of their estimated carrying capacity at the island. Thus, crab landings would increase by approximately 6 percent from the 10-year average of 6,350 pounds. We assume that the crab population would rebound from sea otter predation in four years.[20] We further assume that the associated increase in landings would be equally distributed across four years, so that landings would rise by approximately 2 percent (about 100 pounds) annually between 2005 and 2008, stabilizing to an annual benefit of approximately 400 pounds after 2008 (Table 6-33).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the

[20] Crabs can reach a commercially harvestable size (4.25 inch carapace width) in 4 to 5 years (Parker, 2001). We assume that crab landings would rebound prior to six years because otters are unable to consume crabs inhabiting deep crevices. Thus, crabs may be harvested in less than 4 years.

mainland range for comparable habitat, commercial crab fishing in these areas would likely no longer be viable, and landings in these areas would likely approach zero. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight. Therefore, there may be a slight benefit to the crab fishery, compared to the baseline, as a result of some delay in sea otter predation.

Thus, the maximum non-discounted benefit to crab vessels for Alternative 3A would total $9,000. The discounted 10-year benefit for this Alternative would be between $6,000 (discounted at 7 percent) and $7,600 (discounted at 3 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-6.

On average in the southern California crab fishery, 76 vessels participate annually landing 15,100 pounds each (Thomson 2001). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels, then each vessel would have increased landings of approximately 90 pounds and increased revenue between $80 and $100 totaled over 10 years (discounted at 7 percent and 3 percent, respectively).

As described in Chapter 5, we define levels of significance in this supplement by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 3A is expected to result in an increase in crab ex-vessel revenues within the Southern California Bight of 0.1 percent compared to the baseline (a total benefit of 6,900 pounds over 10 years compared to the projected total for southern California of 7.7 million pounds), the benefit is very low and therefore not significant (see Table 5-1 for definitions of levels of significance).

6.5.5 AQUACULTURE

Effects on aquaculture resulting from Alternative 3A are essentially the same as for the baseline. Although Alternative 3A would require the removal of sea otters from San Nicolas Island and the management zone, the removal of these animals is not likely to affect aquaculture operations noticeably compared to the baseline. Removal of sea otters from the management zone would not likely have an effect on aquaculture because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which is occupied generally on a seasonal basis, and 2) sea otters are capable of returning rapidly to areas from which they have been removed. The removal of sea otters from San Nicolas Island would not affect aquaculture because there are currently no aquaculture operations at San Nicolas Island.

Therefore, just as under the baseline, the effects of Alternative 3A within the next 10 years would likely be a local, episodic reduction of mussel densities on offshore oil platforms in the Santa Barbara Channel. Beyond 10 years, aquaculture operations located in other portions of the Southern California Bight may be affected by sea otters, but these effects are expected to be relatively minor. In April 2002, there were only 2 registered aquaculture leases in Ventura County (producing a variety of shellfish and finfish) and only 2 in San Diego County (producing exclusively abalone). Because sea otter range expansion is expected to occur gradually over the course of many decades, and because sea

otters affect only some aquaculture operations (and these only at the local scale), effects on aquaculture operations overall would likely be minor.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. In the case of aquaculture, there are no effects at San Nicolas Island, regardless. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

Significance criteria are not defined for aquaculture because of the extent of uncertainty involved.

6.5.6 Seafood Processing Industry (Sea Urchins)

Under Alternative 3A, impacts to the sea urchin processing industry would be a function of the change in sea urchin landings. Alternative 3A would have no impact on sea urchin landings along the coastline from Point Conception to Santa Barbara compared to the baseline. However, the removal of sea otters from San Nicolas Island would increase southern California landings by one percent over 10 years. Thus, impacts to the sea urchin processing industry would likely be low, representing a slight benefit to the sea urchin processing industry compared to the baseline.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, sea urchin harvesting would no longer be viable in these areas, and the sea urchin processing industry would be required to obtain sea urchins harvested from other areas of the Southern California Bight. The sea urchin processing industry would eventually be eliminated in southern California if sea otters reached carrying capacity where sea urchin harvesting occurs in the Southern California Bight and processors were unable to obtain sea urchins from elsewhere. This long-term projection is equivalent to the baseline.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly

shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

Within 10 years, Alternative 3A is expected to have a beneficial effect of low significance on the on the seafood processing industry (a gain of 1 percent in possible inputs from the Southern California Bight).

6.5.7 Kelp Harvest

Effects of Alternative 3A on the amount of kelp available for harvest are the same as those described for the baseline, except for possible effects associated with the removal of sea otters from the management zone and translocation zone (for a description of the relationship between sea otters and kelp abundance, see section 6.2.2).

The removal of sea otters from the management zone would not likely have any discernible effects on kelp abundance compared to the baseline because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which is occupied generally on a seasonal basis, 2) sea otters are capable of returning rapidly to areas from which they have been removed, and 3) the return of *Macrocystis* canopy to an area may require a decade or more after the restriction of invertebrate herbivores to cryptic and inaccessible habitat, in which context the effects of a temporary fluctuation in sea otter predation would be undetectable.

The removal of animals from San Nicolas Island would eliminate the colony, probably resulting in minor increases in invertebrate prey populations within a few years. Removing sea otters from San Nicolas Island could impact the kelp harvest at the beds that are currently leased around the island's nearshore areas. Any enhancement of kelp that would have been afforded by a colony persisting at San Nicolas Island (as projected under the baseline) would not occur, representing a possible slight cost to the kelp industry. Elimination of the sea otter colony at San Nicolas Island would likely slow sea otter recolonization of the Southern California Bight and thus would also delay possible associated increases in kelp abundance throughout the area. A slight loss to the kelp harvesting industry, compared to the baseline, could additionally result from this delay.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

Significance criteria are not defined for kelp harvesting because of the extent of uncertainty involved.

6.5.8 Recreational Fishing and Diving

Recreational fishing and diving activities that may be affected by sea otters include lobster diving, abalone diving, and finfish fishing. Lobster diving and finfish fishing are addressed below. Abalone diving is included under "Abalone Fishery Restoration" (section 6.5.9).

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

6.5.8.1 Lobster Diving

Within the next 10 years under Alternative 3A, the recreational lobster fishery would be (1) eliminated along the coastline from Point Conception to Santa Barbara and (2) improved at San Nicolas Island. If sea otters are removed from the managed coastline that they currently occupy, we would not expect recreational dive trips to increase before sea otters move back into the area. The recreational fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Santa Barbara (CDFG statistical blocks 654, 655, 656, and 657). Therefore, there is no impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island may result in an increase in recreational lobster diving trips, compared to the baseline, for two reasons. First, dive trips would not decrease the projected 10 percent as in the baseline because there would be no sea otter population at the island. Therefore, recreational diving would not decrease an anticipated 285 trips from 2005 to 2014. Second, recreational diving may increase because newly recruited lobsters and those lobsters that escaped predation in the past would now potentially be available for recreational harvest. This potential increase follows the assumption that recreational fishery impacts correspond directly to the sea otter's carrying capacity percentage. As of 2004, sea otters were at about 6 percent of their estimated carrying capacity at the island. Thus, recreational dive trips would increase by approximately 6 percent from the 9-year average of 521 trips. We assume that the lobster population would rebound from sea otter predation in seven years[21] for recreational harvest. We further assume that the associated increase in trips would be equally distributed across seven years, so that trips would rise by 1 percent (about 5 trips) annually between 2005 and 2011, stabilizing to an annual benefit of approximately 33 trips after 2011 (Table 6-34).

Whether sea otters would recolonize other nearshore areas of the Southern California

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

TABLE 6-34. RECREATIONAL DIVE TRIPS: BENEFITS OF ALTERNATIVE 3A

Year	Dive Trip Increase (no 10% decrease at SNI)	Dive Trip Increase (increase of 6% at SNI)
2005	5	5
2006	10	10
2007	15	14
2008	21	19
2009	26	24
2010	31	29
2011	36	33
2012	41	33
2013	47	33
2014	52	33
Total Benefits	518 trips	

Note: Benefits are rounded to the nearest trip.
SNI=San Nicolas Island

Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, recreational lobster dive trips in these areas would likely approach zero. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight. Therefore, there may be a slight benefit to the recreational lobster fishery, compared to the baseline, as a result of some delay in sea otter predation.

The benefit to recreational dive trips for Alternative 3A would total 518 trips over 10 years. On average in the southern California recreational fishery, there are 22 commercial passenger fishing vessels (CDFG 1995-2003). If the increased trips were distributed equally among these commercial passenger fishing vessels, and no other vessels entered the industry, then each commercial passenger fishing vessel would supply 24 additional trips over 10 years, if there is demand for these additional trips. This change would represent a slight benefit to both recreational lobster divers and commercial passenger fishing vessels compared to the baseline.

Alternative 3A would provide the recreational lobster fishery with an average annual benefit (for the 10-year time frame) of about 52 trips. This benefit is less than one percent of the annual average of 8,983 trips for the Southern California Bight (see section 6.2.8.1). Therefore, Alternative 3A is expected to have a very low beneficial effect on recreational lobster diving. This effect is not significant.

6.5.8.2 Finfish Fishing

The effects of Alternative 3A are the same as for the baseline except with respect to San Nicolas Island. Although Alternative 3A would require the removal of sea otters that are in the management zone at the time the translocation program is formally declared a failure, this removal is not expected to have any discernible effects because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which is occupied generally on a seasonal basis and 2) sea otters are capable of returning rapidly to areas from which they have been removed. Therefore, the removal of sea otters from the management zone would have no impact on recreational finfish fishing relative to the baseline.

As described for the baseline, the presence of sea otters may improve habitat for recreationally important finfish and thus have a positive effect on the abundance of finfish available for harvest. Such changes would likely require more than 10 years to become noticeable (because the reestablishment of giant kelp canopies in areas where sea urchin grazing is limiting kelp is expected to take at least 10 years)

and could occur gradually over several decades. A discussion of the long-term effects of sea otter predation on the kelp forest community, including finfish production, is given in section 6.2.2.

The removal of sea otters from San Nicolas Island is generally expected to affect recreational finfish fishing negatively relative to the baseline by eliminating the stabilizing and enhancing effects that a persistent sea otter colony may have on the kelp beds surrounding the island.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized areas of the Southern California Bight at the densities seen in the mainland range for comparable habitat, recreational finfish fishing may benefit. This long-term projection differs from the baseline only to the extent that the removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight.

Significance criteria are not defined for recreational finfish fishing because of the extent of uncertainty involved.

6.5.9 Abalone Fishery Restoration

The effects of Alternative 3A are the same as for the baseline except with respect to San Nicolas Island. Although Alternative 3A would require the removal of sea otters that are in the management zone at the time the translocation program is formally declared a failure, this removal is not expected to have any discernible effects on abalone fishery restoration because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which is occupied generally on a seasonal basis, 2) sea otters are capable of returning rapidly to areas from which they have been removed, and 3) abalone fishery restoration is expected to require decades, in which context effects of the removal of sea otters would be undetectable.

As described for the baseline, within 10 years sea otter range expansion along the coastline towards Santa Barbara would preclude the reestablishment of abalone fishing in that area. Because it does not appear that there is any potential for reopening the abalone fishery (for any species) during the next 10 years, regardless of the presence or absence of sea otters (see section 6.2.9), effects projected for Alternative 3A, as for the baseline, along the coastline during this time period are essentially speculative.

San Nicolas Island is identified in the draft Abalone Recovery and Management Plan (CDFG 2002c) as 1 of 10 key recovery areas for black abalone. Compared to the baseline, removing sea otters from San Nicolas Island may increase the probability that black abalone would reach Criterion 1 (and possibly even Criteria 2 and 3, at which point the population could be considered for a reopening of the abalone fishery). However, even if sea otters were successfully removed, it is possible that they would recolonize San Nicolas Island through natural range expansion before abalone populations have reached the fishery consideration phase (Criterion 3), which is expected to require several decades. In this case, a reopening of the abalone fishery would be precluded in this area.

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

areas of the Southern California Bight at the densities seen in the mainland range for comparable habitat, the restoration of an abalone fishery in these areas would not be viable. This long-term projection differs from the baseline only to the extent that the removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

Significance criteria are not defined for abalone fishery restoration because of the extent of uncertainty involved.

6.5.10 ECOTOURISM

The effects of Alternative 3A are the same as for the baseline except with respect to San Nicolas Island. Although Alternative 3A would require the removal of sea otters that are in the management zone at the time the translocation program is formally declared a failure, this removal is not expected to have any discernible effects because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which is occupied generally on a seasonal basis, 2) ecotourism activity directed specifically at sea otter watching is now rare in the management zone, and 3) sea otters are capable of returning rapidly to areas from which they have been removed. Therefore, the removal of sea otters from the management zone would not change ecotourism relative to the baseline. As described for the baseline, tourism based on sea otter watching would be enhanced within 10 years as sea otters progressively reoccupy and begin to reside year-round along the stretch of mainland coastline between Point Conception and Santa Barbara. Overall economic value of this tourism is difficult to quantify and would not necessarily result in increased economic activity. Rather, it would likely manifest itself as an added value to other tourist draws in the area.

The removal of sea otters from San Nicolas Island is generally expected to affect ecotourism negatively relative to the baseline by reducing or eliminating the possibility of a sea otter sighting at the island. Under the baseline, we do not expect ecotourism in this area to grow considerably (in terms of number of trips) over the next 10 years as a result of the increased abundance of sea otters, but we do expect that the quality of recreational trips to San Nicolas Island would be enhanced due to the better possibility of a sea otter sighting. Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized areas of the Southern California Bight at the densities seen in the mainland range for

comparable habitat, ecotourism would benefit. This long-term projection is differs from the baseline only to the extent that the removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

Significance criteria are not defined for ecotourism because of the extent of uncertainty involved.

6.5.11 Federal and State Agency Programs

Significance criteria are not defined for effects on agency programs because these effects and programs are various and cannot be meaningfully compared with a single set of criteria. For a discussion of the regulatory environment, see section 6.5.12.

In the following discussions, we assume that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight. Nevertheless, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

6.5.11.1 U.S. Fish and Wildlife Service

The effects of Alternative 3A on southern sea otter recovery are also addressed in section 6.5.3.3 (“Southern Sea Otter”). Here we address our ability to meet our mandates under the Endangered Species Act and Marine Mammal Protection Act and give the implementation costs of the alternative.

Ability to Meet Mandate

Our ability to achieve recovery and OSP under Alternative 3A is the same as under the baseline scenario in terms of the area available for sea otters to recolonize. Alternative 3A (like the baseline and Alternatives 3B and 3C) maximizes the habitat available to sea otters for recolonization and would permit the possible eventual expansion of sea otters throughout their historic range in the

Southern California Bight. However, the time that would be required for sea otters to reach recovery and OSP is unknown. The removal of sea otters from the management zone would not likely have any discernible effects compared to the baseline because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which is occupied generally on a seasonal basis, and 2) sea otters are capable of returning rapidly to areas from which they have been removed.

One potentially important difference between 3A and the baseline arises from the removal of sea otters from San Nicolas Island, which could have unpredictable effects on the rapidity with which other areas of the Southern California Bight are recolonized and, consequently, on our ability to bring southern sea otters to recovery and OSP. Removal of sea otters from San Nicolas Island (if sea otters did not immediately return) would likely slow the eventual colonization of the Southern California Bight because dispersing sea otters could come from only the mainland range. Overall, the removal of sea otters from San Nicolas Island and their placement into the mainland range would likely be extremely disruptive, if not harmful, to the animals removed, and disruptive also to the animals in the receiving population. In this situation, both the displaced colony and the receiving population would suffer disturbance to their social structure and encounter increased competition for food. Individuals from San Nicolas Island, where there is abundant prey, may be unable to compete successfully in the mainland range, where food resources are more limited. Moved animals would additionally be subjected to the stress of capture and transport, which could result in the deaths of some individuals. These negative effects are likely to delay, to some unknown extent, the prospect of recovery and achievement of OSP.

Alternative 3A differs notably from the baseline with respect to the regulatory provisions that would apply to sea otters in the Southern California Bight because the management and translocation zones would no longer exist. For a discussion of these provisions, see section 6.5.12.

Because of the various effects outlined above, Alternative 3A is not as conducive to our achievement of mandates under the Endangered Species Act and the Marine Mammal Protection Act as is Alternative 3C, but it is far more likely to result in achievement of these mandates than are either Alternative 1 or Alternative 2.

IMPLEMENTATION COSTS (10-YEAR PERIOD)

The change in the regulatory provisions that apply to sea otters in the Southern California Bight under Alternative 3A may result, in the long term, in increased coordination and consultation between the Service and other parties regarding activities that may affect the southern sea otter. Costs resulting from an increased consultation workload are not included here because few or no activities requiring consultation presently occur or are expected to occur in the area that sea otters would likely reoccupy within the next 10 years. New implementation costs would be incurred under Alternative 3A. These costs derive from the removal sea otters from San Nicolas Island and the management zone and include expenditures for personnel, transportation, and equipment (Table 6-35).

