FINAL
Programmatic Environmental Assessment

for

Fisheries Research Conducted and Funded by the
Southwest Fisheries Science Center





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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ACCRONYMS AND ABBREVIATIONS

AERD	Antarctic Ecosystem Research Division
AMLR	Antarctic Marine Living Resources Program
CCAML	Convention for the Conservation of Antarctic Marine Living Resources
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EIS	Environmental Impact Statement
ERD	Environmental Research Division
FED	Fisheries Ecology Division
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FRD	Fisheries Resources Division
IATTC	Inter-American Tropical Tuna Commission
IDCP	International Dolphin Conservation Program
IDCPA	International Dolphin Conservation Program Act
IHA	Incidental Harassment Authorization
ISC	International Scientific Committee for Tuna and Tuna-like Species
IWC	International Whaling Commission
LOA	Letters of Authorization
MBTA	Migratory Bird Treaty Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NADS	non-associated and dependent species
NMFS	National Marine Fisheries Service
NMS	National Marine Sanctuary
NOAA	National Oceanic and Atmospheric Administration
NPFMC	North Pacific Fisheries Management Council
OPR	Office of Protected Resources
PFMC	Pacific Fisheries Management Council
SWFSC	Southwest Fisheries Science Center
U.S.	United States
U.S.C.	United States Code
WCPFC	Western and Central Pacific Fisheries Commission
WPRFM	Western Pacific Regional Fishery Management Council

EXECUTIVE SUMMARY

CHAPTER 1 – INTRODUCTION AND PURPOSE AND NEED

The federal government has a responsibility to conserve and protect living marine resources in waters of the United States (U.S.), also referred to as federal waters. These waters generally lie 3 to 200 nautical miles (nm) from the shoreline, and comprise an area known as the Exclusive Economic Zone (EEZ)[1]. The National Oceanic and Atmospheric Administration (NOAA) has the primary responsibility for managing marine finfish and shellfish, certain marine mammal species, sea turtles in marine waters, and their habitats. Within NOAA, the National Marine Fisheries Service (NMFS) has been delegated primary responsibility for the science-based management, conservation, and protection of living marine resources within the U.S. EEZ.

NMFS is fundamentally a science-based agency, with its primary mission being the stewardship of living marine resources through science-based conservation and management. So central is science-based management to NMFS fishery management efforts, it is listed among the ten National Standards set forth in the Magnuson-Stevens Fishery Conservation and Management Act: "(2) Conservation and management measures shall be based upon the best scientific information available." (16 U.S.C. §§ 1801-1884).

Fisheries Science Centers

In order to direct and coordinate the collection of scientific information needed to make informed fishery conservation and management decisions, NMFS established six Regional Fisheries Science Centers[2], each a distinct organizational entity and the scientific focal point within NMFS for region-based federal fisheries-related research in the United States. The Fisheries Science Centers conduct primarily *fisheries-independent* research studies[3] but may also participate in *fisheries-dependent* and *cooperative* research studies. This research is aimed at monitoring fish stock recruitment, survival and biological rates, abundance and geographic distribution of species and stocks, and providing other scientific information needed to improve our understanding of complex marine ecological processes.

Southwest Fisheries Science Center Research Activities

The Southwest Fisheries Science Center (SWFSC) is one of the two research arms of NMFS in the West Coast Region (the other being the Northwest Fisheries Science Center). The SWFSC conducts research and provides scientific advice to manage fisheries and conserve protected species along the U.S. West Coast, throughout the Eastern Tropical Pacific Ocean, and in the Scotia Sea area off Antarctica (Figure 1.1-2). The SWFSC provides scientific information to support the Pacific Fishery Management Council and numerous other domestic and international fisheries management organizations.

In addition to fisheries management organizations, SWFSC generates and communicates scientific information to support the restoration of California rivers, the recovery of protected species, the establishment of marine protected areas, the emergence of marine spatial planning, and to advance scientific understanding of the structure and function of marine ecosystems and the impacts of climate change on these systems.

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[1] An area over which a nation has special rights over the exploration and use of marine resources.

[2] Northeast FSC, Southeast FSC, Southwest FSC, Northwest FSC, Alaska FSC, and Pacific Islands FSC

[3] Fisheries-independent research is designed and conducted independent of commercial fishing activity to meet specific research goals, and includes research directed by SWFSC scientists and conducted on board NOAA- owned and operated vessels or NOAA-chartered vessels. Fisheries-dependent research is research that is carried out in partnership with commercial fishing vessels. The vessel activity is not directed by the SWFSC, but researchers collect data on the commercial catch. Cooperative research programs are those where SWFSC scientists play a significant role in some aspect of study design, administration, or assessment of results but which are carried out by cooperating scientists (other agencies, academic institutions, commercial fishing-associated groups, or independent researchers) on board non-NOAA vessels.

The specimen archives collected during SWFSC research cruises include some of the world's preeminent collections of ichthyoplankton, marine invertebrates, and tissue samples for molecular genetics. Sample coverage from temperate, tropical, and polar ecosystems is unique in the world because of the long time series and extensive area from which they have been sampled. These collection archives provide an important record of species diversity, community composition, genetic structure, and an extraordinary record of climate change and other human impacts for current and future studies.

NMFS has prepared this Final Programmatic Environmental Assessment (Final PEA) under the National Environmental Policy Act (NEPA) to evaluate several alternatives for conducting and funding these fisheries and ecosystem research activities as the primary federal action. NMFS is also evaluating in this Final PEA a related action—also called a "connected action" under NEPA (Sec. 1508.25)—which is the proposed promulgation of regulations and authorization of "takes"[4] of marine mammals incidental to the research activities through issuance of Letters of Authorization (LOA) under the Marine Mammal Protection Act (MMPA) (see Section 6.3 for detailed discussion). Additionally, because the proposed fisheries and ecological research activities occur in areas inhabited by a number of marine mammals, birds, sea turtles, fishes, and invertebrates listed under the Endangered Species Act (ESA) as threatened or endangered, this Final PEA evaluates activities that could result in unintentional impacts on ESA-listed marine species.

CHAPTER 2 - ALTERNATIVES

The National Environmental Policy Act requires federal agencies to consider alternatives to a proposed federal action. The evaluation of alternatives under NEPA assists the decision maker in ensuring that any unnecessary impacts are avoided through an assessment of alternative ways to achieve the underlying purpose of the proposed action that may result in less environmental harm.

To warrant detailed evaluation under NEPA, an alternative must be reasonable and meet the stated purpose and need for the proposed actions (see Section 1.3). Additionally, NEPA requires consideration of a "no action" alternative, which is Alternative 1 in this Final PEA.

For this Final PEA, NMFS has applied the following screening criteria to a range of alternatives to identify which ones should be brought forward for detailed analysis:

Screening Criteria

To be considered "reasonable" for purposes of this Final PEA, an alternative must meet the following criteria:

- The action must not violate any federal statute or regulation.
- The action must be consistent with reasonably foreseeable funding levels.
- The action must be consistent with long-term research commitments and goals to maintain scientific integrity of ongoing research efforts or consider no federal funding availability for fisheries research.

To maintain scientific integrity, fisheries and marine ecosystem scientific research must meet the following criteria:

- Methods and techniques must provide standardized, objective, and unbiased sampling consistent with past data sets (time series) in order to facilitate long-term trend analyses.

[4] The term "take" under the MMPA means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." The MMPA defines "harassment" as "any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption or behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment)." (16 U.S.C. Sec 1361 *et seq.*)

- Collected data must adequately characterize living marine resource and fishery populations and the health of their habitats.
- The surveys must enable tracking population dynamics and provide predictive capabilities required to respond to changing ecosystem conditions and manage future fisheries.
- Research on new methodologies to collect fisheries and ecosystem information (e.g. active and passive acoustic instruments and video surveys of benthic habitats in lieu of dredge gear or bottom trawls) and research oriented toward modifications of fishing gear to address bycatch or other inefficiencies should be conducted with sufficient scientific controls to allow statistically-valid comparisons with relevant alternatives.

NMFS evaluated each potential alternative against these criteria. Based on this evaluation, the No-Action/Status Quo Alternative and two other action alternatives were identified as reasonable and were carried forward for more detailed evaluation in this Final PEA. NMFS also evaluated a second type of no-action alternative that considers no federal funding for fisheries research activities. This has been called the No Research Alternative to distinguish it from the No-Action/Status Quo Alternative. The No-Action/Status Quo Alternative was used as the baseline to compare all of the other alternatives.

Three of the alternatives include a program of fisheries and ecosystem research projects conducted or funded by the SWFSC as the primary federal action. Because this primary action is connected to a secondary federal action (also called a connected action under NEPA), to consider NMFS issuance of five-year regulations and subsequent LOAs under Section 101(a)(5)(A) of the MMPA for the incidental, but not intentional, taking of marine mammals, NMFS must identify as part of this evaluation under the MMPA "(t)he means of effecting the least practicable adverse impact on the species or stock and its habitat." (MMPA Section 101 (a)(5)(A)). As a result, NMFS has identified and evaluated a reasonable range of mitigation measures to minimize impacts to protected species that occur in SWFSC research areas. These mitigation measures are considered as part of the identified alternatives in order to evaluate their effectiveness to minimize potential adverse environmental impacts. The three action alternatives also include mitigation measures intended to minimize potentially adverse interactions with other protected species that occur within the action area. Protected species include all marine mammals, which are covered under the MMPA, all species listed under the ESA, and bird species protected under the Migratory Bird Treaty Act.

Alternative 1 - No-Action/Status Quo Alternative - Conduct Federal Fisheries and Ecosystem Research with Scope and Protocols Similar to Past Effort

The Status Quo Alternative includes fisheries research using the same protocols as were implemented from 2008 through 2012. These federal research activities are necessary to fulfill NMFS mission to provide science-based management, conservation, and protection of living marine resources in the three areas covered by the SWFSC: the California Current Research Area (CCRA), Eastern Tropical Pacific Research Area (ETPRA), and the Antarctic Research Area (ARA). Under Alternative 1, the SWFSC would use the same scope of research as in recent years and with current mitigation measures for protected species.

The Status Quo Alternative considers 14 scientific research surveys in the CCRA and one research survey each in the ETPRA and ARA (Table 2.2-1) that were conducted in the recent past (2008-2012). These surveys generally used fishing gear to capture fish and invertebrates for stock assessment purposes, and also included collection of plankton and larval life stages and oceanographic and acoustic data to characterize the marine environment. The main gear types of concern for potential interactions with protected species included mid-water trawls, surface trawls, and pelagic longline gear. The SWFSC did not use bottom-contact trawl gear except in the ARA, where bottom trawl surveys are conducted every few years to monitor the recovery of depleted finfish stocks. These past activities are considered as the basis for analysis of future activities under the Status Quo Alternative.

The Status Quo Alternative research activities include a suite of mitigation measures that were developed by the SWFSC in consultation with marine mammal scientists and other protected species experts. These mitigation measures have been implemented on SWFSC surveys since the 2008-2009 field seasons:

- Visual monitoring for protected species prior to deployment of gear;
- Use of the "move-on" rule if marine mammals are sighted from the vessel in the 30 minutes prior to setting trawl or pelagic longline gear and appear to be at risk of interaction with the gear as determined by the professional judgment of the Chief Scientist or officer on watch; and
- Use of a marine mammal excluder device in the NETS Nordic 264 trawl gear.

However, these mitigation measures may not be sufficient to reduce the effects of SWFSC fisheries research activities on marine mammals to the level of least practicable adverse impact, as required under the MMPA (see Alternative 2). Other mitigation measures would be required under the MMPA and ESA processes for the specified research activities conducted by the SWFSC.

Alternative 2 – Preferred Alternative - Conduct Federal Fisheries and Ecosystem Research (New Suite of Research) with Mitigation for MMPA and ESA Compliance

The Preferred Alternative includes the same set of research surveys as the Status Quo Alternative with the addition of a new pelagic longline survey in the ETPRA. Under this alternative, the SWFSC would apply to NMFS Office of Protected Resources (OPR)[5] to promulgate regulations governing the issuance of LOAs for incidental take of marine mammals under the MMPA. OPR would consider these activities and mitigation measures and determine whether it should promulgate regulations and issue LOAs as appropriate to the SWFSC. If regulations are promulgated and LOAs are issued, they would prescribe: the permissible methods of taking; a suite of mitigation measures intended to reduce the risk of potentially adverse interactions with marine mammals and their habitats during the specified research activities.

In addition, the SWFSC has engaged in ESA Section 7 consultations with NMFS West Coast Regional Office (and U.S. Fish and Wildlife Service) for species that are listed as threatened or endangered. These consultations resulted in the development of a Biological Opinion (BiOp) that describes the determinations of NMFS that the primary and secondary federal actions are not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of any critical habitat. The BiOp contains incidental take statements that include reasonable and prudent measures along with implementing terms and conditions intended to minimize the number and impact of incidental takes of ESA-listed species during SWFSC research activities; and monitoring and reporting requirements.

The Preferred Alternative also includes new research efforts to test the efficacy, safety, and practicability of new equipment and procedures designed to reduce potentially adverse impacts on protected species, while maintaining the utility of survey results with regard to research objectives (conservation engineering and analysis). If these programs are successful, the SWFSC would incorporate new mitigation protocols into their research programs. These new efforts include:

- Development of a marine mammal excluder device for use in Modified Cobb trawl gear, and
- A retrospective analysis of potential factors influencing incidental take of protected species.

The SWFSC continually reviews its procedures and investigates options for incorporating new mitigation measures and equipment into its on-going survey programs. Evaluations of new mitigation measures include assessments of their effectiveness in reducing risk to protected species, but any such measures must also pass safety and practicability considerations, allow survey results to meet research objectives, and remain consistent with previous data sets.

[5] Permits and Conservation Division, Incidental Take Program

The Preferred Alternative includes the same suite of mitigation measures as the Status Quo Alternative to reduce the risk of adverse interactions with protected species. It also includes at least two new mitigation measures:

- Modification of the “move-on” rule for trawl and pelagic longline sets to include a one nautical mile safety radius,
- The implementation of a new training program where all Chief Scientists and crew likely to be responsible for monitoring and addressing incidental capture of protected species participate in the elements of the existing commercial fisheries Observer Training Program that address appropriate responses to protected species interactions.

The modifications to the “move-on” rule are intended to restrict and clarify the conditions under which Chief Scientists and officers on watch may use professional judgment to reduce the risk of interactions with protected species, although such judgments are still an important element in reducing risks of potentially adverse interactions. The new training program would include a process for Chief Scientists and vessel captains to communicate with each other about their experiences with protected species interactions during research work with the goal of improving decision-making regarding avoidance of adverse interactions. It would also include Chief Scientists and crew receiving formal training through the commercial fisheries Observer Training Program currently conducted by NMFS West Coast Regional Office. Topics covered in this program include monitoring and sighting protocols, species identification, decision-making factors for avoiding take, procedures for handling and documenting protected species caught in research gear, and reporting requirements. This training program would formalize and standardize the information provided to all crew that might experience protected species interactions during research activities. Depending on the results of the conservation engineering and analysis described above, the Preferred Alternative may also include several other new mitigation measures that would be implemented in the future under this Final PEA. The mitigation measures considered under the Preferred Alternative are intended to reduce the effects of SWFSC fisheries research activities on marine mammals to the level of least practicable adverse impact, as required under the MMPA. The mitigation measures to be implemented in this Preferred Alternative are mandatory, non-discretionary operational requirements of the MMPA authorization and the ESA section 7 consultation processes.

Alternative 3 - Modified Research Alternative – Conduct Federal Fisheries and Ecosystem Research (New Suite of Research) with Additional Mitigation

Under Alternative 3, the SWFSC would conduct and fund the same scope of fisheries research as described in the Preferred Alternative and would include all of the same mitigation measures considered under the Preferred Alternative. Under this alternative, the SWFSC would also apply for authorizations under the MMPA and the ESA for incidental take of protected species during these research activities. The difference between Alternative 3 and the Preferred Alternative is that Alternative 3 includes a number of additional mitigation measures derived from a variety of sources including: (1) comments submitted from the public on similar fisheries actions, (2) discussions within NMFS OPR as part of the proposed rulemaking process under the MMPA, and (3) a literature review of past and current research into potential mitigation measures.

Some of the mitigation measures considered under Alternative 3 (e.g., no night fishing or broad spatial/temporal restrictions on research activities) would not allow survey results to remain consistent with previous data sets and would essentially prevent the SWFSC from collecting data required to provide for fisheries management purposes under the Magnuson-Stevens Act. Some research surveys necessarily target fish species that are preyed upon by marine mammals with an inherent risk of interactions with marine mammals during these surveys. The SWFSC acknowledges the inherent risk of these surveys (e.g., the Coastal Pelagic Species Survey, Juvenile Salmon Survey, and Juvenile Rockfish Survey), and it has implemented a variety of measures to help mitigate that risk. As part of the analysis in this Final PEA, NMFS has concluded that the SWFSC currently has no viable alternatives to collecting the data derived from these surveys that meet the research objectives described under Purpose and Need. As a result, NMFS does not propose to implement potential mitigation measures that would preclude continuation of these surveys, such as the elimination of night surveys or pelagic trawl gear.

The connected federal action covered under this Final PEA is the issuance of regulations and subsequent LOAs for incidental takes of marine mammals under the MMPA, which requires NMFS to consider a reasonable range of mitigation measures that may reduce the impact on marine mammals among other factors. As described above, some of these measures could prevent the SWFSC from maintaining the scientific integrity of its research programs. These measures would normally be excluded from consideration in the Final PEA for not being consistent with the purpose and need (Chapter 1). However, these additional mitigation measures were considered during the MMPA rulemaking process and/or ESA section 7 consultation and are therefore covered in this Final PEA.

Alternative 4 - No Research Alternative - No Fieldwork for Federal Fisheries and Ecosystem Research Conducted or Funded by SWFSC

Under the No Research Alternative, no direct impacts on the marine environment would occur from the primary or secondary federal actions. The SWFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered in the scope of this Final PEA in marine waters of the California Current, Eastern Tropical Pacific, or Antarctic Research Areas. This moratorium on fieldwork would not extend to research that is not in scope of this Final PEA, such as directed research on marine mammals and ESA-listed species covered under separate research permits and NEPA documents. NMFS would need to rely on other data sources, such as fishery-dependent data (i.e., harvest data) and state or privately supported fishery-independent data collection surveys or programs to fulfill its responsibility to manage, conserve and protect living marine resources in the U.S. Under this alternative, organizations that have participated in joint research programs may or may not continue their research efforts depending on whether they are able to secure alternative sources of funding. Any non-federal fisheries research would occur without NMFS funding, direct control of program design, or operational oversight. It is unlikely that these non-NMFS fisheries research surveys would be consistent with the time series data NMFS has collected over many years, which is the core information supporting NMFS science and management missions and vital to fishery management decisions made by NMFS, the Fishery Management Councils and other marine resource management institutions, leading to greater uncertainty for fishery and other natural resource management decisions.

CHAPTER 3 – AFFECTED ENVIRONMENT

Chapter 3 presents baseline information on the marine environment affected by SWFSC research activities. This information is not intended to be encyclopedic but to provide a foundation for the analysis of environmental impacts of the alternatives and the cumulative effects analysis. Sources of additional information are incorporated by reference.

The marine environment affected by SWFSC research surveys includes sections of several coastal Large Marine Ecosystems (LMEs), including the California Current LME, the Gulf of California (Sea of Cortez) LME, the Pacific-Central American Coastal LME, the Humboldt Current LME, and the Antarctica LME (Sherman et al. 1996). However, a substantial amount of the SWFSC fisheries research activities are also conducted in offshore areas that lie outside of the coastal LME boundaries. There are many areas with special designations to protect various resources and are subject to various levels of conservation and management under a variety of authorities. Classifications of these special resource areas include Essential Fish Habitat, permanent or temporary fisheries closure areas, and designated Marine Protected Areas including National Marine Sanctuaries.

There are thousands of finfish and shellfish species that occur within the three SWFSC research areas. Descriptions or lists are provided for ESA-listed species, species targeted by commercial fisheries and subject to SWFSC research assessments, sharks and highly migratory species, and other species caught frequently in SWFSC surveys.

Marine mammal species that occur in each of the three research areas are listed in Table 3.2-4, including at least 46 species of cetaceans (whales, dolphins, and porpoise), 16 species of pinnipeds (seals and sea lions), and one species of fissiped (sea otter). All of these species are federally protected under the MMPA regardless of where they occur. Seven large whale species, one pinniped, and one subspecies of sea otter are currently listed as threatened or endangered under the ESA. Information is presented on marine mammal acoustics and functional hearing ranges for several groups of marine mammals. Marine mammals rely on sound production and reception for social interactions (e.g., reproduction and communication), to find food, to navigate, and to respond to predators.

ESA-listed bird species that occur in the three SWFSC research areas include three species in the CCRA and five species in the ETPRA. There are no ESA-listed species in the ARA. Other common species in these areas that are susceptible to entanglement in fishing gear are listed. All species likely to occur in the U.S. EEZ are protected by the Migratory Bird Treaty Act.

Five species of sea turtles occur within the CCRA and ETPRA, all of which are listed as endangered under the ESA. Sea turtles are susceptible to damage of onshore nesting habitat, exploitation of eggs, and interactions with research, sport, and commercial fisheries. Two areas within the CCRA have been designated as critical habitat for leatherback turtles (77 FR 4170, January 26, 2012).

There are two species of ESA-listed invertebrates in the CCRA (white and black abalone) and one major target species (market squid). There are no ESA-listed invertebrate species in the ETPRA and the SWFSC does not conduct stock assessment research for any invertebrate fisheries in the area. There are no ESA-listed invertebrate species in the ARA, but the SWFSC conducts substantial research and provides stock abundance and distribution information for management of commercial fisheries on Antarctic krill.

Several components of the social and economic environment are summarized. A number of commercial fisheries harvest marine fish and invertebrates in the waters of the CCRA, ETPRA, and ARA. Complex associations exist between the fishing industry, fisheries management processes, and the social well-being of many communities. Commercial fisheries in the ETPRA and ARA are international in scope but information on fishing communities in the Final PEA are limited to the U.S. West Coast. Recreational fisheries play an important role in the well-being of individuals and communities. These fisheries and communities receive scientific and economic benefits from the SWFSC research activities as they contribute to the scientific management of sustainable fisheries. Information is also presented on the basic operating costs of the SWFSC (approximately $50 million annually) and average costs for conducting research programs in the three research areas. These expenses include funds for ship time, fuel and supplies, crew, charter vessels, and other logistic support, some of which also benefits communities on the U.S. West Coast.

CHAPTER 4 – ENVIRONMENTAL EFFECTS

As indicated earlier, NMFS is fundamentally a science-based agency, with its primary mission being the stewardship of living marine resources through science-based conservation and management. Of the four alternatives evaluated in this Final PEA, three alternatives maintain an active research program (Status Quo, Preferred, and Modified Research Alternatives) that clearly enables collection and development of additional scientific information and one alternative (No Research) that does not. In NMFS view, the inability to acquire scientific information essential to developing robust fisheries management measures that must prevent overfishing and rebuild overfished stocks would ultimately imperil the agency's ability to meet its mandate to promote healthy fish stocks and restore the nation's fishery resources. The scientific information provided by fisheries research programs also allows NMFS to address potential effects of climate change and ocean acidification. Long-term, consistent fisheries and ecosystem research programs contribute substantially to developing effective and timely fisheries management actions and assists in meeting international treaty obligations.

The following discussion summarizes the direct and indirect impacts by resource area associated with the alternatives evaluated in Chapter 4 of this Final PEA. The analysis shows that the potential direct and indirect impacts on the physical and biological environments under the three research alternatives are similar and have minor adverse effects. The three research alternatives would have moderate beneficial economic effects on commercial and recreational fishermen and fishing communities by providing the scientific information needed for sustainable fisheries management and by providing funding, employment, and services. The similarity of impacts among the three research alternatives is due to the fact that the scope of research activities under these alternatives is similar; they differ primarily in the type of mitigation measures included for protected species. The No Research Alternative, in contrast, would eliminate the direct adverse effects of the research alternatives on the marine environment but would have minor to moderate adverse, indirect effects on several biological and socioeconomic resources due to increasing uncertainty in future resource management decisions caused by the loss of scientific information from the SWFSC on the marine environment. Table ES-1 provides a summary of impact determinations for each topic and Alternative considered.

Table ES-1 Summary of environmental effect conclusions by research area and by alternative. All conclusions refer to potentially adverse effects unless noted.

California Current Research Area				
Topic	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Physical Environment	Minor	Minor	Minor	Minor to Moderate
Special Resource Areas	Minor	Minor	Minor	Minor to Moderate
Fish	Minor	Minor	Minor	Moderate
Marine Mammals	Minor	Minor	Minor	Minor
Birds	Minor	Minor	Minor	Minor
Sea Turtles	Minor	Minor	Minor	Minor
Invertebrates	Minor	Minor	Minor	Minor to Moderate
Social and Economic Environment	Moderate *beneficial*	Moderate *beneficial*	Moderate *beneficial*	Moderate
Eastern Tropical Pacific Research Area				
Topic	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Physical Environment	Minor	Minor	Minor	Minor
Special Resource Areas	Minor	Minor	Minor	Minor
Fish	Minor	Minor	Minor	Minor
Marine Mammals	Minor	Minor	Minor	Minor
Birds	Minor	Minor	Minor	Minor
Sea Turtles	Minor	Minor	Minor	Minor
Invertebrates	Minor	Minor	Minor	Minor

Social and Economic Environment	Minor *beneficial*	Minor *beneficial*	Minor	Minor
Antarctica Research Area				
Topic	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**
Physical Environment	Minor	Minor	Minor	Minor
Special Resource Areas	Minor	Minor	Minor	Minor
Fish	Minor	Minor	Minor	Minor
Marine Mammals	Minor	Minor	Minor	Minor
Birds	Minor	Minor	Minor	Minor
Sea Turtles	N/A	N/A	N/A	N/A
Invertebrates	Minor	Minor	Minor	Minor
Social and Economic Environment	Minor *beneficial*	Minor *beneficial*	Minor	Minor

Physical Environment and Special Resource Areas

Under the three research alternatives, direct impacts to benthic habitats would be limited to the ARA, which is the only research area where bottom-contact trawl gear is used. This bottom trawl survey would only be conducted every few years and would have a very small footprint and minor localized adverse effects on the physical environment in the ARA. An analysis is presented on the proportion of research sampling and biomass removals made within National Marine Sanctuaries in the CCRA. While some surveys have substantial sampling effort within one or more sanctuaries, the removals of fish and invertebrates for scientific purposes is very small compared to estimated biomass metrics and is considered to have minor adverse effects on the sanctuaries.

Under the No Research Alternative, there would be no direct impacts on the physical environment or special resource areas from federal fisheries and ecological research. However, the loss of scientific information generated by SWFSC research would contribute to greater uncertainty about the effects of climate change and ocean acidification on three major marine ecosystems as well as the status of biological resources in marine protected areas. Indirect effects on resource management agencies and conservation plans for protected areas would likely vary from minor to moderate adverse under the No Research Alternative.

Fish

Under the three research alternatives, short term, minor, adverse impacts to fish populations are expected as a result of on-going research activities. Mortality from captures in surveys is a potential impact for some ESA-listed species but past levels of catch in SWFSC research surveys are small and considered minor to their respective populations. For species targeted by commercial fisheries, mortality due to research surveys is much less than one percent of commercial harvest and is considered to have minor adverse effects for all species. However, SWFSC research on several key species in the CCRA, such as sardines and Pacific hake (whiting), provides the scientific foundation for sustainable fisheries management and therefore has substantial long-term beneficial effects on target species populations. Under the No Research Alternative, there would be no direct adverse impacts on fish from federal fisheries research. However, the loss of scientific information for fisheries management could lead to long-term minor to moderate adverse impacts including overfishing on some stocks and uncertainty about the recovery of overfished stocks.

Marine Mammals

The primary direct effects of the three research alternatives on ESA-listed and non-listed marine mammals include behavioral responses to sound produced through the use of active acoustic sources (Level B harassment under the MMPA), capture or entanglement in fishing gear but released without serious injury (Level A harassment), and capture or entanglement resulting in serious injury or mortality. The potential for effects from ship strikes, contamination of the marine environment, and removal of marine mammal prey species was considered minor for all alternatives and research areas. The MMPA requires applicants for LOAs to estimate the number of each species of marine mammal that may be incidentally taken by harassment or serious injury/mortality during the proposed action. The SWFSC LOA application (attached to the Final PEA as Appendix C) includes estimates of takes in all three research areas using the scope of research and mitigation measures described in the Preferred Alternative.

Level B harassment takes are estimated based on the acoustic properties of sonars and other acoustic equipment used during research, calculations of the volume of water ensonified to 160 decibels or more (NMFS recommended threshold for Level B harassment from active acoustic equipment used in research), estimates of the densities of marine mammals in the three research areas, and a partitioning of species that typically do not dive deeper than 200 meters and those that do (which affects the size of the ensonified area they may be exposed to). The Final PEA includes summary tables of the number of estimated Level B harassment takes by acoustic sources of each species affected in the three research areas. It also includes a summary of an assessment of biological effects from SWFSC acoustic equipment used during research (Appendix C, Section 7). Output frequencies of some active acoustic sources (short range echosounders, Acoustic Doppler Current Profilers) are higher than the functional hearing ranges of marine mammals so no adverse effects are anticipated. Other acoustic sources operate at frequencies within the hearing range of one or more groups of marine mammals and may cause temporary and minor behavioral reactions such as swimming away from an approaching ship. None of the SWFSC acoustic equipment is likely to present risks of hearing loss or injury to any marine mammal.

The LOA application combines estimated Level A harassment takes with serious injury or mortality takes because the degree of injury resulting from gear interaction cannot be predicted. The estimated take numbers are based on the historical capture of two species of cetaceans (Pacific white-sided dolphin and northern right whale dolphin) and two species of pinnipeds (California sea lion and northern fur seal) during SWFSC research surveys, primarily in pelagic trawls but also on pelagic longline gear. From 2008 through 2012, a total of 58 marine mammals were captured in trawl gear (three different surveys); 50 were killed, one was released alive but considered injured, and seven were released alive with no obvious signs of injury. Of the 50 animals that were killed, 27 were Pacific white-sided dolphins, six were northern right whale dolphins, 14 were California sea lions, and three were northern fur seals. During this period, five California sea lions were caught or entangled in pelagic longline gear; all were released alive but two had apparent injuries.

The number of marine mammals that have interacted with research gear varied substantially from 2008 through 2012. After many years with no or very rare takes of marine mammals, the 2008 field season ended with a large number of marine mammals being taken (43 total, with 38 killed), including several “disaster sets” where multiple animals were taken at once, primarily with the Nordic 264 trawl during the Coastal Pelagic Species survey (CPS, aka Sardine Survey). The CPS survey was suspended in 2008 due to the high number of takes and the SWFSC convened a panel of experts to examine the problem and develop more effective mitigation measures and formalized procedures. Most of the mitigation measures that are part of the Status Quo Alternative have been implemented since 2009 as a result of that expert review (Hewitt 2009), including development and deployment of a marine mammal excluder device for the Nordic 264 trawl.

For the four species that have been taken in research gear in the past, the LOA application uses a conservative approach for estimating future takes, using the average annual number of animals caught in different gear types from 2008-2012, rounding up to the nearest whole number of animals, and assuming this number of animals could be caught every year during the five- year authorization period. The SWFSC considers this estimation method to be conservative in that it likely overestimates the number of animals that would be caught in the future in order to ensure accounting for the maximum amount of potential take. This is especially true because additional mitigation measures and equipment have been implemented since the highest numbers of historical takes occurred in 2008. The Final PEA uses the estimated takes in the LOA application to assess the impacts on marine mammals, given the likelihood that these are overestimates, the actual effects from injury, serious injury or mortality could be substantially less than described.

Other species that have not been captured in the past have been included in the LOA application's request for take authorization based on their similarity to species that have been taken by the SWFSC and incidental take in analogous commercial fisheries. Because the scope of research activities under the Status Quo Alternative is the same as the Preferred Alternative in the CCRA, the estimated take numbers from the LOA application are used as part of the analysis of effects on marine mammals in this research area under both alternatives. The Status Quo Alternative does not include any gear that is likely to cause Level A harassment or lethal takes in the ETPRA. The Preferred Alternative adds a new pelagic longline survey in the ETPRA; the LOA application estimates future takes in the ETPRA on pelagic longline gear based on incidental take of marine mammals in analogous commercial fisheries. SWFSC research in the ARA does not include any fishing gear likely to result in interactions with marine mammals and no takes by gear interaction are anticipated under any of the alternatives in this area.

The Final PEA includes summary tables of the number of estimated Level A/serious injury or mortality takes for each species affected in the CCRA and ETPRA. One of the key elements of the effects analysis is to determine the adverse impact of takes on each species. The Final PEA and LOA application compare estimated future takes for each species with its Potential Biological Removal (PBR) as part of this impact determination. The MMPA defines PBR as, "...the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population." PBR was intended to serve as an upper limit guideline for fishery-related mortality for each species. Given the similarity of fisheries research to many commercial fisheries and the role research plays in supporting commercial fisheries, it is appropriate to assess the impacts of incidental takes in a similar manner.

PBR is used as one of the criteria for determining the level of adverse impacts on marine mammals in the Final PEA. For the purposes of this analysis under NEPA, research-related incidental serious injury or mortality less than or equal to 10% of PBR for the marine mammal stock is considered minor in magnitude for the population. Serious injury or mortality between 10% and 50% of PBR is considered moderate in magnitude. Serious injury or mortality greater than or equal to 50% of PBR is considered major in magnitude.

In the CCRA, estimated takes of all but two species of marine mammals would be less than 10% of their respective PBRs, would be considered unlikely to occur and rare or infrequent events, be distributed over large geographic areas, and would be considered to have overall minor adverse effects on the population. Risso's and Bottlenose dolphins are the exception, with estimated takes greater than 10% of PBR but less than 50% of PBR. The magnitude of such mortality effects, if they actually occurred, would be considered moderate and adverse on these stocks. However, given the implementation of new mitigation measures and the fact that the SWFSC has never taken either of these dolphin species in the past, the SWFSC considers the risk of taking either species to be very low (i.e., a rare event unlikely to occur in the next five years) and the overall assessment of potential adverse impact on the population of these species is minor.

In the ETPRA, the Status Quo Alternative does not include any fishing gear likely to cause interactions with marine mammals and no takes are anticipated. Under the Preferred Alternative, the new pelagic longline survey has the potential to result in interactions with marine mammals. The LOA application estimates an average of one take per five-year period for each of nine cetacean species and an average of one take per year over the five-period for each of two pinniped species. Because the ETPRA is outside of U.S. waters, the MMPA does not require PBR to be calculated for these stocks. However, for the purpose of the analysis in this Final PEA, the SWFSC has calculated PBR for these stocks using the best available information. For all of the marine mammal species with estimated takes in future SWFSC ecosystem research, the level of estimated takes, if they occurred, would be less than 10% of their respective PBRs, would be considered unlikely to occur and rare or infrequent events, be distributed over large geographic areas, and would be considered to have overall minor adverse effects on these populations.

The Modified Research Alternative includes the same scope of research in all three of the SWFSC research areas as the Preferred Alternative but considers a number of other mitigation measures that the SWFSC is not proposing to implement in its LOA application. The SWFSC considers the suite of mitigation measures to be implemented under the Preferred Alternative to represent the most effective and practicable means to reduce the risk of adverse interactions with marine mammals during the conduct of its research program without compromising the scientific integrity of the research program. The potential direct and indirect effects of this alternative on marine mammals would be the same as described for the Preferred Alternative except for the potential of the additional mitigation measures to reduce Level A/serious injury or mortality takes through gear interactions.

Scientists at the SWFSC continually review their procedures to see if they can do their work more efficiently and with fewer incidental effects on the marine environment, including effects on marine mammals. Many of the additional mitigation measures included in this alternative have been discussed and considered in the past by SWFSC scientists. However, any changes to operational procedures or the equipment used during surveys must also be considered from the standpoint of how they affect the integrity of the scientific data collected, the cost of implementing equipment or operational changes, and the safety of the vessel and crew. It would be speculative to quantify how much any one of these measures (or some combination of them) may reduce the risk of future takes relative to the Status Quo or Preferred Alternatives. The analysis provides a qualitative discussion of the potential for each additional mitigation measure to reduce takes and other effects on marine mammals as well as how each measure may affect practicability, data integrity, and other aspects of the research survey work.

Some elements of the Modified Research Alternative (e.g., use of Protected Species Observers and examining spatial/temporal risk factors) would offer mitigation advantages compared to the Status Quo Alternative but are addressed to some extent in the Preferred Alternative. Operational restrictions such as not allowing trawls to be set at night or in poor visibility conditions and spatial/temporal restrictions to avoid high densities of marine mammals would certainly reduce the risk of taking marine mammals. However, such restrictions would have a serious adverse impact on the ability of the SWFSC to collect certain kinds of research data and would have impacts to the cost and scope of research that could be conducted. Some concepts and technologies considered in the Modified Research Alternative are promising as a means to reduce risks to marine mammals and NMFS would continue to evaluate the potential for implementation if they become more practicable.

Under the No Research Alternative, no direct adverse impacts to marine mammals from fisheries and ecological research (i.e., takes by gear interaction and acoustic disturbance) would occur. However, some of the SWFSC research projects that would be eliminated under this alternative generate valuable ecological information on marine mammal prey distribution and abundance in the three research areas. The loss of ecological information related to marine mammals could indirectly affect resource management decisions concerning the conservation of marine mammals. There are too many unknown variables to estimate the specific effects this lack of information would mean to any particular stock of marine mammal but the No Research Alternative would likely have minor adverse effects for some species.

Seabirds

There have been no known adverse interactions with seabirds during SWFSC research activities; there are no records of gear interactions or ship strikes. The addition of a new pelagic longline survey in the ETPRA under the Preferred Alternative increases the risk of capturing seabirds in that area. However, incidental take of seabirds is unlikely and would not result in any measurable changes to seabird populations. Under the Modified Research Alternative, the SWFSC would deploy streamer lines before longline gear is set to mitigate the risk of catching seabirds. If seabird interactions with longline gear are documented in the future, the SWFSC would revisit whether use of streamer lines is warranted given the tradeoffs between the potential conservation benefit and operational and safety considerations. The adverse effects of the three research alternatives on seabirds are considered minor. Some of the SWFSC surveys have bird biologists on board to conduct transect surveys for bird distribution and abundance in each of the three research areas. This information is used by the U.S. Fish and Wildlife Service and other international resource management agencies to help with bird conservation issues and is considered to have indirect beneficial effects on the birds. Under the No Research Alternative, the risk of direct adverse effects on seabirds from SWFSC research would be eliminated, but there could be potential long-term minor to moderate adverse impacts to seabirds because resource management authorities would lose important ecological information needed to establish effective and timely management measures.

Sea Turtles

There has been only one sea turtle captured during SWFSC research in the past, a leatherback turtle that was caught in a trawl net but released alive with no signs of severe injuries. Most SWFSC pelagic longline surveys use large circle hooks and finfish bait to minimize the risk of catching sea turtles, and no takes have occurred on this gear. Under the three research alternatives, adverse impacts to sea turtles are expected to be rare and have minor effects on all species of sea turtles in the CCRA and ETPRA. As with seabirds and marine mammals, sea turtle studies included in the three research alternatives provide information for NMFS and other institutions interested in sea turtle recovery and conservation. The information collected during SWFSC research has indirect beneficial effects on sea turtles that would be lost under the No Research Alternative.

Invertebrates

Under the three research alternatives, short term, minor adverse impacts to invertebrates are expected from SWFSC research activities. The amount of invertebrates caught in research surveys is minimal compared to population levels. The SWFSC conducts research to monitor the recovery of two ESA-listed invertebrate species, white abalone and black abalone, but these studies are conducted with camera technologies and have no adverse impacts on these species. As is the case with fish, the SWFSC conducts research and provides stock assessment advice for several species of invertebrate species with valuable commercial fisheries, such as market squid in the CCRA and krill in the ARA. The SWFSC research is important for the scientific and sustainable management of these fisheries, helping to prevent overfishing on the stocks. Under the No Research Alternative, direct adverse impacts to invertebrates would be eliminated. However, the loss of stock assessment information could result in minor to moderate adverse effects on commercially targeted species through increasing uncertainty in the fishery management environment.

Social and Economic Environment

Under the three research alternatives, long term, beneficial impacts to the social and economic environment are expected from ongoing SWFSC fisheries and ecosystem research activities. Research provides important scientific information which is the basis for sustainable fisheries management for some of the most valuable commercial and recreational fisheries along the U.S. West Coast, which benefits commercial and recreational fisheries and the communities that support them. These industries have large economic footprints, generating billions of dollars' worth of sales and thousands of commercial fishing-related jobs; millions of recreational fishers participate and support fishing gear and support service industries. Fisheries research activities also provide financial support for fishing communities through purchase of fuel, vessel charters, and supplies. Continued SWFSC fisheries research is important to build trust and cooperation between the fishing industry and NMFS scientists and fisheries managers. In the Eastern Tropical Pacific, SWFSC ecosystem research provides fundamental information on the status and distribution of marine mammals that informs international management of the yellowfin tuna fishery and conservation efforts related to military exercises and shipping traffic. In the Antarctic, SWFSC fisheries and ecosystem research fulfills U.S. international treaty obligations by providing scientific information for the sustainable management of valuable commercial fisheries on krill and Antarctic toothfish, of which the U.S. is the largest importer.

The No Research Alternative would likely have long term adverse impacts on the social and economic environment through greater uncertainty in fisheries management, which could lead to more conservative fishing quotas or an increased risk of overfishing, followed by reductions in commercial and recreational fisheries harvest quotas. The lack of scientific information would also compromise efforts to rebuild overfished stocks and monitor the effectiveness of no-fishing conservation areas. These impacts would cripple the ability of NMFS to comply with its obligations under the Magnuson-Stevens Fishery Conservation and Management Act. It would also eliminate research-associated federal spending on charter vessels, fuel, supplies, and support services in various communities. The No-Research Alternative would also have long-term adverse impacts on the scientific information the SWFSC contributes to meet U.S. obligations for living marine resource management under international treaties. The SWFSC provides scientific advice to support numerous international fisheries councils, commissions, and conventions. Research conducted by the SWFSC has also been critical in development and successful implementation of ecosystem-based management in Antarctica in order to fulfill the conservation objectives of the Antarctic Treaty. Under the No Research Alternative, the contribution of the SWFSC to supporting U.S. treaty obligations would be lost. In these international management organizations, NMFS fisheries conservation and management measures would be compromised and other, potentially competing interests to those of NMFS and the U.S., would have a relatively greater voice.

CHAPTER 5 – CUMULATIVE EFFECTS

Cumulative effects are the net result of all past, present, and reasonably foreseeable future actions on the human environment over time. An individual action may have only minor or moderate impacts, but the cumulative effects of all actions may be major. NEPA requires an analysis of cumulative effects in order to alert decision makers to the full environmental consequences of a proposed action and its alternatives on resource areas of concern. This analysis looks at the overall cumulative impact and the contribution of fisheries research activities to the overall cumulative impact.

In terms of fisheries, understanding how the cumulative impacts from human activities and trends in the natural environment have influenced the marine environment over time is key to understanding the importance of NMFS role in fisheries management. The need for scientific information from SWFSC research activities is in large part the result of past actions that contributed to major adverse impacts on fish stocks from overfishing, pollution of coastal and ocean areas from accidental and intentional discharges, runoff of agricultural and industrial waste, and degradation of habitat from commercial fishing and dam construction, among other activities. Federal efforts within the last 40 years to reduce pollution, restore degraded habitats, and effectively manage commercial and recreational fishery harvests have reversed some of these trends. A number of important fishery stocks have been restored to healthy levels and others are in the rebuilding process.

Similarly, cumulative impacts from human activities and trends in the natural environment over time have contributed major adverse impacts to populations of marine mammals, marine turtles, and other marine species. As a result, the MMPA and ESA were enacted to help address specific conservation concerns and many human activities are subject to federal management measures to protect marine species and promote recovery of impacted populations.

Climate change and increase in ocean acidification have the potential to impact populations and distributions of many marine species. Fisheries research activities do not contribute to these long-term, global environmental processes. However, long-term, systematic marine research provides important scientific information on changes and trends in marine ecosystems.

In addition to SWFSC research efforts, there are many current and reasonably foreseeable activities that may contribute to cumulative impacts on the three marine environments the SWFSC operates in, including: conservation efforts, commercial shipping, commercial and recreational fisheries, oil and gas and alternative energy development, military activities, coastal development projects, marine research activities by other agencies and institutions, and other human activities that contribute to global climate change. These actions can produce both adverse and beneficial impacts that directly and indirectly affect ocean resources managed by NMFS and the social and economic environment of fishing communities that rely on them.

This Final PEA generally considers the contribution of the three research alternatives to the cumulative effects on given resources to be very similar and they are often discussed together. The contribution of the No Research Alternative to the cumulative effects on resources is quite different and is discussed separately.

As described in the Chapter 4 summary above, SWFSC research activities would have minor adverse effects on the various resource components of the physical and biological environments. Because SWFSC research activities involve such a small number of vessels compared to other vessel traffic and collect relatively small amounts of biomass compared to commercial and recreational fisheries, the contribution of the three research alternatives to cumulative adverse effects on fish, marine mammal, and other species and resource areas is very small. The proposed SWFSC scientific research activities would also have beneficial contributions to cumulative effects on both biological and socioeconomic resources. The research alternatives contribute substantially to the science that feeds into federal fishery management measures aimed at rebuilding and managing fish stocks in a sustainable manner. It also contributes to understanding the nature of changes in the marine environment and adjusting resource management plans accordingly, and it helps meet international treaty research obligations. The research activities under the three research alternatives help alleviate adverse cumulative impacts on the biological and socioeconomic environments, resulting in long-term beneficial contributions to cumulative effects.

The No Research Alternative would not contribute to direct adverse effects on the marine environment (e.g., research catch of fish and incidental take of marine mammals) but would contribute indirect adverse effects on both the biological and socioeconomic environments based on the lack of scientific information to inform future resource management decisions.

OTHER SECTIONS

In addition to the chapters summarized above, the Final PEA includes a description of the laws applicable to SWFSC research activities in Chapter 6, cited references in Chapter 7, and a list of preparers and consulting agencies in Chapter 8. Appendix A provides a description of the fishing gear, other scientific instruments, and vessels used during SWFSC research activities. Appendix B includes figures showing the seasonal distribution of research effort in the three research areas. Appendix C is the SWFSC's application for promulgating regulations under the Marine Mammal Protection Act and Letters of Authorization from NMFS Office of Protected Resources for incidental take of marine mammals. Appendix D contains proposed handling and data collection procedures for marine mammals and sea turtles that are incidentally caught during the conduct of SWFSC fisheries research activities; these procedures would be implemented after the SWFSC receives authorization for such incidental takes when the MMPA LOA and ESA consultation processes are completed.

CONCLUSION

Based on the analysis in this Final PEA, NMFS has determined the proposed actions to conduct scientific research activities and issue LOAs would not significantly impact the quality of the human environment. In addition, with implementation of the mitigation measures identified during the analysis and in consultation with NMFS, all beneficial and adverse impacts of the proposed action have been addressed to reach the conclusion of no significant impacts. Accordingly, preparation of an environmental impact statement for this action is not necessary. A final determination on whether potential impacts of the proposed action are significant will be made and documented in the Finding of No Significant Impact (FONSI), which will be noticed in the Federal Register and made available to the public.

1.1 NOAA'S RESOURCE RESPONSIBILITIES AND ROLE IN FISHERIES RESEARCH

The Federal Government has a responsibility to protect living marine resources in waters of the United States (U.S.), also referred to as federal waters. These waters generally lay 3 to 200 nautical miles (nm) from the shoreline, and comprise the Exclusive Economic Zone (EEZ). The U.S. government has also entered into a number of international agreements and treaties related to the management of living marine resources in international waters outside of the U.S. EEZ. To carry out its responsibilities over federal and international waters, Congress has enacted several statutes authorizing certain federal agencies to administer programs to manage and protect living marine resources. Among these federal agencies, the National Oceanic and Atmospheric Administration (NOAA) has the primary responsibility for protecting marine finfish and shellfish species and their habitats. Within NOAA, the National Marine Fisheries Service (NMFS) has been delegated primary responsibility for the science-based management, conservation, and protection of living marine resources.

Within the area covered by this Final Programmatic Environmental Assessment (Final PEA), NMFS manages finfish and shellfish harvest under the provisions of several major statutes, including the Magnuson-Stevens Fishery Conservation and Management Act (MSA)[6], the Tuna Conventions Act, the Marine Mammal Protection Act (MMPA), the Endangered Species Act (ESA), the International Dolphin Conservation Program Act (IDCPA), and the Antarctic Living marine resources Convention Act (AMLRCA). Accomplishing the requirements of these statutes requires the close interaction of numerous entities in a sometimes complex fishery management process. In the NMFS West Coast Region, the entities involved are the Southwest Fisheries Science Center (SWFSC), Northwest Fisheries Science Center (NWFSC), NMFS West Coast Regional Office, NOAA Fisheries Headquarters, the Pacific Fisheries Management Council, the Pacific Salmon Commission, the Pacific States Marine Fisheries Commission, Native American tribal governments, stakeholder groups, and a number of international fisheries management organizations and commissions.

1.1.1 Fisheries Science Centers

Six Regional Fisheries Science Centers direct and coordinate the collection of scientific information needed to make fisheries management decisions[7]. Each Fisheries Science Center is a distinct entity and is the scientific focal point for a particular region (Figure 1.1-1). Until recently, the SWFSC provided scientific support for NMFS Southwest Region while the NWFSC provided scientific support for NMFS Northwest Region. In the fall of 2013, NMFS merged the Southwest and Northwest regional offices into a single administrative unit, the West Coast Regional Office. However, the SWFSC and NWFSC remain separate research institutions which independently contribute scientific information to the West Coast Region, although they frequently collaborate and have overlapping geographical research areas. The SWFSC conducts research and provides scientific advice to manage fisheries and conserve protected species along the U.S. West Coast, throughout the Eastern Tropical Pacific (ETP) Ocean, and in the Southern Ocean off Antarctica (Figure 1.1-2).

[6] 16 U.S.C. §§ 1801-1884, (MSA 2007).

[7] The six Regional Fisheries Science Centers are: 1) Northeast, 2) Southeast, 3) Southwest, 4) Northwest, 5) Alaska, and 6) Pacific Islands.

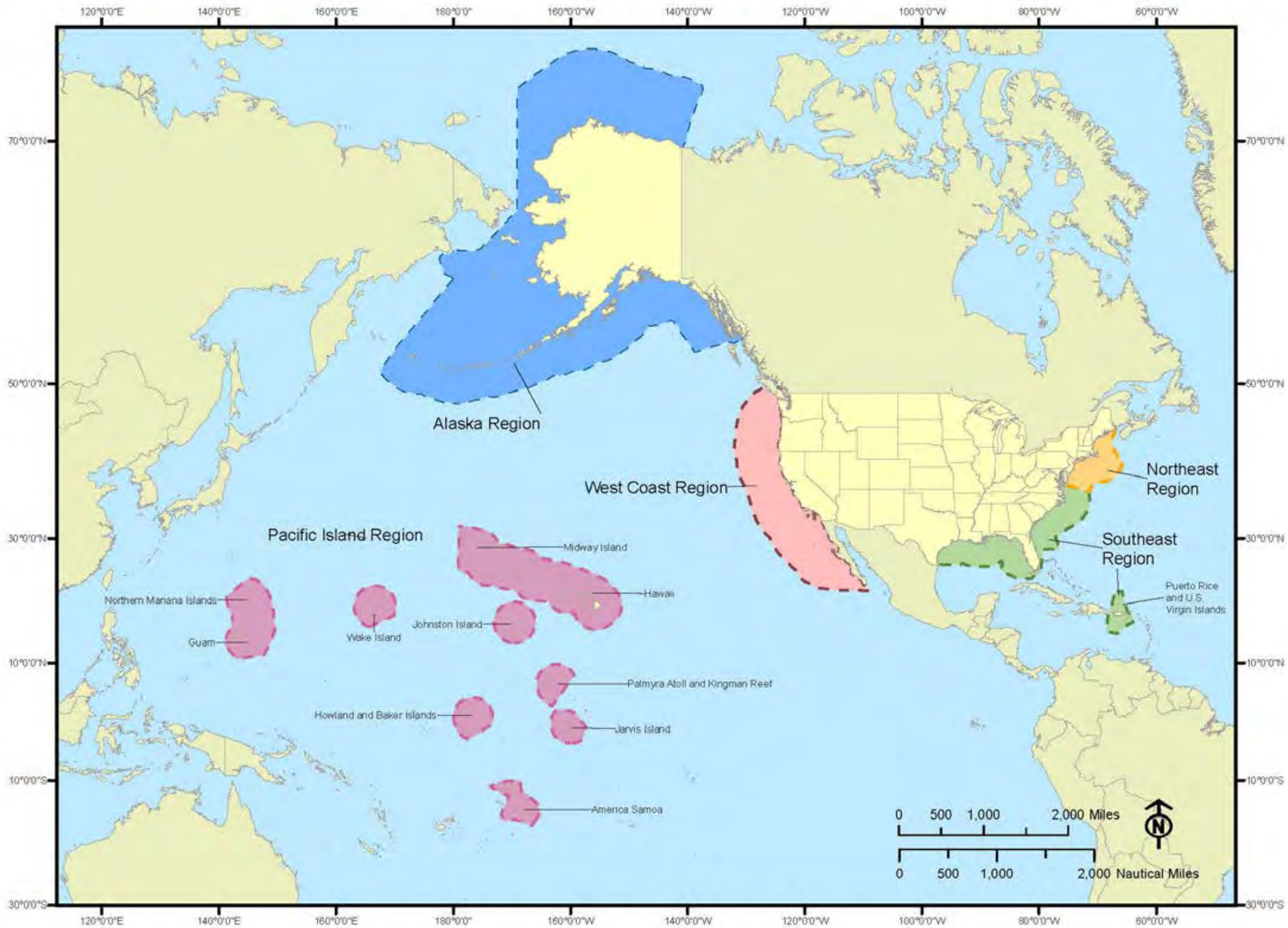


Figure 1.1-1 NMFS Fisheries Regions.

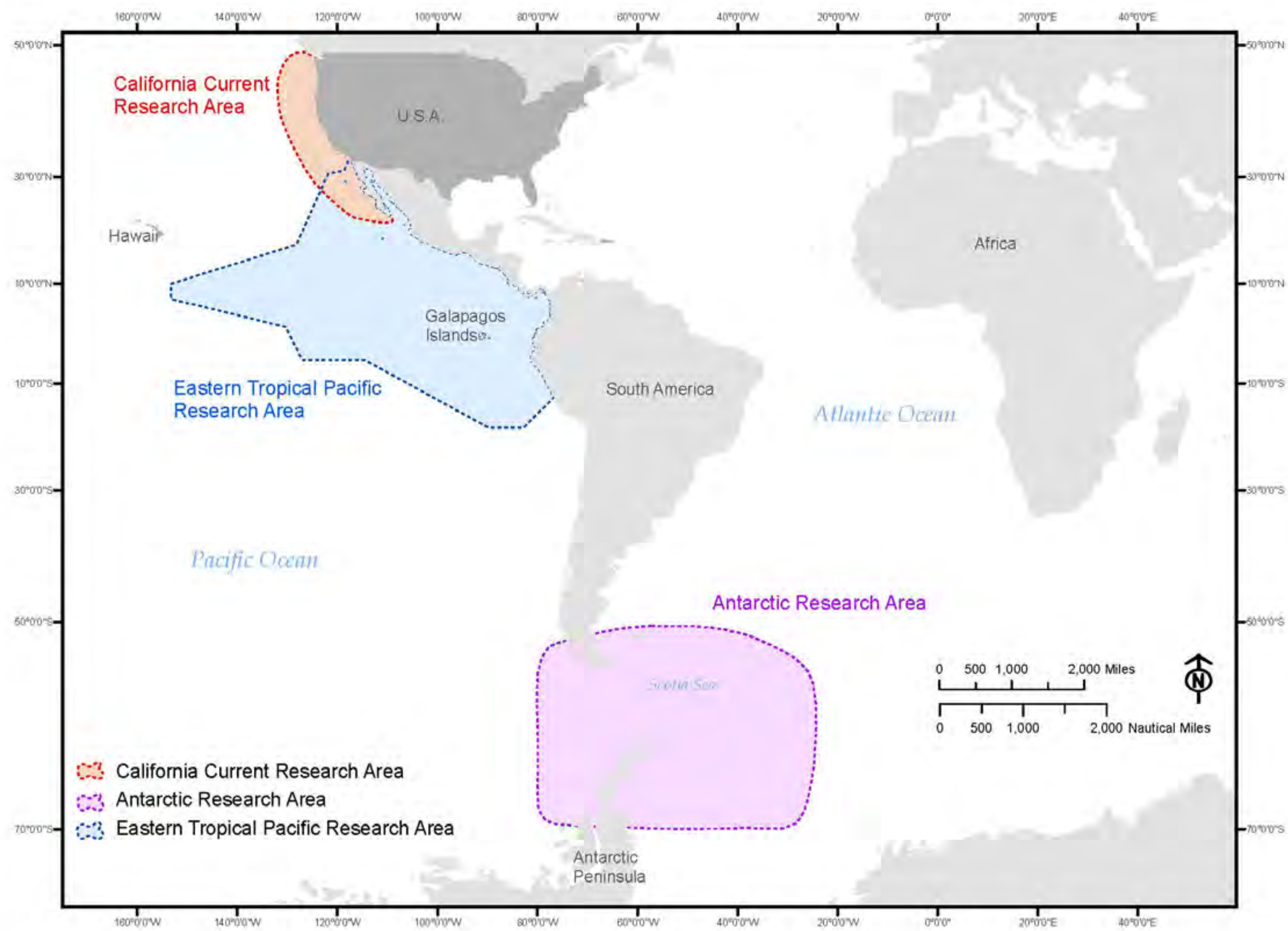


Figure 1.1-2 SWFSC Research Areas.

1.1.2 Fisheries Management Councils

In order to encourage a collaborative approach to fisheries management, the MSA established the nation's eight Regional Fishery Management Councils[8]. In the Pacific, the Pacific Fisheries Management Council (PFMC) includes Washington, Oregon, California, and Idaho. The North Pacific Fisheries Management Council (NPFMC) is concerned with the waters around Alaska. In the far west, the Western Pacific Regional Fishery Management Council covers federal waters off the shores of the U.S. Pacific Islands including Hawaii, American Samoa, the Mariana Archipelago, and U.S. Pacific Remote Islands. The councils, which include fishing industry representatives, fishers, scientists, government agency representatives, federal appointees, and others, are designed to provide all resource users and managers a voice in the fisheries management process. Under the MSA, the councils are charged with developing Fishery Management Plans (FMPs) and management measures for the fisheries occurring within the EEZ adjacent to their constituent states. Data collected by fisheries science centers are often used to inform FMPs, as well as to inform other policies and decisions promulgated by the Fishery Management Councils. Such policies and decisions sometimes affect areas that span the jurisdictions of several Fishery Management Councils, and make use of data provided by multiple fisheries science centers.

1.1.3 Federal Tribal Obligations

NMFS West Coast Regional Office has frequent contact with federally recognized Native American tribes in Washington, Oregon, and California that have retained treaty rights to harvest salmon and other fish species (marine and freshwater) as well as shellfish and terrestrial food resources. Many inland tribes also have strong interests in marine and coastal issues because of anadromous fish species they value. The SWFSC regularly collaborates and consults with various tribes and tribal groups that may be interested in fisheries research in both marine and fresh waters.

Additionally, there are a number of tribes that have commercial marine fisheries of whiting, rockfish, groundfish, and other species. Although there is not currently a specific tribal consultation requirement for fisheries management councils, the councils often engage in robust and substantial outreach efforts. Activities include community, tribal consortia, and other forums for meetings and outreach efforts that in many ways exceed the formal consultation requirements of federal agencies. All FMPs promulgated by the Pacific Fisheries Management Council involve tribal fishing rights. Council fisheries are managed as part of a larger group of fisheries, in which management authority over tribal fisheries is effectively conferred to the tribes themselves, allowing tribal self-management and state-management to co-exist within a relationship of co-management. In addition, the MSA section 302(b)(5)(D) requires that the PFMC includes one representative and an alternate from a Native American tribe with federally recognized fishing rights from California, Oregon, Washington, or Idaho.

On April 23, 2013, SWFSC sought advice from and to engage in consultation with the Hoh, Makah, Quileute and Quinault tribes in the Pacific Northwest on the potential impacts of proposed fisheries and ecosystem research activities on tribal trust resources, including Pacific sardine, Pacific hake, other coastal pelagic species, juvenile salmon and juvenile rockfish. In addition, on August 7, 2014, SWFSC sought similar advice from and engagement with the following California tribes whose trust resources might be affected by SWFSC proposed research: Bear River of Rohnerville, Big Lagoon, Elk Valley, Hoopa Valley, Karuk, Klamath, Manchester, Quartz Valley, Round Valley, Smith River, Stewarts Point, Table Mountain, Trinidad and Yurok. SWFSC received no responses or expressions of interest to engage in further discussions as a result of its consultation letters. As such, SWFSC concluded that these tribes agreed with its preliminary assessment that any impacts resulting from proposed fisheries and ecosystem resources to tribal trust resources would not be significant because of the negligible magnitude and intensity, short-term duration, localized geographic extent and low likelihood of measurable population change or localized depletion.

[8] The eight fisheries management councils are New England, Mid-Atlantic, South Atlantic, Gulf of Mexico, Caribbean, Pacific, North Pacific, and Western Pacific.

1.1.4 Other Domestic and International Fisheries Management Organizations

In addition to providing information to domestic fisheries management councils, the SWFSC provides scientific advice to support numerous domestic and international fisheries councils, commissions, and conventions. Marine Fisheries Commissions were created in the recognition that fish do not adhere to political boundaries. Scientists from the SWFSC regularly interact with the Pacific States Marine Fisheries Commission (PSMFC), Western and Central Pacific Fisheries Commission (WCPFC), Pacific Salmon Commission (PSC), International Pacific Halibut Commission (IPHC), International Scientific Committee for Tuna and Tuna-like Species (ISC), Inter-American Tropical Tuna Commission (IATTC), International Whaling Commission (IWC), the Parties to the Agreement on the International Dolphin Conservation Program (AIDCP), and the Convention for the Conservation of Antarctic Living marine resources (CCAMLR). Research conducted by the SWFSC has also been critical in development and successful implementation of ecosystem-based management in Antarctica in order to fulfill the conservation objectives of the Antarctic Treaty.

In the West Coast Region, the PSMFC is a domestic organization that promotes and supports policies and actions to conserve, develop, and manage fishery resources in California, Oregon, Washington, Idaho and Alaska. Although the PSMFC has no regulatory or management authority, the commission serves a number of other functions vital to the sustainable utilization of marine fisheries, such as providing for collective participation for Pacific States to work on mutual concerns, and serving as a forum for discussion of fisheries resource issues that may fall outside of state or regional management council jurisdiction.

The WCPFC is an international organization that aims to ensure the long-term conservation and sustainable use of highly migratory fish stocks (i.e., tunas, billfish, and marlin) in the western and central Pacific Ocean. The WCPFC was established by the Convention for the Conservation and Management of Highly Migratory Fish Stocks in the western and central Pacific Ocean (WCPFC Convention) which was enacted in 2004. WCPFC is made up of 25 member nations (including the European Union), plus several participating territories and cooperating nations, who have an interest in the management of high seas fisheries in the western Pacific Ocean. The Convention applies to waters of the Pacific Ocean including areas around Hawaii, American Samoa, Guam, the Commonwealth of the Northern Marianas Islands, and U.S. Pacific Remote Island areas, and therefore encompasses the operational area of significant U.S. purse seine, longline, and distant-water troll fisheries, as well as local fisheries for highly migratory species (HMS). Through the WCPFC, the U.S. is directly engaged in the development of fisheries management measures to manage and conserve bigeye, yellowfin, and albacore tunas, and to minimize impacts on the non-associated and dependent species, such as sea turtles and seabirds. SWFSC scientists serve and/or provide scientific advice to U.S. representatives on WCPFC committees.

The PSC is a sixteen-person body with four Commissioners and four alternates each from the United States and Canada, representing the interests of commercial and recreational fisheries as well as federal, state and tribal governments. The PSC provides regulatory advice and recommendations to the appropriate agencies in the United States and Canada. The commission has responsibility for all salmon originating in the waters of one country which are subject to interception by the other, affect management of the other country's salmon, or affect the biology of salmon stocks of the other country. In addition, the PSC is charged with taking into account the conservation of steelhead trout while fulfilling its other functions.

The IPHC is an international organization responsible for the preservation of the halibut fishery of the North Pacific Ocean and Bering Sea. The main functions of the IPHC are to conduct and coordinate scientific studies relating to the halibut fishery and to formulate regulations designed to develop the stocks of halibut to levels that permit optimal utilization. The IPHC submits regulations, mainly the total allowable catch of halibut, to the governments of the United States and Canada for approval. Upon approval, the regulations are enforced by the appropriate agencies of both governments.

Current members of the ISC include Canada, China, Chinese-Taipei, Japan, Korea, Mexico, and the U.S. The purpose of the ISC is to enhance scientific research and cooperation for conservation and rational use of the species of tuna and tuna-like fisheries that inhabit the North Pacific Ocean, and to establish the scientific groundwork for the conservation and rational use of these species in the region. The results of the ISC are made available to participating members and HMS Regional Fishery Management Organizations of the Pacific Ocean. Through a Memorandum of Understanding, the ISC provides scientific support for the work of the Northern Committee of the WCPFC.

The IATTC is an international fisheries management organization concerned with the long-term conservation and sustainable use of tunas and billfish, as well as other components of the ecosystem (e.g., dolphins, turtles, non-target finfish, and sharks) that may be affected either directly or indirectly by fishing operations conducted in the Eastern Pacific Ocean (east of 150° W longitude to the coast of North, Central and South America between 50° N and 50° S latitudes). The IATTC was established under a 1949 convention between Costa Rica and the U.S. In 2010, the Antigua Convention entered into force, broadening the scope of the IATTC to include the conservation of non-target stocks and other components of the Eastern Pacific Ocean ecosystem. The IATTC is currently made up of 21 nations and fishing entities. The U.S. provides scientific input into stock assessments and conservation and management recommendations for target and non-target stocks in the convention area.

The agreement on the International Dolphin Conservation Program (IDCP) is closely aligned with the IATTC. The two organizations share a secretariat, an onboard observer program, some parts of their annual budgets, and a convention area. Whereas the IATTC has historically been primarily concerned with the management and sustainable use of tunas and tuna-like species in the Eastern Pacific Ocean, the agreement on the IDCP has been focused on monitoring and decreasing dolphin deaths in purse-seine fisheries for tunas in “dolphin sets.” This technique involves intentionally chasing and encircling schools of dolphins to capture large yellowfin tuna that associate with certain dolphin stocks in the Eastern Pacific Ocean.