Activities related to the removal of sea otters from the translocation and management zones are expected to continue for two years. After all reasonable efforts are expended to remove sea otters from the

TABLE 6-35. PERSONNEL AND EQUIPMENT NEEDED TO IMPLEMENT ALTERNATIVE 3A

Personnel	Transportation	Equipment
Program Manager	2 Vans	Boat Maintenance
Capture Teams	1 Tow Vehicle	Dive Gear and Maintenance
Transport Team	2 Monitor Vehicles	Tracking Equipment
Monitoring Team	Air Charters	Training
Veterinary Services	Boat Charters	
	Travel Costs	

zones, no further maintenance would continue. In the third year, only monitoring efforts would be implemented. Therefore, implementation costs would cease after the third year of effort.

Personnel costs to maintain the management zone comprise about 72 percent of annual implementation costs. Within the personnel costs, capture team represent the largest expense, at $300,000 per year. These capture teams would patrol the management zone and capture and relocate any sea otter found within it. Most likely, effort would be concentrated at the northern border of the management zone boundary near Point Conception.

The following estimated expenditures represent the entire program costs over a 10-year period (Table 6-36). Based upon past and projected efforts, the non-discounted annual implementation costs would sum to about $1.6 million over three years.

6.5.11.2 Channel Islands National Park

The effects of Alternative 3A are virtually the same as under the baseline scenario. Alternative 3A would allow sea otters to recolonize the Southern California Bight. While no effects of sea otters would be expected within 10 years, sea otters would likely eventually re-establish their range within Park boundaries. Alternative 3A is consistent with the mission and mission-related goals of the Channel Islands National Park to protect and restore natural ecosystems and to practice ecosystem management.

The removal of sea otters from the management zone would not likely have any

TABLE 6-36. IMPLEMENTATION COSTS FOR REMOVAL OF SEA OTTERS FROM SAN NICOLAS ISLAND AND THE MANAGEMENT ZONE

Year	Annual Cost			Discounted Cost (3% discount rate)	Discounted Cost (7% discount rate)
	Personnel	Transportation	Equipment		
2005	$535,000	$128,000	$85,000	$726,214	$699,065
2006	$535,000	$128,000	$56,000	$677,726	$628,002
2007	$90,000	$21,000	$1,000	$102,496	$91,425
2008	-	-	-	-	-
2009	-	-	-	-	-
2010	-	-	-	-	-
2011	-	-	-	-	-
2012	-	-	-	-	-
2013	-	-	-	-	-
2014	-	-	-	-	-
Total	*$1,579,000*			*$1,506,436 (PV @ 3%)*	*$1,418,493 (PV @ 7%)*

Note: A 10-year period allows for comparison of the alternatives.

discernible effects compared to the baseline because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which is occupied generally on a seasonal basis, and 2) sea otters are capable of returning rapidly to areas from which they have been removed. The potential difference between 3A and the baseline arises from the removal of sea otters from San Nicolas Island, which could have unpredictable effects on the rapidity with which other areas of the Southern California Bight are recolonized. Removal of sea otters from San Nicolas Island (if sea otters did not immediately return) would likely slow the eventual colonization of islands in the Channel Islands National Park because dispersing sea otters would come from only one direction (the mainland range). Generally, however, the effect of this alternative would be to allow the eventual return of sea otters to the islands of the Channel Islands National Park.

Under Alternative 3A, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.5.12). This change could result, in the long term, in increased coordination and consultation between the Service and Channel Islands National Park regarding activities that may affect the southern sea otter if sea otters recolonize historic range within Park boundaries.

6.5.11.3 Channel Islands National Marine Sanctuary

The effects of Alternative 3A are virtually the same as under the baseline scenario. Alternative 3A would allow sea otters to recolonize the Southern California Bight. While no effects of sea otters would be expected within 10 years, sea otters would likely eventually re-establish their range within Sanctuary boundaries. Alternative 3A is consistent with the mission of the Channel Islands National Marine Sanctuary to conserve and enhance the biodiversity, ecological integrity, and cultural legacy of areas of special national significance.

The removal of sea otters from the management zone would not likely have any discernible effects compared to the baseline because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which is occupied generally on a seasonal basis, and 2) sea otters are capable of returning rapidly to areas from which they have been removed. The potential difference between 3A and the baseline arises from the removal of sea otters from San Nicolas Island, which could have unpredictable effects on the rapidity with which other areas of the Southern California Bight are recolonized. Generally, removal of sea otters from San Nicolas Island (if sea otters did not immediately return) is likely to slow the eventual colonization of islands in the Channel Islands National Marine Sanctuary because dispersing sea otters would come from only one direction (the mainland range). However, the overall effect of this alternative would be to allow the eventual return of sea otters to the islands within the Channel Islands National Marine Sanctuary.

Under Alternative 3A, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.5.12). This regulatory change could result, in the long term, in increased coordination and consultation between the Service and Channel Islands National Marine Sanctuary regarding activities that may affect the southern sea otter if sea otters recolonize historic range within Sanctuary boundaries.

6.5.11.4 California Department of Fish and Game

Note: Effects on the recovery of white and black abalone and sea otters are discussed under "Candidate, Threatened, and Endangered Species" (section 6.5.3). Effects on existing commercial fisheries and the restoration of the abalone fishery are discussed under "Commercial Fisheries" (section 6.5.4) and "Abalone Fishery Restoration" (section 6.5.9). Effects on Marine Protected Areas (MPAs) are discussed here.

The effects of Alternative 3A are virtually the same as under the baseline scenario. Alternative 3A would allow sea otters to recolonize the Southern California Bight. While no effects of sea otters would be expected within 10 years, sea otters would likely eventually re-establish their range within MPA boundaries. Alternative 3A would have a positive effect on Marine Protected Areas overall. For a full discussion of the expected effects of sea otters on Marine Protected Areas, see section 6.2.11.4.

The removal of sea otters from the management zone would not likely have any discernible effects compared to the baseline because 1) sea otters have not become established in any parts of the management zone except the Cojo Anchorage area, which is occupied generally on a seasonal basis, and 2) sea otters are capable of returning rapidly to areas from which they have been removed. The potential difference between 3A and the baseline arises from the removal of sea otters from San Nicolas Island, which could have unpredictable effects on the rapidity with which other areas of the Southern California Bight are recolonized. Removal of sea otters from San Nicolas Island (if sea otters did not immediately return) would likely slow the eventual colonization of areas designated as Marine Protected Areas in the Channel Islands National Marine Sanctuary because dispersing sea otters would come from only one direction (the mainland range). Generally, however, the effect of this alternative would be to allow the eventual return of sea otters to areas designated as Marine Protected Areas.

6.5.11.5 U.S. Navy

Effects on the U.S. Navy are regulatory. Under Alternative 3A, the translocation program would be declared a failure, and the management zone and translocation zone would be abolished. As a consequence, the regulatory environment would change (see section 6.5.12).

The change in the regulatory provisions that apply to sea otters in the Southern California Bight under Alternative 3A could result in increased coordination and consultation between the Service and the U.S. Navy regarding activities that may affect the southern sea otter. Under Alternative 3A, sea otters would be removed from San Nicolas Island, but it is possible that some animals would return after removal efforts had ceased. To date, we have no evidence that defense-related activities have had any adverse effects on sea otters at San Nicolas Island or in the management zone. As mitigation for the effects of an increased regulatory burden on the U.S. Navy, we would propose to coordinate with the U.S. Navy to develop a programmatic consultation for activities that may affect southern sea otters. Because the U.S. Navy is already required to obtain an Incidental Harassment Authorization under the Marine Mammal Protection Act for the incidental non-lethal "take by harassment" of other marine mammals during missile and target launch operations at San Nicolas Island, the addition of a programmatic consultation for

sea otters would likely introduce only a minor additional regulatory burden.

6.5.11.6 U.S. Minerals Management Service

Effects on the Minerals Management Service are regulatory. Under Alternative 3A, the translocation program would be declared a failure, and the management zone and translocation zone would be abolished. As a consequence, the regulatory environment would change (see section 6.5.12).

In the long term, the change in the regulatory provisions that apply to sea otters in the Southern California Bight under Alternative 3A could result in increased coordination and consultation between the Service and the Minerals Management Service regarding activities that may affect the southern sea otter. However, the added consultation and permitting requirements for actions that may affect sea otters in the Southern California Bight would likely impose only a minor additional regulatory burden on the Minerals Management Service for the following reasons: 1) the physical presence of the oil industry is expected to diminish offshore of California over the next several decades (MMS pers. comm. 2005); 2) all proposed actions that may affect *other* threatened or endangered species or marine mammals are already subject to consultation and permitting requirements under the Endangered Species Act and Marine Mammal Protection Act; 3) the regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of this alternative, and requirements for consultations or permits related to the southern sea otter have been minimal; 4) southern sea otters would not be present in most of southern California for decades (if range expansion continues to occur).

6.5.12 Regulatory Environment

The regulatory environment under Alternative 3A would be identical to the regulatory environment under Alternatives 3B and 3C, although the actual effects of regulatory changes relative to the baseline depend on the presence or absence of sea otters in the Southern California Bight (see section 6.5.11 for a discussion of possible scenarios).

Under Alternative 3A, as under Alternatives 3B and 3C, the translocation program would be declared a failure and terminated, the management and translocation zones would be abolished, and the provisions of Public Law 99-625 would become inoperative. California Fish and Game Code section 8664.2 would also become inoperative. As a result, all activities that may affect southern sea otters within the Southern California Bight would be fully subject to the Endangered Species Act, the Marine Mammal Protection Act, and California state law, including applicable consultation requirements and take prohibitions under these laws.

All federal agencies planning activities that may affect southern sea otters in the Southern California Bight would be required to consult with the Fish and Wildlife Service under section 7 of the Endangered Species Act and seek authorization for incidental take of sea otters under the Endangered Species Act and provisions of the Marine Mammal Protection Act. If otherwise allowable under applicable state law, including California Fish and Game Code section 4700, non-federal activities that would result in take of southern sea otters in California would require incidental take authorization from the Fish and Wildlife Service under section 10(a)1(B) of the

Endangered Species Act and section 101(a)(5) of the Marine Mammal Protection Act. Incidental take of southern sea otters in commercial fisheries cannot be authorized under the Marine Mammal Protection Act. Therefore, incidental take of southern sea otters in commercial fisheries throughout the Southern California Bight would be prohibited, as it is currently prohibited throughout the remainder of the range of the species (north of Point Conception). Intentional take would continue to be prohibited unless authorized, as under the current regulations.

This change in the regulatory environment would not be likely to result in substantial effects on activities now being conducted within the Southern California Bight for several reasons:

1) The current regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of Alternatives 3A, 3B, or 3C in the Southern California Bight. Commercial fishing activities, harbor maintenance, oil and gas exploration, and other human activities are similar in the two sections of coastline. Along the central coast, requirements for consultations and take authorizations under the Endangered Species Act and Marine Mammal Protection Act related to the southern sea otter have been minimal, and we would expect the same to be the case for the Southern California Bight. This is because there are few otherwise legal activities that result in take of southern sea otters and because the southern sea otter's historic habitat, although somewhat degraded, is essentially intact.

2) Southern sea otters would not be present in most of southern California for many decades. In fact, we cannot reliably assert that range expansion will occur at all. Critical habitat has not been designated for the southern sea otter and is not proposed or required (the southern sea otter was listed under the Endangered Species Act prior to passage of the requirement to designate critical habitat). With no sea otters present in most of the Southern California Bight and no designated critical habitat, the likelihood that adverse interactions between sea otters and human activities would occur would be less than the likelihood that currently exists along the central coast, where substantial numbers of sea otters are found, and where the regulatory environment is the same as that proposed under Alternatives 3A, 3B, and 3C.

3) If the translocation program were declared a failure and terminated, California Fish and Game Code section 4700 would prohibit all take, as defined and applied under state law, of southern sea otters, and the Marine Mammal Protection Act would prohibit incidental take of southern sea otters by commercial fisheries. Nevertheless, commercial fisheries in the Southern California Bight are unlikely to be adversely affected by the change in regulatory environment because few fisheries will likely interact with sea otters. Gill-net fisheries, historically a concern for incidental take of sea otters, are currently prohibited in the nearshore waters of southern California and the offshore Channel

Islands where sea otters would be found (Marine Resources Protection Act, California Constitution Article 10B). Dive fisheries (sea urchin, abalone) are extremely unlikely to result in take of sea otters by virtue of the methods they employ to harvest shellfish. Trap fisheries (lobster, crab, live-fish) could potentially result in the entrapment and drowning of sea otters and thus could be affected by a change in the regulatory environment. However, there are few data to assess the possibility of incidental take of southern sea otters in these fisheries, and therefore we cannot reliably anticipate the impact of this regulatory change on this segment of the commercial fishing community.

4) Because of potential effects on the receiving population of sea otters in the mainland range caused by the relocation of sea otters removed from the translocation zone, we would be required to consult under section 7 of the Endangered Species Act before implementation of this alternative.

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

6.6.1 Introduction

Alternative 3 entails declaring the southern sea otter translocation program a failure and terminating the program, thereby eliminating the management zone and translocation zone established through Public Law 99-625 and 50 CFR §17(d). Sub-alternative 3B would require the removal of sea otters from San Nicolas Island but allows sea otters to remain in the management zone. All sea otters within the translocation zone at San Nicolas Island would be captured and placed within the parent range. No effort would be made to enforce a management zone, effectively allowing sea otters from the parent population to recolonize historic range throughout the Southern California Bight.

This action would not increase or decrease the projected sea otter range, compared to the baseline, because sea otters are already expected to reach carrying capacity along the coastline from Point Conception to Santa Barbara in the next 10 years (CDFG statistical blocks 654, 655, 656, and 657) (Appendix F). However, the removal of sea otters from San Nicolas Island would impact the sea otter population compared to the baseline, and would, therefore, impact some socioeconomic activities.

The assumptions that apply to the analysis for Alternative 3B are the same as those described for the baseline. For a more detailed description of the baseline, to which each activity is compared, refer to section 6.2, "Baseline (Status Quo)—The No Action Alternative."

6.6.2 Nearshore Marine Ecosystem

Alternative 3B entails declaring the translocation program a failure (thereby abolishing the management zone and translocation zone) and removing only those sea otters present in the translocation zone at the time of the final decision. The effects of this alternative on the nearshore marine ecosystem are the same as those for Alternative 3A because the removal of sea otters from the management zone (evaluated under Alternative 3A) is not expected to have any discernible community effects.

The removal of animals from San Nicolas Island would eliminate or greatly reduce the colony, probably resulting in minor increases in invertebrate prey populations within a few years. Any changes to the nearshore marine ecosystem (see section 6.2.2) that would have been afforded by a colony persisting at San Nicolas Island as projected under the baseline would not occur. Elimination of the sea otter colony at San Nicolas Island would likely slow sea otter recolonization of the Southern California Bight and thus would also delay associated ecosystem changes throughout the area.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could

establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

Significance criteria are not defined for effects on the nearshore marine ecosystem because of the extent of uncertainty involved.

6.6.3 Effects on Candidate, Threatened, and Endangered Species

In the following discussions, we assume that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight. Nevertheless, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

6.6.3.1 White Abalone

Effects on white abalone resulting from the implementation of Alternative 3B are essentially the same as for the baseline (see section 6.2.3.1, “Establishing the Baseline for White Abalone”) except for possible benefits that may result from the removal of sea otters from San Nicolas Island.

The benefit to white abalone under Alternative 3B relates to the potential for the removal of sea otters to slow sea otter range expansion into the Southern California Bight. However, based on our analysis of baseline conditions (unrestricted movement of sea otters without removal) this potential benefit is minor. There is little overlap between the habitat utilized by sea otters and habitat used by white abalone. Deep water and offshore habitats provide refuge for white abalone from sea otter predation. In addition, if white abalone make use of cryptic and inaccessible habitat as do other species of abalone, this habitat can provide another form of refuge even where sea otter and white abalone habitats overlap.

Although it is not expected that Alternative 3B would affect white abalone at the population level, it is possible that sea otters, unrestricted by a management zone, may find and consume individual white abalone. Therefore, we would request formal consultation with the National Marine Fisheries Service under section 7 of the Endangered Species Act and confer with the California Department of Fish and Game if this alternative is selected.

Within 10 years, Alternative 3B is expected to have a beneficial effect of low significance on white abalone.

6.6.3.2 Black Abalone

Effects on black abalone resulting from the implementation of Alternative 3B are essentially the same as for the baseline (see section 6.2.3.2, “Establishing the Baseline for Black Abalone”) except for possible benefits that may result from the removal of sea otters from San Nicolas Island.

The benefit to black abalone under Alternative 3B relates to the potential for the removal of sea otters to slow sea otter range expansion into the Southern California Bight. However, based on our analysis of baseline conditions (unrestricted movement of sea otters without removal) this potential benefit is believed to be minor. In areas of the Southern California Bight with sufficient cryptic and inaccessible habitat, black abalone populations would likely persist and have the opportunity to recover in the presence of sea otters. In areas with less suitable habitat, which were occupied by black abalone subsequent to the local extirpation of sea otters, black abalone would be more vulnerable to sea otter predation.

If sea otters are unrestricted by a management zone, predation of black abalone is likely to occur. We would therefore confer with the National Marine Fisheries Service and the California Department of Fish and Game if Alternative 3B is selected.

Within 10 years, Alternative 3B is expected to have a beneficial effect of moderate significance on black abalone.

6.6.3.3 Southern Sea Otter

Effects on southern sea otters resulting from the implementation of Alternative 3B are essentially the same as those identified in our baseline analysis with the exception of 1) negative effects on individual sea otters removed from San Nicolas Island and possible negative effects on the southern sea otter population resulting from this action, and 2) potential effects resulting from regulatory changes if incidental take is affecting sea otters (see section 6.6.12).

Under Alternative 3B, as under baseline conditions, sea otters may expand their range naturally into the Southern California Bight. This scenario enhances the opportunity for southern sea otter recovery by allowing sea otters to recolonize historic habitat. Although the marine habitat in the Southern California Bight has been degraded by a multitude of human activities, the southern sea otter range has expanded into this area. Allowing natural range expansion maximizes habitat available for southern sea otter recovery, avoids the potential threat to the species caused by capturing and releasing sea otters throughout the range, and avoids the potential for injuring or killing individual sea otters removed from the management zone.

Alternative 3B would require the removal of sea otters from San Nicolas Island. Removal of the colony at San Nicolas Island may slow the recolonization of the Southern California Bight and thereby inhibit recovery of the species. Capture and relocation efforts also inevitably cause stress to the sea otters subject to removal and may cause the death of some the animals. Aside from stress inherent to capture and transport, sea otters that have learned to forage in prey-rich environments may not be able to find adequate food in prey-limited areas of the mainland range, resulting in starvation or an attempt to return to the Southern California Bight. Overall, removing sea otters from San Nicolas Island and placing them in the mainland range would likely be extremely disruptive, if not harmful, to the animals removed, and disruptive also to animals in the receiving population. Both the displaced animals and the receiving population would suffer disturbance to their social structure and encounter increased competition for food.

Alternative 3B partially reflects recommendations made in the Revised Recovery Plan for the Southern Sea Otter

(USFWS 2003). The revised recovery plan continues to focus on efforts to increase the size of the southern sea otter's population; however, it no longer recommends translocating sea otters as a means to achieve this goal. Rather, the plan advises against additional translocations (USFWS 2003). Additionally, the recovery team recommended declaring the translocation program a failure, allowing natural range expansion to occur, and allowing the colony at San Nicolas Island (although it is small and its ability to persist is uncertain) to remain at the island rather than capturing these sea otters and releasing them in the mainland range (USFWS 2003). Alternative 3B implements these recommendations except the recovery team's recommendation to allow the colony to remain at San Nicolas Island.

The potential benefit of the reversion to "threatened" status for southern sea otters is difficult to estimate because its value can be realized only in reference to future actions that may affect members of the species found in the Southern California Bight. If, in the future, the incidental take of sea otters were shown to be hindering the recovery of the species, then the value of the regulatory change could be high. Based on current levels of activity in the Southern California Bight, we would expect that the regulatory change, viewed on its own, would result in a beneficial effect of low significance on southern sea otters. However, because Alternative 3B requires the removal of the colony at San Nicolas Island, overall Alternative 3B is expected to have an adverse effect of low significance on sea otters within 10 years relative to the baseline.

6.6.4 Commercial Fisheries

For a discussion of the regulatory environment (including as it pertains to commercial fisheries) see section 6.6.12.

In the following discussions, we assume that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight. Nevertheless, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

6.6.4.1 Sea Urchin Fishery

Under Alternative 3B, commercial sea urchin landings within 10 years would (1) be eliminated along the coastline from Point Conception to Santa Barbara and (2) increase around San Nicolas Island. The sea urchin fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Santa Barbara (CDFG statistical blocks 654, 655, 656, and 657). Therefore, there is no impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island would result in a sea urchin harvest increase, compared to the baseline, for two reasons. First, sea urchin landings would not decrease the projected 10 percent as in the baseline because there would be no sea otter population at the island. Therefore, landings would not decrease the anticipated

TABLE 6-37. SEA URCHIN LANDINGS: BENEFITS OF ALTERNATIVE 3B

Year	Commercial Landings (no 10% decrease at SNI)	Commercial Landings (increase of 6% at SNI)	Total Increase in Commercial Landings (Pounds)	Total Ex-Vessel Revenue*	Total Ex-Vessel Discounted Revenue (3%)*	Total Ex-Vessel Discounted Revenue (7%)*
2005	11,524	14,750	26,274	$27,850	$27,039	$26,028
2006	23,047	29,500	52,547	$55,700	$52,502	$48,650
2007	34,570	44,250	78,820	$83,550	$76,460	$68,201
2008	46,094	59,000	105,094	$111,399	$98,977	$84,986
2009	57,617	73,750	131,367	$139,249	$120,117	$99,283
2010	69,141	73,750	142,890	$151,464	$126,849	$100,927
2011	80,664	73,750	154,414	$163,679	$133,086	$101,931
2012	92,187	73,750	165,937	$175,893	$138,852	$102,372
2013	103,711	73,750	177,461	$188,108	$144,169	$102,318
2014	115,234	73,750	188,984	$200,323	$149,059	$101,834
Total Benefits	633,790	589,998	1,223,788	$1,297,215	$1,067,110 (PV @ 3%)	$836,530 (PV @ 7%)

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price divers received for sea urchin (in shell) from 1994 to 2003, which is $1.03 per pound in 2004 dollars.
SNI=San Nicolas Island
PV=present value

634,000 pounds from 2005 to 2014. Second, newly recruited sea urchins and those sea urchins that escaped sea otter predation in the past would now potentially be available for commercial harvest. This potential increase follows the assumption that fishery impacts correspond directly to the sea otter's carrying capacity percentage. As of 2004, sea otters were at about 6 percent of their estimated carrying capacity at the island. Thus, sea urchin landings would increase by approximately 6 percent from the 10-year average of 1,152,340 pounds. We assume that the sea urchin population would rebound from sea otter predation in five years.[22] We further assume that the associated increase in landings would be equally distributed across five years, so that landings would rise by 1 percent (about 14,750 pounds) annually between 2005 and 2009, stabilizing to an annual benefit of approximately 73,750 pounds after 2009 (Table 6-37). This landings increase relies upon the assumption that the catch per unit of effort (CPUE) at San Nicolas Island is not already at a maximum level, so that the existing vessels have the ability to increase their catch.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial sea urchin landings would approach zero because sea urchin divers would fish other areas where their catch per unit effort would be greater. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern

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

areas of the Southern California Bight. Therefore, there may be a slight benefit to the sea urchin fishery, compared to the baseline, as a result of some delay in sea otter predation.

The maximum non-discounted benefit to sea urchin fishing vessels for Alternative 3B would total about would total $1.3 million. The discounted 10-year benefit for this alternative would be about $1.1 million (discounted at 3 percent) or $837,000 (discounted at 7 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-6.

On average in the southern California sea urchin fishery, 223 vessels participate annually landing 60,200 pounds each (Thomson 2001). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels, then each vessel would have increased landings of approximately 5,500 pounds and increased revenue between $3,800 (discounted at 7 percent) and $4,800 (discounted at 3 percent) totaled over 10 years.

As described in Chapter 5, we define levels of significance in this supplement by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 3B is expected to result in an increase in sea urchin ex-vessel revenues within the Southern California Bight of 1 percent compared to the landings baseline (a total landings benefit of 1.2 million pounds 10 years compared to the projected total for southern California of 112.7 million pounds), the benefit is of low significance (see Table 5-1 for definitions of levels of significance).

6.6.4.2 Spiny Lobster Fishery

Under Alternative 3B, commercial lobster landings within 10 years would (1) be eliminated along the coastline from Point Conception to Santa Barbara and (2) increase at San Nicolas Island. The lobster fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Santa Barbara (CDFG statistical blocks 654, 655, 656, and 657). Therefore, there is no additional impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island would result in an increase in the lobster catch, compared to the baseline, for two reasons. First, lobster landings would not decrease the projected 10 percent as in the baseline because there would be no sea otter population at the island. Therefore, landings would not decrease the anticipated 21,000 pounds from 2005 to 2014. Second, newly recruited lobsters and those lobsters that escaped sea otter predation in the past would now potentially be available for commercial harvest. This potential increase follows the assumption that fishery impacts correspond directly to the sea otter's carrying capacity percentage. As of 2004, sea otters were at about 6 percent of their estimated carrying capacity at the island. Thus, lobster landings would increase by approximately 6 percent from the 10-year average of 37,722 pounds. We assume that the lobster population would rebound from sea otter predation in seven years.[23] We

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

further assume that the associated increase in landings would be equally distributed across seven years, so that landings would rise by 1 percent (about 345 pounds) annually between 2005 and 2011, stabilizing to an annual benefit of approximately 2,400 pounds after 2011 (Table 6-38).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial lobster landings would approach zero because lobster fishers would fish other areas where their catch per unit effort would be greater. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight. Therefore, there may be a slight benefit to the commercial lobster fishery, compared to the baseline, as a result of some delay in sea otter predation. The maximum non-discounted benefit to lobster vessels for Alternative 3B would total about $300,000. The discounted 10-year benefit for this Alternative would range between about $191,000 (discounted at 7 percent) and $246,000 (discounted at 3 percent). For the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-6.

On average in the southern California lobster fishery, 202 vessels participate annually, landing 3,700 pounds each (Thomson 2001). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels, then each vessel would have increased landings of approximately 190 pounds and increased revenue of between

TABLE 6-38. LOBSTER LANDINGS: BENEFITS OF ALTERNATIVE 3B

Year	Commercial Landings (no 10% decrease at SNI)	Commercial Landings (increase of 6% at SNI)	Total Increase in Commercial Landings (Pounds)	Total Ex-Vessel Revenue*	Total Ex-Vessel Discounted Revenue (3%)*	Total Ex-Vessel Discounted Revenue (7%)*
2005	377	345	722	$5,760	$5,592	$5,383
2006	754	690	1,444	$11,523	$10,861	$10,064
2007	1,131	1,035	2,166	$17,285	$15,818	$14,110
2008	1,509	1,380	2,888	$23,047	$20,477	$17,583
2009	1,886	1,724	3,610	$28,810	$24,852	$20,541
2010	2,263	2,069	4,332	$34,572	$28,954	$23,037
2011	2,640	2,414	5,054	$40,335	$32,796	$25,118
2012	3,017	2,414	5,432	$43,345	$34,217	$25,227
2013	3,395	2,414	5,809	$46,355	$35,527	$25,214
2014	3,772	2,414	6,186	$49,365	$36,732	$25,095
Total Benefits	20,744	16,899	37,644	$300,398	$245,827 (PV @ 3%)	$191,373 (PV @ 7%)

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price fishers received for lobsters from 1994 to 2003, which is $7.98 per pound in 2004 dollars.
SNI=San Nicolas Island
PV= present value

$900 (discounted at 7 percent) and $1,200 (discounted at 3 percent) totaled over 10 years.

As described in Chapter 5, we define levels of significance in this supplement by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 3B is expected to result in an increase in lobster ex-vessel revenues within the Southern California Bight of 0.6 percent compared to the landings baseline (a total benefit of 38,000 pounds over 10 years compared to the projected total for southern California of 6.1 million pounds), the benefit is very low and therefore not significant (see Table 5-1 for definitions of levels of significance).

6.6.4.3 Crab Fishery

Under Alternative 3B, commercial crab landings within 10 years would (1) be eliminated along the coastline from Point Conception to Santa Barbara and (2) increase at San Nicolas Island. The crab fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Santa Barbara (CDFG statistical blocks 654, 655, 656, and 657). Therefore, there is no impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island would result in a crab harvest increase, compared to the baseline, for two reasons. First, crab landings would not decrease the projected 10 percent as in the baseline because there would be no sea otter population at the island. Therefore, landings would not decrease the anticipated 3,500 pounds from 2005 to 2014. Second, newly recruited crabs and those crabs that escaped sea otter predation in the past would now potentially be available for commercial harvest. This potential increase follows the assumption that fishery impacts correspond directly to the sea otter's carrying capacity percentage. As of 2004, sea otters were at about 6 percent of their estimated carrying capacity at the island. Thus, crab landings would increase by approximately 6 percent from the 10-year average of 6,350 pounds. We assume that the crab population would rebound from sea otter predation in four years.[24] We further assume that the associated increase in landings would be equally distributed across four years, so that landings would rise by approximately 2 percent (about 100 pounds) annually between 2005 and 2008, stabilizing to an annual benefit of approximately 400 pounds after 2008 (Table 6-39).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial crab landings would approach zero because crab fishers would fish other areas where their catch per unit effort would be greater. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight. Therefore, there may be a slight benefit to the commercial crab fishery, compared to the baseline, as a result of some delay in sea otter predation. The maximum non-discounted benefit to crab vessels for Alternative 3B would total about $9,000. The discounted 10-year benefit for this Alternative would be between $6,000 (discounted at 7 percent) and $7,600 (discounted at 3 percent). For

[24] Crabs can reach a commercially harvestable size (4.25 inch carapace width) in 4 to 5 years (Parker, 2001). We assume that crab landings would rebound prior to six years because otters are unable to consume crabs inhabiting deep crevices. Thus, crabs may be harvested in less than 4 years.

TABLE 6-39. CRAB LANDINGS: BENEFITS OF ALTERNATIVE 3B

Year	Commercial Landings (no 10% decrease at SNI)	Commercial Landings (increase of 6% at SNI)	Total Increase in Commercial Landings Pounds)	Total Ex-Vessel Revenue*	Total Ex-Vessel Discounted Revenue (3%)*	Total Ex-Vessel Discounted Revenue (7%)*
2005	63	102	165	$220	$213	$205
2006	127	203	330	$439	$414	$384
2007	190	305	495	$659	$603	$538
2008	254	406	660	$878	$780	$670
2009	317	406	724	$963	$830	$686
2010	381	406	787	$1,047	$877	$698
2011	444	406	851	$1,132	$920	$705
2012	508	406	914	$1,216	$960	$708
2013	571	406	978	$1,301	$997	$707
2014	635	406	1,041	$1,385	$1,031	$704
Total Benefits	3,492	3,454	6,947	$9,239	$7,625 (PV @ 3%)	$6,005 (PV @ 7%)

Note: Benefits are rounded to the nearest dollar.
*Ex-vessel revenue is based upon the average price fishers received for crab from 1994 to 2003, which is $1.33 per pound in 2004 dollars.
SNI=San Nicolas Island
PV=present value

the regional economic context, which can help to put this number in perspective, see Tables 4-3 and 4-6.

On average in the southern California crab fishery, 76 vessels participate annually, landing 15,100 pounds each (Thomson 2001). We recognize that effects would not be distributed equally among vessels, and that those fishing in areas occupied by sea otters would be disproportionately affected. However, if the increased landings and ex-vessel revenue were distributed equally among these vessels, then each vessel would have increased landings of approximately 90 pounds and increased revenue between $80 to $100 totaled over 10 years (discounted at 7 percent and 3 percent, respectively).
As described in Chapter 5, we define levels of significance in this supplement by viewing projected effects on an entity or activity within the regional context of that entity or activity. Because Alternative 3B is expected to result in an increase in crab ex-vessel revenues within the Southern California Bight of 0.1 percent compared to the baseline (a total benefit of 6,900 pounds over 10 years compared to the projected total for southern California of 7.7 million pounds), the benefit is very low and therefore not significant (see Table 5-1 for definitions of levels of significance).

6.6.5 AQUACULTURE

Effects on aquaculture resulting from Alternative 3B are essentially the same as for the baseline. Although Alternative 3B would require the removal of sea otters from San Nicolas Island, the removal of these animals is not likely to affect aquaculture operations noticeably compared to the baseline. The removal of sea otters from San Nicolas Island would not affect aquaculture because there are currently no aquaculture operations at San Nicolas Island.

Therefore, just as under the baseline, the effects of Alternative 3B within the next 10 years would likely be a local, episodic

reduction of mussel densities on offshore oil platforms in the Santa Barbara Channel. Beyond 10 years, aquaculture operations located in other portions of the Southern California Bight may be affected by sea otters, but these effects are expected to be relatively minor. In April 2002, there were only 2 registered aquaculture leases in Ventura County (producing a variety of shellfish and finfish) and only 2 in San Diego County (producing exclusively abalone). Because sea otter range expansion is expected to occur gradually over the course of many decades, and because sea otters affect only some aquaculture operations (and these only at the local scale), effects on aquaculture operations overall would likely be minor.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. In the case of aquaculture, there is no effect, regardless. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

Significance criteria are not defined for aquaculture because of the extent of uncertainty involved.

6.6.6 Seafood Processing Industry (Sea Urchins)

Under Alternative 3B, impacts to the sea urchin processing industry would be a function of the change in sea urchin landings. Alternative 3B would have no additional impact on sea urchin landings along the coastline from Point Conception to Santa Barbara. However, the removal of sea otters from San Nicolas Island would increase southern California landings by one percent over 10 years. Thus, impacts to the sea urchin processing industry are likely to be minor, representing a slight benefit to the sea urchin processing industry compared to the baseline.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, sea urchin harvesting would no longer be viable in these areas, and the sea urchin processing industry would be required to obtain sea urchins harvested from other areas of the Southern California Bight. The sea urchin processing industry would eventually be eliminated in southern California if sea otters reached carrying capacity where sea urchin harvesting occurs in the Southern California Bight and processors were unable to obtain sea urchins from elsewhere. This projection is equivalent to the baseline.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow

range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

Within 10 years, Alternative 3B is expected to have a beneficial effect of low significance on the seafood processing industry (resulting from an increase of 1 percent in regional sea urchin inputs).