The IWC was established in 1946 under the International Convention for the Regulation of Whaling for the purpose of conserving whale populations and managing commercial and subsistence whaling efforts. In addition to its whaling management responsibilities, the IWC encourages, coordinates, funds, and publishes the results of scientific whale research. The IWC Scientific Committee includes many of the world’s leading whale biologists, including scientists from the SWFSC, and provides advice on management issues based on scientific research. SWFSC research on whale distribution, abundance, and behavior in the Scotia Sea has provided valuable ecological information for the conservation of many species.

The CCAMLR was established in 1982 for the purpose of protecting and conserving the living marine resources in the waters surrounding Antarctica. CCAMLR is based upon an ecosystem approach to the conservation of living marine resources and incorporates standards designed to ensure the conservation of individual populations and species, and the Antarctic marine ecosystem as a whole. CCAMLR is comprised of the commission, executive secretary, and the scientific committee. The commission consists of one representative from each member nation and is responsible for facilitating research, compiling data on the status of and changes in Antarctic Marine Living Resources (AMLR), ensuring the acquisition of catch and effort data, publishing information, identifying conservation needs, adopting conservation measures, and implementing a system of observation and inspection. The executive secretary handles the administrative matters for the commission. The scientific committee recommends research programs and conservation and other measures to the commission. The results of SWFSC research are presented to the scientific advisory bodies of the CCAMLR. SWFSC scientists have held leadership positions in all of CCAMLR’s Working Groups and the Scientific Committee. In addition, SWFSC is the primary source of scientific advice to the U.S. Commissioner and delegation to CCAMLR.

1.1.5 Role of Fisheries Research in Federal Fisheries Management

Fisheries managers use a variety of techniques to manage marine resources, a principal one being the development of FMPs. FMPs articulates fishery goals as well as the methods used to achieve those goals, and their development is specifically mandated under the MSA. The SWFSC provides scientific information and advice to assist with the development of FMPs prepared by the NMFS, the PFMC, the WPFMC, and other agencies.

Through its Regional Fisheries Science Centers, NMFS conducts primarily fisheries-independent research on the status of living marine resources and associated habitats. Fisheries-independent research is designed and conducted independent of commercial fishing activity to meet specific research goals, and includes research directed by SWFSC scientists and conducted on board NOAA-owned and operated vessels or NOAA-chartered vessels.

SWFSC resource surveys are designed to collect the data needed to inform fisheries stock assessment models so that harvest guidelines and management actions will foster sustainable commercial and recreational fisheries. Stock assessments rely on a suite of biological attributes: data on abundance, demographic composition (age composition and length) and life history (vital rates such as growth and maturity). SWFSC resource surveys take a multidisciplinary approach with a goal of characterizing the ecosystem by collecting data on oceanography, plankton, mid-trophic level species, and top predators; ecological data are used to interpret trends in abundance of the fish and mammal stocks of interest and to set harvest guidelines that take the state of the environment into account. To accomplish these goals, resource surveys provide data on spawning biomass (via various methods depending on the species of interest, including acoustics, capture, plankton sampling and continuous underwater egg counts).Trawls collect fish in order to determine demographic parameters (age composition, length), vital rates (growth, maturity), and tissue samples are taken for stock identification and other genetic analyses. Plankton samples are collected for species identification and to determine changes in community composition. For highly migratory species, SWFSC longline surveys provide samples and data for examining the relative abundance and size of key species and their growth and movement patterns through the use of conventional and chemical tags. The AMLR surveys are designed to map krill distribution and abundance, to measure environmental variables influencing krill abundance and distribution, and to conduct bottom trawl surveys to characterize Antarctic finfish populations and their relationships to other components of the Antarctic ecosystem. The long time series and the extensive sample collections enable the SWFSC to study the impacts of climate variability and change on marine populations and trends in community composition.

SWFSC resource surveys collect the information needed to inform stock assessment models (abundance, demographics and life history) which form the basis for natural resource decisions. SWFSC scientists collect the data in the field, analyze samples back at the lab and, combining these data with fishery dependent sources, generate stock assessment models, or work in collaboration to produce these models (many stocks are trans-boundary and require a team of international scientists to pool data).. SWFSC stock assessment science is well-regarded nationally and internationally for the quality of the data, expertise in assessment, and long, trusted working relationships with colleagues around the globe. Stock assessment data are used to set harvest rates. For species that are endangered, stock assessment data provides protection, determines closed fishing areas, and is used to generate conservation measures to promote recovery.

The SWFSC also helps fund, staff, or analyze data from fishery-independent research directed by cooperating scientists (other agencies, academic institutions, and independent researchers) conducted on board non-NOAA vessels. SWFSC fisheries-dependent research is limited to collection of harvest data while fishing vessels are in port and does not involve research conducted in marine waters during commercial fishing operations.

The fishery-independent research activities carried out by the SWFSC are programmatically evaluated within this Final PEA. (see Section 1.4).

1.2 SWFSC FISHERIES RESEARCH AREAS AND FACILITIES

The SWFSC is one of the two research arms of NMFS in the West Coast Region (the other being the NWFSC). The SWFSC plans, develops, and manages a multidisciplinary program of basic and applied research to:

- Generate the scientific information necessary for the conservation and management of the region’s living marine resources.
- Inform management of the region's marine and anadromous fish and invertebrate populations to ensure they remain at sustainable and healthy levels. Responsibilities include maintaining healthy fish stocks for commercial and recreational fishing; sustaining ecosystem services; and coordinating with domestic and international organizations to implement fishery agreements and treaties.

SWFSC research is conducted in three distinct marine environments: California Current Research Area (CCRA, Figure 1.2-1), Eastern Tropical Pacific Research Area (ETPRA, Figure 1.2-2), and Antarctic Research Area (ARA, Figure 1.2-3). The SWFSC headquarters, which includes the Torrey Pines Court Laboratory and the La Jolla Shores Drive Laboratory, is located in La Jolla, California. The Fisheries Ecology Division (FED) is based in Santa Cruz, California, adjacent to University of California Santa Cruz's Long Marine Laboratory, and the Environmental Research Division (ERD) is based in Pacific Grove, California. The SWFSC operates two field stations in California, located in Arcata and Granite Canyon. In Arcata, the Cooperative Fisheries Oceanography Research Team is a partnership between the SWFSC and Humboldt State University for fisheries oceanography. On the Antarctic Peninsula, the SWFSC’s Antarctic Ecosystem Research Division (AERD) maintains two field stations located at Cape Shirreff on Livingston Island and at Copacabana in Admiralty Bay on King George Island.

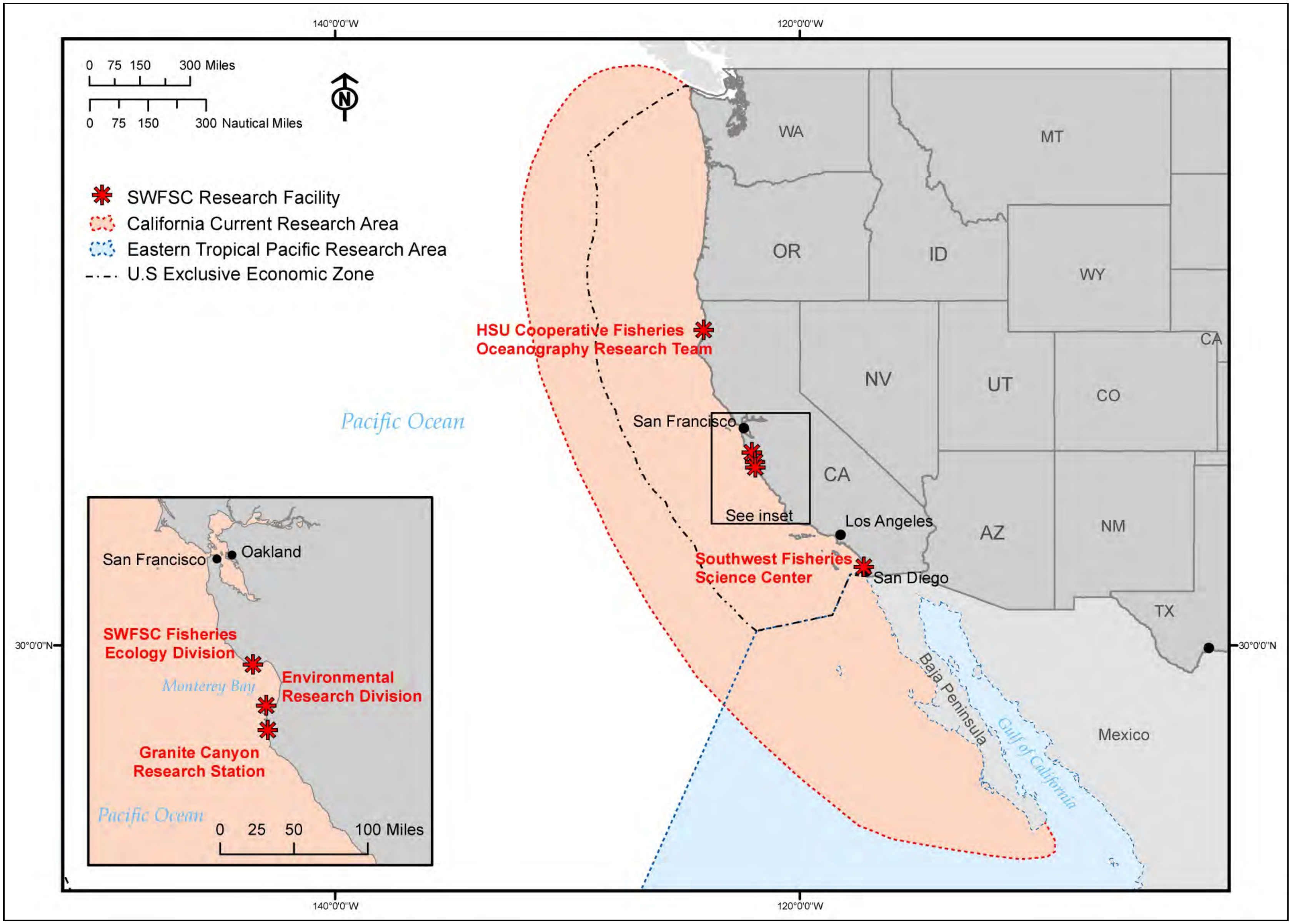


Figure 1.2-1 California Current Research Area and Research Facilities.

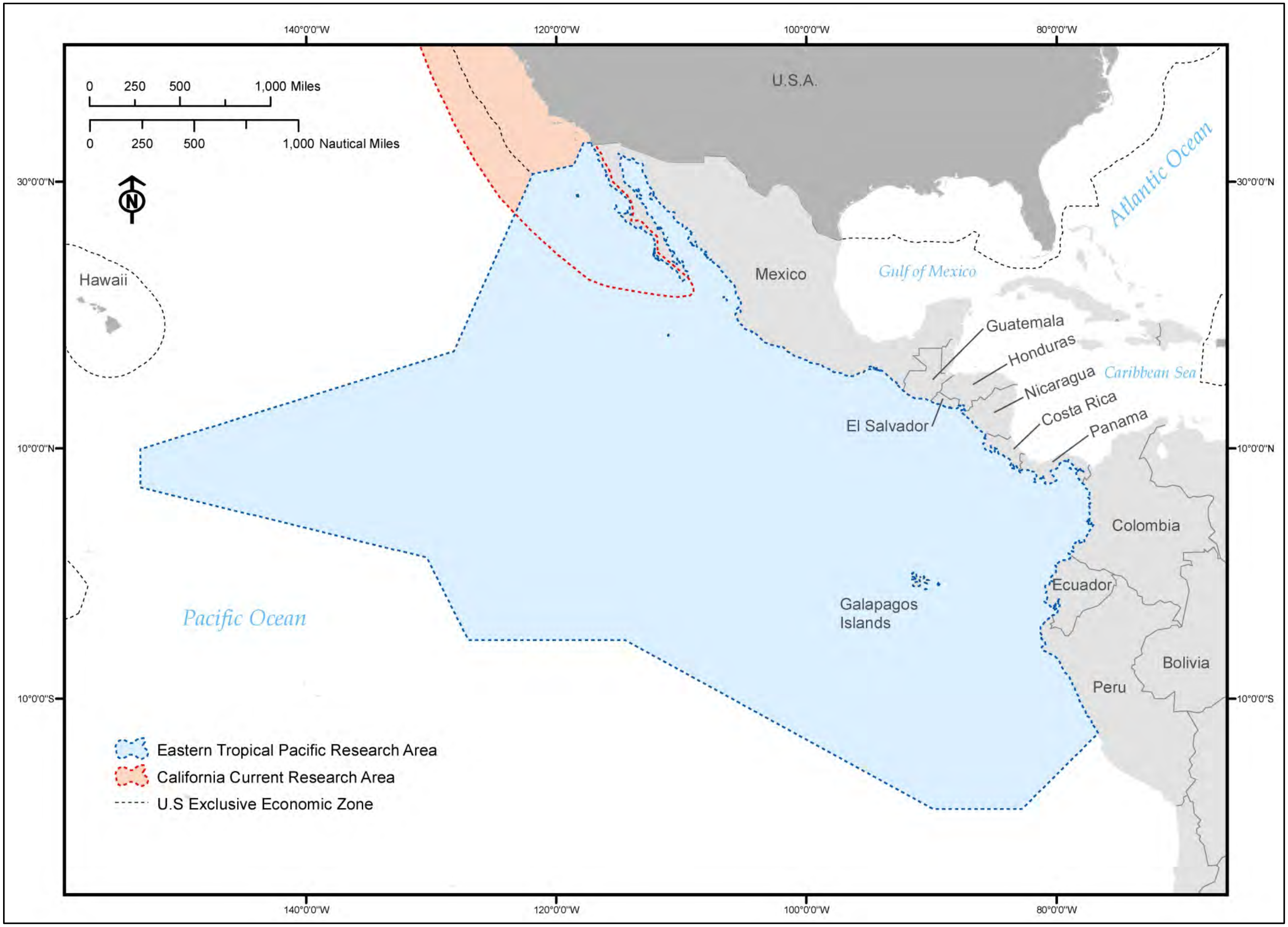


Figure 1.2-2 Eastern Tropical Pacific Research Area.

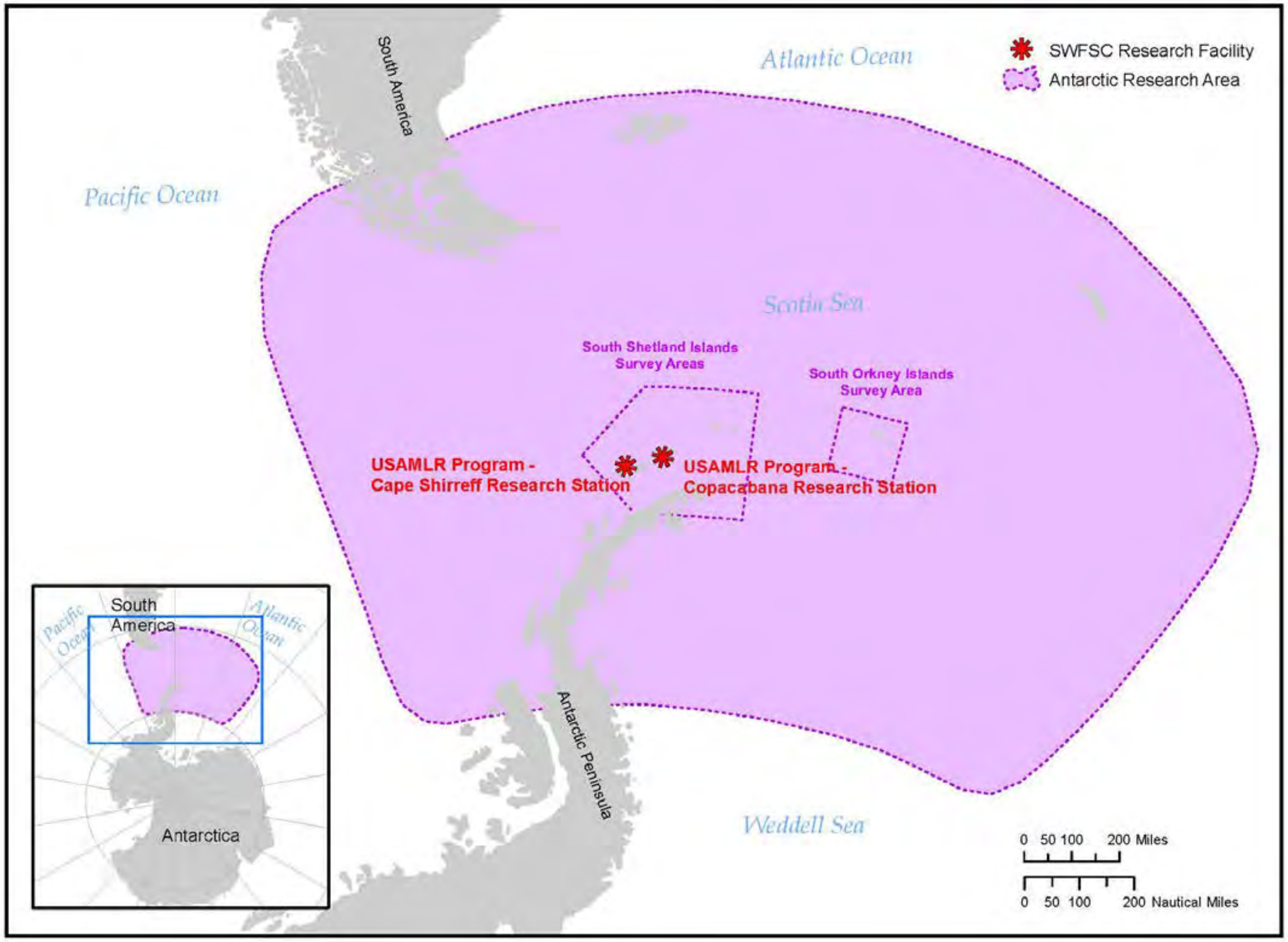


Figure 1.2-3 Antarctic Research Area and Research Facilities.

The South Shetland Islands survey area indicates the location of annual krill surveys and the South Orkney Islands survey area indicates the location of periodic benthic finfish surveys.

SWFSC research efforts are divided among five research divisions that are tasked with different roles in collecting scientific information on living marine resources and the ecosystems that sustain them.

1.2.1 Fisheries Resources Division

The SWFSC Fisheries Resources Division (FRD) develops the scientific foundation for the conservation and management of marine resources in the California Current and Pan-Pacific Pelagic Ecosystems. The division conducts seagoing surveys, genetic and morphometric research to define stock structure, life history studies to estimate production of eggs and larvae and adult vital rates, engineering work to develop advanced survey technologies, oceanographic studies to define critical habitat and population response to climate change, quantitative population assessments, and economic studies to define the value of fisheries and alternative management options. The division responds to the information needs of the Coastal Pelagic Species (CPS) FMP, Highly Migratory Species FMP, West Coast Salmon FMP and Groundfish FMP. FRD scientists also participate in international working groups and provide scientific advice to the ISC, IATTC and WCPFC.

1.2.2 Fisheries Ecology Division

The FED conducts research on the ecology of groundfish, economic analysis of fishery data, Pacific salmon studies (including 10 endangered salmon and steelhead runs), and coastal habitat issues affecting the San Francisco Bay and the Gulf of Farallones.

Results from FED research are used by the PFMC and NMFS to manage fisheries, and by NMFS to manage threatened and endangered species. FED scientists study causes of variability in abundance and health of fish populations, analyze ecological relationships in marine communities, and study the economics of exploiting and protecting natural resources. They also assess the stocks of species targeted by various fisheries, and assist in evaluating potential impacts of human activities on threatened or endangered species.

1.2.3 Antarctic Ecosystem Research Division

The AERD manages the U.S. AMLR, which provides information for U.S. policy on the management and conservation of Antarctic living resources and supports U.S. participation in international efforts to protect the Antarctic and its marine life. Research is directed toward gathering ecological and biological information to quantify the functional relationships between finfish and krill, their environment and their predators; to develop an ecosystem approach to ensure sustained harvesting of krill, fish and crabs; and to protect predator populations of seals, penguins, and pelagic seabirds resident in the Southern Ocean surrounding Antarctica.

1.2.4 Marine Mammals and Turtles Division

The Marine Mammals and Turtle Division (formerly known as the Protected Resources Division) promotes and conducts research that contributes to the conservation and management of U.S. and international populations of marine mammals and sea turtles and their designated critical habitats. Provisions of the MMPA and the ESA guide the division's activities, which include monitoring the abundance of pinniped and cetacean stocks and sea turtle populations, assessing and helping to minimize the effect of fishing operations and other human activities on these populations, determining stock structure and population dynamics, and conducting research on "dolphin-safe" tuna fishing methods. Research efforts span the entire migratory range of marine mammal and sea turtle populations. The Marine Mammals and Turtle Division monitors the life history, condition and health of populations, performs regular abundance estimates, advances studies of marine mammal acoustics, and strives to interpret these results in an ecosystem context. To do this, oceanographic data are collected to characterize habitat and its variation over time. Data are also collected on the distributions and abundance of prey fishes and squids, seabirds, and sea turtles and are used to further characterize the ecosystems in which marine mammals and other protected species live.

While the directed marine mammal and sea turtle research is outside the scope of this NEPA analysis, the specific activities using net sampling and use of active acoustics during the research conducted for marine mammal prey (fish, squid, krill, etc.) on these surveys, and other surveys conducted by the SWFSC, are in scope.

1.2.5 Environmental Research Division

The ERD conducts a flexible research program to assess, understand, and predict climate and environmental variability and its impacts on marine fish populations and ecosystems. The ERD provides science-based, globally integrated, and fisheries-relevant environmental data, products, and information to meet the research and management needs of the SWFSC, NMFS, and NOAA.

1.3 PURPOSE AND NEED

Primary Action: This Final PEA evaluates both a primary and a secondary action under the National Environmental Policy Act (NEPA). The primary action is the proposed performance of SWFSC fisheries research activities (as described above and in Section 2.2). The purpose of this primary action is to produce scientific information necessary for the management and conservation of domestic and international living marine resources in a manner that promotes both the recovery of certain species and the long-term sustainability and recovery of these resources and generates social and economic opportunities and benefits from their use. The information developed from these research activities is essential to the development of a broad array of fisheries, marine mammal, and ecosystem management actions taken not only by NMFS, but also by other federal, state, and international authorities.

The ultimate purpose of SWFSC fisheries and ecosystem research activities is to inform management of the region's marine and anadromous fish and invertebrate populations to ensure they remain at sustainable and healthy levels. In order to achieve this, the SWFSC needs to continue its research activities through a suite of programs that generate the scientific information necessary for the conservation and management of the region’s living marine resources.

Secondary Action: A secondary, related action—also called a “connected action” under NEPA (Sec. 1508.25)—is the issuance of proposed regulations and subsequent Letters of Authorization (LOA) under Section 101(a)(5)(A) of the MMPA of 1972, as amended (MMPA; 16 United States Code [U.S.C.] 1361 *et seq*.) that would govern the unintentional taking of small numbers of marine mammals incidental to the SWFSC’s research activities.

Under the MMPA, any activities resulting in the take of marine mammals must be authorized by NMFS; this includes research programs conducted by the NMFS science centers. Because the SWFSC’s research activities have the potential to take marine mammals by Level A and B harassment, serious injury and/or mortality, the SWFSC is applying to NMFS for an incidental take authorization (ITA) for its research programs.

Section 101(a)(5)(A) and (D) of the MMPA direct the Secretary of Commerce (Secretary) to allow, upon request, the incidental, but not intentional taking of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review. Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth.

Take, under the MMPA is defined as, “To harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal.” The MMPA defines harassment as, “Any act of pursuit, torment, or annoyance, which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment].”

The purpose of issuing incidental take authorizations is to provide an exemption to the take prohibition in the MMPA and to ensure that the action complies with the MMPA and NMFS implementing regulations. ITAs may be issued as either: (1) regulations and associated LOAs under Section 101(a)(5)(A) of the MMPA; or (2) an Incidental Harassment Authorizations (IHAs) under Section 101(a)(5)(D) of the MMPA. An IHA can only be issued when there is no potential for serious injury and/or mortality or where any such potential can be negated through required mitigation measures. Because there is a potential for lethal takes and takes that may result in serious injury that could lead to mortality, the SWFSC is requesting rulemaking and the issuance of LOAs for this action.

Pursuant to Section 101(a)(5)(A) of the MMPA, NMFS, upon application from the SWFSC, may propose regulations to govern the unintentional taking of marine mammals incidental to the proposed fisheries research activities by the SWFSC in the Pacific and Southern Oceans for a period of up to five years. Because the issuance of regulations and associated LOAs to the SWFSC is a major federal action, NMFS is required to analyze the effects of their issuance on the human environment pursuant to NEPA requirements and NOAA policies. As a result, one branch of NMFS (the Office of Protected Resources, Permits and Conservation Division [NMFS PR1]) evaluates the effects of issuing regulations and an ITA to another branch of NMFS (the SWFSC).

This Final PEA analyzes the environmental impacts associated with issuance of the requested authorization of the take of marine mammals incidental to the SWFSC’s conduct of fisheries research activities in the California Current and ETP areas in the Pacific Ocean and the Scotia Sea area of the Southern Ocean. It also analyzes a reasonable range of mitigation measures that were considered during the MMPA authorization process. The analysis of mitigation measures includes a consideration of benefits to the affected species or stocks and their habitat, and an analysis of the practicability and efficacy of each measure. This analysis of mitigation measures was used to support requirements pertaining to mitigation, monitoring, and reporting specified in MMPA regulations and subsequent LOAs.

Further, because the proposed research activities occur in known habitat areas of species that are listed as threatened or endangered under the ESA[9], this Final PEA evaluates potential impacts to ESA-listed species that may result from either the primary or secondary action. Likewise, because the proposed research activities occur partially within the boundaries of National Marine Sanctuaries, and within areas identified as Essential Fish Habitat (EFH), this Final PEA evaluates potential impacts to sanctuary resources and EFH as required under section 304(d) of the National Marine Sanctuaries Act and section 305(b)(2) of the Magnuson-Stevens Act. The SWFSC used the Draft PEA as the basis for consultations with the appropriate offices and agencies in compliance with these and other applicable laws (Table 1.6-1).

1.4 SCOPE AND ORGANIZATION OF THIS FINAL PEA

In considering the proposed action, NMFS is responsible for complying with a number of federal statutes, regulations, and executive orders, including NEPA. As such, the purpose of this Final PEA is to provide an environmental analysis to support the NMFS proposal to continue the research activities under the requirements of an LOA and to encourage and facilitate public involvement in the environmental review process.

[9] 16 U.S.C. §1531 *et seq.*

Under NEPA, an EA is prepared to determine if any significant environmental impacts are likely to be caused by a proposed action. If the EA does not identify potentially significant impacts, a Finding of No Significant Impact (FONSI) is prepared to document the decision maker's determination and to approve the proposed action. If at any time during preparation of the EA it appears that significant impacts would result from the proposed action, the agency would halt development of the EA and begin preparation of an Environmental Impact Statement (EIS) to more thoroughly evaluate the potential impacts and potential ways to reduce or mitigate those impacts. Thus, while the EA objectively evaluates the full extent of potential impacts of a proposed action (from minor to major, adverse or beneficial, short-term to long-term – see discussion below), the FONSI provides the decision maker's rationale with regard to the significance of those impacts.

This Final PEA provides a programmatic-level assessment of the potential impacts on the biological and human environments associated with the proposed SWFSC research programs. A programmatic approach is used when initiating or reevaluating a federal program for NEPA compliance. It takes a broad look at issues and alternatives (compared to documents for a specific project or action), and provides a baseline for future management actions. Programmatic documents are often intended to provide NEPA compliance for management and other activities over a fixed period before a formal review is again initiated.

The SWFSC Final PEA assesses not only the potential direct and indirect impacts of the alternatives presented to the physical, biological and socioeconomic systems in the SWFSC area of responsibility, but also the potential impacts of the management processes that are used to monitor the health of the resources, develop plans to manage the resources to balance recovery goals and socioeconomic goals, and ensure the sustainability of the resources and affected fishing communities. This Final PEA assesses the impacts of research activities conducted by SWFSC in three geographic areas: the CCRA, ETPRA, and ARA.

The chapters that follow describe the proposed research activities and potential alternatives considered (Chapter 2), the affected environment as it currently exists (Chapter 3), the probable direct and indirect consequences on the human environment that may result from the implementation of the proposed research activities and their alternatives (Chapter 4), and the potential contribution to cumulative impacts from the proposed activities and their alternatives (Chapter 5).

The scope of this Final PEA covers research activities conducted by the SWFSC or its research partners that:

- Contribute to fishery management and ecosystem management responsibilities of NMFS under U.S. law and international agreements.
- Take place in marine waters in the California Current, the Eastern Tropical Pacific, and the Scotia Sea in the Southern Ocean off Antarctica.
- Involve the transiting of these waters in research vessels, the deployment of fishing gear and scientific instruments into the water in order to sample and monitor living marine resources and their environmental conditions, and/or use active acoustic devices for navigation and remote sensing purposes.
- Have the potential to interact adversely with marine mammals and protected species of fish, sea turtles, birds, and invertebrates. However, the research activities covered under this Final PEA involve only *incidental* interactions with protected species, not *intentional* interactions with those species.

The primary focus of this Final PEA is on fisheries-related research but several other types of surveys are also included because they deploy fishing gear and other instruments similar to those used in fisheries research in order to monitor the environment important to protected species and therefore involve the same potential risks of incidental interactions with protected species.

This Final PEA does NOT cover:

- Directed research on protected species that involves intentional pursuit or capture of marine mammals or sea turtles for tagging, tissue sampling, or other intentional takes under the MMPA or ESA which require directed scientific research permits. Directed research on protected species is covered by other environmental review processes, consultations, and permits issued under applicable regulations.
- The potential effects of research conducted by scientists in other NMFS Science Centers.
- Other activities of the SWFSC that do not involve the deployment of vessels or gear in marine waters, such as evaluations of socioeconomic impacts related to fisheries management decisions, taxonomic research in laboratories, fisheries enhancements such as hatchery programs, and educational outreach programs.

In the future, additional research activities may propose to use methods that were not considered in the evaluation of impacts in this Final PEA. Some of these proposed projects may require further environmental impact assessment or satisfaction of other consultation, approval, or permitting requirements before being allowed to proceed (see also Section 2.3.3). In particular, proposed future projects that may impact protected species and require permits under the ESA or the MMPA may require individual NEPA analyses and decisions tiered off this Final PEA. As the details of any such studies are presently unavailable, they cannot be assessed here. After new projects are sufficiently well defined and their potential environmental consequences are understood, specific impacts would be evaluated as necessary. If the proposed new research activities are not within or similar to the range of alternatives addressed in the programmatic document and may have adverse environmental impacts that are not within the scope of the analysis in this Final PEA, additional NEPA review would be required.

In developing this Final PEA, NMFS adhered to the procedural requirements of NEPA; the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations [CFR] 1500-1508)[10], and NOAA's procedures for implementing NEPA[11].

The following definitions are used to characterize the nature of the various impacts evaluated with this Final PEA:

- Short-term or long-term impacts. These characteristics are determined on a case-by-case basis and do not refer to any rigid time period. In general, short-term impacts are those that would occur only with respect to a particular activity or for a finite period. Long-term impacts are those that are more likely to be persistent and chronic.
- Direct or indirect impacts. A direct impact is caused by a proposed action and occurs contemporaneously at or near the location of the action. An indirect impact is caused by a proposed action and might occur later in time or be farther removed in distance but still be a reasonably foreseeable outcome of the action. For example, a direct impact of erosion on a stream might include sediment-laden waters in the vicinity of the action, whereas an indirect impact of the same erosion might lead to lack of spawning and result in lowered reproduction rates of indigenous fish downstream.
- Minor, moderate, or major impacts. These relative terms are used to characterize the magnitude of an impact. Minor impacts are generally those that might be perceptible but, in their context, are not amenable to measurement because of their relatively minor character. Moderate impacts are those that are more perceptible and, typically, more amenable to quantification or measurement. Major impacts are those that, in their context and due to their intensity (severity), have the potential to meet the thresholds for significance set forth in CEQ regulations (40 CFR 1508.27) and, thus, warrant heightened attention and examination for potential means for mitigation to fulfill the requirements of NEPA.

[10] See Reference (CEQ 1969).
[11] NOAA Administrative Order (NAO) 216-6, Environmental Review Procedures for Implementing the National Environmental Policy Act.

- Adverse or beneficial impacts. An adverse impact is one having adverse, unfavorable, or undesirable outcomes on the manmade or natural environment. A beneficial impact is one having positive outcomes on the man-made or natural environment. A single act might result in adverse impacts on one environmental resource and beneficial impacts on another resource.
- Cumulative impacts. CEQ regulations implementing NEPA define cumulative impacts as, "Impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions." (40 CFR 1508.7) Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time within a geographic area.

The SWFSC has consulted the California State Historic Preservation Office (CSHPO) in order to identify fisheries research activities that may have a nexus with historic maritime sites or archaeological resources. Because SWFSC fisheries research activities do not use bottom contact gear within the U.S. EEZ (other than two longline sampling efforts that make minimal bottom contact), the proposed activities are not expected to result in any impacts to underwater historical or archaeological resources within the California Current Research Area. The SWFSC, therefore, finds that the proposed activity would have "No Adverse Effect" on historic properties in the identified areas. However, the SWFSC will contact the CSHPO if it intends to do future research that might impact submerged historic or archaeological properties within one of the "cautionary zones" identified by the CSHPO to protect known maritime heritage resources in U.S. Pacific waters.