6.6.7 Kelp Harvest

The effects of Alternative 3B on the amount of kelp available for harvest are the same as those for Alternative 3A and differ from the baseline only with respect to the removal of sea otters from San Nicolas Island (for a description of the relationship between sea otters and kelp abundance, see section 6.2.2).

The removal of animals from San Nicolas Island would eliminate the colony, probably resulting in minor increases in invertebrate prey populations within a few years. Removing sea otters from San Nicolas Island could impact the kelp harvest at the beds that are currently leased around the island's nearshore areas. Any enhancement of kelp that would have been afforded by a colony persisting at San Nicolas Island (as projected under the baseline) would not occur, representing a possible slight cost to the kelp industry. Elimination of the sea otter colony at San Nicolas Island would likely slow sea otter recolonization of the Southern California Bight and thus would also delay possible associated increases in kelp abundance throughout the area. A slight loss to the kelp harvesting industry, compared to the baseline, could additionally result from this delay.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

Significance criteria are not defined for kelp harvesting because of the extent of uncertainty involved.

6.6.8 Recreational Fishing and Diving

Recreational fishing and diving activities that may be affected by sea otters include lobster diving, abalone diving, and finfish fishing. Lobster diving and finfish fishing are addressed below. Abalone diving is

included under "Abalone Fishery Restoration" (section 6.6.9).

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

6.6.8.1 Lobster Diving

Within the next 10 years under Alternative 3B, the recreational lobster fishery would be (1) eliminated along the coastline from Point Conception to Santa Barbara and (2) improved at San Nicolas Island. The recreational lobster fishery under the baseline is projected to be eliminated along the coastline from Point Conception to Santa Barbara (CDFG statistical blocks 654, 655, 656, and 657). Therefore, there is no impact along the coastline compared to the baseline.

Removing sea otters from San Nicolas Island may result in an increase in recreational sport diving trips, compared to the baseline, for two reasons. First, dive trips would not decrease the projected 10 percent as in the baseline because there would be no sea otter population at the island. Therefore, recreational diving would not decrease the anticipated 285 trips from 2005 to 2014. Second, recreational diving may increase because newly recruited lobsters or those lobsters that escaped predation in the past would now potentially be available for recreational harvest. This potential increase follows the assumption that recreational fishery impacts correspond directly to the sea otter's carrying capacity percentage. As of 2004, sea otters were at about 6 percent of their estimated carrying capacity at the island. Thus, recreational dive trips would increase by approximately 6 percent from the 10-year average of 521 trips. We assume that the lobster population would rebound from sea otter predation in seven years[25] for recreational harvest. We further assume that the associated increase in trips would be equally distributed across seven years, so that trips would rise by 1 percent (about 5 trips) annually between 2005 and 2011, stabilizing to an annual benefit of approximately 33 trips after 2011 (Table 6-40).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, recreational lobster dive trips in these areas would likely approach zero. The removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight.

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

TABLE 6-40. RECREATIONAL DIVE TRIPS: BENEFITS OF ALTERNATIVE 3B

Year	Dive Trip Increase (no 10% decrease)	Dive Trip Increase (increase of 6%)
2005	5	5
2006	10	10
2007	15	14
2008	21	19
2009	26	24
2010	31	29
2011	36	33
2012	41	33
2013	47	33
2014	52	33
Total Benefits	518 trips	

Note: Benefits are rounded to the nearest trip.

Therefore, there may be a slight benefit to the recreational lobster fishery, compared to the baseline, as a result of some delay in sea otter predation.

The benefit to the recreational lobster fishery under Alternative 3B would total 518 trips over 10 years. On average in the southern California recreational fishery, there are 22 commercial passenger fishing vessels (CDFG 1995-2001). If the increased trips were distributed equally among these vessels, then each commercial passenger fishing vessel would supply 24 additional trips annually over 10 years, if there is demand for these additional trips. This change would represent a slight benefit to recreational lobster divers by increasing the potential for catching a lobster or increasing the number of dive trips taken compared to the baseline.

Alternative 3B would provide the recreational lobster fishery with an average annual benefit (for the 10-year time frame) of about 52 trips. This benefit is less than one percent of the annual average of 8,983 trips for the Southern California Bight (see section 6.2.8.1). Therefore, the beneficial effect resulting from Alternative 3B is very low and not significant.

6.6.8.2 Finfish Fishing

The effects of Alternative 3B are the same as for the baseline except with respect to San Nicolas Island. As described for the baseline, the presence of sea otters may improve habitat for recreationally important finfish and thus have a positive effect on the abundance of finfish available for harvest. Such changes would likely require more than 10 years to become noticeable (because the reestablishment of giant kelp canopies in areas where sea urchin grazing is limiting kelp is expected to take at least 10 years) and could occur gradually over several decades. A discussion of the long-term effects of sea otter predation on the kelp forest community, including finfish production, is given in section 6.2.2.

The removal of sea otters from San Nicolas Island is generally expected to affect recreational finfish fishing negatively relative to the baseline by eliminating the stabilizing and enhancing effects that a persistent sea otter colony may have on the kelp beds surrounding the island.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized areas of the Southern California Bight at the densities seen in the mainland range for comparable habitat, recreational finfish fishing may benefit. This long-term projection differs from the baseline only to the extent that the removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight.

Significance criteria are not defined for recreational finfish fishing because of the extent of uncertainty involved.

6.6.9 Abalone Fishery Restoration

The effects of Alternative 3B are the same as for the baseline except with respect to San Nicolas Island. As described for the baseline, within 10 years sea otter range expansion along the coastline towards Santa Barbara would preclude the reestablishment of abalone fishing in that area. Because it does not appear that there is any potential for reopening the abalone fishery (for any species) during the next 10 years, regardless of the presence or absence of sea otters (see section 6.2.9), effects projected for the baseline, as for Alternative 3B, along the coastline during this time period are essentially speculative.

San Nicolas Island is identified in the draft Abalone Recovery and Management Plan (CDFG 2002c) as 1 of 10 key recovery areas for black abalone. Compared to the baseline, removing sea otters from San Nicolas Island would increase the probability that black abalone would reach Criterion 1 (and possibly even Criteria 2 and 3, at which point the population could be considered for a reopening of the abalone fishery). However, even if sea otters were successfully removed, it is possible that they would recolonize San Nicolas Island through natural range expansion before abalone populations have reached the fishery consideration phase (Criterion 3), which is expected to require several decades. In this case, a reopening of the abalone fishery would be precluded in this area.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized areas of the Southern California Bight at the densities seen in the mainland range for comparable habitat, the restoration of an abalone fishery in these areas would not be viable. This long-term projection differs from the baseline only to the extent that the removal of sea otters from San Nicolas Island may slow the movement of sea otters into the southern areas of the Southern California Bight.

Although we assume here that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

Significance criteria are not defined for abalone fishery restoration because of the extent of uncertainty involved.

6.6.10 Ecotourism

The effects of Alternative 3B are the same as for Alternative 3A. They are also the same as for the baseline, except with respect to San Nicolas Island. As described for the baseline, tourism based on sea otter watching would be enhanced within 10

years as sea otters progressively reoccupy and begin to reside year-round along the stretch of mainland coastline between Point Conception and Santa Barbara. Overall economic value of this tourism is difficult to quantify and would not necessarily result in increased economic activity. Rather, it would likely manifest itself as an added value to other tourist draws in the area.

The removal of sea otters from San Nicolas Island is generally expected to affect ecotourism negatively relative to the baseline by reducing or eliminating the possibility of a sea otter sighting at the island. Under the baseline, we do not expect ecotourism in this area to grow considerably (in terms of number of trips) over the next 10 years as a result of the increased abundance of sea otters, but we do expect that the quality of recreational trips to San Nicolas Island would be enhanced due to the better possibility of a sea otter sighting.

The removal of sea otters from San Nicolas Island could have unpredictable effects on the rapidity with which other areas of the Southern California Bight are recolonized, but it would likely slow recolonization because dispersing sea otters would come from only one direction (the mainland range). Generally, however, the long-term effects of Alternative 3B on ecotourism are expected to be the same as for the baseline.

Significance criteria are not defined for ecotourism because of the extent of uncertainty involved.

6.6.11 Federal and State Agency Programs

Significance criteria are not defined for effects on agency programs because these effects and programs are various and cannot be meaningfully compared with a single set of criteria. For a discussion of the regulatory environment, see section 6.6.12.

In the following discussions, we assume that the removal of sea otters from San Nicolas Island would result in their absence from the island for a period of one or more decades, and that their absence from the island would likely slow range expansion into other areas (particularly the southern portions) of the Southern California Bight. Nevertheless, their removal could have unpredictable effects. First, some sea otters may return to San Nicolas Island immediately, in which case the short-term effects projected as resulting from the removal of sea otters would be diminished by some unknown amount. Second, it is plausible that sea otters attempting to return to San Nicolas Island after removal could establish the seed of a colony at San Miguel Island or another island, thereby possibly shortening the time expected for sea otters to establish range in other parts of the Southern California Bight. In this case, effects described as resulting from a slowing of range expansion would be diminished by some unknown amount.

6.6.11.1 U.S. Fish and Wildlife Service

The effects of Alternative 3B on southern sea otter recovery are also addressed in section 6.6.3.3 (“Southern Sea Otter”). Here we address our ability to meet our mandates under the Endangered Species Act and Marine Mammal Protection Act and give the implementation costs of the alternative.

Ability to Meet Mandate

Our ability to achieve recovery and OSP under Alternative 3B is the same as that described for 3A because the removal of sea otters from the management zone (required under Alternative 3A) is not likely to have any discernible effects at the population level (see section 6.6.11.1).

Alternative 3B, like Alternative 3A, differs notably from the baseline with respect to the

regulatory provisions that would apply to sea otters in the Southern California Bight because the management and translocation zones would no longer exist. For a discussion of these provisions, see section 6.6.12.

IMPLEMENTATION COSTS (10-YEAR PERIOD)

The change in the regulatory provisions that apply to sea otters in the Southern California Bight under Alternative 3B may result, in the long term, in increased coordination and consultation between the Service and other parties regarding activities that may affect the southern sea otter. Costs resulting from an increased consultation workload are not included here because few or no activities requiring consultation presently occur or are expected to occur in the area that sea otters would likely reoccupy within the next 10 years. New implementation costs would be incurred under Alternative 3B. These costs derive from the removal sea otters from San Nicolas Island and include expenditures for personnel, transportation, and equipment (Table 6-41).

TABLE 6-41. PERSONNEL AND EQUIPMENT NEEDED TO IMPLEMENT ALTERNATIVE 3B

Personnel	Transportation	Equipment
Program Manager	2 Vans	Boat Maintenance
Capture Teams	1 Tow Vehicle	Dive Gear and Maintenance
Transport Team	2 Monitor Vehicles	Tracking Equipment
Monitoring Team	Air Charters	Training
Veterinary Services	Boat Charters	
	Travel Costs	

Estimated expenditures are given in Table 6-42. Activities related to the removal of sea otters from the translocation zone would be necessary for the first year. After all reasonable efforts were expended to remove sea otters from the zone, no further maintenance would continue. In the second year, only monitoring efforts would be implemented. Therefore, implementation costs would cease after the second year.

The estimated expenditures given in Table 6-42 represent the entire program costs for 10 years. Based upon past and projected efforts, the non-discounted annual implementation costs would sum to about $848,000 over two years.

TABLE 6-42. IMPLEMENTATION COSTS FOR REMOVAL OF SEA OTTERS FROM SAN NICOLAS ISLAND

Year	Annual Cost			Discounted Cost (3% discount rate)	Discounted Cost (7% discount rate)
	Personnel	Transportation	Equipment		
2005	$535,000	$116,000	$85,000	$714,563	$687,850
2006	$90,000	$21,000	$1,000	$105,571	$97,825
2007	-	-	-	-	-
2008	-	-	-	-	-
2009	-	-	-	-	-
2010	-	-	-	-	-
2011	-	-	-	-	-
2012	-	-	-	-	-
2013	-	-	-	-	-
2014	-	-	-	-	-
Total	*$848,000*			*$820,134 (PV @ 3%)*	*$785,676 (PV @ 7%)*

6.6.11.2 Channel Islands National Park

The effects of Alternative 3B are the same as those for 3A. Alternative 3B would allow sea otters to recolonize the Southern California Bight. While no effects of sea otters would be expected within 10 years, sea otters would likely eventually re-establish their range within Park boundaries. Alternative 3B is consistent with the mission and mission-related goals of the Channel Islands National Park to protect and restore natural ecosystems and to practice ecosystem management.

Under Alternative 3B, the regulatory environment would change (see section 6.6.12). The change in the regulatory provisions that apply to sea otters in the Southern California Bight under Alternative 3B could result, in the long term, in increased coordination and consultation between the Service and Channel Islands National Park regarding activities that may affect the southern sea otter if sea otters recolonize historic range within Park boundaries.

6.6.11.3 Channel Islands National Marine Sanctuary

The effects of Alternative 3B are the same as those for 3A. Alternative 3B would allow sea otters to recolonize the Southern California Bight. While no effects of sea otters would be expected within 10 years, sea otters would likely eventually re-establish their range within Sanctuary boundaries. Alternative 3B is consistent with the mission of the Channel Islands National Marine Sanctuary to conserve and enhance the biodiversity, ecological integrity, and cultural legacy of areas of special national significance.

Under Alternative 3B, the regulatory environment would change (see section 6.6.12). The change in the regulatory provisions that apply to sea otters in the Southern California Bight under Alternative 3B could result, in the long term, in increased coordination and consultation between the Service and Channel Islands National Marine Sanctuary regarding activities that may affect the southern sea otter if sea otters recolonize historic range within Sanctuary boundaries.

6.6.11.4 California Department of Fish and Game

Note: Effects on the recovery of white and black abalone and sea otters are discussed under “Candidate, Threatened, and Endangered Species” (section 6.6.3). Effects on existing commercial fisheries and the restoration of the abalone fishery are discussed under “Commercial Fisheries” (section 6.6.4) and “Abalone Fishery Restoration” (section 6.6.9). Effects on Marine Protected Areas (MPAs) are discussed here.

The effects of Alternative 3B are the same as those for 3A. Alternative 3B would allow sea otters to recolonize the Southern California Bight. While no effects of sea otters would be expected within 10 years, sea otters would likely eventually re-establish their range within MPA boundaries. In such as case, Alternative 3B would have a positive effect on Marine Protected Areas overall. For a full discussion of the expected effects of sea otters on Marine Protected Areas, see section 6.2.11.4.

6.6.11.5 U.S. Navy

Under Alternative 3B, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.6.12). This change could result in increased coordination and consultation between the Service and the

U.S. Navy regarding activities that may affect the southern sea otter. Under Alternative 3B, sea otters would be removed from San Nicolas Island, but it is possible that some animals would return after removal efforts had ceased. To date, we have no evidence that defense-related activities have had any adverse effects on sea otters at San Nicolas Island or in the management zone. As mitigation for the effects of an increased regulatory burden on the U.S. Navy, we would propose to coordinate with the U.S. Navy to develop a programmatic consultation for activities that may affect southern sea otters. Because the U.S. Navy is already required to obtain an Incidental Harassment Authorization under the Marine Mammal Protection Act for the incidental non-lethal "take by harassment" of other marine mammals during missile and target launch operations at San Nicolas Island, the addition of a programmatic consultation for sea otters would likely introduce only a minor additional regulatory burden.

6.6.11.6 U.S. Minerals Management Service

The effects of 3B are regulatory and are the same as those under 3A. Under Alternative 3B, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.6.12). This change could result in increased coordination and consultation between the Service and the Minerals Management Service regarding activities that may affect the southern sea otter. However, the added consultation and permitting requirements for actions that may affect sea otters in the Southern California Bight would likely impose only a minor additional regulatory burden on the Minerals Management Service for the following reasons: 1) the physical presence of the oil industry is expected to diminish offshore of California over the next several decades (MMS pers. comm. 2005); 2) all proposed actions that may affect *other* threatened or endangered species or marine mammals are already subject to consultation and permitting requirements under the Endangered Species Act and Marine Mammal Protection Act; 3) the regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of this alternative, and requirements for consultations or permits related to the southern sea otter have been minimal; 4) southern sea otters would not be present in most of southern California for decades (if range expansion continues to occur).

6.6.12 Regulatory Environment

The regulatory environment under Alternative 3B would be identical to the regulatory environment under Alternatives 3A and 3C, although the actual effects of regulatory changes relative to the baseline depend on the presence or absence of sea otters in the Southern California Bight (see section 6.6.11 for a discussion of possible scenarios).

Under Alternative 3B, as under Alternatives 3A and 3C, the translocation program would be declared a failure and terminated, the management and translocation zones would be abolished, and the provisions of Public Law 99-625 would become inoperative. California Fish and Game Code section 8664.2 would also become inoperative. As a result, all activities that may affect southern sea otters within the Southern California Bight would be fully subject to the Endangered Species Act, the Marine Mammal Protection Act, and California state law, including applicable consultation requirements and take prohibitions under these laws.

All federal agencies planning activities that may affect southern sea otters in the Southern California Bight would be required to consult with the Fish and Wildlife Service under section 7 of the Endangered Species Act and seek authorization for incidental take of sea otters under the Endangered Species Act and provisions of the Marine Mammal Protection Act. If otherwise allowable under applicable state law, including California Fish and Game Code section 4700, non-federal activities that would result in take of southern sea otters in California would require incidental take authorization from the Fish and Wildlife Service under section 10(a)1(B) of the Endangered Species Act and section 101(a)(5) of the Marine Mammal Protection Act. Incidental take of southern sea otters in commercial fisheries cannot be authorized under the Marine Mammal Protection Act. Therefore, incidental take of southern sea otters in commercial fisheries throughout the Southern California Bight would be prohibited, as it is currently prohibited throughout the remainder of the range of the species (north of Point Conception). Intentional take would continue to be prohibited unless authorized, as under the current regulations.

This change in the regulatory environment would not be likely to result in substantial effects on activities now being conducted within the Southern California Bight for several reasons:

1) The current regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of Alternatives 3A, 3B, or 3C in the Southern California Bight. Commercial fishing activities, harbor maintenance, oil and gas exploration, and other human activities are similar in the two sections of coastline. Along the central coast, requirements for consultations and take authorizations under the Endangered Species Act and Marine Mammal Protection Act related to the southern sea otter have been minimal, and we would expect the same to be the case for the Southern California Bight. This is because there are few otherwise legal activities that result in take of southern sea otters and because the southern sea otter's historic habitat, although somewhat degraded, is essentially intact.

2) Southern sea otters would not be present in most of southern California for many decades. In fact, we cannot reliably assert that range expansion will occur at all. Critical habitat has not been designated for the southern sea otter and is not proposed or required (the southern sea otter was listed under the Endangered Species Act prior to passage of the requirement to designate critical habitat). With no sea otters present in most of the Southern California Bight and no designated critical habitat, the likelihood that adverse interactions between sea otters and human activities would occur would be less than the likelihood that currently exists along the central coast, where substantial numbers of sea otters are found, and where the regulatory environment is the same as that proposed under Alternatives 3A, 3B, and 3C.

3) If the translocation program were declared a failure and terminated, California Fish and Game Code

section 4700 would prohibit all take, as defined and applied under state law, of southern sea otters, and the Marine Mammal Protection Act would prohibit incidental take of southern sea otters by commercial fisheries. Nevertheless, commercial fisheries in the Southern California Bight are unlikely to be adversely affected by the change in regulatory environment because few fisheries will likely interact with sea otters. Gill-net fisheries, historically a concern for incidental take of sea otters, are currently prohibited in the nearshore waters of southern California and the offshore Channel Islands where sea otters would be found (Marine Resources Protection Act, California Constitution Article 10B). Dive fisheries (sea urchin, abalone) are extremely unlikely to result in take of sea otters by virtue of the methods they employ to harvest shellfish. Trap fisheries (lobster, crab, live-fish) could potentially result in the entrapment and drowning of sea otters and thus could be affected by a change in the regulatory environment. However, there are few data to assess the possibility of incidental take of southern sea otters in these fisheries, and therefore we cannot reliably anticipate the impact of this regulatory change on this segment of the commercial fishing community.

4) Because of potential effects on the receiving population of sea otters in the mainland range caused by the relocation of sea otters removed from the translocation zone, we would be required to consult under section 7 of the Endangered Species Act before implementation of this alternative.

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

6.7.1 Introduction

Alternative 3 entails declaring the southern sea otter translocation program a failure and terminating the program, thereby eliminating the management zone and translocation zone established through Public Law 99-625 and 50 CFR §17(d). Sub-alternative 3C allows sea otters to remain at San Nicolas Island and in the management zone. No effort would be made to enforce a management zone, which would allow southern sea otters to recolonize historic range throughout the Southern California Bight.

This action would not increase or decrease the projected sea otter range compared to the baseline. Rather, this action is identical to the baseline in all respects except with respect to regulatory changes. Even where effects do not differ from the baseline, we summarize those effects below. For a fuller discussion, however, please refer to section 6.2, "Baseline (Status Quo)—The No Action Alternative."

6.7.2 Nearshore Marine Ecosystem

The effects of Alternative 3C on the nearshore marine ecosystem are the same as those described for the baseline. If sea otters reoccupied areas of the Southern California Bight as predicted, community level changes in the nearshore marine ecosystem would take place gradually. Over the next 10 years, an expanding mainland sea otter population would affect invertebrate populations from Point Conception to Santa Barbara, considerably reducing their densities and restricting individuals to cryptic habitat. Changes in giant kelp abundance in this area of the coast would likely take a decade or more to become noticeable and would occur only in areas where invertebrate herbivory is limiting kelp recruitment and survival. Species dependent on kelp canopy would likely benefit from any increases in kelp abundance.

Based on predictions of San Nicolas Island sea otter colony growth and assumptions relating the number of sea otters to effects on invertebrate populations, sea otter predation at San Nicolas Island is expected to increase by 10 percent over the next 10 years. This level of predation may not result in measurable changes in the nearshore marine ecosystem over this period. Significance criteria are not defined for effects on the nearshore marine ecosystem because of the extent of uncertainty involved.

Whether sea otters would reoccupy other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. Those areas reoccupied by sea otters would eventually exhibit the kinds of changes described in section 6.2.2.

Significance criteria are not defined for effects on the nearshore marine ecosystem because of the extent of uncertainty involved.

6.7.3 Effects on Candidate, Threatened, and Endangered Species

6.7.3.1 White Abalone

Effects on white abalone resulting from the implementation of Alternative 3C are the same as for the baseline (see section 6.2.3.1, "Establishing the Baseline for White

Abalone"). Just as under baseline conditions, natural sea otter range expansion may progress into the Southern California Bight, resulting in possible sea otter predation on white abalone along the coastline to Santa Barbara within the next 10 years. Beyond 10 years, it is possible that sea otters would continue to expand their range, but it would likely be many decades before sea otters reoccupied range in the southern portions of the Southern California Bight where key recovery areas for white abalone have been identified (CDFG 2002c). The overall effects of sea otter predation would likely be minor, most notably because white abalone and sea otter foraging depth ranges overlap only marginally, and because the highest abundances of white abalone occur at offshore banks (Tanner and Cortez), which are not known to be utilized by sea otters and thus likely provide a full refuge from sea otter predation.

Although it is unlikely that implementation of Alternative 3C would have adverse effects on white abalone at the population level, it is possible that sea otters, unrestricted by a management zone, may find and consume individual white abalone. Therefore, we would request formal consultation with the National Marine Fisheries Service under section 7 of the Endangered Species Act and confer with the California Department of Fish and Game if this alternative is selected. Because the effects of Alternative 3C are the same as for the baseline, the impact of this alternative on the recovery of white abalone is not significant.

6.7.3.2 Black Abalone

Effects on black abalone resulting from the implementation of Alternative 3C are the same as for the baseline (see section 6.2.3.2, "Establishing the Baseline for Black Abalone). Under the baseline, sea otters are expected to expand their range gradually along the coastline between Point Conception and Santa Barbara and to increase in number at San Nicolas Island. The coastline between Point Conception and Santa Barbara, which sea otters are expected to affect through predation within the next 10 years, has not been identified as an important area for black abalone recovery because intertidal habitat along much of this section of coastline does not support black abalone. However, San Nicolas Island has been identified by the California Department of Fish and Game as 1 of 10 key locations for the recovery of black abalone (CDFG 2002c).

The effect that a persistent colony of sea otters would have on black abalone at the island is uncertain, but the fact sea otters and black abalone historically co-occurred at the island suggests that black abalone populations would have sufficient refuge from sea otter predation to maintain viable populations there.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. The effect that sea otters may have on severely depleted black abalone stocks throughout the area is uncertain, but if sea otters do recolonize the Southern California Bight, the process would likely occur gradually over the course of several decades, allowing time for black abalone populations to recover from the effects of human harvest and disease in the absence of predation pressure from sea otters. Ultimately, in areas of the Southern California Bight with sufficient cryptic and inaccessible habitat, black abalone populations would likely persist and have the opportunity to recover in the presence of sea otters. However, in areas with

insufficient cryptic and inaccessible habitat, into which black abalone populations may have expanded in the absence of sea otters, abalone would be more vulnerable to predation resulting from sea otter range expansion.

If sea otters are unrestricted by a management zone, predation of black abalone in the Southern California Bight is likely to occur. We would therefore confer with the National Marine Fisheries Service and the California Department of Fish and Game if Alternative 3C is selected. Because the effects of Alternative 3C are the same as for the baseline, the impact of this alternative on the recovery of black abalone is not significant.

6.7.3.3 Southern Sea Otter

Effects on southern sea otters resulting from the implementation of Alternative 3C are the same as for the baseline, except for potential positive effects resulting from regulatory changes if incidental take is affecting sea otters (see section 6.7.12). Under Alternative 3C, as under baseline conditions, sea otters may expand their range naturally into the Southern California Bight. This scenario maximizes the opportunity for southern sea otter recovery by allowing sea otters to recolonize historic habitat. Although the marine habitat in the Southern California Bight has been degraded by a multitude of human activities, the southern sea otter range has expanded into this area. Allowing natural range expansion also avoids the potential threat to the species caused by capturing and releasing sea otters in other parts of the mainland range and avoids the potential for injuring or killing individual sea otters removed from the management zone.

Alternative 3C reflects all recommendations made in the revised recovery plan for the southern sea otter with respect to the translocation program (USFWS 2003). The revised recovery plan continues to focus on efforts to increase the size of the southern sea otter's population; however, it no longer recommends translocating sea otters as a means to achieve this goal. Rather, the plan advises against additional translocations (USFWS 2003). Additionally, the recovery team recommends declaring the translocation program a failure, allowing natural range expansion to occur, and allowing the colony at San Nicolas Island to remain at the island rather than capturing these sea otters and releasing them in the mainland range (USFWS 2003).

In all respects except the regulatory changes that pertain to the southern sea otter under this alternative, the effects of Alternative 3C are the same as for the baseline. The potential benefit of the reversion to "threatened" status for southern sea otters is difficult to estimate because its value can be realized only in reference to future actions that may affect members of the species found in the Southern California Bight. If, in the future, the incidental take of sea otters were shown to be hindering the recovery of the species, then the value of the regulatory change could be high. Based on current levels of activity in the Southern California Bight, we would expect that the regulatory change would result in a beneficial effect of low significance.

6.7.4 Commercial Fisheries

For a discussion of the regulatory environment (including as it pertains to commercial fisheries) see section 6.7.12.

6.7.4.1 Sea Urchin Fishery

Effects on the commercial sea urchin fishery resulting from the implementation of Alternative 3C are the same as for the baseline. Along the affected coastline (Point Conception to Santa Barbara), the 10-year

landings average is 194,463 pounds. We assume that once an area is permanently occupied by sea otters, the commercial sea urchin fishery would no longer be viable in that area. Thus, we assume that sea urchin landings along the affected coastline would decrease 10 percent (19,446 pounds) each year, from 194,463 pounds to 175,016 pounds in 2005 to 155,170 pounds in 2006, and so forth to zero landings in 2014. Around San Nicolas Island, the 10-year landings average is 1,152,340 pounds. We assume that the commercial sea urchin fishery in this area would decrease by approximately 10 percent over 10 years. Thus, we assume that sea urchin landings from San Nicolas Island would decrease by 1 percent (11,523 pounds) each year, from 1,152,340 pounds to 1,140,816 pounds in 2005 to 1,129,293 pounds in 2006, and so forth to 1,037,106 pounds in 2014.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial sea urchin landings would approach zero because sea urchin fishers would fish other areas where their catch per unit effort would be greater. Because the effects of Alternative 3C are the same as for the baseline, the impact of this alternative on the commercial sea urchin fishery is not significant.

6.7.4.2 Spiny Lobster Fishery

Effects on the commercial lobster fishery resulting from the implementation of Alternative 3C are the same as for the baseline. From the 10-year average, we project lobster harvest impacts as a direct function of sea otter occupation in each area. Along the affected coastline (Point Conception to Santa Barbara), the 10-year landings average is 29,308 pounds. We assume that once an area is permanently occupied by sea otters, the commercial lobster fishery would no longer be viable in that area. Thus, we assume that lobster landings along the affected coastline would decrease 10 percent (2,931 pounds) each year, from 29,308 pounds to 26,378 pounds in 2005 to 23,447 pounds in 2006, and so forth to zero landings in 2014. Around San Nicolas Island, the 10-year landings average is 37,722 pounds. We assume that the commercial lobster fishery in this area would decrease by approximately 10 percent over 10 years. Thus, we assume that lobster landings from San Nicolas Island would decrease by 1 percent (377 pounds) each year, from 37,722 pounds to 37,345 pounds in 2005 to 36,968 pounds in 2006, and so forth to 33,950 pounds in 2014.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial lobster landings would likely approach zero in these areas because lobster fishers would fish other areas where their catch per unit effort would be greater. Because the effects of Alternative 3C are the same as for the baseline, the impact of this alternative on the commercial lobster fishery is not significant.

6.7.4.3 Crab Fishery

Effects on the commercial crab fishery resulting from the implementation of Alternative 3C are the same as for the baseline. Along the affected coastline (Point Conception to Santa Barbara), the 10-year landings average is 153,545 pounds. We assume that once an area is permanently

occupied by sea otters, the commercial crab fishery would no longer be viable in that area. Thus, we assume that crab landings along the coastline would decrease 10 percent (15,355 pounds) each year, from 153,545 pounds to 138,191 pounds in 2005 to 122,836 pounds in 2006, and so forth to zero landings in 2014. Around San Nicolas Island, the 10-year landings average is 6,350 pounds. We assume that the commercial crab fishery in this area would decrease by approximately 10 percent over 10 years. Thus, we assume that crab landings from San Nicolas Island would decrease by 1 percent (64 pounds) each year, from 6,350 pounds to 6,287 pounds in 2005 to 6,223 pounds in 2006, and so forth to 5,715 pounds in 2014.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized these areas at the densities seen in the mainland range for comparable habitat, commercial crab landings would approach zero because crab fishers would fish other areas where their catch per unit effort would be greater. Because the effects of Alternative 3C are the same as for the baseline, the impact of this alternative on the commercial crab fishery is not significant.

6.7.5 Aquaculture

Effects on aquaculture resulting from Alternative 3C are the same as for the baseline. Therefore, just as under the baseline, the effects of Alternative 3C within the next 10 years would likely be a local, episodic reduction of mussel densities on offshore oil platforms in the Santa Barbara Channel. Beyond 10 years, aquaculture operations located in other portions of the Southern California Bight may be affected by sea otters, but these effects are expected to be relatively minor. In April 2002, there were only 2 registered aquaculture leases in Ventura County (producing a variety of shellfish and finfish) and only 2 in San Diego County (producing exclusively abalone). Because sea otter range expansion is expected to occur gradually over the course of many decades, and because sea otters affect only some aquaculture operations (and these only at the local scale), effects on aquaculture operations overall would likely be minor.

Significance criteria are not defined for aquaculture because of the extent of uncertainty involved.

6.7.6 Seafood Processing Industry (Sea Urchins)

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

Because the effects of Alternative 3C are the same as for the baseline, the impact of this alternative on the seafood processing industry is not significant.

6.7.7 Kelp Harvest

Effects on commercial kelp harvesting resulting from the implementation of Alternative 3C are the same as for the baseline. Sea otter predation on herbivores is generally expected to promote the growth of dense beds of giant kelp (for a description of the relationship between sea otters and kelp abundance, see section 6.2.2). However, because kelp distribution in areas of suitable substrate is not strictly correlated with grazing pressure (storms, pollution, water temperature, and other factors can also limit kelp), the magnitude of impact to this industry cannot be reasonably predicted.

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

The impact around San Nicolas Island is likely to be minimal over the next 10 years because the sea otter population is expected to reach only 16 percent of the estimated carrying capacity for the island. Although some increased predation on invertebrate herbivore populations at the island is expected, San Nicolas Island presently has extensive kelp forests. The predicted increase in sea otter numbers would not likely result in noticeable effects, but the persistence and density of these kelp beds may be enhanced.

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

Significance criteria are not defined for kelp harvesting because of the extent of uncertainty involved.

6.7.8 Recreational Fishing and Diving

Recreational fishing and diving activities that may be affected by sea otters include lobster diving, abalone diving, and finfish fishing. Lobster diving and finfish fishing are addressed below. Abalone diving is included under “Abalone Fishery Restoration” (section 6.7.9).

6.7.8.1 Lobster Diving

Effects on lobster diving resulting from the implementation of Alternative 3C are the same as for the baseline. Under Alternative 3C, lobster fishing trips would be eliminated along the coastline from Point Conception to Santa Barbara as sea otters gradually establish range in the area. Assuming that this decrease would be distributed evenly across 10 years, lobster dive trips would decrease 10 percent (about 1 trip) each year from 9 trips (9-year average) to 8 trips in 2005, and so forth to zero trips in 2014. Around San Nicolas Island, the average number of annual trips is 521. Using the same approach as for the coastline area, trips around San Nicolas Island are predicted to decrease 1 percent per year over 10 years from 521 trips (9-year average) to 516 trips in 2005 to 511 trips in 2006, and so forth to

469 trips in 2014. Because the data on which this projection is based represent only commercial passenger fishing vessels (no private dive trips are included), the number of dive trips may be underestimated.