The proposed SWFSC research activities are not reasonably expected to result in the spread or introduction of non-indigenous species. The research may involve movement of vessels between water bodies. However, ballast water management and other discharge processes for NOAA and charter vessel operations are bound by federal laws, regulations and Executive Orders (EO) that are in place in order to prevent or minimize the potential for spread or introduction of non-indigenous species, including the Clean Water Act, National Invasive Species Act, Nonindigenous Aquatic Nuisance Prevention and Control Act, and EO13112.

The proposed SWFSC research activities are also not expected to result in impacts to public health or safety. SWFSC has initiated consultation with potentially affected entities to determine the potential for impacts to cultural sites and tribal trust resources. These issues are not considered further in this assessment but may be considered further if consultation suggests that SWFSC research activities may impact such resources.

1.5 PUBLIC REVIEW

Public participation is a cornerstone of the NEPA process. In preparing EAs, federal agencies must involve environmental agencies, applicants, and the public to the extent practicable (40 CFR Sec. 1501.4 [b]). Following guidance for public review of EAs in NOAA Administrative Order 216-6 (Sections 5.02b.1 and 5.03e.2), the Draft PEA and the associated LOA application were made available for public review on the Internet, and the notice of availability for these documents was published in the *Federal Register* on May 2, 2013 (78 FR 25702). Notice of the availability of the proposed MMPA regulations was published in the *Federal Register* on February 13, 2015 (80 FR 8166). Public comments received on the Draft PEA are addressed here and in the FONSI.

There was only one public comment on the Draft PEA during the 60-day comment period. That comment requested NMFS to forgo further research for humanitarian reasons but offered no substantive information requiring changes in the Final PEA. There was also one comment received on the LOA application from the U.S. Marine Mammal Commission. That comment included two substantive issues:

- Requesting NMFS to re-estimate numbers of marine mammals that may be taken by Level B harassment through use of acoustic research equipment based on the 120-dB re 1 μPa threshold for continuous sources rather than the 160-dB re 1 μPa threshold for non-impulsive intermittent sound sources.

- Requesting NMFS to consult with experts in the field of sound propagation and marine mammal hearing to revise the acoustic criteria and thresholds that would be more appropriate for a wide range of sound sources, including echosounders and fish-finding sonar.
    - Both of these issues have been raised by the Marine Mammal Commission in contexts other than fisheries research so they are not unique to this PEA. NMFS Office of Protected Resources disagrees that the thresholds used are inappropriate or that the take estimates should be re-calculated, although it does continue to work on updating its marine mammal acoustic exposure criteria and impact thresholds based on emerging research.

There was also one public comment on the proposed MMPA regulations from the Humane Society of the United States. This comment raised three substantive issues:

- Support for the Marine Mammal Commission comments on the LOA application for NMFS to re-evaluate the acoustic thresholds used to calculate Level B harassment estimates (see above).
- Expression of concern that the SWFSC mitigation protocols for avoiding entanglement or hooking of marine mammals in longline gear contained an exception allowing for setting of gear when five or fewer California sea lions were visible within one nautical mile of the vessel (Section 2.1.2.2 of the PEA).
    - The SWFSC acknowledges this concern but believes its reliance on the professional judgment of its scientists to delay or cancel longline sets when they consider sea lions to be at risk of entanglement with gear, even if there are five or fewer animals visible, provides a precautionary level of risk mitigation while allowing research to continue.
- Concern that the SWFSC has not substantiated the difference between disallowing the practice of "chumming" prior to or during the setting of longline gear and allowing the discard of spent bait overboard while longline gear is retrieved (Section 2.1.2.2 of the PEA). The commenter feels the practice of discarding bait while the gear is retrieved may put marine mammals at higher risk of entanglement than if all spent bait was retained on the vessel until all gear was on board.
    - The SWFSC acknowledges that distinguishing between discarding spent bait and chumming may be perceived as merely a matter of semantics. However, there are two important differences between these practices that should be highlighted: intent and effect. Chumming is an intentional act to lure or attract animals. The SWFSC does not intend to attract marine mammals. To the contrary, SWFSC prefers to conduct its surveys where there are fewer marine mammals and where the potential for interactions is minimized (e.g., through the implementation of the move-on rule), recognizing that to do this in absolute terms would preclude it from surveying some nearshore areas, in particular, that are important to its survey methods and objectives. In addition, in practical terms, interactions between SWFSC longline gear and marine mammals are rare events. The practice of discarding spent bait on swordfish surveys has not resulted in frequent interactions or concentrated interactions, as one might expect if discarding spent bait had the effect of attracting aggregations of animals to the survey vessel and gear; SWFSC has never caught more than one sea lion in a longline set. SWFSC strives to reduce these interactions further, but its priority is to achieve this while not compromising the objectives of its fisheries surveys.
    - The SWFSC is not proposing to change its swordfish longline protocols from the status quo in its application for Letters of Authorization. Therefore, to the extent bait discards contributed to historical SWFSC interactions with California sea lions during these

surveys, and it is not clear that this is the case, the potential adverse effects of this practice are already incorporated in the SWFSC request for future interactions with marine mammals. As such, future interactions between SWFSC longline surveys and marine mammals are not expected to increase, and in consideration of mitigation measures SWFSC has proposed (e.g., the move-on rule) future marine mammal-gear interactions may decrease.

1.6 REGULATORY REQUIREMENTS

NMFS is the lead federal agency for the proposed research activities evaluated in this Final PEA. These activities trigger a broad range of regulatory compliance processes because they may both cause adverse impacts to public resources regulated by various statutes, and contribute to reducing impacts caused by other activities, such as fishing, that are also regulated by those same statutes. Chapters 4 and 5 assess the impacts of the research activities on protected species and habitat. Because the research activities are essential for NMFS to carry out its regulatory mandates, Chapters 4 and 5 also describe potential impacts to NMFS ability to effectively monitor and manage fishery resources under the alternatives evaluated. Descriptions of the relevant statutory requirements are provided in Chapter 6, "*Applicable Laws*."

Table 1.6-1, below, presents a brief summary of some of the applicable laws and treaties. This information is provided to aid the reader in understanding the material presented later in the Final PEA and is not intended to be a complete listing of all statutes, orders, or regulations applicable to the proposed action and alternatives.

Table 1.6-1 Applicable Laws and Treaties

Law	Description
National Environmental Policy Act (NEPA)	Requires federal agencies to evaluate potential environmental effects of any major planned federal action and promotes public awareness of potential impacts by requiring federal agencies to prepare an environmental evaluation for any major federal action affecting the human environment.
Magnuson-Stevens Fishery Conservation and Management Act (MSA)	Authorizes the U.S. to manage fishery resources in an area from a state's territorial sea (extending 3nm from shore) to 200nm off its coast (termed as the EEZ). Includes 10 national standards to promote domestic commercial and recreational fishing under sound conservation and management principles, and provide for the preparation and implementation of fishery management plans (FMPs).
Marine Mammal Protection Act (MMPA)	Prohibits the take of marine mammals in U.S. waters and by U.S. citizens on the high seas and the importation of marine mammals and marine mammal products into the U.S. Allows, upon request, the "incidental," but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing).
International Dolphin Conservation Program Act (IDCPA)	The International Dolphin Conservation Program Act (IDCPA) was a 1997 amendment to the U.S.MMPA. It provides for the U.S. implementation of the international Agreement on the International Dolphin Conservation Program (IDCP), to which the U.S. is a signatory.
Endangered Species Act (ESA)	Provides for the conservation of endangered and threatened species of fish, wildlife, and plants throughout all or a significant portion of their range, and the conservation of the ecosystems upon which they depend. Administered jointly by NMFS and the USFWS.
Migratory Bird Treaty Act (MBTA)	Protects approximately 836 species of migratory birds from any attempt at hunting, pursuing, wounding, killing, possessing, or transporting any migratory bird, nest, egg, or part thereof, unless permitted by regulations.
Fish and Wildlife Coordination Act (FWCA)	Requires USFWS and NMFS to consult with other state and federal agencies in a broad range of situations to help conserve fish and wildlife populations and habitats in cases where federal actions affect natural water bodies.

Law	Description
National Marine Sanctuaries Act (NMSA)	Authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities as national marine sanctuaries. Section 304(d) of the NMSA requires interagency consultation between the NOAA Office of National Marine Sanctuaries (ONMS) and federal agencies taking actions that are "likely to destroy, cause the loss of, or injure a sanctuary resource."
Tuna Conventions Act Of 1950	Provides for U.S. representation on the Inter-American Tropical Tuna Convention (IATTC). The principal duties of the IATTC are (1) to study the biology of the tropical tunas, tuna baitfish, and other kinds of fish taken by tuna vessels in the eastern Pacific Ocean and the effects of fishing and natural factors upon them, and (2) to recommend appropriate conservation measures, when necessary, so that these stocks of fish can be maintained at levels which will afford the maximum sustained catches.
Antarctic Marine Living Resources Convention Act Of 1984	Provides the legislative authority necessary to implement, with respect to the U.S., the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). The Act prohibits harvesting of Antarctic living marine resources in violation of the convention.
National Historic Preservation Act (NHPA)	Section 106 requires review of any project funded, licensed, permitted, or assisted by the federal government for impact on significant historic properties.
Executive Order 12989, Environmental Justice	Directs federal agencies to identify and address disproportionately high and adverse effects of federal projects on the health or environment of minority and low-income populations to the greatest extent practicable and permitted by law.
Executive Order 12114, Environmental Effects Abroad of Major Federal Actions	Directs federal agencies to extend their compliance with NEPA and other specified laws to major federal actions outside of the U.S., its territories, and possessions. The purpose of the order is to establish internal procedures for federal agencies to consider the significant effects of their actions on the environment outside the U.S. but it does not require redress of those effects.
Executive Order 13158, Marine Protected Areas	The purpose of this order is to strengthen and expand the Nation's system of marine protected areas (MPAs). It encourages Federal agencies to use science-based criteria and protocols to identify and prioritize natural and cultural resources in the marine environment that should be protected to secure valuable ecological services and to monitor and evaluate the effectiveness of MPAs. Each Federal agency whose actions affect the natural or cultural resources that are protected by an MPA shall identify such actions. To the extent permitted by law and to the maximum extent practicable, each Federal agency, in taking such actions, shall avoid harm to the natural and cultural resources that are protected by an MPA.
Coastal Zone Management Act (CZMA)	Encourages and assists states in developing coastal management programs. Requires any federal activity affecting the land or water use or natural resources of a state's coastal zone to be consistent with that state's approved coastal management program.
U.S.-Canada Albacore Treaty	Under a treaty between the U. S. and Canada, U.S. albacore vessels are authorized to fish for albacore in certain waters under the jurisdiction of Canada and to use certain port facilities in Canada. Similarly, Canadian vessels are authorized to fish in certain waters under U.S. jurisdiction, and to use certain U.S. ports to obtain supplies and other services.
Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean	The convention establishes an international commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean, now more commonly referred to as the Western and Central Pacific Fishery Commission (WCPFC). A noteworthy aspect of the convention is the fact that it will exercise management control into the high seas zones outside national EEZs in contrast to some other regional fishery management organizations.
High Seas Fishing Compliance Act	The United Nations Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas establishes the responsibility of each nation for the actions of vessels fishing under that nation's flag on the high seas. The High Seas Fishing Compliance Act (HSFCA) is the domestic legislation enacted in 1995 to provide authority to the Secretary of Commerce to implement this agreement.

Law	Description
South Pacific Tuna Treaty	The 1987 Multilateral Fisheries Treaty with the U.S.in the Forum Fisheries Agency is a vital component of the political and economic relationship between the U.S. and the Pacific Island Parties. The treaty entered into force in 1987 for an initial period of five years. It has since been extended twice; the most recent extension is for 2003 through 2013. The treaty sets the operational terms and conditions for the U.S. tuna purse seine fleet to fish in a vast area of the central and western Pacific Ocean, including waters under the jurisdiction of the Pacific Island Parties.

ALTERNATIVES CHAPTER 2

2.1 INTRODUCTION

The Council on Environmental Quality (CEQ) is responsible for the development and oversight of regulations and procedures implementing the National Environmental Policy Act (NEPA). The CEQ regulations provide guidance for federal agencies regarding NEPA's requirements (40 Code of Federal Regulations [CFR] Part 1500). National Oceanic and Atmospheric Administration (NOAA) has also prepared environmental review procedures for implementing NEPA, NOAA Administrative Order 216-6 (NAO 216-6). Section 5.03b of NAO 216-6 states: "An Environmental Assessment [EA] must consider all reasonable alternatives, including the preferred action and the no action alternative."

To warrant detailed evaluation by the National Marine Fisheries Service (NMFS), an alternative must be reasonable[12] and meet the purpose and need (see Section 1.3). Screening criteria are used to determine whether an alternative is reasonable and should be considered further or whether it is not reasonable to consider in detail in the Final PEA. Section 2.6 describes potential alternatives that were considered but rejected because they do not meet the purpose and need of the proposed action.

Screening Criteria – To be considered 'reasonable' for the purposes of this Final PEA, an alternative must meet the following criteria:

1. The action must not violate any federal statute or regulation.
2. The action must be consistent with reasonably foreseeable funding levels.
3. The action must be consistent with long-term research commitments and goals to maintain the utility of scientific research efforts, or consider no federal funding availability for fisheries research.

To maintain the utility of scientific research efforts, fisheries and marine ecosystem scientific research should fulfill the following requirements:

1. Methods and techniques must provide standardized, objective, and unbiased data consistent with past data sets (time series) in order to facilitate long-term trend analyses.
2. Collected data must adequately characterize living marine resource and fishery populations and the health of their habitats.
3. The surveys must enable assessment of population dynamics and provide predictive capabilities required to respond to changing ecosystem conditions and manage future fisheries.
4. Research on new methodologies to collect fisheries and ecosystem information (e.g. active and passive acoustic instruments and video surveys of benthic habitats in lieu of dredge gear or bottom trawls), and research oriented toward modifications of fishing gear to address bycatch or other inefficiencies must be conducted with experimental controls sufficient to allow statistically valid comparisons with relevant alternatives.

NMFS evaluated each potential alternative against these criteria and requirements. Based on this evaluation, the No-Action/Status Quo alternative and two other action alternatives were identified as reasonable and are carried forward for more detailed evaluation in this Final PEA. NMFS also evaluates a second type of no-action alternative that considers no federal funding for fisheries research activities. This

[12] "Section 1502.14 (NEPA) requires the EA/Environmental Impact Statement (EIS) to examine all reasonable alternatives to the proposal. In determining the scope of alternatives to be considered, the emphasis is on what is 'reasonable' rather than on whether the proponent or applicant likes or is itself capable of carrying out a particular alternative. Reasonable alternatives include those that are *practical or feasible from the technical and economic standpoint and using common sense*, rather than simply desirable from the standpoint of the applicant." (40 Questions) (emphasis added)

alternative is called the No Research Alternative to distinguish it from the No-Action/Status Quo alternative.

The No-Action/Status Quo Alternative is used as the baseline for comparison of the other alternatives. Three of the alternatives include fisheries and ecosystem research projects conducted or funded by the Southwest Fisheries Science Center (SWFSC) as the primary federal action. These three alternatives also include suites of mitigation measures intended to minimize potentially adverse interactions with protected species. Protected species include all marine mammals, which are covered under the Marine Mammal Protection Act (MMPA), all species listed under the Endangered Species Act (ESA), and bird species protected under the Migratory Bird Treaty Act (MBTA).

The three alternatives involving research activities in the marine environment trigger marine mammal protection requirements under the MMPA. For this reason, NMFS must evaluate the alternatives to ensure that they would fulfill the purpose and need of NMFS issuing regulations and subsequent Letters of Authorization (LOA) under Section 101(a)(5)(A) of the MMPA to the SWFSC, which is the secondary federal action considered in this Final PEA. The LOA, if issued, would provide an exception to the SWFSC from the take prohibitions for marine mammals under the MMPA, incidental to the conduct of the SWFSC's research activities, namely: (1) the issuance of an LOA for the take of marine mammals by Level A and Level B harassment, and by serious injury or mortality incidental to the SWFSC's conduct of research activities; and (2) compliance with the MMPA which sets forth specific findings (e.g. no unmitigable adverse impact on the availability of a species or stock for subsistence uses, negligible impact on a species or stock, reporting, monitoring, and mitigation requirements) that must be made in order for NMFS to issue an LOA. In order to authorize incidental take of marine mammals under the MMPA, NMFS must identify and evaluate a reasonable range of mitigation measures to minimize impacts to marine mammals to the level of least practicable adverse impact. This range of mitigation measures has been incorporated as part of the identified alternatives in order to evaluate their ability to minimize potential adverse environmental impacts. The efficacy and practicability of all potential mitigation measures are assessed in Chapter 4.

Further, because the proposed research activities occur in known habitat areas of species that are listed as threatened or endangered under the ESA, this Final PEA evaluates potential impacts to ESA-listed species that may result from either the primary or secondary action. Likewise, because the proposed research activities occur partially within the boundaries of National Marine Sanctuaries, and within areas identified as Essential Fish Habitat (EFH), this Final PEA evaluates potential impacts to sanctuary resources and EFH as required under section 304(d) of the National Marine Sanctuaries Act and section 305(b)(2) of the Magnuson-Stevens Act.

2.2 ALTERNATIVE 1 – NO-ACTION/STATUS QUO ALTERNATIVE - CONDUCT FEDERAL FISHERIES AND ECOSYSTEM RESEARCH WITH SCOPE AND PROTOCOLS SIMILAR TO PAST EFFORT

As discussed in Chapter 1, the SWFSC collects a wide array of information necessary to evaluate the status of fishery resources and the marine environment. SWFSC scientists conduct fishery-independent research onboard NOAA owned and operated vessels or on chartered vessels in three geographic research areas: the California Current Research Area (CCRA), the Eastern Tropical Pacific Research Area (ETPRA), and Antarctic Research Area (ARA) in waters of the Scotia Sea. The SWFSC also designs and executes a limited number of surveys conducted onboard commercial fishing vessels. In those instances, SWFSC scientists lead the surveys onboard the commercial vessels, and the vessel time is funded by the SWFSC. The SWFSC proposes to administer and conduct 16 survey programs, as described in Table 2.2-1.

Table 2.2-1 Summary description of SWFSC surveys conducted on NOAA vessels and NOAA-chartered vessels under the Status Quo Alternative.

See Appendix A for descriptions of the different gear types and vessels used. Appendix B includes figures showing the spatial coverage of each survey by season. Mitigation measures are described in Section 2.2.1.

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
California Current Research Area								
Survey Using Trawl Gear								
Coastal Pelagic Species (CPS) Survey (aka Sardine Survey)	One or two ship survey. Results of survey inform the annual assessment of sardines and the corresponding harvest guideline. Consists of southern and northern portions conducted on two survey vessels. When possible, preference has been for a two-ship survey. The southern portion is done in conjunction with the spring or summer CalCOFI Survey. Protocols similar to CalCOFI with the addition of mid-water trawls conducted near the surface at night to sample adult sardines.	United States (U.S.) West Coast Exclusive Economic Zone (EEZ)	Annually or biennially, April-May or July-August 70 DAS (~35DAS/vessel)	NOAA ship, Charter vessel One or two ship survey	NETS Nordic 264 two-warp rope trawl	Towed near-surface, primarily at night Tow speed: 2-4 knots (kts) Duration: 30 min at intended depth	50 tows	Acoustic pingers, marine mammal excluder devices (MMEDs), limited visual monitoring (night trawl), "move-on" rule.
					Various plankton nets (Bongo, Pairovet, Manta)	Tow speed: 1.5- 2.5 kts for Bongo and Manta; 0 for Pairovet Duration: 10-20 min	75 tows	
					Conductivity Temperature Depth (CTD) and rosette water sampler	Tow speed: 0 Duration: 20-120 min	75 casts	
					Continuous Underway Fish Egg Sampler (CUFES)		Continuous	
					Multi-frequency single-beam active acoustics	18, 38, 70, 120, 200 kilohertz (kHz)	Continuous	
					Multi-beam echosounder (Simrad ME70) and sonar (Simrad MS70)		Continuous	
Juvenile Rockfish Survey	Targets pelagic phase of juvenile rockfish with nighttime tows. Results of survey inform assessments of several rockfish populations and may soon be used in assessments of Central California salmon productivity.	West Coast EEZ	Annually, May-mid-June 45 DAS	NOAA ship, Charter vessel	Modified Cobb Midwater Trawl	Tow speed: 2 kts Duration: 15 min at intended depth	150 tows	Acoustic pingers, development of MMEDs, limited visual monitoring (night trawl), "move-on" rule.
					CTD profiler and rosette water sampler	Tow speed: 0 Duration: 5-120 min	~250 casts	
					Various plankton nets (Bongo and Tucker)	Tow speed: 1.5- 2.5 kts Duration: 20-60 min	50 tows	
					Multi-frequency single-beam active acoustics	18, 38, 70, 120, 200, 333 kHz	Continuous	

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
Juvenile Salmon Survey	Measures ocean survival of juvenile salmon and produces early estimate of adult returns. Protocols include surface-water trawls, active acoustics, oceanographic and meteorological measurements. Tissue samples are collected for genetic analysis.	Central CA to southern OR	Annually, June and September 30 DAS total for two surveys	Charter vessel	NETS Nordic 264 two-warp rope trawl	Towed at 15-30 meters (m) deep during daytime Tow speed: 2-4 kts Duration: 30 min at intended depth	50 tows	Acoustic pingers, MMEDs, visual monitoring, "move-on" rule.
					CTD profiler and rosette water sampler	Tow speed: 0 Duration: 20-120 min	50 casts	
					Various plankton nets (Bongo and Tucker)	Tow speed: 1.5- 2.5 kts Duration: 20-60 min	50 tows	
					Multi-frequency single-beam active acoustics	18, 38, 70, 120, 200, 333 kHz	Continuous	
Surveys Using Longline Geary								
Highly Migratory Species (HMS) Survey	This survey targets blue sharks, shortfin mako sharks, and other HMS as a basis for stock assessments and support for HMS Fishery Management Plans. Information is also obtained about their biology, distribution, movements, stock structure and status, and potential vulnerability to fishing pressure. Surveys involve catching sharks on longline gear, measuring, attaching various tags, and releasing them alive.	Southern to central CA	Annually, June-July 30 DAS	NOAA ship, Charter vessel	Pelagic longline	Mainline length: 2-4 mile set at 50 to 75 ft deep for mako and blue sharks; 300 to 600 ft for swordfish. Gangion length: 10-15 ft; 36 ft for swordfish Gangion spacing: 50-100 ft apart. Hook size and type: 9/0 J hooks for blue and mako sharks; 16/0 and 18/0 offset, stainless circle hooks for swordfish. Soak time: 2-4 hrs for most species, up to8 hrs for swordfish	60 sets	Visual monitoring, "move-on" rule, operational adjustments to avoid take. Use of circle hooks and finfish bait where possible to minimize sea turtle bycatch.
					CTD profiler and rosette water sampler	Tow speed: 0 Duration: 30 min	60 casts	
					Bongo plankton tows	Tow speed: 1.5 kts Duration: 20 min	60 tows	
					Multi-frequency single-beam active acoustics	18, 38, 70, 120, 200, 333 kHz	Continuous	
Reproductive Life History	This survey is conducted to collect adult sablefish for reproduction studies. Surveys	Central California (near Bodega	Monthly (One day per month), 30 DAS	Charter vessel	Small commercial bottom longline	75 hooks per line, baited with squid, set at depths of 360-	2-3 sets per trip	"move on" rule if a marine mammal is encountered

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
Analysis of Sablefish	involve catching sablefish on longline gear.	Bay)				450m		
Thresher Shark Survey	This survey is conducted to support stock assessment and management of thresher sharks, which are subject to commercial and recreational fisheries. Surveys involve catching sharks on longline gear, measuring and taking tissue samples, attaching various tags, and releasing them alive.	Southern CA Bight	Annually, September 20 DAS	Charter vessel	Anchored pelagic longline	Mainline length: 1-2 mile set at 12 ft deep Gangion length: 10-15 ft Gangion spacing: 50-100 ft apart. Hook size and type:13/0 offset circle hooks for thresher sharks Soak time: 2-4 hr	40 sets	Visual monitoring, "move-on" rule, operational adjustments to avoid take. Use of circle hooks and finfish bait to minimize sea turtle bycatch.
					CTD profiler and rosette water sampler	Tow speed: 0 Duration: 30 min	40 casts	
					Bongo plankton tows	Tow speed: 1.5 kts Duration: 20 min	60 tows	
					Multi-frequency single-beam active acoustics	18, 38, 70, 120, 200, 333 kHz	Continuous	
Surveys Using Trawl and /or Longline Gear								
Habitat Surveys (swordfish and adult rockfish)	Surveys include adult rockfish EFH, co-use of habitat by swordfish and leatherback turtles.	California Current LME	Opportunistically as funds and ship time are available 50 DAS	NOAA ship and charter vessels	NETS Nordic 264 two-warp rope trawl	Towed near-surface at night Tow speed: 2-3 kts Duration: 30 min at intended depth	10 tows	Visual monitoring, "move-on" rule, acoustic pingers, and MMEDs
					Pelagic longline	Mainline length: 2-12 mile set at 600 feet deep depending on target species. Gangion length: 36 ft Gangion spacing: 50-100 ft apart Hook size and type:16/0 and 18/0 offset, stainless circle hooks for swordfish Soak time: up to 8 hr	20 sets	Visual monitoring, operational adjustments to avoid take. Use of circle hooks and finfish bait to minimize sea turtle bycatch.
					Bongo plankton tows	Tow speed: 1.5 kts Duration: 20 min	100 tows	
					CTD profiler and rosette water sampler	Tow speed: 0 Duration: 30 min	100 casts	

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
					Oozeki, IKMT, MOCNESS, Tucker nets	Tow speed: 2-3 kts Duration: 20-60 min	50 tows	
					Manned Submersible	1-3 hour dives	10 dives	
Surveys Using Other Gear								
California Cooperative Oceanic Fisheries Investigation (CalCOFI) **Winter, Spring, Summer and Fall Surveys**	CalCOFI is a partnership of NMFS, California Department of Fish and Game, and Scripps Institution of Oceanography. The survey series was started in 1949 to describe the pelagic ecology of the California Current and its influence on the population dynamics of West Coast sardine stocks. Several hundred taxa of marine fishes and zooplankton are monitored along with aspects of their physical and biological environment. Sampling protocols include transects to assess the distribution and abundance of marine mammals and seabirds	San Diego to San Francisco	Four surveys annually in January-February, April, July and October 90 DAS total for four surveys	NOAA ships and University-National Oceanic Laboratory System fleet (Scripps Institution of Oceanography)	Various plankton nets (Bongo, Pairovet, Manta, PRPOOS)	Tow speed: 1.5- 2.5 knots (kts) for Bongo and Manta; 0 for Pairovet Duration: 10-20 minutes (min)	75-113 stations per survey; 340 samples total	Visual Monitoring
					CTD profiler and rosette water sampler	Tow speed: 0 Duration: 20-120 min	340 casts total	
					Various small, towed, fine-mesh nets designed to sample larval and juvenile fish and small pelagic invertebrates (Matsuda-Oozeki-Hu trawl net [MOHT], Isaacs-Kidd Mid-water Trawl[IKMT], MOCNESS, Tucker)	Tow speed: 2-3 kts Duration: 20-60 min	35-85 tows total	
					CUFES		Continuous	
					Multi-frequency single-beam active acoustics	18, 38, 70, 120, 200 kHz	Continuous	
					Multi-beam echosounder (Simrad ME70) and sonar (Simrad MS70)		Continuous	
Collaborative Optical Acoustical Survey Technology (COAST) Survey	ROV and acoustic surveys of offshore banks designed to monitor recovery of rockfish. Conducted in collaboration with the charter boat fishing industry.	Southern and Central California	Opportunistically as funds and ship time are available 40 DAS	NOAA ship, Charter vessel	Multi-frequency single-beam active acoustics	18, 38, 70, 120, 200, 333 kHz	Continuous	
					Still and video camera images taken from an ROV			

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
Marine Mammal and Ecosystem Assessment Surveys	One or two ship surveys are conducted to assess all marine mammal species in West Coast EEZ, or to focus on the distribution and ecology of a selected group of species. Sampling protocols include transects to assess the distribution and abundance of marine mammals, seabirds, and the status of the ecosystems that support them.	California Current Large Marine Ecosystem (LME)	Tri-annually (July - Dec) 60-120 DAS total for three surveys	NOAA ship One or two ship survey	Bongo plankton tows	Tow speed: 1.5 kts Duration: 20 min	60 tows	
					CTD profiler and rosette water sampler	Tow speed: 0 Duration: 30 min	40 casts	
					Oozeki, IKMT, MOCNESS, Tucker nets	Tow speed: 2-3 kts Duration: 20-60 min	60 tows	
					Expendable bathythermographs (XBTs)		80-240 units	
					Multi-frequency single-beam active acoustics	18, 38, 70, 120, 200, 333 kHz	Continuous	
Pacific Coast Ocean Observing System (PacOOS) Central CA	Extension of CalCOFI observation protocols to CalCOFI lines off Monterey Bay and San Francisco during summer and fall surveys when the CalCOFI sampling grid is confined to the Southern California Bight. Surveys conducted in conjunction with Monterey Bay Aquarium Research Institute, UC Santa Cruz, and Navy Post-Graduate School	Central CA, fixed survey lines off Monterey and San Francisco Bays	Annually, July and October 6 DAS total for two surveys	Research Vessel (R/V) Point Sur	Various plankton nets (Bongo, California Vertical Egg Tow (CalVET), Pairovet, Manta)	Tow speed: 1.5- 2.5 kts for Bongo and Manta; 0 for CalVET and Pairovet Duration: 10-20 min	40 tows	
					CTD profiler and rosette water sampler	Tow speed: 0 Duration: 20-120 min	40 casts	
PacOOS North CA	Extension of CalCOFI observation protocols to a sampling line off Eureka CA. Surveys conducted in conjunction with Humboldt State University.	Northern CA, fixed survey lines off Eureka	Monthly 12 DAS total for 12 surveys	R/V Coral Sea	Various plankton nets (Bongo, CalVET, Pairovet, Manta)	Tow speed: 1.5- 2.5 kts for Bongo and Manta; 0 for CalVET and Pairovet Duration: 10-20 min	100 tows	
					CTD profiler and rosette water sampler	Tow speed: 0 Duration: 20-120 min	100 casts	
Swordfish Tagging using Deep-set Buoy Gear	Investigate the use of deep-set buoy gear to capture and tag swordfish without generating significant bycatch interactions	Southern California Bight	Annually for two years, June-November	PIER research vessel *R/V Malolo*, cooperative commercial fishing vessels	Modified swordfish buoy gear to target pelagic swordfish at depths of 250-400 meters during daylight hours	250-400 m mainline monofilament with a buoy flotation system and a 1-2 kilogram (kg) drop sinker. Two monofilament gangions would branch from the mainline at 250-400 m and would contain	300 - 600 sets per year	Minimize slack in the fishing line to maintain a vertical profile and use a high speed electric reel to reduce the time that baits are within the upper water column and minimize potential for marine mammal interactions. Use circle hooks to increase post-hooking survivorship of non-target species.

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
						a crimped 14/0 circle hook baited with either squid or mackerel. A single set of gear consists of two baited hooks soaked on average for a 4 hour period.		Visually monitor all of the indicator buoys from the vessel. When an indicator flag rises, the buoy set would immediately be tended and the animal caught would either be released or tagged and released in order to increase post-hooking survivorship of all animals.
White Abalone Survey	Remotely Operated Vessel (ROV) surveys of endangered white abalone to monitor population recovery. Surveys confined to offshore banks, island and continental margins, 30-150 m. depth.	Southern CA Bight	Opportunistically as funds and ship time are available 25 DAS	Charter vessel	Still and video camera images taken from an ROV	Tether connecting ROV to the ship is 0.75 inches diameter Avg. speed: 0.5 kts Max. speed: 2.4 kts	100 transects/yr	Slow operating speed minimizes risk of striking a marine mammal. The tether is securely attached to a steel cable and down-weight to minimize slack and prevent loops that might lead to entanglement risk.
Eastern Tropical Pacific Research Area								
Marine Mammal Surveys	Multi-year cetacean and ecosystem assessment study designed to monitor the recovery of several dolphin stocks that were depleted by the yellowfin tuna purse-seine fishery in the ETP Ocean. Sampling protocols include visual observations of marine mammals and seabirds.	Eastern Tropical Pacific Ocean	Tri-annually (Jul – Dec) 240 DAS total for three surveys	NOAA ships Two ship survey	Bongo plankton tows	Tow speed: 1.5 kts Duration: 20 min	500 tows	
					CTD profiler and rosette water sampler	Tow speed: 0 Duration: 30 min	500 casts	
					Oozeki, IKMT, MOCNESS, Tucker nets	Tow speed: 2-3 kts Duration: 20-60 min	50-125 tows	
					Multi-frequency single-beam active acoustics	18, 38, 70, 120, 200, 333 kHz	Continuous	
					XBTs		720 units	
Antarctic Research Area								
Antarctic Survey	Shipboard surveys monitor the abundance and distribution of krill for stock assessments and studies of the foraging ecology of land-breeding penguin and fur seal populations. Protocols include marine mammal and seabird observations. Every 2-3 years these protocols are augmented with a bottom trawl	Scotia Sea sector of the Southern Ocean, including the continental shelf adjacent to the Antarctic Peninsula, and	Annually, January-March or Annually, July-October Bottom trawl conducted every 2-3 years 70 DAS	Charter (R/V Yuzhmorgeolgiya, R/V Moana Wave, R/V Ocean Stalwart)	Oozeki, IKMT, MOCNESS, Tucker nets	Tow speed: 2-3 kts Duration: 20-60 min	200 tows	
					Multi-frequency active acoustics	38, 70, 120 and 200 kHz	Continuous	
					CTD profiler and rosette water sampler	Tow speed: 0 Duration: 45 min	200 casts	
					Video camera tows	Tow speed: <3 kts Duration: <65 min	25 tows	

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
	used to sample benthic invertebrates and fish. Results of the survey inform fish stock assessments and benthic habitat descriptions.	the South Shetland, South Orkney, South Sandwich and South Georgia archipelagos			Two-warp NET Hard-Bottom Snapper Trawl	Tow speed: 2-3 kts Duration: 30 min	100 tows	

As Table 2.2-1 indicates, SWFSC fisheries research surveys are conducted in all seasons and within three primary geographic areas: the CCRA, the ETPRA, and ARA (see Figure 1.1-2).The gear types fall into several categories: pelagic trawl gear used at various levels in the water column, pelagic longlines with multiple hooks, bottom-contact trawls (ARA only), and other gear (various fine-meshed plankton nets, active and passive acoustic instruments, video recording equipment, Conductivity Temperature Depth [CTD] profiler, etc).