Because the effects of Alternative 3C are the same as for the baseline, the impact of this alternative on recreational lobster diving is not significant.

6.7.8.2 Finfish Fishing

The effects of Alternative 3C are the same as for the baseline. As described for the baseline, the presence of sea otters may improve habitat for recreationally important finfish and thus have a positive effect on the abundance of finfish available for harvest. Such changes would likely require more than 10 years to become noticeable (because the reestablishment of giant kelp canopies in areas where sea urchin grazing is limiting kelp is expected to take at least 10 years) and could occur gradually over several decades. A discussion of the long-term effects of sea otter predation on the kelp forest community, including finfish production, is given in section 6.2.2.

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized areas of the Southern California Bight at the densities seen in the mainland range for comparable habitat, recreational finfish fishing would benefit.

Significance criteria are not defined for recreational finfish fishing because of the extent of uncertainty involved.

6.7.9 Abalone Fishery Restoration

The effects of Alternative 3C on abalone fishery restoration are the same as for the baseline. As described for the baseline, within 10 years sea otter range expansion along the coastline towards Santa Barbara would preclude the reestablishment of abalone fishing in that area. Because it does not appear that there is any potential for reopening the abalone fishery (for any species) during the next 10 years, regardless of the presence or absence of sea otters (see section 6.2.9), effects projected for the baseline, as for Alternative 3C, along the coastline during this time period are essentially speculative.

Over the next 10 years, sea otters at San Nicolas Island (CDFG statistical blocks 813 and 814) are expected to increase from 6 percent of carrying capacity in 2004 to 16 percent of carrying capacity in 2014. Abalone populations at San Nicolas Island are expected to persist as sea otter predation increases. However, densities of large individual abalone would likely eventually be reduced to a point that would preclude reestablishment of an abalone fishery at the island. If the colony at San Nicolas Island persists as projected, the area surrounding the island would likely be disqualified from abalone fishery consideration on the grounds that it is not “outside of the sea otter range” (CDFG 2002c).

Whether sea otters would recolonize other nearshore areas of the Southern California Bight after 10 years would be a function of their demographic rates, food supply, and other variables. If sea otters recolonized areas of the Southern California Bight at the densities seen in the mainland range for comparable habitat, the restoration of an abalone fishery in these areas would not be viable. Whether or when an abalone fishery could be reestablished in the absence of sea otters is uncertain, but it is clear that sea otter range expansion would preclude the possibility of recreational or commercial abalone fishing in reoccupied areas.

Significance criteria are not defined for abalone fishery restoration because of the extent of uncertainty involved.

6.7.10 ECOTOURISM

Effects on ecotourism resulting from the implementation of Alternative 3C are the same as for the baseline. Over the next 10 years, southern sea otters are expected to recolonize the stretch of coastline from Point Conception to the Santa Barbara harbor mouth, with a median number of 117 sea otters residing year-round south of Point Conception by the end of the 10-year period. Tourism, based on sea otter watching, would be enhanced with sea otters residing along a coastline accessible by a well-traveled highway. Overall economic value of this tourism is difficult to quantify and would not necessarily result in increased economic activity. Rather, it would likely manifest itself as an added value to other tourist draws in the area.

The sea otter colony at San Nicolas Island is expected to increase by 9 percent annually, resulting in an estimated population size of 79 in 2014. San Nicolas Island is not currently an important destination for ecotourism (U.S. Department of Defense 2002) relative to the other Channel Islands because of its isolation from other islands, its distance from the mainland, and the periodic closure of waters for military operations. We do not expect ecotourism in this area to grow considerably (in terms of number of trips) due to the increased abundance of sea otters. Rather, the quality of recreational trips that do occur at San Nicolas Island would likely be enhanced due to increased opportunities to see sea otters.

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

Significance criteria are not defined for ecotourism because of the extent of uncertainty involved.

6.7.11 FEDERAL AND STATE AGENCY PROGRAMS

Significance criteria are not defined for effects on agency programs because these effects and programs are various and cannot be meaningfully compared with a single set of criteria. For a discussion of the regulatory environment, see section 6.7.12.

6.7.11.1 U.S. Fish and Wildlife Service

The effects of Alternative 3C on southern sea otter recovery are also addressed in section 6.7.3.3 (“Southern Sea Otter”). Here we address our ability to meet our mandates under the Endangered Species Act and Marine Mammal Protection Act and give the implementation costs of the alternative.

ABILITY TO MEET MANDATE

Alternative 3C provides the best opportunity for us to meet our mandate to bring southern sea otters to recovery and OSP for three reasons: 1) it maximizes the area available for sea otters to recolonize; 2) it does not require the movement of any sea otters, which can have a detrimental effect on the individuals moved as well as on the receiving population; and 3) it makes additional legal protections available to sea otters in the Southern California Bight (should these become necessary) by reverting their status to that of sea otters in the mainland range (*i.e.*, threatened).

Alternative 3C would permit the possible eventual expansion of sea otters throughout their historic range in the Southern

California Bight. Although the time that would be required for sea otters to reach recovery and OSP is unknown, Alternative 3C would likely result in a more rapid colonization of the Southern California Bight than Alternatives3A and 3B because the colony at San Nicolas Island would be allowed to remain there. If the colony persisted, it could eventually become a source of dispersing sea otters. Although removal of sea otters from the island (as required under Alternatives3A and 3B) could result in the attempted return of some of these sea otters and the establishment of small groups in other areas of the Southern California Bight, such as at San Miguel Island (thereby possibly increasing the rapidity with which other areas of the Southern California Bight are recolonized) it could also result in the deaths of some individuals and overall would be detrimental to the colony and the receiving population in the mainland range.

Alternative 3C, like Alternatives 3A and 3B, differs notably from the baseline with respect to the regulatory provisions that would apply to sea otters in the Southern California Bight because the management and translocation zones would no longer exist. For a discussion of these provisions, see section 6.7.12.

IMPLEMENTATION COSTS (10-YEAR PERIOD)

The change in the regulatory provisions that apply to sea otters in the Southern California Bight under Alternative 3C could result, in the long term, in increased coordination and consultation between the Service and other parties regarding activities that may affect the southern sea otter. Costs resulting from an increased consultation workload are not included here because few or no activities requiring consultation presently occur or are expected to occur in the area that sea otters would likely reoccupy within the next 10 years. No implementation costs are associated with Alternative 3C.

6.7.11.2 Channel Islands National Park

The effects of Alternative 3C are the same as under the baseline scenario. Alternative 3C would allow sea otters to recolonize the Southern California Bight. While no effects of sea otters would be expected within 10 years, sea otters would likely eventually re-establish their range within Park boundaries. Alternative 3C is consistent with the mission and mission-related goals of the Channel Islands National Park to protect and restore natural ecosystems and to practice ecosystem management.

Under Alternative 3C, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.7.12). This change could result, in the long term, in increased coordination and consultation between the Service and Channel Islands National Park regarding activities that may affect the southern sea otter if sea otters recolonize historic range within Park boundaries.

6.7.11.3 Channel Islands National Marine Sanctuary

The effects of Alternative 3C are the same as under the baseline scenario. Alternative 3C would allow sea otters to recolonize the Southern California Bight. While no effects of sea otters would be expected within 10 years, sea otters would likely eventually re-establish their range within Sanctuary boundaries. Alternative 3C is consistent with the mission of the Channel Islands National Marine Sanctuary to conserve and enhance the biodiversity, ecological integrity, and cultural legacy of areas of special national significance.

Under Alternative 3C, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.7.12). This change could result, in the long term, in increased coordination and consultation between the Service and Channel Islands National Marine Sanctuary regarding activities that may affect the southern sea otter if sea otters recolonize historic range within Sanctuary boundaries.

6.7.11.4 California Department of Fish and Game

Note: Effects on the recovery of white and black abalone and sea otters are discussed under "Candidate, Threatened, and Endangered Species" (section 6.7.3). Effects on existing commercial fisheries and the restoration of the abalone fishery are discussed under "Commercial Fisheries" (section 6.7.4) and "Abalone Fishery Restoration" (section 6.7.9). Effects on Marine Protected Areas (MPAs) are discussed here.

Effects on Marine Protected Areas are the same as under the baseline scenario. Alternative 3C would allow sea otters to recolonize the Southern California Bight. While no effects of sea otters would be expected within 10 years, sea otters would likely eventually re-establish their range within MPA boundaries. In this case, Alternative 3C would have a positive effect on Marine Protected Areas overall. For a full discussion of the expected effects of sea otters on Marine Protected Areas, see section 6.2.11.4.

6.7.11.5 U.S. Navy

The effects of Alternative 3C on the U.S. Navy are regulatory and are the same as under Alternatives 3A and 3B. Under Alternative 3C, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.7.12). This change would likely result in increased coordination and consultation between the Service and the U.S. Navy regarding activities that may affect the southern sea otter. Under Alternative 3C, sea otters would not be removed from San Nicolas Island. To date, we have no evidence that defense-related activities have had any adverse effects on sea otters at San Nicolas Island or in the management zone. As mitigation for the effects of an increased regulatory burden on the U.S. Navy, we would propose to coordinate with the U.S. Navy to develop a programmatic consultation for activities that may affect southern sea otters. Because the U.S. Navy is already required to obtain an Incidental Harassment Authorization under the Marine Mammal Protection Act for the incidental non-lethal "take by harassment" of other marine mammals during missile and target launch operations at San Nicolas Island, the addition of a programmatic consultation for sea otters would likely introduce only a minor additional regulatory burden.

6.7.11.6 U.S. Minerals Management Service

The effects of Alternative 3C are regulatory and are the same as under Alternatives 3A and 3B. Under Alternative 3C, the regulatory provisions that apply to sea otters in the Southern California Bight would change (see section 6.7.12). This change could result in increased coordination and consultation between the Service and the Minerals Management Service regarding activities that may affect the southern sea otter. However, the added consultation and permitting requirements for actions that may affect sea otters in the Southern California Bight would likely impose only a minor additional regulatory burden on the Minerals Management Service for the following reasons: 1) the physical presence of the oil

industry is expected to diminish offshore of California over the next several decades (MMS pers. comm. 2005); 2) all proposed actions that may affect *other* threatened or endangered species or marine mammals are already subject to consultation and permitting requirements under the Endangered Species Act and Marine Mammal Protection Act; 3) the regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of this alternative, and requirements for consultations or permits related to the southern sea otter have been minimal; 4) southern sea otters would not be present in most of southern California for decades (if range expansion continues to occur).

6.7.12 Regulatory Environment

The regulatory environment under Alternative 3C identical to the regulatory environment under Alternatives 3A and 3B, although the actual effects of regulatory changes relative to the baseline depend on the presence or absence of sea otters in the Southern California Bight.

Under Alternative 3C, as under Alternatives 3A and 3B, the translocation program would be declared a failure and terminated, the management and translocation zones would be abolished, and the provisions of Public Law 99-625 would become inoperative. California Fish and Game Code section 8664.2 would also become inoperative. As a result, all activities that may affect southern sea otters within the Southern California Bight would be fully subject to the Endangered Species Act, the Marine Mammal Protection Act, and California state law, including applicable consultation requirements and take prohibitions under these laws.

All federal agencies planning activities that may affect southern sea otters in the Southern California Bight would be required to consult with the Fish and Wildlife Service under section 7 of the Endangered Species Act and seek authorization for incidental take of sea otters under the Endangered Species Act and provisions of the Marine Mammal Protection Act. If otherwise allowable under applicable state law, including California Fish and Game Code section 4700, non-federal activities that would result in take of southern sea otters in California would require incidental take authorization from the Fish and Wildlife Service under section 10(a)1(B) of the Endangered Species Act and section 101(a)(5) of the Marine Mammal Protection Act. Incidental take of southern sea otters in commercial fisheries cannot be authorized under the Marine Mammal Protection Act. Therefore, incidental take of southern sea otters in commercial fisheries throughout the Southern California Bight would be prohibited, as it is currently prohibited throughout the remainder of the range of the species (north of Point Conception). Intentional take would continue to be prohibited unless authorized, as under the current regulations.

This change in the regulatory environment would not be likely to result in substantial effects on activities now being conducted within the Southern California Bight for several reasons:

1) The current regulatory environment along the central California coast is identical to the regulatory environment that would result from implementation of Alternatives 3A, 3B, or 3C in the Southern California Bight. Commercial fishing activities, harbor maintenance, oil and gas exploration, and other

human activities are similar in the two sections of coastline. Along the central coast, requirements for consultations and take authorizations under the Endangered Species Act and Marine Mammal Protection Act related to the southern sea otter have been minimal, and we would expect the same to be the case for the Southern California Bight. This is because there are few otherwise legal activities that result in take of southern sea otters and because the southern sea otter's historic habitat, although somewhat degraded, is essentially intact.

2) Southern sea otters would not be present in most of southern California for many decades. In fact, we cannot reliably assert that range expansion will occur at all. Critical habitat has not been designated for the southern sea otter and is not proposed or required (the southern sea otter was listed under the Endangered Species Act prior to passage of the requirement to designate critical habitat). With no sea otters present in most of the Southern California Bight and no designated critical habitat, the likelihood that adverse interactions between sea otters and human activities would occur would be less than the likelihood that currently exists along the central coast, where substantial numbers of sea otters are found, and where the regulatory environment is the same as that proposed under Alternatives 3A, 3B, and 3C.

3) If the translocation program were declared a failure and terminated, California Fish and Game Code section 4700 would prohibit all take, as defined and applied under state law, of southern sea otters, and the Marine Mammal Protection Act would prohibit incidental take of southern sea otters by commercial fisheries. Nevertheless, commercial fisheries in the Southern California Bight are unlikely to be adversely affected by the change in regulatory environment because few fisheries will likely interact with sea otters. Gill-net fisheries, historically a concern for incidental take of sea otters, are currently prohibited in the nearshore waters of southern California and the offshore Channel Islands where sea otters would be found (Marine Resources Protection Act, California Constitution Article 10B). Dive fisheries (sea urchin, abalone) are extremely unlikely to result in take of sea otters by virtue of the methods they employ to harvest shellfish. Trap fisheries (lobster, crab, live-fish) could potentially result in the entrapment and drowning of sea otters and thus could be affected by a change in the regulatory environment. However, there are few data to assess the possibility of incidental take of southern sea otters in these fisheries, and therefore we cannot reliably anticipate the impact of this regulatory change on this segment of the commercial fishing community.

6.8 Summary and Comparison of Potential Impacts

What follows is a summary of the biological and socioeconomic effects of each alternative evaluated.

6.8.1 ALTERNATIVE 1

6.8.1.1 Biological Effects

Under Alternative 1, sea otters would remain at San Nicolas Island but would be removed from all other areas of the Southern California Bight. As a consequence, ecosystem changes associated with the presence of sea otters (see section 6.2.2) would occur only at San Nicolas Island. Should the number of sea otters at San Nicolas Island continue to increase, at some point we would expect macroinvertebrates, like abalone and sea urchins, to be restricted to habitat that provides refuge from sea otter predation. Macroalgal assemblages would also likely change. The exact nature and magnitude of ecological change is unknown; however, it is likely that the change would result in an ecological community more closely resembling that which occurred naturally prior to the extirpation of sea otters from this area of their historic range during the fur trade.

White abalone have been designated as endangered, and black abalone are now a candidate species. Alternative 1 would exclude sea otters from the management zone (most of the Southern California Bight), thereby limiting the effects of sea otter predation on these species as they recover. However, the benefits to these species of abalone are expected to be of low to moderate significance, primarily because of the depths white abalone typically occupy (which tend to be deeper than sea otters usually dive) and because of the ability of black abalone to maintain reproductively viable populations in cryptic habitat that is inaccessible to sea otters (where sufficient cryptic and inaccessible habitat exists).

Southern sea otters would be affected negatively by Alternative 1. Starting in 1998, large groups of sea otters began moving into the designated management zone from the parent population. Alternative 1 would restrict natural range expansion into historic habitat and cause the disruption of natural behaviors, thereby hampering recovery and possibly causing long-term, large scale adverse effects to the species. The management zone would eliminate about 37 percent of the carrying capacity (for sea otters) of California. Effects on the southern sea otter are expected to be adverse and of high significance.

6.8.1.2 Socioeconomic Effects

Beneficial effects of low to moderate significance would accrue to commercial (sea urchin, lobster, and crab) and recreational fisheries (lobster) as a result of the implementation of Alternative 1. Beneficial effects of low significance would accrue to the seafood processing industry. Beneficial effects of undetermined significance would accrue to aquaculture and abalone fishery restoration. Adverse effects of undetermined significance would likely accrue to the kelp harvesting industry, recreational finfish fishing, and ecotourism because of the exclusion of sea otters from the management zone.