The Status Quo Alternative is to perform fisheries research as it was conducted from 2008 through 2014, as described in Table 2.2-1 (see also Appendices A and B), including a suite of mitigation measures that were developed by the SWFSC in consultation with marine mammal scientists and other protected species experts. These mitigation measures have been implemented on SWFSC surveys since the 2008-2009 field seasons. These mitigation measures are anticipated to be required under the Letters of Authorization (LOA) that would be issued under the Preferred Alternative for the specified research activities conducted by the SWFSC. However, these mitigation measures may not be sufficient to reduce the effects of SWFSC activities on marine mammals to the level of least practicable adverse impact (see Alternative 2), so additional mitigation may be required under the proposed action by the LOA.

The procedures described here are based on protocols used during previous SWFSC research surveys. These procedures are the same whether the survey is conducted on board a NOAA vessel or charter vessel. The SWFSC continually reviews its procedures and investigates options for incorporating new mitigation measures and equipment into its ongoing survey programs. Evaluations of new mitigation measures include assessments of their effectiveness in reducing risk to protected species. Implementation of any such measures must also be subject to safety and practicability considerations, allow survey results to meet research objectives, and maintain consistency with previous data sets.

2.2.1 Mitigation Measures for Protected Species

2.2.1.1 Trawl Surveys

1. Monitoring methods

- The officer on watch, Chief Scientist (or other designated member of the Scientific Party), and crew standing watch on the bridge visually scan for marine mammals, sea turtles, and other ESA-listed species (protected species) during all daytime operations. 7X bridge binoculars are used as necessary to survey the area as far as environmental conditions (lighting, sea state, precipitation, fog, etc.) will allow. A member of the crew designated to stand watch for protected species (dedicated to that function) visually scans the waters surrounding the vessel at least 30 minutes before the trawl net is to be put into the water. This typically occurs during transit prior to arrival at the sampling station, but may also include time on station if other types of gear or equipment (e.g., bongo nets) are deployed before the trawl.

2. Operational procedures

- "Move-On" Rule. If any marine mammals or sea turtles are sighted anywhere around the vessel in the 30 minutes before setting the gear, the vessel may be moved away from the animals to a different section of the sampling area if the animals appear to be at risk of interaction with the gear at the discretion of the officer on watch. Small moves within the sampling area can be accomplished without leaving the sample station. After moving on, if marine mammals or sea turtles are still visible from the vessel and appear to be at risk, the officer on watch may decide to move again or to skip the station. The officer on watch consults with the Chief Scientist or other designated scientist (identified prior to the voyage and noted on the cruise plan) and other experienced crew as necessary to determine the best strategy to avoid potential takes of these species. Strategies are based on the species encountered, their numbers and behavior, their position and vector relative to the vessel, and other factors. For instance, a whale transiting through the area and heading away from the vessel may not require any move, or may require only a short move from the initial sampling site, while a pod of dolphins gathered around the vessel may require a longer move from the initial sampling site or possibly cancellation of the station if the dolphins follow the vessel. In most cases, trawl gear is not deployed if marine mammals have been sighted from the ship in the previous 30 minutes unless those animals do not appear to be in danger of interactions with the trawl, as determined by the judgment of the Chief Scientist or officer on watch. The efficacy of the "move-on" rule is limited during night time or other periods of limited visibility; research gear is deployed as necessary when visibility is poor, although operational lighting from the vessel illuminates the water in the immediate vicinity of the vessel during gear setting and retrieval.

- Trawl operations are usually the first activity undertaken upon arrival at a new station in order to reduce the opportunity to attract marine mammals and other protected species to the vessel. However, in some cases, bongo or vertical nets may be deployed before the trawl in order to check for high densities of jellyfish and salps that may compromise the integrity of the trawl gear. Other exceptions include instances where trawls can only be conducted after night has fully fallen, but CTD's, bongo nets or other samples can be conducted during the crepuscular period (e.g., the juvenile rockfish survey). The order of gear deployment is determined on a case-by-case basis by the Chief Scientist based on environmental conditions and sonar information at the sampling site. Other activities, such as water sampling and most plankton tows, are conducted in conjunction with, or upon completion of, trawl activities.

- Once the trawl net is in the water, the officer on watch, Chief Scientist, or other designated scientist, and/or crew standing watch continues to monitor the waters around the vessel and maintain a lookout for marine mammal and sea turtle presence as far away as environmental conditions allow (as noted previously, visibility can be limited for various reasons). If these species are sighted before the gear is fully retrieved, the most appropriate response to avoid incidental take is determined by the professional judgment of the officer on watch, in consultation with the Chief Scientist or other designated scientist and other experienced crew as necessary. These judgments take into consideration the species, numbers, and behavior of the animals, the status of the trawl net operation (net opening, depth, and distance from the stern), the time it would take to retrieve the net, and safety considerations for changing speed or course. Consideration is also given to the increase in likelihood of marine mammal interactions during retrieval of the net, especially when the trawl doors have been retrieved and the net is near the surface and no longer under tension. Acoustic pingers and excluder devices are not operational under these conditions. In some situations, risk of adverse interactions may be diminished by continuing to trawl with the net at depth until the marine mammals and/or sea turtles have left the area before beginning haul-back operations. In other situations, swift retrieval of the net may be the best course of action. The appropriate course of action to minimize the risk of incidental take of protected species is determined by the professional judgment of the officer on watch and appropriate crew based on all situation variables, even if the choices compromise the value of the data collected at the station.

- If trawling operations have been delayed because of the presence of marine mammals or sea turtles, the vessel resumes trawl operations (when practical) only when these species have not been sighted within 30 minutes or else otherwise determined to no longer be at risk. This decision is at the discretion of the officer on watch and is situationally dependent.

- Care is taken when emptying the trawl, including opening the cod end as close to the deck as possible in order to avoid damage to protected species that may be caught in the gear but are not visible upon retrieval. The gear is emptied as quickly as possible after retrieval in order to determine whether or not protected species are present.

3. **Tow duration**

- Standard tow durations have been reduced to 30 minutes or less at targeted depth, excluding deployment and retrieval time, to reduce the likelihood of attracting and incidentally taking protected species. These short tow durations decrease the opportunity for curious marine mammals to find the vessel and investigate. The resulting tow distances are typically 1 to 2 nautical miles, depending on the survey and trawl speed. Additionally, short tow times reduce the likelihood that captured sea turtles would drown.

4. **Marine mammal excluder devices**

- The SWFSC uses several different types of trawl nets for different surveys. The two types that have taken marine mammals in the past are the Nordic 264 and the Modified Cobb trawl. The Modified Cobb midwater trawl is smaller than the Nordic 264, is towed at slower speeds, at greater depths, and has historically had considerably lower rates of interactions with marine mammals compared to the Nordic 264 trawl which is generally operated closer to the surface. Currently, all Nordic 264 nets are outfitted with marine mammal excluder devices (MMEDs) developed for the SWFSC (Appendix A). Most marine mammals killed during SWFSC operations have been caught in surveys using this type of net before the excluder devices were installed. These excluder devices enable fish to pass through a grid and into the codend while preventing the passage of marine mammals, which contact the slanted grid and slide out through an escape opening or swim back out of the mouth of the net (See Appendix A).
- While this excluder device was designed to minimize small cetacean and pinniped mortalities in trawl gear, the design is an adaptation of turtle excluder devices used in trawl gears in the Atlantic and Gulf of Mexico. The SWFSC believes that due to its similar configuration to turtle excluder devices, the excluder device may also be effective at reducing sea turtle capture and mortality in mid-water trawls. To date, SWFSC has had no known interactions with sea turtles when using mid-water trawl gear with an excluder device in place, so further testing is needed to validate this hypothesis.
- The excluder device is an aluminum grate weighing 17 kilograms (38 pounds), 155 centimeters (cm) (61 inches) long and 112cm (44 inches) wide, with 12.7cm (5 inches) spacing on vertical bars. The excluder device is positioned at a 46-47 degree angle pointing upwards towards an escape panel in an intermediary section of netting sewn in just forward of the cod end. Additional details related to the design and construction of the MMED may be found in Appendix A and Dotson et al. 2010.
- Modified Cobb trawls have a different shape and functionality than the Nordic 264. The Modified Cobb trawl is smaller than the Nordic 264, is towed at slower speeds, at greater depths, and has historically had considerably lower rates of interactions with marine mammals compared to the Nordic 264 trawl which is generally operated closer to the surface. The Modified Cobb trawls do not yet have MMEDs, however, research and design work is currently being performed to develop effective excluders that will not appreciably affect the catch performance of the net and therefore maintain continuity of the fisheries research data set. Successful development and implementation of excluder devices for Modified Cobb trawls is expected to occur within the five-year timeframe of this Final PEA. They are not currently part of standard surveys using this gear and are not considered to be part of the Status Quo Alternative. Use of MMEDs on Modified Cobb trawls is considered as part of the Preferred Alternative.
- The hard-bottom snapper trawl used in periodic Antarctic surveys has no history of interactions with marine mammals; marine mammal sightings during these surveys are rare. There are no MMEDs that have been developed for this type of snapper trawl and no work is being done to develop such devices.

5. **Acoustic pinger devices**

- Acoustic pingers are underwater sound emitting devices that decrease the probability of entanglement or unintended capture of marine mammals (see Appendix A). Acoustic pingers have been shown to effectively deter several species of small cetaceans from becoming entangled in gillnets. While their effectiveness has not been tested on trawls, pingers are believed to represent a mitigation measure worth pursuing given their effectiveness in other gears. They are deployed during all trawl operations using the Nordic 264 and Modified Cobb trawl nets. Two to four pingers are placed along the footrope and/or headrope to minimize marine mammal interactions.
- Pingers are manufactured by STM Products, model DDD-03H. Pingers remain operational at depths between 10 m and 200 m. Tones range from 100 microseconds to seconds in duration, with variable frequency of 5-500 kHz. The pingers generate a maximum sound pressure level of 176 decibels (dB) root mean square (RMS) referenced to 1 micropascal at 1m at 30-80 kHz.

6. **Speed limits and course alterations**

- Vessel speeds are restricted on research cruises in part to reduce the risk of ship strikes with marine mammals. Transit speeds vary from 6-14 knots, but average 10 knots. The vessel's speed during active sampling is typically 2-4 knots due to sampling design. Thus, these much slower speeds essentially eliminate the risk of ship strikes.
- As noted above, if marine mammals are sighted near the vessel within 30 minutes prior to deployment of the trawl net, the vessel will be moved away from the animals to a new station.
- At any time during a survey or in transit, any crew member that sights marine mammals that may intersect with the vessel course immediately communicates their presence to the bridge for appropriate course alteration or speed reduction as possible to avoid incidental collisions, particularly with large whales (e.g., blue whales).

2.2.1.2 Longline Gear

1. **Visual surveillance by officer on watch, Chief Scientist, or other designated scientist, and crew**

- Longline surveys are conducted aboard smaller vessels and with fewer crew members than trawl surveys but the monitoring procedures for longline gear are similar to those described for trawling gear. Some parameters, including the specific location on the vessel and the elevation above sea level from which the surveillance is conducted may be adapted to suit the size and design of the particular vessel. However, surveillance would typically be performed from the wheelhouse or bridge of the vessel, using binoculars or another appropriate optical device.

2. **Operational procedures**

- The "move-on" rule is implemented if any protected species are present within sight of the vessel and appear to be at risk of interactions with the longline gear; longline sets are not made if marine mammals or sea turtles have been seen from the vessel within the past 30 minutes and appear to be in danger of interaction with the longline gear, as determined by the professional judgment of the Chief Scientist or officer on watch. The exception is for California sea lions, which are very common in the longline survey areas. Because they are so commonly seen but very infrequently interact with longline gear, small numbers of California sea lions may be visible from the vessel while the longline gear is set if the officer on watch decides that, because of their behavior or travel vector or other factors, they do not appear to be at risk of interaction with the longline gear. If groups of California sea lions are present, the "move-on" rule is applied and the vessel is moved until the sea lions are at a safe distance away from the setting operation, as determined by the professional judgment of the officer on watch.

- Longline gear is always the first equipment or fishing gear to be deployed when the vessel arrives on station. Longline gear is set immediately upon arrival at each station provided the conditions requiring the move-on rule have not been met.
- Hooks vary in size depending on the target species. For swordfish, 16/0 or 18/0 offset circle hooks (stainless steel) are used. Because the thresher shark survey targets pups, 13/0 offset circle hooks are used during that survey; use of larger circle hooks results in very low catch rates of shark pups. For mako and blue sharks, 9/0 J hooks continue to be used. This has been done because 1) sea turtles have not been taken during this survey and 2) during testing of circle hooks, target catch rates were substantially lower using circle hooks compared to J hooks.
- All SWFSC longline sets are conducted with pelagic gear (either anchored or drifting) marked at both ends with buoys (Appendix A). Typical sets are 2-4 hours. Circle hooks and finfish bait (mackerel or sardine) are used where possible to minimize sea turtle bycatch (the SWFSC has never caught sea turtles on longline gear).
- In shallow-set shark surveys, mainlines are set at a depth of 12 ft, which given the length of the gangions would allow a hooked turtle to reach the surface to breath. During swordfish sets, the mainline is set at a depth greater than 72 ft.
- If marine mammals or sea turtles are detected while longline gear is in the water, the officer on watch exercises similar judgments and discretion to avoid incidental take of these species with longline gear as described for trawl gear. The species, number, and behavior of the protected species are considered along with the status of the ship and gear, weather and sea conditions, and crew safety factors. The officer on watch uses professional judgment and discretion to minimize risk of potentially adverse interactions with protected species during all aspects of longline survey activities.
- If marine mammals or sea turtles are detected during setting operations and are considered to be at risk, immediate retrieval or halting the setting operations may be warranted. If setting operations have been halted due to the presence of these species, setting does not resume until no marine mammals or sea turtles have been observed for at least 30 minutes.
- If marine mammals or sea turtles are detected while longline gear is in the water and are considered to be at risk, haul-back is postponed until the officer on watch determines that it is safe to proceed. Adverse interactions with marine mammals, such as hooking and entanglement, are typically only observed during retrieval of the longline gear when hooks are close to the surface. From limited observations it appears that marine mammals are attracted to fish caught on longline gear (rather than the bait) and on rare occasions are caught when they bite off too much of a hooked fish. Based on these observations, the SWFSC considers the haul back period to be the time when marine mammals are most likely to be caught in longline gear so extra caution is taken during this phase of sampling.

2.2.1.3 Plankton Nets, Small-mesh Towed Nets, Oceanographic Sampling Devices, Video Cameras, and Remotely Operated Vessel (ROV) Deployments

- The SWFSC deploys a wide variety of gear to sample the marine environment during all of their research cruises, such as plankton nets, oceanographic sampling devices, video cameras, and ROVs. These types of gear are not considered to pose any risk to protected species because of their small size, slow deployment speeds, and/or structural details of the gear and are therefore not subject to specific mitigation measures. However, the officer on watch and crew monitor for any unusual circumstances that may arise at a sampling site and use their professional judgment and discretion to avoid any potential risks to protected species during deployment of all research equipment.

2.2.1.4 Handling Procedures for Incidentally Captured Individuals

Marine Mammals

- Captured live or injured marine mammals are released from research gear and returned to the water as soon as possible with no gear or as little gear remaining on the animal as possible. Animals are released without removing them from the water if possible. Data collection is conducted in such a manner as not to delay release of the animal(s) and should include species identification, sex identification if genital region is visible, estimated length, disposition at release (e.g., live, dead, hooked, entangled, amount of gear remaining on the animal, etc.) and photographs. The Chief Scientist or crew should collect as much data as possible from hooked or entangled animals, considering the disposition of the animal; if it is in imminent danger of drowning, it should be released as quickly as possible. Under the Status Quo Alternative, NMFS could collect biological samples in accordance with section 109(h)(1) of the MMPA for live/dead marine mammals (non-listed)[13], or under a directed scientific research and enhancement permit.
- If a large whale is alive and entangled in fishing gear, the vessel should immediately call the U.S. Coast Guard (USCG) at VHF Ch. 16 and/or the appropriate Marine Mammal Health and Stranding Response Network. Entangled whales may be reported to the NOAA Fisheries entanglement reporting hotline (1-877-767-9425).

Sea Turtles

- SWFSC policy currently is to not retain dead sea turtles. Pending the outcome of consultation undertaken pursuant to section 7 of the ESA, sea turtle carcasses would be salvaged or biological data would be obtained from live turtles in accordance with established regulations (50 CFR 223.206 and 222.310). Only one sea turtle has been captured during SWFSC research activities and it was released alive. Captured live and injured sea turtles are handled in accordance with established handling procedures (Appendix D). Data collection includes species identification, length, weight, sex, visible injuries, disposition at release (e.g., live, dead, hooked, entangled, amount of gear remaining on the animal, etc.), photographs, and examination for presence of Passive Integrated Transponder (PIT) tags. Crew may elect to install PIT tags or flipper tags in animals that have not already been tagged. Captured turtles are quickly processed and released in accordance with established handling procedures (50 CFR 223.206 (d)(1)).

2.3 ALTERNATIVE 2 - PREFERRED ALTERNATIVE - CONDUCT FEDERAL FISHERIES AND ECOSYSTEM RESEARCH (NEW SUITE OF RESEARCH) WITH MITIGATION FOR MMPA AND ESA COMPLIANCE

The Preferred Alternative is comprised of a combination of past research and additional, new research, and includes the same set of research surveys described in the Status Quo Alternative with the addition of a new survey in the ETPRA. Details of the additional survey are summarized in Table 2.3-1. Under this alternative, the SWFSC has applied for authorizations under the MMPA and the ESA for incidental take of protected species during these research activities. This process requires regulations and authorizations for incidental take of marine mammals under the MMPA and incidental take of protected species under the ESA. Under this alternative, the SWFSC has applied to NMFS Headquarters Office of Protected Resources (OPR) requesting regulations governing the issuance of LOAs for incidental take of marine mammals under the MMPA. The OPR has made the necessary findings and promulgated regulations and

[13] Section 109(h)(1) specifies that the MMPA does not prohibit federal, state, or local government officials or an employee or person designated under section 112(c) of the MMPA from taking, in the course of his or her duties as an official, employee, or designee, a marine mammal in a humane manner (including euthanasia) if such taking is for (A) the protection or welfare of the mammal, (B) the protection of the public health and welfare, or (C) the nonlethal removal of nuisance animals.

issued LOAs to the SWFSC; the LOAs prescribe mitigation measures intended to reduce the risk of potentially adverse interactions with marine mammals during the specified research activities.

In addition, both OPR and the SWFSC have engaged in ESA section 7 consultations with NMFS West Coast Regional Office (and U.S. Fish and Wildlife Service [USFWS]) for species that are listed as threatened or endangered. These consultations have resulted in the development of a Biological Opinion (BiOp) that describes the determination of NMFS that the federal action is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of any critical habitat. The BiOp contains an incidental take statement (ITS) for ESA-listed species that includes reasonable and prudent measures along with implementing terms and conditions intended to minimize the impact of incidental take of ESA-listed species during SWFSC research activities.

Compared to the status quo, the Preferred Alternative includes several additional research programs to test the efficacy, safety, and practicability of new techniques and equipment for fisheries research designed to reduce adverse impacts to protected species (conservation engineering and analysis). Under the Preferred Alternative, new mitigation protocols would be developed based on the results of this research. These new protocols would become mitigation measures in the future pending the outcome of the following conservation engineering and analysis research programs for fisheries research:

- MMEDs for Modified Cobb trawl gear: The SWFSC will continue to design and develop excluder devices for use on Modified Cobb trawl gear. When one or more prototypes are built, sea trials will take place to test the new gear under actual operating conditions, including side by side or paired trawls with standard gear to test for differences in catchability. If all safety and development concerns can be addressed, the new excluder devices will be installed on Modified Cobb trawl gear as soon as practicable.
- Retrospective analysis of factors influencing incidental take of protected species: SWFSC staff have been using predictive machine-learning methods (classification trees) for various applications, including a recently published paper (Carretta and Barlow 2011) examining bycatch rates of cetaceans and pinnipeds in a commercial swordfish and thresher shark drift gillnet fishery in relation to the use of acoustic pingers. Using similar methods, the SWFSC plans to examine research trawl data for any link between trawl variables and observed marine mammal bycatch. SWFSC staff is currently reviewing historical fisheries research data to determine whether sufficient data exist for such an analysis. Some of the variables SWFSC is considering for this analysis are: moon phase, sky cover, pinger presence, trawl speed, vessel sonar use during trawl, use of deck lights, etc. SWFSC is also exploring patterns in past marine mammal bycatch in its fisheries research surveys to better understand what factors might increase the likelihood of take. If take patterns emerge, the SWFSC will focus future research on reducing or eliminating high-risk factors in ways that enable scientifically important surveys to continue with minimized environmental impact.

Table 2.3-1 Summary description of a new survey in the ETPRA proposed under the Preferred Alternative

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples	Mitigation Measures
Eastern Tropical Pacific Research Area								
HMS Survey	New survey planned for the future to monitor HMS abundance and distribution	Eastern Tropical Pacific Ocean	Annually, June-July 30 DAS	NOAA ship, Charter vessel	Pelagic longline	Mainline length: 2-4 mile set 50 to 75 feet deep for mako and blue sharks; 300 to 600 feet deep for swordfish Gangion length: 10-15 ft Gangionspacing: 50-100 ft apart Hook size and type: 9/0 J hooks for blue and mako sharks; 16/0 and 18/0 offset, stainless circle hooks for swordfish. Soak time: 2-4 hr	60 sets	Visual monitoring, “move-on” rule, operational adjustments to avoid take. Use of circle hooks where possible and finfish bait to minimize sea turtle bycatch.
					Bongo plankton tows	Tow speed: 1.5 kts Duration: 20 min	60 tows	
					CTD profiler and rosette water sampler	Tow speed: 0 Duration: 20-120 min	60 casts	
					Multi-frequency single-beam active acoustics	18, 38, 70, 120, 200, 333kHz	Continuous	

2.3.1 Mitigation Measures for Protected Species

The Preferred Alternative also includes the same suite of mitigation measures described in the Status Quo Alternative to reduce the risk of adverse interactions with protected species but includes at least two and (as described previously) possibly several additional new mitigation measures that would be implemented in the future under this Final PEA. The mitigation measures to be implemented in this Preferred Alternative are non-discretionary requirements of the MMPA incidental take authorization and the ESA section 7 consultation process. In addition to the mitigation measures included in the Status Quo Alternative, the Preferred Alternative also includes the following new measures:

- The "move-on" rule would be modified for both trawl and longline gear to clarify and restrict when some of the decisions currently left to the professional judgment of the Chief Scientist or officer on watch may be made and situations when they may not be made. The Status Quo includes a monitoring zone limited only by environmental conditions (visibility factors) but the Chief Scientist or officer on watch may decide to set gear even if animals are seen if they consider the risk of interaction to be low (either because of the animals' distance, behavior, or trajectory).The Preferred Alternative would implement a one nautical mile (1.85 km) monitoring zone within which sets may not be made if marine mammals are present within the zone (at the discretion of the Chief Scientist or officer on watch). The crew assigned to monitor for marine mammals or sea turtles would use one or more methods (e.g., reticulated binoculars) to determine the distance of protected species seen from the vessel during daytime and the best available means during nighttime observations. If any protected species are seen within 1 nautical mile of the vessel within the 30 minutes prior to the trawl or longline gear being set, the vessel would be moved to at least 1 nautical mile away from the animals before gear is set. If the vessel is moved to avoid animals monitoring will continue, but the 30 minute monitoring period requirement would be waived; gear may be deployed immediately upon arrival at the new position, provided that no marine mammals or sea turtles are detected within 1 nautical mile. Professional judgment would still be considered but only for decisions involving animals more than 1 nautical mile from the vessel; in such cases the Chief Scientist or officer on watch may decide to move the vessel or delay setting gear if they consider the animals to be at risk of interacting with the gear even if they are farther away than 1 nautical mile (e.g., they are on a trajectory to intercept the vessel and are species known to interact with gear).
- One exception applies to this modified "move-on" rule for longline surveys only. Due to the prevalence of California sea lions in the areas where longline surveys are conducted in the California Current Research Area, it would be impractical to apply the move-on rule whenever a California sea lion is seen within 1 nautical mile of a research vessel during the 30-minute period preceding deployment of longline gear. This exception has been defined considering the rarity of past interactions between this gear and California sea lions and in order to make this mitigation measure practicable to implement. Without it, given the density of California sea lions in the areas where longline surveys are conducted, the SWFSC believes implementing the move-on rule for a single animal would preclude sampling in some areas and introduce significant bias into survey results. For California sea lions only, the vessel would not be required to move if a group of five or fewer animals is sighted during the watch period within 1 nautical mile of the set location. The SWFSC believes this exception to the move-on rule would allow sampling for target species without increasing the number of interactions between marine mammals and research longline gear. If more than five California sea lions are seen within 1 nautical mile, the vessel would be moved at least 1 nautical mile away from the animals before the gear is set. As described above, the officer on watch may also choose to move the vessel before setting gear if they consider the risk of interaction to be too high even if the conditions of the "move-on" rule are not met.

- If seabird interactions with longline gear are documented in the future, the SWFSC will revisit whether use of streamer lines is warranted given the tradeoffs between the potential conservation benefit and operational and safety considerations.
- The SWFSC would initiate a process for its Chief Scientists and vessel captains to communicate with each other about their experiences with protected species interactions during research work with the goal of improving decision-making regarding avoidance of adverse interactions. As noted above, there are many situations where professional judgment is used to decide the best course of action for avoiding marine mammal interactions when research gear is in the water. The intent of this mitigation measure would be to draw on the collective experience of people who have been making those decisions, provide a forum for the exchange of information about what went right and what went wrong, and try to determine if there are any rules-of-thumb or key factors to consider that would help in future decisions regarding avoidance practices. The SWFSC would coordinate not only among its staff and vessel captains but also with those from other fisheries science centers with similar experience. The initial process would focus on discussing past experiences but the goal would be to develop a training program for both new and experienced crew members. Training programs would be conducted on a regular basis and would include topics such as monitoring and sighting protocols, species identification, decision-making factors for avoiding take, procedures for handling and documenting protected species caught in research gear, and reporting requirements. These topics are currently covered under existing NMFS training programs for the commercial fisheries Observer Program. The SWFSC would examine the Observer Program training material and incorporate elements of that training appropriate for their research crews. This proposed new training program would be developed with guidance from NMFS West Coast Regional Office Protected Resources Division, and would formalize and standardize the information provided to all crew that might experience protected species interactions during research activities.

2.3.2 Handling Procedures for Protected Species

Another difference between the Status Quo and the Preferred Alternative involves handling and data collection procedures for incidentally captured marine mammals. Under the Preferred Alternative, the Chief Scientist or other designated scientists would participate in the commercial fisheries Observer Training Program currently conducted by NMFS West Coast Regional Office. This formalized training would provide the Chief Scientist or other designated scientists the instructions necessary for determining the severity of injuries to marine mammals. The SWFSC would work with the West Coast Regional Office to customize these trainings to meet their particular needs.

Certain types of data are needed to evaluate the severity of a particular injury. The Chief Scientist or other designated scientists would collect biological information from captured, live marine mammals before they are released, including species identification, sex identification (if genital region is visible), estimated length, and photographs. This information would be recorded on standardized regional commercial fishery observer forms. If the safety of the crew or the captured animal would be compromised by this data collection effort, however, the animal would be immediately released. The Chief Scientist would submit data on all captured animals to marine mammal experts at the appropriate NMFS Science Center who would use specific criteria to determine whether the injury is considered serious (i.e., more likely than not to result in mortality). If insufficient data has been collected for any reason, the marine mammal experts may not be able to determine the severity of the injury. However, the marine mammal experts may use other types of information to assign the injury to either the serious or non-serious categories for reporting and stock assessment purposes. These injury assessments would also affect the classification of takes for MMPA and ESA compliance purposes. The Chief Scientist or other designated scientist would be required to remove as much gear as possible from an animal before release. Gear remaining on an animal that has the potential to cause future entanglements generally increases the chances that an injury will be serious. Human safety is paramount when considering whether and how to disentangle or dehook a marine mammal.

2.3.3 Unknown Future SWFSC Research Activities

In addition to the activities identified above, the SWFSC may propose additional surveys or research activities within the timeframe covered by this programmatic analysis. Because of the annual cycle under which decisions to fund and/or conduct research are made, the SWFSC cannot identify in advance all the potential future activities that may take place over the next five years. For purposes of this programmatic analysis, NMFS has examined the research activities that have occurred from 2008-12 and used this information as a proxy for future proposed research activities that may occur through the five-year MMPA authorization period. Taken together, these activities comprise the actions evaluated within this Final PEA under the Preferred Alternative.

In the future, as congressional appropriations and NMFS fisheries research budgets are established, the SWFSC will examine the proposed future research to determine if the activities are consistent with the scope of actions considered under the Preferred Alternative. To be considered 'within scope' under this Final PEA, future proposals for specific research projects must be consistent with the gear types, spatial/temporal distribution of research activities, and types of effects analyzed within this document. If future research projects are not consistent with the type or scope of fisheries research activities analyzed in this Final PEA, they may be subject to additional NEPA, ESA, and MMPA evaluations.

More specifically, the basic methodology used to evaluate any proposed future research activity will be as follows:

1. **Evaluate the activity to determine if it would be conducted within the geographic scope of the region evaluated in the Final PEA.** The evaluation described in Chapter 4 of this Final PEA is based on the historic spatial distribution of research surveys. Any future research activities proposed within the geographic areas described in Chapter 4 would pass this step of the evaluation. The geographic scope of this Final PEA is extensive, but some areas (e.g., areas with permanent exclusions) were not subject to research surveys and are not included in this evaluation. Any proposed research in those areas would require additional evaluation.
2. **Evaluate the seasonal distribution of the activity**. The activities evaluated in this Final PEA are conducted throughout the year but certain surveys are only conducted in specific time frames/seasons. If a program was proposed that was similar in methodology to past surveys but significantly shifted the timing of research activities from what was analyzed in this Final PEA, additional evaluation may be required.
3. **Evaluate the gear types proposed**. The gear types that were included in the analysis are described in Appendix A. If the proposed future research activity used the same or similar gear in the same manner analyzed in this Final PEA, then the research activity would fall within the analysis conducted. The research activity would not have to exactly match the descriptions in this Final PEA, because the same impacts would be expected from similar gear types and activities. For example, if a new side-scan sonar were to be deployed, but the signal strength and frequency were within the ranges evaluated for bottom sounding sonar evaluated in this Final PEA, then the impacts would be similar because only the area swept by the sonar would be changing. If a new type of gear was to be deployed, or if a gear type was to be used in substantially different ways than described, and if environmental impacts not considered in this Final PEA could result, then additional NEPA analysis would be required.

To reiterate, any proposed action 1) conducted in regional areas described in this Final PEA, 2) during times of the year considered, and 3) using gear types and methods generally equivalent to the methods evaluated, would be considered covered by the scope of analysis and conclusions drawn in this Final

PEA. If future proposed research activities, projects, or programs are not consistent with the type or scope of fisheries research activities analyzed in this Final PEA, they would require additional NEPA evaluations.

2.4 ALTERNATIVE 3 - MODIFIED RESEARCH ALTERNATIVE – CONDUCT FEDERAL FISHERIES AND ECOSYSTEM RESEARCH (NEW SUITE OF RESEARCH) WITH ADDITIONAL MITIGATION

Under Alternative 3, the SWFSC would continue fisheries research as described in Section 2.2 and Appendix A and would apply for authorizations of incidental take of protected species under the MMPA and the ESA. Alternative 3 would include all of the same mitigation measures required by the MMPA and ESA authorization procedures as described for the Preferred Alternative. The difference between Alternative 3 and the Preferred Alternative is that Alternative 3 includes a number of additional mitigation measures derived from a variety of sources including: (1) comments submitted from the public on similar fisheries actions, (2) discussions within NMFS as a part of the proposed rulemaking process, and (3) a literature review of past and current research into potential mitigation measures. The new suite of research activities is a combination of past research and additional, new research, as described for the preferred alternative.