Alternative 1 would also affect the programs of the Service and other agencies. The cost of maintaining the management zone over a 10-year period is just under $6 million (discounted at 3 percent), and it provides less opportunity, relative to the other alternatives, to meet our mandates to recover sea otters under the Endangered Species Act

and to bring them to their OSP level under the Marine Mammal Protection Act. Under this alternative, the Channel Islands National Park and Channel Islands National Marine Sanctuary would be unable to restore a key component of the historic marine ecosystem, and the California Department of Fish and Game would be hindered in its efforts to achieve ecological balance in the newly designated Channel Islands Marine Protected Areas. The U.S. Navy would continue to be exempt from endangered species consultation requirements with regard to sea otters in either the management zone or translocation zone, and the Minerals Management Service would continue to be exempt from endangered species consultation requirements with regard to sea otters in the management zone. The existing obligation of these agencies to conference on actions that are likely to jeopardize the continued existence of the sea otter or, should critical habitat be proposed in the future, on actions likely to adversely modify such proposed critical habitat would continue.

6.8.2 ALTERNATIVE 2

6.8.2.1 Biological Effects

Under Alternative 2, the sea otter colony would remain at San Nicolas Island, and sea otters from the mainland population could expand their range naturally along the coastline as far as the city of Santa Barbara and into the nearshore areas surrounding San Miguel and Santa Rosa Islands. Maintenance of the modified management zone under Alternative 2 would allow sea otters to recolonize additional nearshore marine habitat in the Southern California Bight relative to Alternative 1, but it would prevent further range expansion. If sea otters expanded their range into the areas open to them, the changes described in section 6.2.2 would likely occur. In 10 years, sea otters are projected to recolonize the coastline area to Santa Barbara but not the islands of San Miguel and Santa Rosa. Therefore, all effects expected to occur within 10 years are the same as for the baseline.

In areas recolonized by sea otters, macroinvertebrates, like abalone and sea urchins, would likely be restricted to habitat that provides refuge from sea otter predation. Macroalgal assemblages would also likely change. The exact nature and magnitude of ecological change is unknown; however, it would likely result in an ecological community more closely resembling that which occurred prior to the extirpation of sea otters from the area during the fur trade.

Alternative 2 would provide white and black abalone with less protection from sea otter predation than would Alternative 1, but the modified zone would cover much of the area of the Southern California Bight suitable for these species. Alternative 2 is expected to provide some benefit for individuals of white abalone and possibly local populations of black abalone (those not in cryptic, inaccessible habitat) in the long term, relative to the baseline, but it is not expected to provide benefits at the species level. Benefits provided by the modified management zone are limited because under baseline conditions white abalone are already protected from sea otter predation, to a large extent, by natural refugia (depth, offshore banks, etc.), and because black abalone can maintain reproductively viable populations in the presence of sea otters where sufficient cryptic and inaccessible habitat exists.

Sea otters would be allowed under Alternative 2 to re-occupy a greater portion of their historic habitat than they would be under Alternative 1, representing a benefit

for sea otter recovery (if viewed in relation to Alternative 1). However, the continued removal of sea otters from the redefined management zone would hamper recovery of the species and would also likely make it more difficult to bring sea otters to their OSP level under the Marine Mammal Protection Act. The modified management zone would eliminate about 27 percent of the carrying capacity (for sea otters) of California.

6.8.2.2 Socioeconomic Effects

Shellfish fisheries, both commercial and recreational (lobster diving), would likely be eliminated in the areas re-occupied by sea otters. Changes in the fisheries would likely take place over many years or decades, with the area from Point Conception to Santa Barbara expected to be affected within the next 10 years. Effects are the same as for the baseline within the 10-year time horizon. If in the future sea otters recolonize San Miguel and Santa Rosa Islands, the loss of these areas would be a greater impact on the sea urchin fishery, and possibly the crab and lobster fisheries, than loss of other areas of comparable size in southern California because these islands are important fishing grounds. Similarly, recolonization of these islands could have a disproportionate effect on efforts to restore the abalone fishery. Possible long-term effects at San Miguel and Santa Rosa Islands are the same as would be expected under the baseline but are losses in relation to Alternative 1. If sea otters continue to expand their range, over time the modified management zone would represent a benefit (of unknown magnitude) relative to the baseline for fisheries located within the modified zone because containment would occur in that area. Relative to the baseline, possible future benefits would also accrue to aquaculture, the seafood processing industry, and abalone fishery restoration within the modified management zone. Adverse effects of undetermined significance would likely accrue to the kelp harvesting industry, recreational finfish fishing, and ecotourism within the modified management zone because of the exclusion of sea otters.

The effects of Alternative 2 on agencies would be similar to the effects of Alternative 1. The cost of maintaining the modified management zone would be about $5.4 million over 10 years (discounted at 3 percent). The effects on sea otters (as described under “Biological Effects”) would hinder our ability to recover the species and to bring the population to its OSP level. The reduced size of the management zone under Alternative 2 would allow the Channel Islands National Park and the Channel Islands Marine Sanctuary to work towards attaining their goal of restoration of the marine ecosystem in areas within their jurisdiction at two of the five islands they manage. The U.S. Navy would continue to be exempt from endangered species consultation requirements with regard to sea otters at San Nicolas Island and throughout the redefined management zone, and the Minerals Management Service would be exempt from endangered species consultation requirements with regard to sea otters in the modified zone as well. The existing obligation of these agencies to conference on actions that are likely to jeopardize the continued existence of the sea otter or, should critical habitat be proposed in the future, on actions likely to adversely modify such proposed critical habitat would continue. Both agencies would be required to consult on activities affecting sea otters outside the redefined management zone.

6.8.3 Alternatives 3A-3C

The effects of Alternatives 3A-3C are generally similar to those for the baseline (status quo).

6.8.3.1 Biological Effects

Under Alternatives 3A-3C, sea otters may expand their range naturally throughout the entire Southern California Bight. Should sea otters expand their range, we would expect macroinvertebrates, like abalone and sea urchins, to be restricted to habitat that provides refuge from sea otter predation. Macroalgal assemblages would also likely change. The exact nature and magnitude of ecological change is unknown; however, the change would likely result in an ecological community more closely resembling that which occurred naturally prior to the extirpation of sea otters from this area of their historic range during the fur trade.

Alternatives 3A-3C would not provide white and black abalone with the protection of a management zone as would Alternatives 1 and 2. However, as sea otter range expansion is expected to occur gradually, and as both abalone species have refugia from sea otter predation (white abalone in deep waters, black abalone in cryptic and inaccessible habitat), sea otters are not expected to have effects at the species level. Because of the ability of white and black abalone to make use of these refugia, only a portion of each abalone population would be exposed to sea otter predation even in general areas of the Southern California Bight that sea otters eventually reoccupy.

Sea otters may re-occupy any or all of their historic habitat under Alternatives 3A-3C. The allowance of natural range expansion clearly benefits recovery efforts under the Endangered Species Act and the return to OSP under the Marine Mammal Protection Act. Risks to individual animals subject to removal from a management zone (as under Alternative 1 or 2) would be eliminated, natural range expansion would be unimpeded, and the extension of sea otters' range over a larger area would reduce the risk that a single catastrophic event, such as an oil spill, could cause extinction of the species.

6.8.3.2 Socioeconomic Effects

Shellfish fisheries, both commercial and recreational (lobster), would likely be eliminated in areas re-occupied by sea otters. Changes in the fisheries would likely take place over many years or decades, with some localized areas along the coastline to Santa Barbara being affected within the next 10 years. Widespread fishery changes across the southern California Bight would be gradual, taking place over many decades. In the long term, aquaculture, the seafood processing industry, and abalone fishery restoration would not benefit, relative to the baseline, as they would under Alternatives 1 and 2.

Under Alternatives 3A-3C, kelp harvesting, recreational finfish fishing, and ecotourism would be generally enhanced.

Federal activities that may affect southern sea otters in the southern California Bight would require consultation under Section 7 of the Endangered Species Act. Exemption from consultation requirements, as authorized under Public Law 99-625, would no longer be applicable. The Channel Islands National Park and the Channel Islands Marine Sanctuary would be able to work towards attaining their goal of restoring the marine ecosystem in all areas within their jurisdiction.

Commercial and recreational fisheries would no longer be exempt from the incidental take prohibitions of the Endangered Species Act and the Marine Mammal Protection Act within the former management zone. Instead, the same general provisions that apply to sea otters in central California would apply to sea otters in the Southern

California Bight. While Section 7 and Section 10 the Endangered Species Act provide means to authorize incidental take of sea otters, the Marine Mammal Protection Act does not provide means to authorize the incidental take of sea otters by commercial fisheries.

Several sub-alternatives are presented for consideration should the translocation program be formally declared a failure [50 CFR §17.84(d)(8)]. The actions and impacts related to these sub-alternatives are summarized below.

6.8.4 ALTERNATIVE 3A

Potential impacts of Alternative 3A include all of the impacts noted above for Alternative 3. Additional effects would result from the removal of sea otters from San Nicolas Island and the management zone. Some sea otters captured and moved from San Nicolas Island and the management zone may die, and the removal of sea otters naturally moving into the management zone may have adverse affects on the parent population (depending on the numbers of sea otters removed from the management zone). The removal of sea otters from San Nicolas Island could have unpredictable effects. Although the colony's removal is generally expected to slow but not eliminate range expansion and subsequent competition with shellfisheries, it is also possible that it could speed recolonization because some sea otters may try to return and may establish the seed of a colony elsewhere in the Southern California Bight. Overall, removing sea otters from San Nicolas Island and the management zone and placing them in the mainland range would likely be extremely disruptive, if not harmful, to the animals removed, and disruptive also to animals in the receiving population. Both the displaced animals and the receiving population would suffer disturbance to their social structure and encounter increased competition for food.

6.8.5 ALTERNATIVE 3B

Potential impacts of Alternative 3B include all of the impacts noted above for Alternative 3. Additional effects would result from the removal of sea otters from San Nicolas Island. Some sea otters captured and moved from San Nicolas Island may die. The removal of sea otters from San Nicolas Island could have unpredictable effects. Although the colony's removal is generally expected to slow but not eliminate range expansion and subsequent competition with shellfisheries, it is also possible that it could speed recolonization because some sea otters may try to return and may establish the seed of a colony elsewhere in the Southern California Bight. Overall, removing sea otters from San Nicolas Island and placing them in the mainland range would likely be extremely disruptive, if not harmful, to the animals removed, and disruptive also to animals in the receiving population. Both the displaced animals and the receiving population would suffer disturbance to their social structure and encounter increased competition for food.

6.8.6 ALTERNATIVE 3C (PROPOSED ACTION)

Potential impacts of Alternative 3C include all of the impacts noted above for Alternative 3. This alternative would likely result in a more rapid reoccupation of historic sea otter habitat in the Southern California Bight than Alternatives 3A or 3B and may accelerate changes in affected fisheries. This alternative represents the most favorable option for the accomplishment of sea otter recovery goals because it allows for natural range expansion and would likely increase the resiliency of the species in the event of a catastrophic oil spill or similar event in a portion of its range.

TABLE 6-43. SUMMARY OF BIOLOGICAL IMPACTS BY ALTERNATIVE

Impact Topic			No Action	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C (Proposed Action)
Nearshore Marine Ecosystem		10 yrs	Top carnivore returns to area PC to SB, increases use of habitat at SNI; invertebrate densities decrease PC to SB and slightly at SNI	No return of top carnivore; invertebrate densities increase near Cojo Anchorage, remain same in SCB except decrease slightly at SNI	Top carnivore returns to area PC to SB, increases use of habitat at SNI; invertebrate densities decrease PC to SB and slightly at SNI (same as No Action in 10 years)	Top carnivore returns to area PC to SB, invertebrate densities decrease PC to SB but increase slightly at SNI in short-term		Top carnivore returns to area PC to SB, increases use of habitat at SNI; invertebrate densities decrease PC to SB and slightly at SNI (same as No Action)
		Sig.	**Significance criteria not defined**					
		Long term	Top carnivore gradually returns to SCB, kelp/ biodiversity increases in reoccupied areas throughout SCB, ecosystem enhanced	Top carnivore never returns to most of SCB nearshore area; ecosystem enhanced only at SNI	Top carnivore never returns to much of SCB nearshore area; ecosystem enhanced PC to SB and at SNI, SMI, and SRI but not in remainder of SCB	Possible delay in SCB ecosystem enhancement from removing SNI sea otters; otherwise, top carnivore gradually returns to SCB, kelp/ biodiversity increases in areas throughout SCB, ecosystem enhanced (almost same as No Action)		Top carnivore gradually returns to SCB, kelp/ biodiversity increases in reoccupied areas through-out SCB, ecosystem enhanced (same as No Action)
Candidate, Threatened, and Endangered Species	**White Abalone**	10 yrs	Likely predation on shallow-living individuals PC to SB and slight increase in predation on shallow-living individuals at SNI; no effect at local population level	Probable benefit to shallow-living individuals PC to SB but no benefit at local population level; at SNI, same as No Action (slight increase in predation on shallow-living individuals; no effect at local population level)	Likely predation on shallow-living individuals PC to SB and at SNI; no effect at local population level (same as No Action within 10 years)	Same as No Action PC to SB; probable slight short-term benefit to shallow-living individuals at SNI from removing SNI sea otters		Likely predation on shallow-living individuals PC to SB and at SNI; no effect at local population level (same as No Action)
		Sig.		**Beneficial effect, low significance**	**No change, not significant**	**Beneficial effect (very low), not significant**		**No change, not significant**
		Long term	Predation on shallow-living individuals; no adverse effect at species level	Probable benefit to shallow-living individuals in mgmt. zone but no benefit at species level	Probable benefit to shallow-living individuals in modified mgmt. zone but no benefit at species level	Possible benefit to shallow-living individuals in SCB from slowed range expansion; otherwise, predation on shallow-living individuals; no adverse effect at species level (almost same as No Action)		Predation on shallow-living individuals; no adverse effect at species level (same as No Action)
	Black Abalone	10 yrs	Likely predation on emergent individuals and local population effects PC to SB and at SNI; no adverse	Probable benefit to emergent individuals and local population benefits PC to SB but no benefit at species level; at SNI likely predation on emergent	Likely predation on emergent individuals and local population effects PC to SB and at SNI; no adverse effect at species level (same as No Action within 10	Likely predation on emergent individuals and local population effects PC to SB (same as No Action PC to SB); probable benefit to emergent individuals and local population benefits at SNI from removing SNI sea otters		Likely predation on emergent individuals and local population effects PC to SB and at SNI; no adverse effect at species level (same as No Action)

TABLE 6-43. SUMMARY OF BIOLOGICAL IMPACTS BY ALTERNATIVE

Impact Topic			No Action	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C (Proposed Action)
	Black Abalone (cont'd)		effect at species level	individuals and local population effects (same as No Action at SNI)	years)			
		Sig.		**Beneficial effect, moderate significance**	**No change, not significant**	**Beneficial effect, moderate significance**		**No change, not significant**
		Long term	Emergent individuals consumed, local population effects; no effect at species level	Probable benefit to emergent individuals and local populations in mgmt. zone but no benefit at species level	Probable benefit to emergent individuals and local populations in modified mgmt. zone but no benefit at species level	Possible benefit to emergent individuals in SCB from slowed range expansion; otherwise, emergent individuals consumed, local population effects; no effect at species level (almost same as No Action)		No adverse effect at species level (same as No Action)
	Southern Sea Otter	10 yrs	Sea otters gradually expand range along coastline toward Santa Barbara and increase by 9% per year at SNI	Range expansion restricted; possible injury or death to moved sea otters; range-wide disturbance of behavior; at SNI sea otter colony increases by 9% per year (same as No Action at SNI)	Sea otters gradually expand range along coastline toward Santa Barbara and increase by 9% per year at SNI (same as No Action within 10 years)	Possible benefit to individuals from protections afforded by incidental take provisions Possible death or injury to sea otters removed (short-term) from SNI Possible death or injury to sea otters removed (short-term) from mgmt. zone		
		Sig.		**Adverse effect, high significance**	**No change, not significant**	**Adverse effect, moderate significance**	**Adverse effect, low significance**	**Beneficial effect, low significance**
		Long term	Maximizes habitat available for sea otter recovery	Range restricted; approximately 37% of carrying capacity of CA for sea otters eliminated by mgmt. zone	Range restricted; approximately 27% of carrying capacity of CA for sea otters eliminated by modified mgmt. zone	Maximizes opportunity for sea otter recovery and attainment of OSP through habitat available and possible benefit afforded by incidental take provisions (same as No Action except incidental take provisions)		
				Range-wide disturbance of behavior; possible injury or death to moved sea otters; increased vulnerability to oil spills, disease, etc.		Recovery possibly slowed by removal of SNI sea otters		
				Cumulative effects of range restriction and containment would likely have long-term, large scale adverse effects on species	Cumulative effects of range restriction and containment may have long-term, large scale adverse effects on species			

PC=Point Conception
SB=Santa Barbara
SNI=San Nicolas Island
SCB=Southern California Bight
OSP=Optimum Sustainable Population level for sea otters
Sig.=level of significance

Local population level=Change in population densities of all age- or size-classes in a limited area of the affected species' range
Species level=Change in population densities in a substantial portion of the affected species' range that would likely affect its long-term survival

TABLE 6-44. SUMMARY OF SOCIOECONOMIC IMPACTS BY ALTERNATIVE

Impact Topic			No Action	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C (Proposed Action)
Commercial Fisheries	**Sea Urchin Fishery**	10 yrs	Landings from PC to SB decrease 10% per year to zero in 2014 & 1% per year at SNI; landings in other areas not affected	+$2,579,214 over 10 years (representing a gain of 3% for the SCB sea urchin fishery as a whole)	Same as No Action within 10 years	+$1,067,110 over 10 years (representing a gain of 1% for the SCB sea urchin fishery as a whole) from avoided short-term losses at SNI		Landings from PC to SB decrease 10% per year to zero in 2014 & 1% per year at SNI; landings in other areas not affected (same as No Action)
		Sig.		**Beneficial effect, low significance**	**No change, not significant**	**Beneficial effect, low significance**		**No change, not significant**
		Long term	Landings decrease in areas of SCB reoccupied by sea otters	Benefit to sea urchin fishery of unknown magnitude No decrease in SCB landings due to sea otters except at SNI	No decrease in SCB landings due to sea otters except from PC to SB & at SNI	Landings decrease in areas of SCB reoccupied by sea otters (same as No Action)		
	Spiny Lobster Fishery	10 yrs	Landings from PC to SB decrease 10% per year to zero in 2014 & 1% per year at SNI; landings in other areas not affected	+$2,003,107 over 10 years (representing a gain of 5% for the SCB lobster fishery as a whole)	Same as No Action within 10 years	+$245,827 over 10 years (representing a gain of 0.6% for the SCB lobster fishery as a whole)		Landings from PC to SB decrease 10% per year to zero in 2014 & 1% per year at SNI; landings in other areas not affected (same as No Action)
		Sig.		**Beneficial effect, low significance**	**No change, not significant**	**Beneficial effect (very low), not significant**		**No change, not significant**
		Long term	Landings decrease in areas of SCB reoccupied by sea otters	Benefit to lobster fishery of unknown magnitude No decrease in SCB landings due to sea otters except at SNI	No decrease in SCB landings due to sea otters except from PC to SB & at SNI	Landings decrease in areas of SCB reoccupied by sea otters (same as No Action)		
	Crab Fishery	10 yrs	Landings from PC to SB decrease 10% per year to zero in 2014 & 1% per year at SNI; landings in other areas not affected	+$915,675 over 10 years (representing a gain of 11% for the SCB crab fishery as a whole)	Same as No Action within 10 years	+$7,625 over 10 years (representing a gain of 0.1% for the SCB crab fishery as a whole)		Landings from PC to SB decrease 10% per year to zero in 2014 & 1% per year at SNI; landings in other areas not affected (same as No Action)
		Sig.		**Beneficial effect, moderate significance**	**No change, not significant**	**Beneficial effect (very low), not significant**		**No change, not significant**

TABLE 6-44. SUMMARY OF SOCIOECONOMIC IMPACTS BY ALTERNATIVE

Impact Topic		No Action	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C (Proposed Action)
Crab Fishery (cont'd)	Long term	Landings decrease in areas of SCB reoccupied by sea otters	Benefit to crab fishery of unknown magnitude		Landings decrease in areas of SCB reoccupied by sea otters (same as No Action)		
			No decrease in SCB landings due to sea otters except at SNI	No decrease in SCB landings due to sea otters except from PC to SB & at SNI			
Aquaculture	10 yrs	Local, sporadic reduction in mussel densities at offshore oil platforms to the 1-2 mussel-producing leaseholders in the SB Channel	Slight benefit to the 1-2 mussel-producing leaseholders in the SB Channel from absence of risk of local, sporadic clearing of patches in mussel colonies	Same as No Action within 10 years	Local, sporadic reduction in mussel densities at offshore oil platforms to the 1-2 mussel-producing leaseholders in the SB Channel (same as No Action)		
	Sig.	**Significance criteria not defined**					
	Long term	Sporadic losses at unprotected open-water aquaculture leases	Slight benefit to aquaculture leaseholders in mgmt. zone from absence of sporadic losses at unprotected open-water aquaculture leases	Slight benefit to aquaculture leaseholders in modified mgmt. zone from absence of sporadic losses at unprotected open-water aquaculture leases	Sporadic losses at unprotected open-water aquaculture leases (same as No Action)		
Seafood Processing Industry (Sea Urchins)	10 yrs	Inputs to sea urchin processing facilities from PC to SB decrease 10% per year to zero in 2014 & 1% per year at SNI; inputs from other areas not affected	Possible benefit to sea urchin processing facilities from 3% increase in inputs from SCB	Same as No Action within 10 years	Possible benefit to sea urchin processing facilities from 1% increase in SCB landings resulting from removal of sea otters from San Nicolas Island		Inputs to sea urchin processing facilities from PC to SB decrease 10% per year to zero in 2014 & 1% per year at SNI; inputs from other areas not affected (same as No Action)
	Sig.		**Beneficial effect, low significance**	**No change, not significant**	**Beneficial effect, low significance**		**No change, not significant**
	Long term	Elimination of inputs to sea urchin processing facilities from areas recolonized by sea otters	Benefit to sea urchin processing facilities of unknown magnitude		Adverse effects of unknown magnitude; elimination of inputs to sea urchin processing facilities from areas recolonized by sea otters (same as No Action)		
			No decrease in SCB inputs due to sea otters except at SNI	No decrease in SCB inputs due to sea otters except PC to SB and at SNI			

TABLE 6-44. SUMMARY OF SOCIOECONOMIC IMPACTS BY ALTERNATIVE

Impact Topic			No Action	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C (Proposed Action)
Kelp Harvest		10 yrs	Possible enhancement of kelp stability and persistence PC to SB (may require more than 10 years) and at SNI	No enhancement of kelp stability and persistence PC to SB but same as No Action at SNI	Same as No Action within 10 years	Possible slight loss of kelp available for harvest at SNI resulting from removal of sea otter colony; otherwise, same as No Action		Possible enhancement of kelp stability and persistence PC to SB (may require more than 10 years) and at SNI (same as No Action)
		Sig.	**Significance criteria not defined**					
		Long term	Likely increase in kelp available for harvest in areas reoccupied by sea otters	Adverse effect on kelp harvesting industry of unknown magnitude No increase in kelp available for harvest in SCB except enhancement of kelp beds at SNI	No increase in kelp available for harvest in SCB except enhancement of kelp beds PC to SB and at SNI	Likely increase in kelp available for harvest in areas reoccupied by sea otters (same as No Action)		
Recreational Fishing and Diving	**Lobster Diving**	10 yrs	Lobster diving trips PC to SB decrease 10% per year (about 1 trip) to zero in 2014 & 1% per year at SNI (from 521 to 469 trips per year); trips in other areas not affected	Average annual benefit of 0.9 lobster dive trips, representing less than 1% of the annual average of SCB lobster dive trips (8,983)	Same as No Action within 10 years	Average annual benefit of 52 trips, representing less than 1% of the annual average of SCB lobster dive trips (8,983)		Lobster dive trips PC to SB decrease 10% per year (about 1 trip) to zero in 2014 & 1% per year at SNI (from 521 to 469 trips per year); trips in other areas not affected (same as No Action)
		Sig.		**Beneficial effect (very low), not significant**	**No change, not significant**	**Beneficial effect (very low), not significant**		**No change, not significant**
		Long term	Decrease or elimination of lobster dive trips in areas recolonized by sea otters	Benefit to recreational lobster diving of unknown magnitude No decrease in SCB lobster dives due to sea otters except at SNI	No decrease in SCB lobster dives due to sea otters except PC to SB and at SNI	Decrease or elimination of lobster dive trips in areas recolonized by sea otters (same as No Action)		
	Finfish Fishing	10 yrs	Possible enhancement of kelp-canopy-associated finfish PC to SB but not likely noticeable within 10 years; possible enhancement of finfish habitat and production at SNI	No enhancement of kelp-canopy-associated finfish PC to SB but not likely noticeable within 10 years; possible enhancement of finfish habitat and production at SNI	Same as No Action within 10 years	Possible decline in kelp-canopy-associated finfish if kelp stability and persistence decreases at SNI due to removal of sea otters; otherwise, same as No Action		Possible enhancement of kelp-canopy-associated finfish PC to SB but not likely noticeable within 10 years; possible enhancement of finfish habitat and production at SNI (same as No Action)
		Sig.	**Significance criteria not defined**					

TABLE 6-44. SUMMARY OF SOCIOECONOMIC IMPACTS BY ALTERNATIVE

Impact Topic		No Action	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C (Proposed Action)
Finfish Fishing (cont'd)	Long term	Possible enhancement of kelp-associated finfish and recreational fishing in SCB where sea otters recolonize range	Possible adverse effect on recreational finfish fishing of unknown magnitude		Possible enhancement of kelp-associated finfish and recreational fishing in SCB where sea otters recolonize range (same as No Action)		
			No enhancement of recreational finfish fishing in SCB except at SNI	No enhancement of recreational finfish fishing in SCB except PC to SB and at SNI			
Abalone Fishery Restoration	10 yrs	No effect in 10 years because no chance of abalone fishery restoration in this time, but presence of sea otters PC to SB and at SNI would exclude these areas from possible future abalone fishery consideration	No effect in 10 years because no chance of abalone fishery restoration in this time, but PC to SB would not be excluded from possible future fishery consideration	Same as No Action within 10 years	Probably no effect from removal of sea otters from SNI because possible abalone fishery restoration is expected to require decades; most likely same as No Action		No effect in 10 years because no chance of abalone fishery restoration in this time, but presence of sea otters PC to SB and at SNI would exclude these areas from possible future abalone fishery consideration (same as No Action)
	Sig.	**Significance criteria not defined**					
	Long term	Possible abalone fishery restoration precluded in areas of SCB reoccupied by sea otters	Possible abalone fishery restoration precluded at SNI but not in other areas of SCB	Possible abalone fishery restoration precluded PC to SB and at SNI but not in other areas of SCB	Possible abalone fishery restoration precluded in areas of SCB reoccupied by sea otters (same as No Action)		
Ecotourism	10 yrs	Enhancement of ecotourism PC to SB and at SNI	No enhancement of ecotourism PC to SB but ecotourism enhanced at SNI	Same as No Action within 10 years	Negative effect on ecotourism trips to SNI; otherwise same as No Action		Same as No Action
	Sig.	**Significance criteria not defined**					
	Long term	Enhancement of ecotourism in areas of SCB reoccupied by sea otters	No enhancement of ecotourism in SCB except at SNI	No enhancement of ecotourism in SCB except PC to SB and at SNI	Enhancement of ecotourism in areas of SCB reoccupied by sea otters (same as No Action)		

TABLE 6-44. SUMMARY OF SOCIOECONOMIC IMPACTS BY ALTERNATIVE

Impact Topic			No Action	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C (Proposed Action)
Agency Programs	U.S. Fish and Wildlife Service	10 yrs	--	-$5,992,867 to maintain management zone over 10 years	-$5,431,101 to maintain modified management zone over 10 years	-$1,506,436 (over 3 years)	-$820,134 (over 2 years)	Same as No Action
		Sig.	**Significance criteria not defined**					
		Long term	Maximum opportunity to meet mandate to recover southern sea otter under ESA and to bring its population to OSP under MMPA	Difficult or impossible to meet mandate to recover southern sea otter under ESA and to bring its population to OSP under MMPA	Would likely make it difficult to meet mandate to recover southern sea otter under ESA and to bring its population to OSP under MMPA	Removal of SNI colony would have adverse effects on individual sea otters and may slow future recovery; possible benefit from incidental take provisions; otherwise, maximum opportunity to meet mandate to recover southern sea otter under ESA and to bring its population to OSP under MMPA		Possible benefit from change in incidental take provisions; otherwise, maximum opportunity to meet mandate to recover southern sea otter under ESA and to bring its population to OSP under MMPA
	Channel Islands National Park	10 yrs	No effect within 10 years					
		Sig.	**Significance criteria not defined**					
		Long term	Consistent with mission and "Park Mission Goals" to protect and restore natural ecosystems within the Park	Not consistent with mission and "Park Mission Goals" to protect and restore natural ecosystems within the Park	Allows Park to fulfill mission and "Park Mission Goals" to protect and restore natural ecosystems in two of five islands within the Park	Consistent with mission and "Park Mission Goals" to protect and restore natural ecosystems within the Park (Same as No Action)		
	Channel Islands National Marine Sanctuary	10 yrs	No effect within 10 years					
		Sig.	**Significance criteria not defined**					
		Long term	Consistent with mission to conserve and enhance biodiversity and ecological integrity in the Sanctuary	Not consistent with mission to conserve and enhance biodiversity and ecological integrity in the Sanctuary	Allows Sanctuary to fulfill mission to conserve and enhance biodiversity and ecological integrity in two of the five islands within the Sanctuary	Consistent with mission to conserve and enhance biodiversity and ecological integrity in the Sanctuary (Same as No Action)		

TABLE 6-44. SUMMARY OF SOCIOECONOMIC IMPACTS BY ALTERNATIVE

Impact Topic			No Action	Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C (Proposed Action)
	California Dept. of Fish and Game (MPAs)	10 yrs	No effect within 10 years					
		Sig.	**Significance criteria not defined**					
		Long-term	Consistent with many objectives outlined for Channel Islands MPAs; adverse effect on fishery enhancement goals for sea urchins, lobster, crabs, and abalone	Inconsistent with many objectives outlined for Channel Islands MPAs; consistent with fishery enhancement goals for sea urchins, lobster, crabs, and abalone		Consistent with many objectives outlined for Channel Islands MPAs; adverse effect on fishery enhancement goals for sea urchins, lobster, crabs, and abalone		
	U.S. Navy	10 yrs	No consultation requirements under section 7 of ESA for actions that may affect southern sea otters in mgmt. zone or translocation zone except for actions that may jeopardize the continued existence of the species			Consultation requirement for all actions that may affect the southern sea otter in the SCB; requirements can be met with programmatic consultation		
		Sig.	**Significance criteria not defined**					
		Long-term	Same as above			Same as above		
	U.S. Minerals Mgmt. Service	10 yrs	No consultation requirements under section 7 of ESA for actions that may affect southern sea otters in management zone except for actions that may jeopardize the continued existence of the species; consultation requirement for all actions that may affect the southern sea otter in the translocation zone			Consultation requirement for all actions that may affect the southern sea otter in the SCB		
		Sig.	**Significance criteria not defined**					
		Long-term	Same as above			Same as above		

Note: All dollar amounts are discounted at 3%
PC=Point Conception
SB=Santa Barbara
SNI=San Nicolas Island
SCB=Southern California Bight
OSP=Optimum Sustainable Population level for southern sea otters
ESA=Endangered Species Act
MMPA=Marine Mammal Protection Act
MPAs=Marine Protected Areas
Sig.=level of significance

6.9 Other Considerations Required by NEPA

A. Possible conflicts between the proposed action and objectives of federal, state, and local land-use plans, policies, and controls for the area concerned.

The proposed action does not conflict with the objectives of federal, regional, state, and local land use plans, policies, and controls. Table 6-43 summarizes environmental compliance for the proposed action.

B. Energy requirements and conservation potential of various alternatives and mitigation measures.

The proposed action (Alternative 3C) has no energy requirements and thus has the greatest conservation potential of the alternatives considered. The remaining alternatives have various levels of energy requirements (fuel for boats, airplanes, and vans/trucks) associated with the monitoring, capture, and transport of sea otters. Of the remaining alternatives, energy requirements are lowest for 3B and next-lowest for 3A because these alternatives call for only the removal of sea otters from San Nicolas Island and/or the management zone. Energy requirements are highest for Alternative 1 and next-highest for Alternative 2, because these alternatives require maintenance of a management zone in perpetuity.

C. Urban quality, historic and cultural resources, and the design of the built environment, including the reuse and conservation potential of various alternatives and mitigation measures.

This topic is not relevant to the alternatives under consideration.

TABLE 6-45. RELATIONSHIP BETWEEN THE PROPOSED ACTION AND THE OBJECTIVES OF FEDERAL, STATE, AND LOCAL LAND USE PLANS, POLICIES, AND CONTROLS

Plans, Policies, and Controls	Responsible Agency	Status of Compliance
National Environmental Policy Act (42 United States Code [U.S.C.] §4321 *et seq.*)	U.S. Fish and Wildlife Service	This Supplemental Environmental Impact Statement (SEIS) has been prepared in accordance with the Council on Environmental Quality regulations implementing NEPA. The preparation of this SFEIS and the provision for its public review are being conducted in compliance with NEPA.
Coastal Zone Management Act (CZMA) (16 Code of Federal Regulations [C.F.R.] §1451 *et seq.*) California Coastal Act (14 California Code of Regulations [C.C.R.])	California Coastal Commission	The Service has determined that the proposed action is consistent with the policies of the California Coastal Act and will complete a Coastal Consistency Determination in accordance with the CZMA.
Endangered Species Act (16 U.S.C. §1531)	National Marine Fisheries Service (NMFS)	The Service initiated informal consultation with NMFS for effects of the proposed action (Alternative 3C) on white abalone in February of 2003. The Service will conclude formal section 7 consultation with NMFS for effects on white abalone and confer with NMFS for effects on black abalone before selection of any of the alternatives under consideration.
EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (Executive Order 12898, 59 FR 7629 [Section 1-101])	U.S. Fish and Wildlife Service	Minority or low-income populations would not be disproportionately affected by the proposed action.