As described in the Preferred Alternative, the SWFSC continually reviews its procedures and investigates options for incorporating new mitigation measures and equipment into its ongoing survey programs. Evaluating new mitigation measures includes assessing their effectiveness in reducing risk to protected species, but measures must also: pass safety and practicability considerations, meet survey objectives, allow survey results to remain consistent with previous data sets, and be consistent with the purpose and need for SWFSC research activities (Section 1.3). Some of the mitigation measures considered in this alternative (e.g., no night fishing or broad spatial/temporal restrictions) would essentially prevent the SWFSC from collecting data required to provide for fisheries management purposes under the Magnuson-Stevens Fishery Conservation and Management Act. Some research surveys necessarily target fish species that are preyed upon by marine mammals with an inherent risk of interactions with marine mammals during these surveys. The SWFSC acknowledges the inherent risk of these surveys (e.g., the CPS survey, juvenile salmon survey, and juvenile rockfish survey), and it has implemented a variety of measures to mitigate that risk. The SWFSC currently has no viable alternatives to collecting the data derived from these surveys and does not propose to implement potential mitigation measures that would preclude continuation of these surveys, such as the elimination of night surveys or use of pelagic trawl gear. An analysis of the potential efficacy and practicability of the additional mitigation measures considered in this alternative is presented in Section 4.4.

The secondary federal action covered under this Final PEA is the issuance of regulations and subsequent Letters of Authorization under Section 101(a)(5)(A) of the MMPA that would regulate the unintentional taking of small numbers of marine mammals incidental to the SWFSC's research activities. In order to authorize incidental take of marine mammals under the MMPA, NMFS must identify and evaluate mitigation measures to minimize impacts to marine mammals to the level of "least practicable adverse impact." As described above, some mitigation measures could prevent the SWFSC from maintaining the utility of ongoing scientific research efforts, and those mitigation measures would normally be excluded from consideration in the Final PEA under screening criteria 3 (Section 2.1). However, such mitigation measures were considered during the MMPA incidental take authorization process and/or ESA section 7 consultation and are therefore considered under Alternative 3 in this Final PEA.

2.4.1 Additional Mitigation Measures for Protected Species

2.4.1.1 Trawl Surveys

1. Monitoring methods

Visual observations (using bridge binoculars as needed) by the officer on watch, Chief Scientist or other designated scientist, and crew standing watch are currently the primary means of detecting protected species in order to avoid potentially adverse interactions. However, there are other detection methods that have been used in commercial fisheries, naval exercises, and geotechnical exploration that could be considered. These additional types of detection methods would be intended to be used in specific circumstances, such as operating at night or in low visibility conditions.

- Visual surveillance by dedicated protected species observers. This measure would require the SWFSC to use trained protected species observers whose dedicated job is to detect the presence of marine mammals and other protected species within the survey area and communicate their presence to ship operations personnel. This dedicated observer position would be different than having marine mammal and/or bird biologists on board whose job is to conduct abundance and distribution surveys (as is currently the practice on CalCOFI and other surveys). Considerations include the use of dedicated observers for all surveys or during trawl surveys of particular concern.
- Use of a camera or underwater video system to monitor any interactions of protected species with the trawl gear. Underwater video technology may allow the SWFSC to determine the frequency of interactions with the trawl gear and to evaluate the effectiveness of a measure's ability to mitigate injurious or lethal interactions.
- Use of passive acoustic monitoring for marine mammal vocalizations to aid in the detection of marine mammals present in the survey area and to implement appropriate modifications of trawl operations.
- Use of aircraft, unmanned aerial vehicles, or autonomous underwater gliders to provide additional detection capabilities.
- Use of infrared (IR) technologies to detect marine mammals.
- Use of night-vision devices to detect marine mammals.

2. Operational restrictions

- This measure would require the SWFSC to suspend trawl operations at night or during periods of low visibility (including fog and high sea state) to minimize interactions with marine mammals that would be difficult to detect by visual monitoring.
- Video sampling with an open cod end: The SWFSC would investigate the use of video cameras to identify fish and their encounter rates in lieu of a closed cod end on pelagic trawls, which may take protected species as well as target fish. This approach would be appropriate for swept area surveys designed to determine the density of fish or verification of acoustic target identification (e.g., all surveys). However, it would not be appropriate for surveys designed to determine the reproductive condition of adult fish (e.g., Coastal Pelagic Species [CPS] surveys) or the growth rates of fish (e.g., juvenile salmon surveys) as these measurements require the dissection of specimens. Considerable insight and experience may be gained by experimenting with open cod end trawls and associated high-resolution, high-speed video cameras, particularly with real-time video feeds to the ship. In some cases this experience could lead to routine use of cameras instead of capture. In other situations the number of closed cod end trawls required for estimating vital rates could be reduced. While it would not be the primary objective, video camera data may also provide documentation of protected species interactions with trawl gear and may thus provide insight into the efficacy of other measures intended to reduce the interactions with protected species (e.g., excluder devices or acoustic pingers).

3. Acoustic and visual deterrents

- This measure would require the SWFSC to use deterrents, such as recordings of predator vocalizations (e.g., killer whale) to deter interactions with trawl gear, or use visual deterrence techniques (e.g., lights, light sticks, reflective twine/rope) to reduce marine mammal interactions with the gear.

4. Temporal or geographic restrictions

- Spatial/temporal restrictions are one of the most direct means of reducing adverse impacts to protected species. By reducing the overlap in time and space of the survey's footprint with known concentrations of protected species, the SWFSC may reduce the amount of incidental take of such species. This measure would require the SWFSC to identify areas and times that are most likely to result in adverse interactions with protected species (e.g., areas of peak abundance) and to avoid, postpone, or limit their research activity to minimize the risk of such interactions with protected species as long as such spatial/temporal restrictions do not conflict with the ability of the SWFSC to conduct scientifically valid surveys and to provide the best scientific information available for purposes of managing commercial fisheries. This may include limits on specific locations, physical or oceanographic features, biologically important times, and/or gear types.
- Avoidance of federal and state marine protected areas. This measure would disallow or restrict SWFSC trawl surveys in federal and/or state marine protected areas (Section 3.1.2.4).

2.4.1.2 Longline Gear

1. Monitoring methods

- Visual surveillance by independent protected species observers. This measure would require the SWFSC to use trained, independent, protected species observers on each longline survey to detect the presence of marine mammals and other protected species within the survey area. Considerations include the use of independent observers for all surveys or during longline surveys of particular concern.

2. Operational procedures

- Decoy vessels. This measure would require use of a decoy research vessel playing prerecorded longline fishing sounds to distract marine mammals away from the fishing grounds.
- Streamer lines. Under this measure, the SWFSC would deploy streamer lines before longline gear is set to mitigate the risk of catching seabirds. Deploying streamer lines on each side of the baited longline to discourage seabirds from diving on baited hooks has been proven effective in reducing seabird bycatch in several Pacific fisheries (Melvin et al. 2001).

3. Acoustic deterrents

- This measure would require the SWFSC to use deterrents such as acoustic pingers or recordings of predator vocalizations (e.g., killer whale) to deter interactions with longline gear.

4. Visual deterrents

- This measure would require the crew to use visual deterrence techniques (e.g., lights, light sticks, reflective twine/rope, or marked lines) to make the longline gear more detectable thereby potentially reducing the likelihood of hooking or entangling a marine mammal. Note that lights and light sticks are prohibited for use on longline gear in some Pacific fisheries as they may contribute to increased turtle bycatch.

2.5 ALTERNATIVE 4 – NO RESEARCH ALTERNATIVE - NO FIELDWORK FOR FEDERAL FISHERIES AND ECOSYSTEM RESEARCH CONDUCTED OR FUNDED BY SWFSC

Under the No Research Alternative the SWFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered in the scope of this Final PEA in marine waters of the California Current, Eastern Tropical Pacific, or Antarctic Research Areas. This moratorium on fieldwork would not extend to research that is not in scope of this Final PEA, such as directed research on marine mammals and ESA-listed species covered under separate research permits and NEPA documents. NMFS would need to rely on other data sources, such as fishery-dependent data (e.g., harvest data) and state or privately supported fishery-independent data collection surveys or programs to fulfill its responsibility to manage, conserve and protect living marine resources in the U.S. Under this alternative, organizations that have participated in joint research programs may or may not continue their research efforts depending on whether they are able to secure alternative sources of funding. Any non-federal fisheries research would occur without NMFS funding, direct control of program design, or operational oversight. It is unlikely that these non-NMFS fisheries research surveys would be consistent with the time series data NMFS has collected over many years, which is the core information supporting NMFS science and management missions and vital to fishery management decisions made by the Fishery Management Councils, NMFS, and other marine resource management institutions, leading to greater uncertainty for fishery and other natural resource management decisions.

Currently, fisheries and marine ecological research is also being conducted by state agencies, other international agencies, and research institutes in the three SWFSC research areas, sometimes with funding support from the SWFSC. However, this research is generally confined to state waters and near-shore ocean areas and does not cover many fisheries topics currently investigated by the SWFSC. Under the No Research Alternative, it is unlikely that any of the state or other institutional research programs would be able to undergo the fundamental realignment of budgets and scientific programs necessary to maintain the level and continuity of information currently provided by the SWFSC. No agencies or other entities would likely conduct marine research to replace the research abandoned by the SWFSC in the three research areas under the No Research Alternative.

2.6 ALTERNATIVES CONSIDERED BUT REJECTED FROM FURTHER ANALYSIS

As stated previously, the alternatives evaluated in an EA must achieve the purpose and need of the proposed action without violating any of the applicable laws and regulations described in Chapter 6 and summarized in section 1.6. Other potential alternatives that do not satisfy the agency's purpose and need, or would not meet minimum environmental standards, are not considered reasonable and need not be carried forward for evaluation in an EA. The following alternatives were considered but rejected because they do not meet the purpose and need as stated in Section 1.3 or the screening criteria described in Section 2.1.

2.6.1 Sole Reliance on Commercial Fishery Data

One alternative that NMFS considered was to rely solely on commercial fisheries data such as Catch Per Unit Effort, seasonal and geographic distribution of harvests, and other harvest data to assess the status of commercially important stocks. This alternative was rejected from further analysis because it would not provide sufficient information on the age/size class structure of exploited fish stocks and would be insufficient to track fish population dynamics or provide other types of predictive capabilities required to manage the fisheries. This approach would also not meet the need to maintain a standardized, objective, and unbiased sampling approach provided by independent surveys.

Conclusion: This alternative does not meet screening criteria 1 or 3. It would not meet statutory obligations because directed research activities would not be conducted. It would not maintain scientific integrity of research programs because the results would not maintain the consistency of data with prior research efforts. For these reasons this alternative is not carried forward for detailed evaluation.

2.6.2 New Methodologies

Another alternative considered was to adopt other types of survey methodologies or develop new methodologies based primarily on their potential to eliminate or greatly reduce interactions with protected species or effects on habitat, as opposed to adopting new methods and gear for fisheries research purposes. Although NMFS continues to place a high priority on avoiding adverse interactions with protected species and is continually reviewing potential mitigation measures for research activities, the purpose and need for conducting fisheries research requires future sampling methodologies be consistent with past data sets to maintain long-term trend analyses for commercially fished and ecologically important species. NMFS is currently evaluating alternative sampling methods for fisheries and marine ecosystem research, some of which may reduce the potential for incidental takes of protected species or effects on benthic habitats. However, these new methodologies would be evaluated primarily for consistency with the purpose and need for fisheries and marine ecosystem research and whether they provide information that can build on and supplement past data sets.

Conclusion: This alternative did not meet screening criterion 3. It would not maintain scientific integrity of research programs because the results would not maintain the consistency of data with prior research efforts. Therefore, this alternative is not carried forward for detailed evaluation.

2.6.3 Alternative Research Program Design

In this alternative the types of research conducted would be revised to determine if alternative levels of a particular research would result in different levels of impacts. This alternative would emphasize minimizing potential adverse environmental impacts when designing research activities. Other factors, such as maximizing efficient use of scientific research funding and maintaining the integrity of long-term data sets, would not be considered in this approach.

Conclusion: This alternative was rejected because it would not meet screening criterion 3 and would intrude on inherently technical and scientific decisions. Therefore, this alternative is not carried forward for detailed evaluation.

3.1 PHYSICAL ENVIRONMENT

The geographic areas and physical environments potentially affected by the Southwest Fisheries Science Center's (SWFSC's) research surveys are located throughout the Pacific Ocean and in the Southern Ocean off Antarctica. These areas include the California Current, Eastern Tropical Pacific Ocean, and Antarctic ecosystems. SWFSC research surveys occur both inside and outside the United States Exclusive Economic Zone, and sometimes span across multiple ecological, physical, and political boundaries.

3.1.1 Large Marine Ecosystems

Large Marine Ecosystems (LMEs) are large areas of coastal ocean space. LMEs generally include greater than 200,000 square kilometers (km^2) of ocean surface area, and are located in coastal waters where primary productivity is generally higher than in open ocean areas. LME physical boundaries are based on four ecological criteria: bathymetry, hydrography, productivity, and trophic relationships. Based on these four criteria, 10 LMEs have been delineated for the coastal marine waters of the U.S., and a total of 64 distinct LMEs have been delineated around the coastal margins of the Atlantic, Pacific and Indian Oceans (Sherman et al. 2004). Figure 3.1-1 shows the world's LMEs as defined at www.lme.noaa.gov. Each color represents a distinct LME.

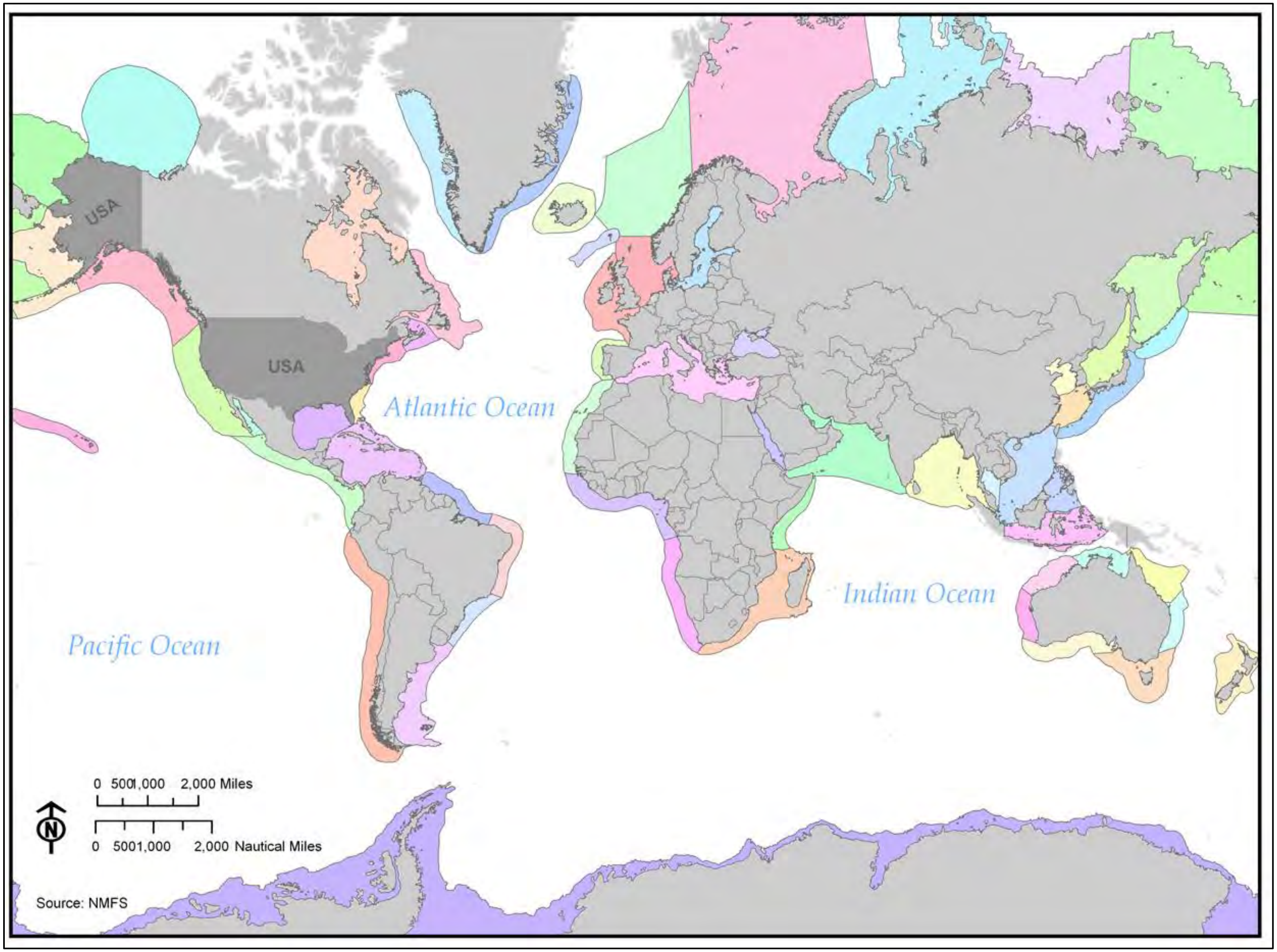


Figure 3.1-1 Large Marine Ecosystems of the World.

Globally, LMEs are the source of 80 to 95 percent of the world's marine fish harvest, and are centers of economic activity for oil and gas, shipping, and tourism industries. The LME concept provides a practical framework for the application of ecosystem-based approaches to fisheries assessment and management, habitat restoration, and research on pollution and ecosystem health. NMFS has implemented a management approach designed to improve the long-term sustainability of LMEs and their resources by using practices that focus on ensuring the sustainability of the productive potential for ecosystem goods and services. For more detailed information on the LME management concept and trends in ecosystem health, see *The UNEP* [United Nations Environmental Program] *Large Marine Ecosystem Report: A perspective on changing conditions in LMEs of the world's Regional Seas* (Sherman and Hempel 2008).

SWFSC's fisheries research activities take place in three primary research areas: the California Current Research Area (CCRA), the Eastern Tropical Pacific Research Area (ETPRA), and the Antarctic Research Area (ARA), which are described in detail in the following sections. These areas include sections of several coastal LMEs, including the California Current LME, the Gulf of California (Sea of Cortez) LME, the Pacific-Central American Coastal LME, the Humboldt Current LME, and the Antarctica LME. However, a substantial amount of the SWFSC fisheries research activities are also conducted in offshore areas that lie outside of the coastal LME boundaries.

3.1.1.1 California Current

The SWFSC conducts research surveys in the CCRA, both inside and outside of the LME boundaries. The California Current LME has a surface area of about 2.2 million km² and is bordered by the U.S. and Mexico. The California Current moves south along the western coast of North America, beginning off southern British Columbia, flowing southward past Washington, Oregon and California, and ending off southern Baja California (Bograd *et al*. 2010). The California Current is part of the North Pacific Gyre and brings cool waters southward. Additionally, extensive upwelling of colder sub-surface waters supports large populations of whales, seabirds and important fisheries along the West Coast of the U.S. (Sherman and Hempel 2008). The California Current LME includes coastal areas where SWFSC conducts research surveys for rockfish, coastal pelagics and numerous other species. However the SWFSC also conducts research that extends into deeper waters beyond the California Current LME boundary.

On the shoreward side of the California Current, the California Current Front separates cold low-salinity upwelled waters from the warmer saltier waters close to shore. Offshore frontal filaments transport the frontal water across the entire LME. In winter, the Davidson Current Front forms along the boundary between inshore subtropical waters and colder offshore temperate and subarctic waters (see Figure 3.1-2) (Sherman and Hempel 2008).

The California Current determines the general hydrography off the coast of California. The current is related to the anticyclonic circulation of the central North Pacific. In general, an area of divergence parallels the coast of California, with a zone of convergence 200-300 kilometers (124-186 miles) from the coastline. Surface flow of the California Current appears to be diverted offshore at Point Conception and again at Punta Eugenia, while semi-permanent eddies exist south of these headlands. These eddies contribute to the recruitment of pelagic larvae to the adult species populations in these areas (Hewitt 1981).

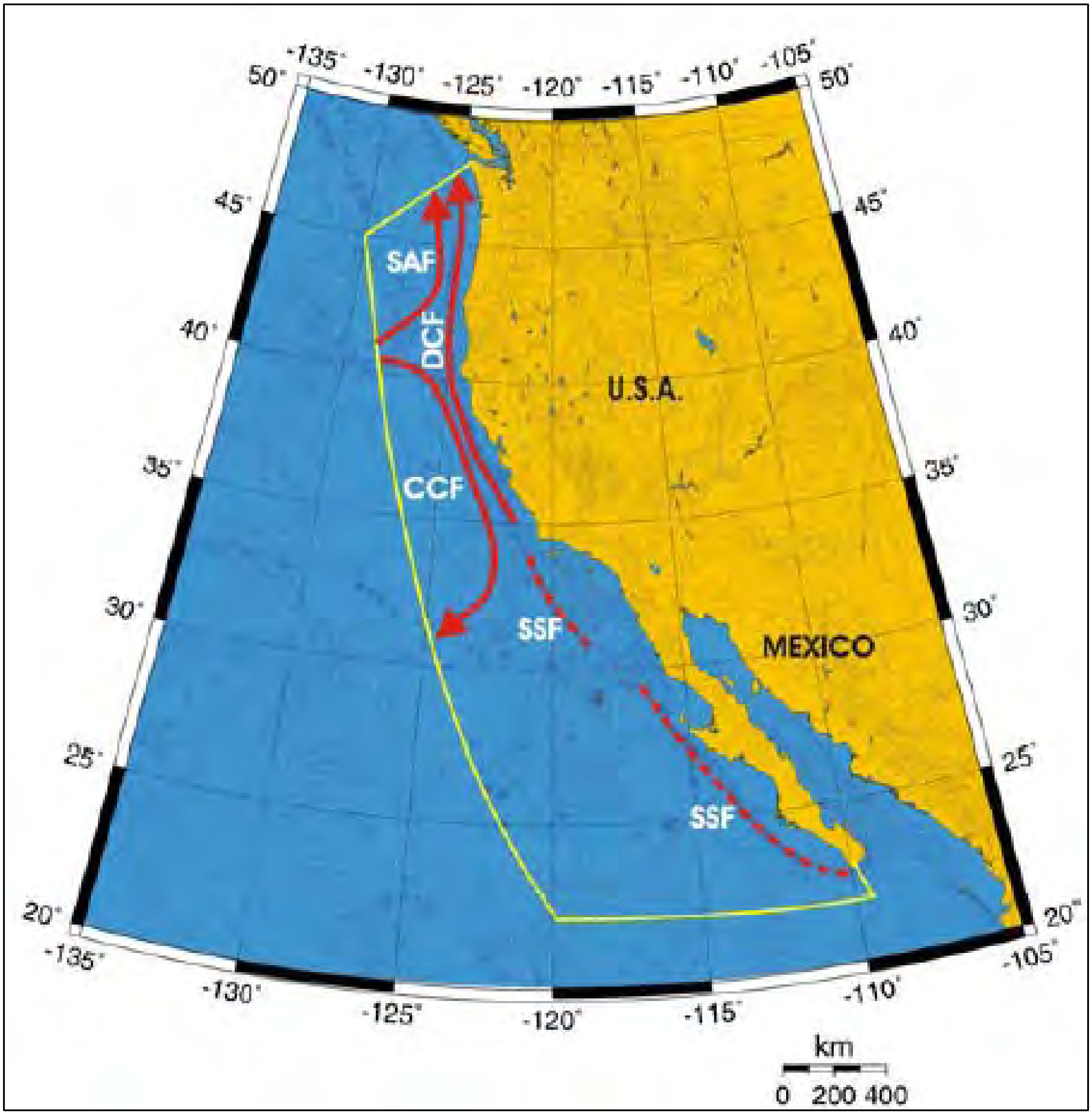


Figure 3.1-2 Oceanographic Fronts of the California Current.

Figure 3.1-2 shows the California Current Front (CCF), Davidson Current Front (DCF), Subarctic Front (SAF), Shelf Slope Front (SSF), and the California Current LME boundary (yellow line) (from Sherman and Hempel 2008; Belkin et al. 2009).

3.1.1.2 Eastern Tropical Pacific Ocean

The eastern tropical portion of the Pacific Ocean extends from San Diego west to Hawaii and south to Peru. Located between the subtropical gyres of the North and South Pacific, this area is one of the most productive tropical oceans in the world. Cool, low-salinity eastern boundary current waters flow into the ETP from the north and south, while warm, high-salinity subtropical surface waters flow into the ETP after being subducted into the thermocline primarily in the southern Subtropical Convergence. As a result of upwelling, the surface layer has relatively cool temperatures, high salinity, and high nutrient concentrations along the equator, coastal Peru and Baja California, and at the Costa Rica Dome. Nutrient-rich thermocline waters lie close to the surface along the countercurrent thermocline ridge between the North Equatorial Countercurrent and the North Equatorial Current. Deep and bottom waters formed in the Antarctic and North Atlantic are relatively homogeneous in the ETP (Fiedler and Lavın 2006).

The SWFSC's ETP Research Area spans the boundaries of several LMEs, including the California Current LME, the Gulf of California (Sea of Cortez) LME, the Pacific-Central American Coastal LME, and the Humboldt Current LME. The Research Area also includes a large portion of the offshore ETP Ocean outside of coastal LME boundaries (Sherman and Hempel 2008).

3.1.1.3 Antarctic

The Antarctic region includes the waters encircling Antarctica south of 60°S latitude. Cold waters flowing north from Antarctica mix with warm sub-Antarctic waters in the Antarctic Ocean. The Antarctic Circumpolar Current moves eastward and comprises the world's longest ocean current. There are only limited areas of shallow waters in the Southern Ocean, where the average depth is between 4,000 and 5,000 meters (13,000 to 16,000 feet) over most of its extent. The continental shelf is unusually deep, averaging 450 meters (1,462 feet) and in places measuring over 1,000 meters (3,250 feet) deep.

The Southern Ocean seafloor is primarily composed of siliceous ooze formed over thousands of years from dead phytoplankton deposits (Griffiths 2010). The Southern Ocean continental shelf sediments are predominantly a combination of glacial deposits and diatomaceous muds (Griffiths 2010). Shelf faunas are characterized by a high degree of endemism, approaching 90 percent in taxa such as sponges, peracarid crustaceans, and some gastropod families (Brandt et al. 2004). Benthic sampling has largely been restricted to the shelf and less is known about the fauna of the deeper waters of the Southern Ocean, including the Scotia and Weddell seas. Deep sea meiofaunal studies in the Southern Ocean indicate nematodes, harpacticoid copepods and foraminiferans are abundant and widely distributed (Brandt et al. 2004). The keystone species of the Antarctic ecosystem is the Antarctic krill, which provides an important food source for many species of marine mammals, sea birds, and fishes (SWFSC 2010). The SWFSC's ARA survey activities are usually conducted within the Antarctic LME, which is defined by the Antarctic Convergence. The location of the Antarctic Convergence oscillates between 48 and 60 degrees south and represents the boundary between cold Antarctic surface water and warmer sub-Antarctic waters (Sherman and Hempel 2008).

3.1.2 Special Resource Areas

3.1.2.1 Essential Fish Habitat

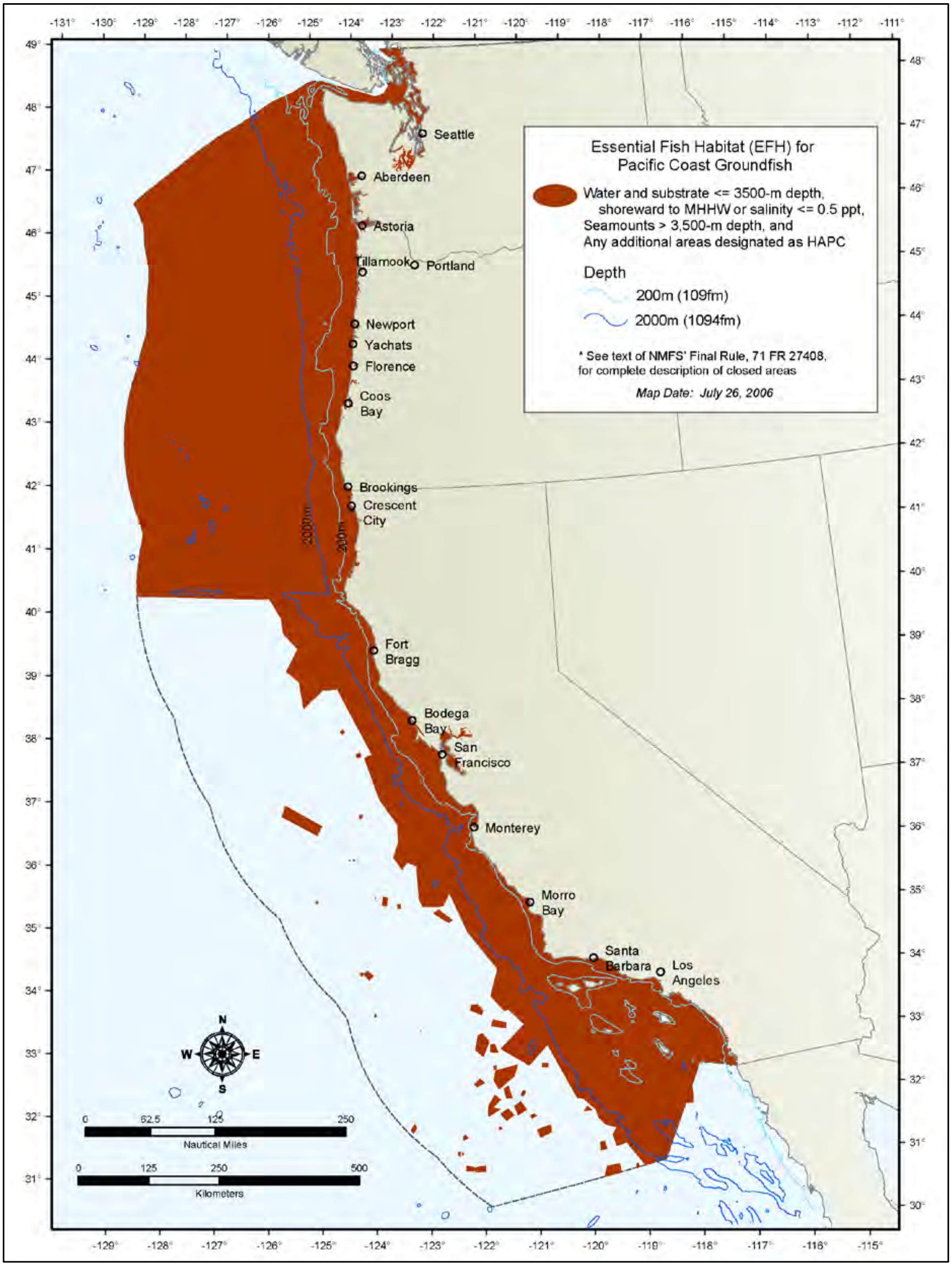
Essential Fish Habitat (EFH) is comprised of the waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16 United States Code [U.S.C.] §1802 sec. 3(10)). Regulatory guidelines explain that EFH should be sufficient to "support a population adequate to maintain a sustainable fishery and the managed species' contributions to a healthy ecosystem" (50 Code of Federal Regulations [CFR] § 600, subpart J). EFH applies to federally managed species in both state and federal jurisdictional waters throughout the range of the species within U.S. waters. Where a species' range extends beyond U.S. waters, EFH stops at the boundary. For this reason, no EFH exists within the ARA or the portion of the ETPRA that lies outside of the U.S. EEZ.

The designation of EFH by itself does not confer any protection of the areas from non-fishing or fishing impacts. Instead, it is a tool used by managers to reduce impacts and improve fisheries management. It is described and identified in Fishery Management Plans (FMPs) that are developed by regional fisheries management councils. NMFS regional offices implement FMPs to facilitate long-term protection of EFH through conservation and management measures.

The EFH for a managed species is designated separately for each life stage: eggs, larvae (normally pelagic), juveniles, and adults (pelagic and/or demersal). In certain species EFH is also designated for spawning adults. Many species require different habitats for different life stages, sometimes resulting in vast areas of EFH for a single species. Overlapping EFH areas for numerous federally managed species, including over 82 species covered by the Pacific Coast Groundfish FMP, have been identified in areas where SWFSC research surveys occur (Pacific Fisheries Management Council [PFMC] 2008). Descriptions of groundfish EFH for the various life stages of each of the species result in the definition of over 400 distinct EFH areas. As shown in Figure 3.1-3, when these EFHs areas are combined, groundfish EFH includes all waters less than 3,500 meters in depth from the mean higher high water line, and the upriver extent of saltwater intrusion in river mouths, to the seaward boundary of the U.S. EEZ along the coasts of California, Oregon, and Washington (PFMC 2008).

The Coastal Pelagic Species (CPS) FMP describes EFH for five pelagic species: northern anchovy, Pacific sardine, Pacific (chub) mackerel, jack mackerel and market squid (PFMC 1998). These four finfish and one squid are treated as a single species complex because of similarities in their life histories and habitat requirements. Krill was added to the FMP as an essential component of the California Current Ecosystem under amendment 12 of the CPS FMP in February 2008. EFH for these CPS includes all marine and estuarine waters above the thermocline where sea surface temperatures range between 10 and 26 C° along the coasts of California, Oregon, and Washington from the shoreline to the seaward boundary of the U.S. EEZ. The southern boundary of the EFH area for CPS is effectively the maritime boundary between U.S. and Mexican waters while the northern boundary for the EFH area is defined by the 10 C° isotherm, the location of which changes seasonally and annually (PFMC 1998).

Three species of salmon (Chinook, coho, and pink) are covered by the Pacific Salmon FMP (PFMC 2003). In estuarine and marine areas, salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters to the seaward boundary of the U.S. EEZ along the coasts of Washington, Oregon, and California north of Point Conception. The Pacific Salmon FMP also includes the salmon EFH in marine areas off the coast of Alaska designated by the North Pacific Fisheries Management Council. Freshwater EFH for Pacific salmon includes all streams, lakes, ponds, wetlands, and other water bodies currently or historically accessible to salmon in Washington, Oregon, Idaho, and California, with the exception of areas upstream of certain impassable manmade barriers (as identified by the PFMC), and upstream of longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for several hundred years) (PFMC 2003).



Source: http://www.pcouncil.org/wp-content/uploads/A18-19Final.pdf

Figure 3.1-3 Essential Fish Habitat for Pacific Coast Groundfish.

From Amendment 19 to the Pacific Coast Groundfish FMP (PFMC 2008).

The FMP for U.S. West Coast Fisheries for Highly Migratory Species defines EFH for thirteen species (common thresher shark, pelagic thresher shark, bigeye thresher shark, shortfin mako shark, blue shark, albacore tuna, bigeye tuna, northern bluefin tuna, skipjack tuna, yellowfin tuna, striped marlin, swordfish, and dorado or dolphinfish) (PFMC 2007). The combined EFH for these species includes a large fraction of the pelagic marine waters within the U.S. EEZ along the coasts of California, Oregon, and Washington.

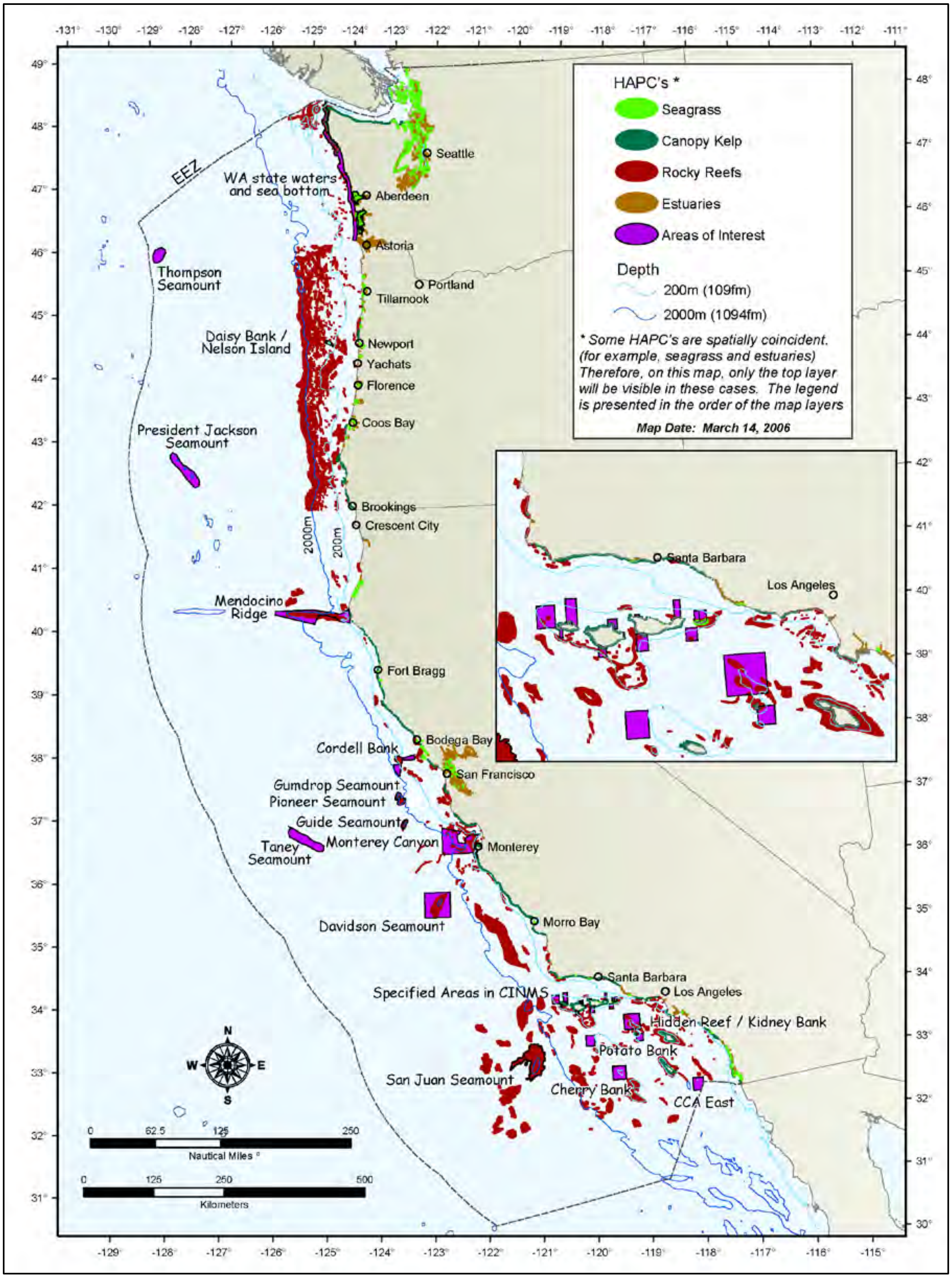
3.1.2.2 Habitat Areas of Particular Concern

The EFH provisions of the regulations implementing the Magnuson-Stevens Fishery Conservation and Management Act (50 CFR part 600) recommend that specific areas of habitat within EFH are identified as "habitat areas of particular concern." Habitat Areas of Particular Concern (HAPC) are discrete subsets of EFH that provide important ecological functions or are especially vulnerable to degradation. Fishery management councils may designate a specific habitat area as a HAPC for one or more of the following reasons: the importance of the ecological function provided by the habitat, the extent to which the habitat is sensitive to human-induced environmental degradation, whether and to what extent development activities are or will be stressing the habitat type, and the rarity of habitat type.

The intended goal of identifying HAPC is to focus conservation efforts on the most important areas. While the HAPC designation does not trigger any specific regulatory process or confer any specific protection, it highlights certain habitat types that are of high ecological value. This designation is manifested in EFH consultations, during which NMFS can recommend protective measures for specific HAPCs.

Several fishery management councils have designated discrete habitat areas as HAPCs, while others have broadly designated all areas of a specific habitat type as HAPCs. The PFMC designated the following HAPCs in Amendment 19 to the Pacific Coast Groundfish FMP: seagrasses, canopy kelp, estuaries, rocky reefs, and a number of clearly defined areas of interest but none in its three other FMPs. The "areas of interest" and estuaries designated by the Council in the Pacific Coast Groundfish FMP are examples of discrete HAPC, while the seagrass, canopy kelp, and rocky reef HAPC are examples of broadly defined HAPC that are based on a description of the habitat (PFMC 2008). Figure 3.1-4 shows the location of these HAPCs. For HAPC defined by habitat type, as opposed to discrete areas, this map offers an approximation of their location and extent (from Amendment 19 to the Pacific Coast Groundfish FMP; PFMC 2008**)**. HAPCs, like EFH, are subject to periodic reviews and may be modified over time.

During the review process for Pacific Coast Salmon EFH, PFMC recommended but has not yet formally designated the following five habitat types as potential HAPCs: complex channels and floodplains, thermal refugia, spawning habitat, estuaries, and marine and estuarine submerged aquatic vegetation. The Pacific Fishery Management Council concluded that more research is needed before HAPCs can be established under the FMPs for highly migratory species and coastal pelagic species. Shark pupping grounds have been suggested as potential HAPCs to be included under the FMP for highly migratory species.



Source: http://www.pcouncil.org/wp-content/uploads/A18-19Final.pdf

Figure 3.1-4 HAPCs for Pacific Coast Groundfish

For HAPCs defined by habitat type (sea grasses, canopy kelp, and rocky reef areas) this map offers an approximation of their location and extent (from Amendment 19 to the Pacific Coast Groundfish FMP).

3.1.2.3 Closed Areas

The Pacific Fishery Management Council has established seasonal and year-round areas closed to all fishing gear and specific to trawl gear within the CCRA. These specially managed areas protect key habitats and species and have contributed to the precautionary approach the council has undertaken to manage its fisheries. Detailed information on the restrictions within of the Habitat Closure Areas and Closed Areas can be found in the Multi-species Fishery Regulations (NOAA 2010). The types of marine areas closed to fishing by federal regulation are categorized by fishing type, and are listed below.

Commercial Trawl Closed Areas

Commercial vessels fishing with trawl gear are prohibited from fishing in any of the following areas:

- Trawl (Groundfish and Non-Groundfish) Rockfish Conservation Areas
- Cowcod Conservation Areas
- Cordell Banks Closed Area
- Farallon Islands Closed Areas
- EFH Conservation Areas

Commercial Non-Trawl Closed Areas

Commercial vessels fishing with gear other than trawl gear are prohibited from fishing in any of the following areas:

- Non-trawl Rockfish Conservation Areas
- Cowcod Conservation Areas
- Cordell Banks Closed Area
- Farallon Islands Closed Areas
- EFH Conservation Areas
- Yelloweye Rockfish Conservation Areas
- North Coast Commercial Yelloweye Rockfish Conservation Area
- Salmon Troll Yelloweye Rockfish Conservation Area
- North Coast Recreational Yelloweye Rockfish Conservation Area (voluntary closure)
- South Coast Recreational Yelloweye Rockfish Conservation Area (voluntary closure)
- Westport Offshore Recreational Yelloweye Rockfish Conservation Area (voluntary closure)

Recreational Closed Areas

Recreational fishing vessels are prohibited from fishing in any of the following areas:

- Recreational Rockfish Conservation Areas
- Yelloweye Rockfish Conservation Areas
- North Coast Recreational Yelloweye Rockfish Conservation Area
- South Coast Recreational Yelloweye Rockfish Conservation Area
- Westport Offshore Recreational Yelloweye Rockfish Conservation

- Stonewall Bank Yelloweye Rockfish Conservation Area
- Cowcod Conservation Areas
- Cordell Banks Closed Area
- Farallon Islands Closed Areas
- EFH Conservation Areas

The states of California, Oregon, and Washington have established additional closed areas within state waters.

In addition to closed areas within the U.S. EEZ, a series of closed areas in the Antarctic region have been established by the Convention for the Conservation of Antarctic Living marine resources (CCAMLR) conservation measures, as discussed in *Schedule of Conservation Measures in Force 2010/11 Season* (CCAMLR 2010). Taking of all finfish, other than for scientific research purposes, is prohibited in CCAMLR statistical subareas 48.1 and 48.2, which overlap with the SWFSC ARA (Figure 3.1-5). In addition, directed fishing for certain species in certain areas (except for scientific research purposes) is prohibited as described in a series of CCAMLR conservation measures. Directed fishing for sharks (except for scientific research purposes) is prohibited throughout the CCAMLR convention area, and any sharks caught accidentally are required to be released alive, if possible.

An additional series of closed areas have been proposed as a management tool to determine the efficacy of small scale management units in the Antarctic krill fishery (Constable *et al*. 2000; Hill et al. 2009).

Closed areas within the ETP region are described in Section 3.1.2.4 Marine Protected Areas.

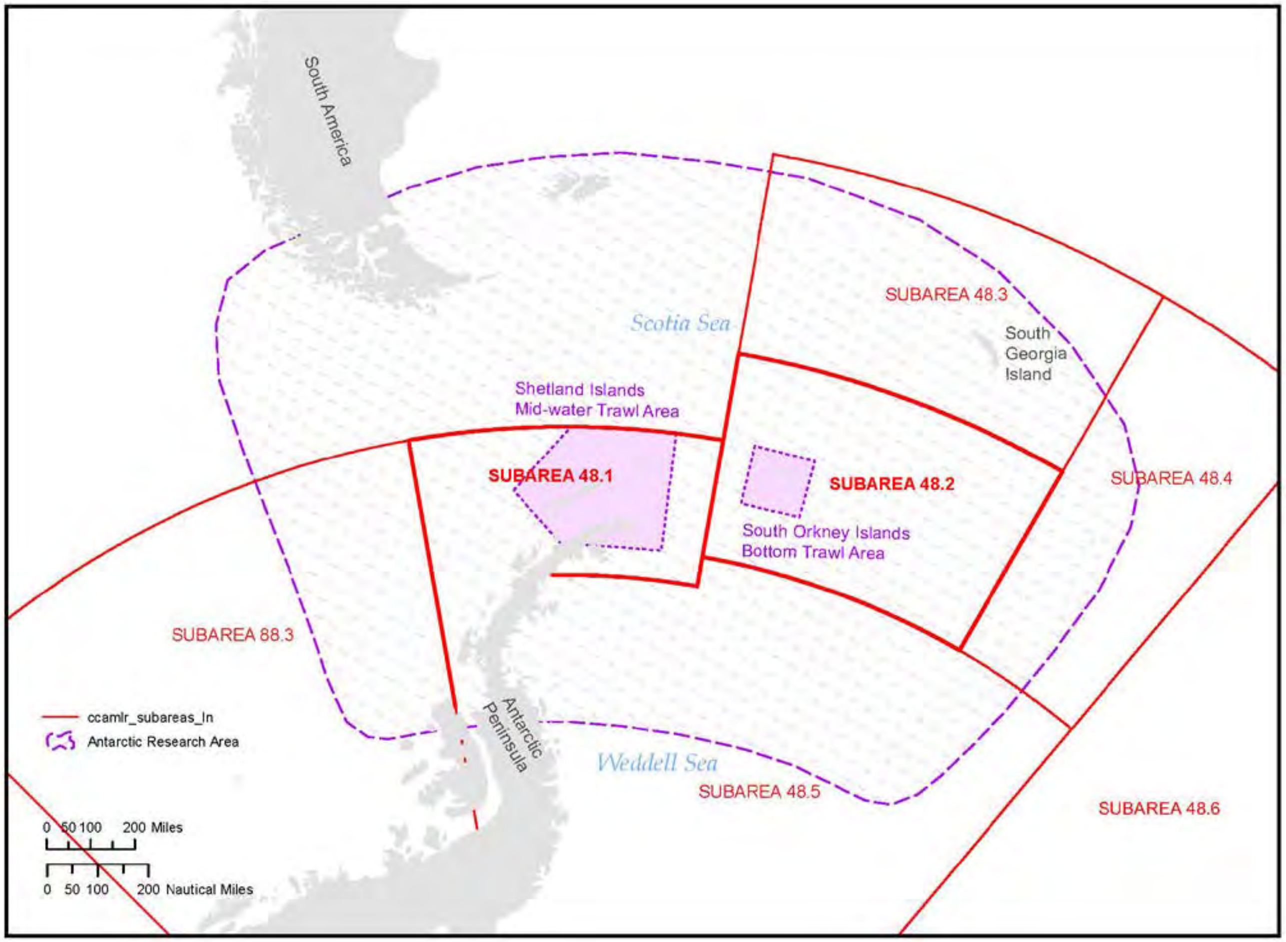


Figure 3.1-5 Areas closed to finfish fisheries in the ARA.

Taking of all finfish, other than for scientific research purposes, is prohibited in CCAMLR statistical subareas 48.1 and 48.2.

3.1.2.4 Marine Protected Areas

A Marine Protected Area (MPA) is defined by Executive Order 13158 as "any area of the marine environment that has been reserved by federal, state, tribal, territorial, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein." They are a group of sites, networks, and systems established and managed by federal, state, tribal, and local governments. Most MPAs have legally established goals, conservation objectives, and intended purposes. MPAs generally address one or more of three areas of conservation focus:

Natural Heritage: established and managed wholly or in part to sustain, conserve, restore, and understand the protected area's natural biodiversity, populations, communities, habitats, and ecosystems; the ecological and physical processes upon which they depend; and, the ecological services, human uses and values they provide to this and future generations.

Cultural Heritage: established and managed wholly or in part to protect and understand submerged cultural resources that reflect the nation's maritime history and traditional cultural connections to the sea.

Sustainable Production: established and managed wholly or in part with the explicit purpose of supporting the continued extraction of renewable living resources (such as fish, shellfish, plants, birds, or mammals) that live within the MPA, or that are exploited elsewhere but depend upon the protected area's habitat for essential aspects of their ecology or life history.

MPAs encompass almost the entire area where research surveys are conducted. They contain: California's State Marine Reserves, State Marine Parks, State Marine Conservation Areas, and State Marine Recreational Management Areas; Oregon's MPAs; Washington's MPAs; Wildlife Refuges; National Parks; Federal Marine Reserves; and National Marine Sanctuaries. MPAs vary widely in the level and type of legal protection afforded to the site's natural and cultural resources and ecological processes. Many of the MPAs within the action area have various levels of fishing restrictions. Marine reserves, a type of MPA, are areas where some or all fishing is prohibited for a lengthy period of time. Marine reserves provide an alternative means of controlling fishing mortality and serve as a valuable management tool when the status of a fish stock is uncertain. Details of MPAs located within the U.S. EEZ, can be found on the List of National System MPAs (NOAA 2009). This list also includes Habitat Closed Areas and Closed Areas (see Section 3.1.2). Although these areas are not formally classified as marine reserves, they provide similar levels of protection for many species.

The National Marine Sanctuaries Act authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities as national marine sanctuaries. The National Marine Sanctuary System is intended to (A) improve the conservation, understanding, management, and wise and sustainable use of marine resources; (B) enhance public awareness, understanding, and appreciation of the marine environment; and (C) maintain for future generations the habitat, and ecological services, of the natural assemblage of living resources that inhabit these areas. Day-to-day management of national marine sanctuaries has been delegated by the Secretary of Commerce to NOAA's Office of National Marine Sanctuaries. The primary objective of the National Marine Sanctuaries Act is to set aside marine areas of special national significance for their permanent protection and to manage them as ecosystems to maintain their natural biodiversity and historical and cultural heritage, consistent with compatible uses. The National Marine Sanctuary System consists of 14 MPAs that encompass more than 150,000 square miles of marine and Great Lakes waters. The square mileage noted here may increase per revisions to Fagatele Bay National Marine Sanctuary. The SWFSC CCRA includes five National Marine Sanctuaries: Olympic Coast, Cordell Banks, Gulf of the Farallones, Monterey Bay, and Channel Islands (Figure 3.1-6). Site-specific regulations applicable to each of these marine sanctuaries may be found in the National Marine Sanctuary Program Regulations (15 CFR § 922). Descriptions of each of the five West Coast sanctuaries are provided below.

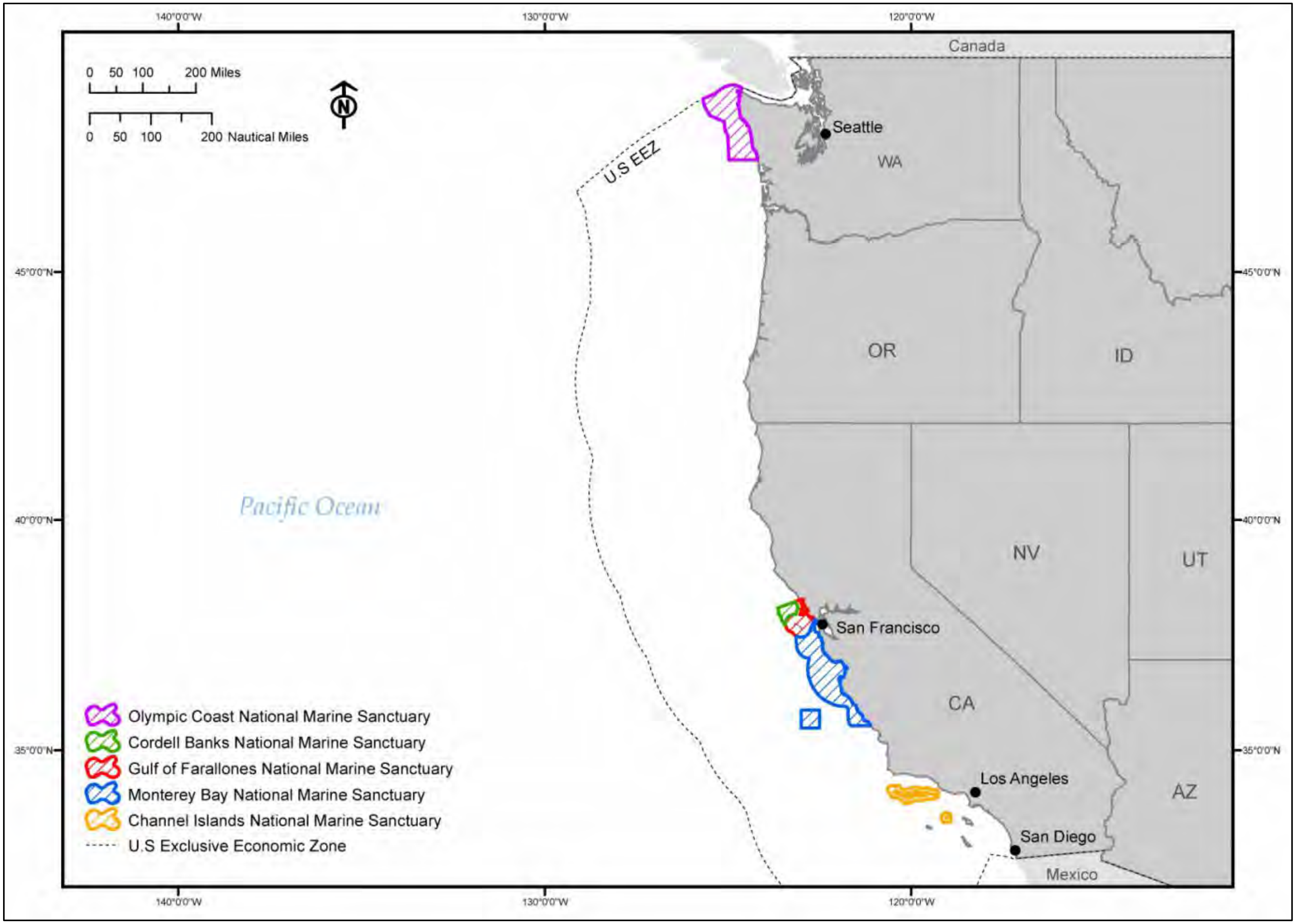


Figure 3.1-6 National Marine Sanctuaries in the CCRA.

Olympic Coast National Marine Sanctuary includes 3,310 square miles of marine waters off the Olympic Peninsula coastline. The sanctuary extends 25 to 50 miles seaward, covering much of the continental shelf and several major submarine canyons. The sanctuary protects a productive upwelling zone, including habitat for marine mammals and seabirds. Along its shores are thriving kelp and intertidal communities. On the seafloor, scattered communities of deep sea coral and sponges form habitats for fish and other important marine wildlife.

Cordell Bank National Marine Sanctuary was established in 1989 to protect and preserve the extraordinary marine ecosystem surrounding the Cordell Bank. Surrounded by soft sediments of the continental shelf seafloor, Cordell Bank consists of a rocky habitat, which supports a diverse population of invertebrates, algae, and fishes. The productive waters attract migratory seabirds and marine mammals from throughout the Pacific Ocean to feed in this dynamic food web. With its southernmost boundary located 42 miles north of San Francisco the sanctuary is entirely offshore, with the eastern boundary six miles from shore and the western boundary 30 miles offshore. In total, the sanctuary protects an area of 529 square miles.

Gulf of the Farallones National Marine Sanctuary spans 1,279 square miles just north and west of San Francisco Bay, and protects open ocean, nearshore tidal flats, rocky intertidal areas, estuarine wetlands, subtidal reefs, and coastal beaches within its boundaries. In addition, the sanctuary has administrative jurisdiction over the northern portion of the Monterey Bay National Marine Sanctuary, from the San Mateo/Santa Cruz County line northward to the existing boundary between the two sanctuaries and maintains an office in San Francisco. It provides breeding and feeding grounds for at least 25 endangered or threatened species; 36 marine mammal species, including blue, gray, and humpback whales, harbor seals, elephant seals, Pacific white-sided dolphins, Steller sea lions; over a quarter-million breeding seabirds; and a significant population of white sharks.

Monterey Bay National Marine Sanctuary is a federally protected marine area off California's central coast designated in 1992. The sanctuary encompasses a shoreline length of 276 miles and 6,094 square miles of ocean, extending an average distance of 30 miles from shore. It was established for the purposes of resource protection, research, education and public use. Its natural resources include our nation's largest kelp forest, one of North America's largest underwater canyons, and the closest-to-shore deep ocean environment in the continental U.S. The sanctuary provides habitat for 33 species of marine mammals, 94 species of seabirds, 345 species of fishes, and numerous invertebrates and plants.

Channel Islands National Marine Sanctuary consists of an area of approximately 1,470 square miles off the coast of southern California. It is adjacent to the following islands and offshore rocks: San Miguel Island, Santa Cruz Island, Santa Rosa Island, Anacapa Island, Santa Barbara Island, Richardson Rock, and Castle Rock extending seaward to a distance of approximately six nautical miles. The islands and rocks vary in distance from 12 to 40 nautical miles offshore from Santa Barbara and Ventura counties. A fertile combination of warm and cool currents in this area results in a diversity of plants and animals including kelp forests, fish and invertebrates, pinnipeds, cetaceans and sea birds. The sanctuary also has a wealth of maritime heritage resources including Chumash Native American artifacts and more than 100 historic shipwrecks. Human uses in the area include commercial and recreational fishing, marine wildlife viewing, boating, diving, kayaking, maritime shipping, nearby offshore oil and gas development, research and monitoring, military and numerous educational activities.

Within the ETP region, but outside of the U.S. EEZ, the United Nations Educational, Scientific and Cultural Organization has established five World Heritage Sites: Galapagos Islands and Marine Reserve (Ecuador), Islands and Protected Areas of the Gulf of California (Mexico), Cocos Island (Costa Rica), Coiba National Park (Panama), and Malpelo Island (Columbia). The Cocos Island World Heritage Site is managed by the Costa Rican government as the “Seamounts Marine Management Area” (Area Marina de Manejo Montes Submarinos), which includes a roughly 200,000 hectare no-fishing-zone, Cocos Island National Park, and surrounding areas with restrictions on fish harvest. The Malpelo Fauna and Flora

Sanctuary, located 506 kilometers off the coast of Colombia, includes Malpelo island (350 hectares) and the surrounding marine environment (857,150 hectares), which is managed as a marine park. The Malpelo Island marine park includes the largest no-fishing zone in the ETP. While each World Heritage Site remains part of the legal territory of the state wherein the site is located, the United Nations Educational, Scientific and Cultural Organization considers it in the interest of the international community to preserve each site.

Other marine areas protected as national parks or under other designations established by the nations that border the ETPRA and CCRA are listed in Table 3.1-1.

Table 3.1-1 Marine Reserves in the Eastern Tropical Pacific

Mexico
Rocas Alijos
Isla San Benedicto
Reserva de la Biosfera Isla Guadelupe
Reserva de la Biopsfera Islas de Golfo California
Reserva de la Biopsfera Alto Golfo de California y Delta Río de Colorado
Reserva de la Biosfera Bahía de los Ángeles, canales de Ballenas y de Salsipuedes, Baja California
Reserva de la Biosfera El Vizcaíno, Baja California Sur
Parque Nacional Bahía de Loreto, Baja California Sur
Reserva de la Biosfera Complejo Lagunar Ojo de Liebre, Baja California Sur
Colombia
Isla Malpelo
Costa Rica
Cocos Island
Ecuador
Galapagos Islands
France
Clipperton Island

In addition, a transnational Marine Conservation Corridor has been established between Costa Rica, Panama, Columbia, and Ecuador in cooperation with a team involving the UNEP, the World Conservation Union, and the International Union for the Conservation of Nature (Guzman *et al*. 2008). Commercial fishing activities are not permitted within the Clipperton Island EEZ (France) (Pauly 2009).

In the ARA, specific mechanisms exist under the Antarctic Treaty System and CCAMLR for protection of sensitive marine areas. The entire Antarctic region is protected to some degree by the Antarctic Treaty System and CCAMLR, and therefore all marine areas south of the 60°S parallel fulfill the operational definition of MPAs. However, specific areas may be further protected as either Antarctic Specially Protected Areas or Antarctic Specially Managed Areas, which are established under the Antarctic Treaty System. Antarctic Specially Protected Areas are closed except to permit holders, while Antarctic Specially Managed Areas are intended to assist in the planning and coordination of activities within specified areas where certain activities pose risks of mutual interference or cumulative environmental impacts. In addition, several specific MPAs are established by CCAMLR conservation measures

(CCAMLR 2010). This process is ongoing, with continued efforts to designate further MPAs throughout the Antarctic LME. For example, the South Orkney Islands Southern Shelf MPA has recently been established in relatively close proximity to SWFSC research facilities near the Antarctic Peninsula. All types of fishing are prohibited within the South Orkney Islands MPA, with the exception of approved scientific fishing research activities (CCAMLR 2010).

The CCAMLR conservation measures also stipulate specific requirements related to exploratory fisheries for Antarctic krill (*Euphausia superba*) (CCAMLR 2010).

3.2 BIOLOGICAL ENVIRONMENT

3.2.1 Fish

Thousands of finfish species occur within the three SWFSC research areas. This section of the Final PEA provides baseline information for species important to the analysis of effects in Chapter 4; ESA-listed species, important target species caught in SWFSC survey efforts, and prohibited and highly migratory species.

3.2.1.1 Threatened and Endangered Fish Species

The information presented in the following species accounts is primarily from the NOAA Fisheries Office of Protected Resources website (NOAA 2011a), available online at: http://www.nmfs.noaa.gov/pr/species/fish/.

Bocaccio

The bocaccio *(Sebastes paucispinis)* is a large piscivorous rockfish ranging from Punta Blanca, Baja California, to the Gulf of Alaska off Krozoff and Kodiak Islands, but most commonly observed between Oregon and northern Baja California. Bocaccio are most common between 160 and 820 feet. (50-250 meter) depth, but may be found as deep as 1,560 feet (475 meters). Adults generally move into deeper water as they increase in size and age, and typically exhibit strong site fidelity to rocky bottoms and outcrops. Juveniles and subadults may be more common than adults in shallower water, and are associated with rocky reefs, kelp canopies, and artificial structures, such as piers and oil platforms. Like all species of the genus *Sebastes*, fertilization and embryo development is internal and female rockfish give birth to live larval young. Larvae are found in surface waters and may be distributed over a wide area extending several hundred miles offshore. It is thought that larvae and small juveniles may remain in open waters for several months, being passively dispersed by ocean currents. Bocaccio are difficult to age, but it is thought that approximately 50 percent of adult bocaccio mature in 4 to 6 years and scientists suspect they can live as long as 50 years. Bocaccio are fished for directly and are often caught as bycatch in fisheries such as the salmon fishery.

Bocaccio is comprised of three distinct population segments (DPS): a southern coastal population off California, currently listed as a species of concern, a northern coastal population extending from the California/Oregon border north to British Columbia, and a Puget Sound/Georgia Basin population. The bocaccio Puget Sound/Georgia DPS was listed as endangered by NOAA on April, 28, 2010 and is the only bocaccio DPS protected under the ESA. The final rule became effective on July 27, 2010. Under this ruling it was determined the Puget Sound/Georgia Basin DPS was discrete from other bocaccio populations and significant in relation to the entire species. The main reason for listing is the magnitude of decline in abundance. Critical habitat has yet to be established for this DPS (75 FR 22276). Fishing restrictions have been placed on this species since they are slow-growing, late to mature, and long lived; which means even if threats are no longer affecting the species, recovery will take many years (NOAA 2011a).

Canary rockfish

The canary rockfish *(Sebastes pinniger)* is a Pacific coast rockfish that ranges between Punta Colnett, Baja California, and the Western Gulf of Alaska, but are most commonly found off the coast of central Oregon. Canary rockfish primarily inhabit waters from 160 to 820 feet (50 to 250 meters.) deep but may be found up to 1,400 feet (425 meters). Approximately 50 percent of adult canary rockfish are mature around 5 to 6 years of age and 14 inches (36 centimeters) total length. Canary rockfish are directly fished for and are often caught as bycatch in other fisheries, including salmon fisheries. Canary rockfish are long lived (up to 75 years), and slow to recover from population declines.

The canary rockfish is comprised of two DPSs, coastal and Puget Sound/Georgia Basin. The Puget Sound/Georgia Basin DPS was listed as threatened by NOAA on April 28, 2010 and is the only canary rockfish DPS protected under the ESA. The final rule became effective on July 27, 2010. Under this ruling it was determined the Puget Sound/Georgia Basin DPS was discrete from other coastal canary rockfish populations and significant in relation to the entire species. Critical habitat has yet to be established for this DPS (75 FR 22276). Various restrictions have been placed on fishing to assist in the recovery of this threatened species (NOAA 2011a).

Yelloweye rockfish

The yelloweye rockfish *(Sebastes ruberrimus)* is a Pacific coast rockfish that ranges from northern Baja California to the Aleutian Islands in Alaska, but are most commonly found in central California northward to the Gulf of Alaska. As adult yelloweye rockfish age and increase in size, they generally move into deeper water; they also exhibit strong site fidelity to rocky bottoms and outcrops. Yelloweye rockfish are among the longest lived rockfish, living up to 118 years old. Yelloweye rockfish are fished directly and are often caught as bycatch in other fisheries, including salmon fisheries (NOAA 2011a).

The yelloweye rockfish is comprised of two DPSs: coastal and Puget Sound/Georgia Basin. The Puget Sound/Georgia Basin DPS was listed as threatened by NOAA on April 28, 2010 and is the only yelloweye rockfish DPS protected under the ESA. The final rule became effective on July 27, 2010. Under this ruling, it was determined the Puget Sound/Georgia Basin yelloweye rockfish DPS was discrete from other coastal yelloweye rockfish populations and significant in relation to the entire species. Critical habitat has yet to be established for this DPS due to the lack of currently available information to assess impacts of designation and incomplete information pertaining to the physical and biological features essential to conservation (75 FR 22276). Various restrictions have been placed on fishing to assist in the recovery of this threatened species.

Chinook salmon

Chinook salmon *(Oncorhynchus tshawytscha)* is one of several species of salmon that have some evolutionarily significant units (ESUs) listed as endangered or threatened by the USFWS. In the U.S., Chinook salmon are found from the Bering Strait off Alaska's coast, south to Southern California. Chinook salmon are an anadromous species of fish that spawn in freshwater rivers and streams and mature in the ocean. Juvenile Chinook may spend from 3 months to 2 years in freshwater before migrating to estuarine areas as smolts, and then to the ocean to feed and mature. Salmonid species on the West Coast of the U.S. have experienced dramatic declines in abundance during the past several decades as a result of human activities and natural factors.

NOAA Fisheries has identified seventeen Chinook salmon ESUs that occur within the SWFSC research area and of these two are considered endangered: Sacramento Winter Run and Upper Columbia River Spring Run ESUs. Seven Chinook salmon ESUs are listed as threatened: California coastal, Central Valley spring-run, lower Colombia River, Puget Sound, Snake River fall-run, Snake River spring/summer-run and upper Willamette River (NOAA 2011a). The remaining eight ESUs are not ESA listed and considered generally abundant.

Chum salmon

Chum salmon *(Oncorhynchus keta)* is a species with a wide geographic and spawning distribution but the Columbia River ESU and Hood Canal summer-run ESU have been listed as threatened under the ESA. Chum salmon range farther along the shores of the Arctic Ocean than any other salmonids; major spawning populations are found only as far south as Tillamook Bay on the northern Oregon coast. Chum salmon spawn in the lowermost reaches of rivers and streams, typically within 62 miles (100 kilometers) of the ocean, often near springs. Chum salmon migrate, almost immediately after hatching, to estuarine and ocean waters. This means that the survival and growth of juvenile chum salmon depends less on freshwater conditions and more on favorable estuarine and marine conditions.

NOAA Fisheries has identified four chum salmon ESUs that occur within the SWFSC research area and of these two are considered threatened under the ESA: Hood Canal Summer-run and Columbia River ESUs (NOAA 2011a). The Puget Sound/Strait of Georgia and Pacific Coast chum salmon ESUs are currently not listed under the ESA.

Coho salmon

Coho salmon *(Oncorhynchus kisutch)* is an anadromous fish that were historically distributed throughout the North Pacific Ocean from central California to Point Hope, Alaska, through the Aleutian Islands, and from the Anadyr River, Russia, south to Hokkaido, Japan. It is probable that coho salmon inhabited most coastal streams in Washington, Oregon, and central and northern California. Coho spend the first half of their life cycle rearing and feeding in streams and small freshwater tributaries. The remainder of their life cycle is spent foraging in estuarine and marine waters of the Pacific Ocean. Coho salmon prefer to spawn in small streams with stable gravel substrates.

NOAA Fisheries has identified seven coho salmon ESUs that occur within the SWFSC research area. The Central California Coast coho salmon ESU is listed as endangered under the ESA and three are listed as threatened: (Southern Oregon/Northern California Coasts, lower Columbia River, and Oregon Coast coho salmon ESUs (NOAA 2011a). The Puget Sound/Strait of Georgia, Southwest Washington and Olympic Peninsula coho salmon ESUs are currently not listed under the ESA.

Sockeye salmon

Sockeye salmon *(Oncorhynchus nerka*) inhabit riverine, marine, and lake environments from the Klamath River in Oregon and its tributaries north and west to the Kuskokwim River in western Alaska. With the exception of certain river-type and sea-type populations of sockeye, the vast majority of sockeye salmon spawn in or near lakes, where the juveniles rear for 1 to 3 years prior to migrating to sea. As sockeye generally require lakes for a portion of their life cycle, their distribution in river systems depend on the presence of usable lakes in the system; therefore, their distribution and abundance may be more intermittent than for other Pacific salmon. Seven recognized ESUs occur within the SWFSC research areas however only two are listed under the ESA: Snake River ESU, endangered, and Ozette Lake ESU, threatened.

Steelhead trout

Steelhead trout (*Oncorhynchus mykiss*) occur along the entire Pacific Coast in streams with deep low-velocity pools. Of the 15 recognized DPSs within the SWFSC research area, one DPS (Southern California) is listed as endangered and 10 are listed as threatened (Upper Columbia River, Snake River Basin, Middle Columbia River, Lower Columbia River, Upper Willamette River, South-Central California Coast, Central California Coast, North California, California Central Valley and Puget Sound ESUs) (NOAA 2011a). The Oregon Coast ESU is considered a species of concern. While all O. mykiss hatch in gravel-bottomed, fast-flowing, well-oxygenated rivers and streams, some stay in fresh water all their lives; these fish are then named rainbow trout. Unlike other Pacific salmonids, steelhead can spawn more than one time. Adults migrate from the marine environment to their natal freshwater streams and rivers in order to spawn.

Green sturgeon

The green sturgeon *(Acipenser medirostris)* is the most broadly distributed, wide-ranging, and most marine-oriented species in the sturgeon family. The green sturgeon ranges from Mexico to Alaska (and possibly beyond) in marine waters, and are observed in bays and estuaries up and down the West Coast of North America. Green sturgeon use both freshwater and saltwater habitat, using deep pools in large, turbulent, freshwater rivers to spawn. Green sturgeon are believed to spend the majority of their lives in nearshore oceanic waters, bays, and estuaries. Younger fish reside in fresh water, while adults only return to freshwater for spawning after they reach 15 years of age and are over 4 feet (1.3 meters.) in length. Likely threats to green sturgeon are: insufficient freshwater flow rates in spawning areas, contaminants such as pesticides, bycatch in fisheries, potential poaching for caviar, introduction of exotic species, small population size, impassable barriers, and elevated water temperatures. In October 2009, NMFS designated critical habitat for the Southern DPS (NOAA 2011a).

The green sturgeon is comprised of two DPSs that qualify as species under the ESA: the Northern DPS, extending from the Eel River of northern California north to British Columbia, and the Southern DPS, extending from the Eel River of northern California south to the Sacramento-San Joaquin Delta, California. NMFS published a final rule on April 7, 2006 listing the Southern DPS as threatened (71 FR 17757), which took effect on June 6, 2006. Critical habitat for the Southern DPS was designated on October 9, 2009 (74 FR 52300) and includes freshwater, estuarine and marine habitat from Cape Flattery, Washington south to the Sacramento-San Joaquin Delta, California (Figure 3.2-1). A principal factor in the decline of the Southern DPS of green sturgeon is the reduction of their spawning area to a limited portion of the Sacramento River.

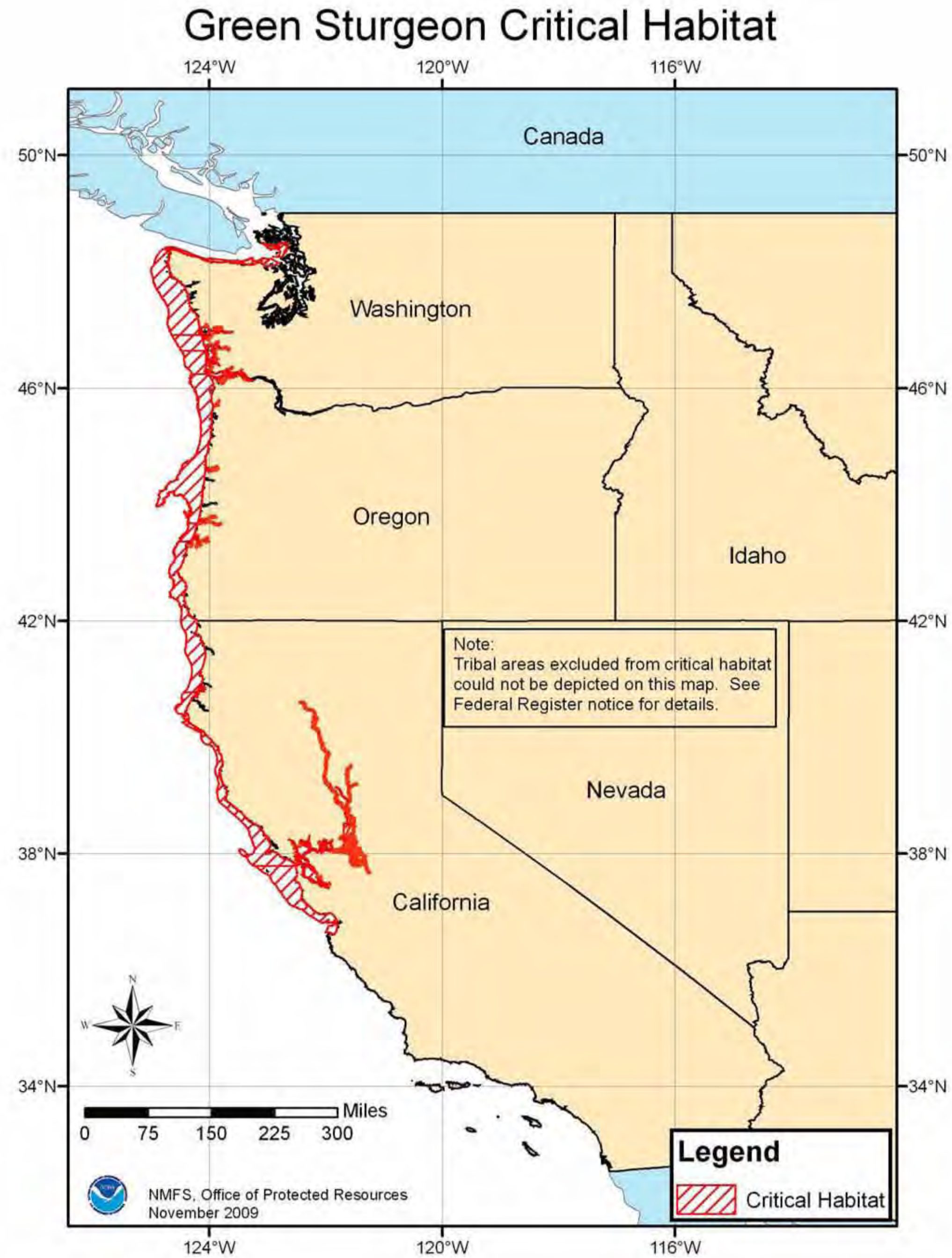


Figure 3.2-1 Green sturgeon critical habitat

Pacific eulachon/smelt

The Pacific eulachon *(Thaleichthys pacificus)* is found in the eastern Pacific Ocean, ranging from northern California to southwest Alaska and into the southeastern Bering Sea. Eulachon occur in nearshore ocean waters and up to 1000 feet (300 meters) in depth, returning for a brief time to spawn in their natal streams. Typically, eulachon spend 3 to 5 years in saltwater before returning to freshwater to spawn from late winter through mid-spring. During spawning, eulachon eggs are fertilized in the water column and after fertilization the eggs sink and adhere to the gravel and coarse sand river bottoms. Most adults die after spawning and eggs hatch in 20 to 40 days. After hatching, the larvae are then carried downstream and are dispersed by estuarine and ocean currents. Juvenile eulachon move from shallow nearshore areas to mid-depth areas. Habitat loss and degradation threaten the eulachon, particularly in the Columbia River basin.

The Pacific eulachon is comprised of two DPSs: A Northern DPS, extending from the US-Canada border north into the southeastern Bering Sea, and a southern DPS, extending from the US-Canada border south to central California at Point Conception. In March 2010, NMFS listed the Southern DPS of eulachon as threatened under the ESA (75 FR 13012). In October 2011, NMFS designated critical habitat for the Southern DPS of Eulachon (76 FR 65324) (NOAA 2011a). Critical habitat includes freshwater creeks and rivers and their associated estuaries within the states of California, Oregon and Washington (Figure 3.2-2).

Figure 3.2-2 Designated Critical Habitat for Southern DPS of Eulachon

Totoaba

The totoaba *(Totoaba macdonaldi)* is listed as an endangered species throughout its range (44 FR 29478). Critical habitat has not been designated for this species. Totoaba mainly inhabit the upper half of the Gulf of California and are primarily found in the top 75 feet (22.8 meters) of the water column. Totoaba school and migrate northward in the winter to the Colorado River delta where they remain for weeks before spawning in the spring. After spawning, the adults migrate south along the West Coast, while the juveniles remain in the upper gulf for 2 years. Totoaba begin reproducing at 6 years of age for females and 7 years of age for males, and are believed to live up to 25 years. Totoaba are the largest of the Scianenidae family and have been measured at over 6.5 feet and over 220 pounds (99.8 kilograms). Threats to this species include a lack of freshwater, and disruption of salinity levels due to dams in the Colorado River, as well as fishing pressure from commercial and sport fishermen. Juveniles have also been taken as by-catch in shrimp fisheries. The Mexican government has been imposing fishery restrictions to assist in conservation efforts since the 1940s (NOAA 2011a).

3.2.1.2 Target Species

Target species are those fish which are managed for commercial and recreational fisheries and are the subject of SWFSC research surveys for stock assessment purposes. For the purposes of this Final PEA, only those species that have had an average research catch of over 100 kilograms per year over the 2008-2012 period are described.

California Current Research Area

Table 3.2-1 displays a list of target species in the CCRA and their stock and management status. For information on life history traits and habitat for each of the species, please see the Pacific Fishery Management Council's website: http://www.pcouncil.org .

Table 3.2-1 Target species in the California Current Research Area

Stock status information is from the Pacific Fishery Management Council website.

Species	Scientific Name	Stock Status	Fishery Management Council	Fishery Management Plan (FMP)	Survey name
Blue shark	*Prionace glauca*	Not overfished, abundant	PFMC	Highly Migratory Species (HMS) FMP	California Cooperative Oceanic Fisheries Investigation (CalCOFI) HMS
Chinook salmon	*Oncorhynchus tshawytscha*	Most non ESA-listed stocks are not overfished	PFMC	Pacific Coast Salmon FMP	CalCOFI Juvenile Salmon Survey
Coho salmon	*Oncorhynchus kisutch*	Non ESA-listed stocks are not overfished	PFMC	Pacific Coast Salmon FMP	CalCOFI Juvenile Salmon Survey
Common Thresher Shark	*Alopias vulpinus*	Not overfished	PFMC	HMS FMP	CalCOFI HMS
Jack mackerel	*Trachurus symmetricus*	Monitored	PFMC	Coastal Pelagic Species (CPS) FMP	CalCOFI Juvenile Salmon Survey
North Pacific Albacore	*Thunnus alalunga*	Not overfished, abundant	WCPFC PFMC WPFMC NPFMC	HMS FMP and Fishery Ecosystem Plan for Pelagic Fisheries of the Western Pacific	CalCOFI HMS
Northern Anchovy	*Engraulis mordax*	Monitored	PFMC NPFMC	CPS FMP	CalCOFI CPS Juvenile Rockfish Survey Juvenile Salmon Survey

Species	Scientific Name	Stock Status	Fishery Management Council	Fishery Management Plan (FMP)	Survey name
Pacific hake (whiting)	*Merluccius productus*	Not overfished	PFMC	Pacific Coast Groundfish FMP	CalCOFI Sardine Survey Juvenile Rockfish Survey Juvenile Salmon Survey
Pacific mackerel	*Scomber japonicus*	Not overfished	PFMC	CPS FMP	CalCOFI Juvenile Salmon Survey Thresher Shark Survey
Pacific sardine	*Sardinops sagax*	Not overfished	PFMC	CPS FMP	CalCOFI CPS Juvenile Rockfish Survey Juvenile Salmon Survey Thresher Shark Survey
Pacific swordfish	*Xiphias gladius*	Not overfished, abundant	PFMC	HMS FMP	HMS Longline and Habitat Surveys Swordfish Tagging using Deep-set Buoy Gear
Shortfin mako shark	*Isurus oxyrinchus*	Not overfished	PFMC	HMS FMP	HMS Thresher Shark survey
Yellowtail rockfish	*Sebastes flavidus*	Not overfished	PFMC	Pacific Coast Groundfish FMP	CPS Juvenile Rockfish Survey COAST Habitat surveys

Eastern Tropical Pacific Research Area

Sampling of fish species in the ETPRA is very limited and is not oriented toward stock assessments of any target species. Marine mammal studies conducted in this area have identified some common prey species, including lanternfish, flying fish, anchovies, sardines, and herring.

Antarctic Research Area

In the ARA, most surveys are focused on krill. The periodic bottom-trawl surveys are intended to monitor the recovery of several finfish species that had been subject to severe overfishing in the past. The finfish fishery in the Antarctic was closed in 1990 by the Convention on the Conservation of Antarctic Living marine resources (CCAMLR) due to the decimation of several fish stocks in the 1970s and 1980s (NOAA 2011b). Table 3.2-2 shows the primary species that were caught in the most recent SWFSC bottom trawl survey (Antarctic Living marine resources [AMLR] Program 2009). These species have not been subject to full stock assessment analysis. For life history and distribution information, see Van Cise (2009).

Table 3.2-2 Finfish species with catches of greater than 100 kg in the 2008/2009 Antarctic bottom trawl survey.

Species	Scientific Name
Blackfin icefish	*Chaenocephalus aceratus*
Mackerel icefish	*Champsocephalus gunnari*
Ocellated icefish	*Chionodraco rastrospinosus*
Humped rockcod	*Gobionotothen gibberifrons*
Grey rockcod	*Lepidonotothen squamifrons*
Black rockcod	*Notothenia coriiceps*
South Georgia icefish	*Pseudochaenichthys georgianus*

3.2.1.3 Prohibited Species and Highly Migratory Fish Species

Prohibited Fish Species

Prohibited species are those species caught as bycatch during commercial fisheries that cannot be retained under provisions of one or more FMPs, unless authorized by another applicable law (PFMP 2007). Prohibited species in the SWFSC region are the great white shark, basking shark, megamouth shark, Pacific halibut, and Pacific salmon. Pacific salmon are described in the ESA-listed species section above; the others are described below.

Great white shark

Great white sharks *(Carcharodon carcharias*) are found off the Pacific coast from southeast Alaska to California, around the Hawaiian Islands, in the eastern Pacific, and rarely, in the central Pacific. This species can be found in coastal waters, along continental shelves and islands, particularly near seal or sea lion colonies, and offshore in the open ocean (NOAA 2011c). Female great white sharks are believed to mature when they are 13-14 feet in length and typically have few young per brood. The great white shark's low productivity, its accessibility in certain localized areas, and its appeal to trophy hunters, make it especially vulnerable to overfishing. The species has been protected in the state of California since 1995 and may not be removed except for scientific and educational purposes under state permit; finning is prohibited.

<u>Basking shark</u>

The basking shark *(Cetorhinus maximus)* is designated as a species of concern by NOAA and the north Pacific stock of this species is listed as endangered by the International Union for Conservation of Nature (IUCN). The IUCN is a global union of states, governmental agencies, and non-governmental organizations in a partnership that assesses the conservation status of species. While found globally, the basking shark is most commonly observed in coastal temperate waters. The basking shark is the second largest shark species and is a filter feeder, foraging near the base of the food web. This species is recommended for protection because it is highly vulnerable to depletion due to its low productivity. The basking shark was targeted heavily in the 1950s in the U.S. and 1970s in Canada and the eastern North Pacific population does not appear to have recovered since that time. Despite decades with no directed fishing pressure, basking sharks are still impacted by human activities; they are struck by vessels and caught incidentally in a range of fishing gear including longlines, nets, and the lines from prawn traps (NOAA 2011a).

<u>Megamouth shark</u>

Megamouth sharks *(Megachasma pelagio)* are extremely rare and little is known about this species. The IUCN characterizes megamouth sharks as "Data Deficient". Megamouths are thought to be filter feeders and despite their rarity, four individuals have been caught in the drift gillnet fishery in recent years. Protection is recommended because of extreme rarity and uniqueness of this species (PFMC 2011).

<u>Halibut</u>

Pacific halibut *(Hippoglossus stenolepis)* are found in coastal waters from southern California, to the West Coast of Alaska. Halibut are most commonly found in the central Gulf of Alaska, particularly near Kodiak Island (NOAA 2012a). Halibut are also found on the other side of the Pacific, from the Gulf of Anadyr in Russia to Hokkaido, Japan. Juveniles live in shallow, near-shore waters off Alaska and British Columbia and move to deeper water as they age. Adults migrate seasonally from shallow summer feeding grounds to deeper winter spawning grounds (NOAA 2012a). Males sexually mature when they are 8 years old and females can reproduce as early as 12 years of age. Halibut spawn during the winter in deep water along the continental slope, mainly in the Bering Sea, Aleutian Islands, Gulf of Alaska, and south to British Columbia. Females can have between 500,000 and 4 million eggs, depending on their age (NOAA 2012a). Scientists believe females release their eggs in batches over several days during the spawning season and eggs hatch 12 to 15 days later. The halibut larvae float close to the surface where they remain for about 6 months, until they reach their adult form and settle to the bottom in shallow water (NOAA 2012a). While not a highly migratory species, halibut are important as incidental catch in some HMS fisheries and so are recommended to be prohibited, except to authorized fishers (PCOUN 2011).

<u>Highly Migratory Fish Species</u>

HMS are designated due to their wide geographic distribution and their significant, but variable migrations across oceans for the purpose of feeding or reproduction (PFMC 2011). Their extensive geographic ranges extend beyond the 200-mile EEZ found offshore of the U.S., making them more available for harvest by multiple fisheries and more challenging to manage (PFMC 2011). HMS in the Pacific Region that are actively managed under the HMS FMP include: tunas (North Pacific albacore, yellowfin, bigeye, skipjack, and northern bluefin); sharks (common thresher, shortfin mako, and blue); billfish/swordfish (striped marlin and Pacific swordfish); and dorado, also known as dolphinfish or mahi-mahi (PFMC 2011).

North Pacific albacore tuna

The North Pacific albacore tuna (*Thunnus alalunga*) is an abundant, circumglobal species. North Pacific albacore, particularly juveniles, begin their expansive migration in the spring and early summer in waters off Japan, move into inshore waters off the U.S. Pacific coast by late summer, then spend the late fall and winter in the western Pacific Ocean. The timing and distance of the albacore tunas' migrations in a given year depend largely on oceanic conditions. Less is known about the movements of albacore in the South Pacific Ocean, where juveniles move southward from the tropics when they are about a foot in length and then head eastward to about 130°W. When the fish reach sexual maturity at 5 to 6 years of age, they return to waters centered around 20°N to 20°S latitude to spawn (NOAA 2011d).

Pacific bigeye tuna

Bigeye tuna (*Thunnus obesus*) is an abundant species ranging across the Pacific Ocean between northern Japan and the north island of New Zealand in the western Pacific, and from 40°N to 30°S in the eastern Pacific Ocean. Bigeye tuna are capable of large scale migrations and move freely within broad regions of favorable water temperature and dissolved oxygen levels. Juvenile and small adult bigeye tuna school at the surface, sometimes with skipjack and juvenile yellowfin tunas. Schools may associate with floating objects or large, slow moving marine animals such as whale sharks or manta rays. Once reaching sexual maturity at around 3 years of age, bigeyes are capable of spawning throughout the year in tropical waters and seasonally at higher latitudes at water temperatures above 75° F. Bigeye tuna release millions of eggs per spawning event, which float on the top layer of the ocean, buoyed at the surface by a single oil droplet, until they hatch (NOAA 2011d).

Pacific northern bluefin tuna

The Pacific northern bluefin tuna (*Thunnus orientalis*) ranges throughout the Northern, Eastern, and Western Pacific and across the high seas, where they are fished by Japanese, Korean, Taiwanese as well as U.S. fisheries. Bluefin tuna larvae have only been found in the vicinity of Japan and between Japan and the Philippines, so it is assumed that spawning occurs only in those areas (Inter-American Tropical Tuna Commission [IATTC] 2002). Some fish remain in the Western Pacific Ocean, while others migrate to the Eastern Pacific Ocean during the first 2 years of life, eventually returning to the Western Pacific Ocean.

Skipjack tuna

The skipjack tuna (*Katsuwonus pelamis*) is an abundant species made up of two stocks in the Pacific Ocean, one in the eastern Pacific Ocean and one in the western and central Pacific Ocean. Skipjack tuna live mostly in the open ocean, though they do spend part of their life cycle in nearshore waters. Skipjacks are often found in large schools swimming in surface waters throughout the Pacific. Skipjack tuna reach sexual maturity early, once they reach around 1.3 feet (4 meters) in length, and are capable of spawning almost daily. The maximum life span is estimated between 8 to 12 years (NOAA 2011d).

Yellowfin tuna

The yellowfin tuna (*Thunnus albacares*) is a healthy species found throughout the tropical and sub-tropical waters of the Pacific Ocean. Yellowfin are known to gather around drifting flotsam, fish aggregating devices (FADs), anchored buoys, dolphins and other large marine animals. Yellowfin tuna reach sexual maturity at approximately 2 years of age and spawn frequently, but are short lived with a maximum life span of 6 to 7 years (NOAA 2011d).

Pacific Swordfish

The North Pacific Swordfish *(Xiphias gladius)* is a healthy species found worldwide in all tropical, subtropical, and temperate seas, though little is known of their migration patterns. Swordfish are abundant near boundary zones where there are sharp gradients of temperature and salinity. Swordfish reach sexual maturity around 5 to 6 years of age and about 5-5.5 feet (1.6 meters) in length and have a maximum life span of at least 9 years. Swordfish do not seem to have a specific spawning season or grounds, they spawn throughout the year in equatorial waters, but in higher latitudes spawning is restricted to spring and summer (NOAA 2011d).

Striped marlin

The striped marlin *(Tetrapturus audax)* is a healthy species, though the stock structure is not known. Striped marlin are widely distributed throughout most tropical and sub-tropical waters of the Pacific and Indian oceans and fishery data indicate a horseshoe-shaped distribution across the central north- and central south Pacific with a continuous distribution along the West Coast of the Central Americas. Movements tend to be diffuse as striped marlin do not to form dense schools, but occur singularly or in small groups, usually segregated by size. Adult fish are found in the north- and south- central Pacific where spawning occurs, in the central Pacific and off central Mexico. Sub-adult fish move east toward the coast of Mexico where they are found in high abundance around the tip of the Baja peninsula, Striped marlin are not reproductively active while off southern California (NOAA 2011d).

Dorado

The dorado *(Coryphaena hippurus)*, also known as dolphinfish or mahi mahi, is found in tropical and subtropical waters of all oceans. Dorado are unmonitored, but it is believed the population is stable and is able to withstand a relatively high level of exploitation. Dorado reach sexual maturity at 4 to 5 months of age and are prolific spawners, reproducing repeatedly. Spawning is thought to occur year round in temperate waters, above 75°F, but peaks vary with latitude. Dorado spawning grounds appear to be in the North Pacific in waters less than 50 nautical miles from islands and banks off the continents, they appear to spawn on the continental shelf. The lifespan of dorado is thought to be five years for a female, longer for males (NOAA 2011d).

Blue shark

Blue sharks *(Prionace glauca)* are found in warm seas worldwide and are likely the most wide-ranging of all sharks. Male blue sharks reach sexual maturity around 4 to 5 years of age, while females reach maturity between 5 and 6 years of age. Blue sharks bear fully formed, live young in litters averaging approximately 30 pups. Mating occurs in late spring to early winter, the gestation period is about 9-12 months and off the coast of California parturition reportedly occurs in early spring (NOAA 2011e). Young pups found in the California-Oregon drift net catch suggest the nursery habitat may extend northward to off the Columbia River mouth. It is believed that the maximum life span is 20 years.

In the North Pacific, seasonal migrations occur with northward movements extending into the Gulf of Alaska as waters warm during the summer months, and southward movements occurring during the winter months (NOAA 2011e). In U.S. West Coast waters, mature females are thought to start their northward journey in early spring as warm water moves northward, while juveniles of both sexes follow closely; large males start later and tend to stay further offshore. Blue sharks tagged off southern California have been recaptured to the south off Baja, California and Acapulco, Mexico; northward to off Oregon, and westward to off the Hawaiian Islands and Midway Islands in the central Pacific. These recaptures indicate a wide ranging stock that may overlap with the population fished by longliners in the central Pacific Ocean (NOAA 2011e).

3.2.1.4 Other Fish Species

Hundreds of fish species have been caught during the course of SWFSC research that may not be subject to formal stock assessments or belong to one of the categories above. Table 3.2-3 displays a list of these species that have an average catch of over 100 kilograms per year during SWFSC surveys over the 2008-2012 period.

Table 3.2-3 Other fish species caught in the California Current Research Area

Species	Scientific Name	Survey name
Blue lanternfish	*Tarletonbeania crenularis*	CalCOFI CPS Juvenile Rockfish Survey
Common Mola (ocean sunfish)	*Mola mola*	CalCOFI HMS
Jacksmelt	*Atherinopsis californiensis*	Juvenile Salmon Survey Thresher Shark Survey
Opah	*Lampris regius*	HMS
Pacific angel shark	*Squatina californica*	Thresher Shark Survey
Pelagic stingray	*Dasyatis violacea*	HMS Thresher Shark Survey
Soupfin shark	*Galeorhinus galeus*	CalCOFI Thresher Shark Survey
Spiny dogfish	*Squalus acanthias*	CalCOFI HMS Juvenile Salmon Survey Thresher Shark Survey

3.2.2 Marine Mammals

The marine mammal species listed in Table 3.2-4 occur in the areas frequented by the SWFSC research surveys in the CCRA, ETPRA and the ARA. Marine mammal species encountered during transit to and from the AMLR study sites are included with Antarctic species in Table 3.2-4. All marine mammals are federally protected under the U.S. Marine Mammal Protection Act (MMPA) of 1972. In addition, seven species of whales occurring in the SWFSC research areas are listed as endangered under the ESA, two pinnipeds and one fissiped are listed as threatened under the ESA, and two dolphin species in the ETP are considered depleted under the MMPA. The survey areas also encompass designated critical habitat for several species. Threatened and endangered species encountered in the SWFSC survey areas are described in Section 3.2.2.2. Non-ESA listed marine mammals that have historically been taken during SWFSC research activities are described in Section 3.2.2.3. Information provided here summarizes data on stock status, abundance, density, distribution and habitat, and auditory capabilities, as available in published literature and reports, including marine mammal stock assessments.

Table 3.2-4 Marine mammal species encountered in the SWFSC California Current, Eastern Tropical Pacific, and Antarctic Research Areas.

Species		CCRA	ETPRA	ARA	Federal ESA/MMPA Status[1]
Common Name	**Scientific Name**				
Cetaceans					
Harbor porpoise	*Phocoena phocoena*	X			-
Burmeister's porpoise	*Phocoena spinipinnis*		X		-

Species		CCRA	ETPRA	ARA	Federal ESA/MMPA Status[1]
Common Name	Scientific Name				
Spectacled porpoise	*Phocoena dioptrica*			X	-
Dall's porpoise	*Phocoenoides dalli*	X			-
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	X	X		-
Dusky dolphin	*Lagenorhynchus obscurus*		X	X	-
Peale's dolphin	*Lagenorhynchus australis*			X	-
Hourglass dolphin	*Lagenorhynchus cruciger*			X	-
Fraser's dolphin	*Lagenodelphis hosei*		X		-
Risso's dolphin	*Grampus griseus*	X	X	X	-
Bottlenose dolphin	*Tursiops truncatus*	X	X		-
Short-beaked common dolphin	*Delphinus delphis*	X	X		-
Long-beaked common dolphin	*Delphinus capensis*	X	X		-
Rough-toothed dolphin	*Steno bredanensis*		X		-
Striped dolphin	*Stenella coeruleoalba*	X	X		-
Spinner dolphin	*Stenella longirostris*		X		-
-"Whitebelly"	*Stenella longirostris longirostris*		X		-
-Central American	*Stenella longirostris centroamericana*		X		-
-Eastern	*Stenella longirostris orientalis*		X		Depleted
Pantropical spotted dolphin					
-Offshore form	*Stenella attenuata attenuata*		X		Depleted[2]
-Coastal form	*Stenella attenuata graffmani*		X		-
Commerson's dolphin	*Cephalorhynchus commersonii*			X	-
Black (Chilean) dolphin	*Cephalorhynchus eutropia*			X	-
Northern right whale dolphin	*Lissodelphis borealis*	X			-
Southern right whale dolphin	*Lissodelphis peronii*			X	-
Killer whale	*Orcinus orca*	X	X	X	-
-Southern Resident DPS		X			Endangered
Pygmy killer whale	*Feresa attenuata*		X		-
False killer whale	*Pseudorca crassidens*		X		-
Short-finned pilot whale	*Globicephala macrorhynchus*	X	X		-
Long-finned pilot whale	*Globicephala melas edwardii*			X	-
Melon-headed whale	*Peponocephala electra*		X		-
Cuvier's beaked whale	*Ziphius cavirostris*	X	X	X	-
Baird's beaked whale	*Berardius bairdii*	X	X		-
Arnoux's beaked whale	*Berardius arnuxii*			X	-
Mesoplodont beaked whales	*Mesoplodon spp.*	X	X	X	-
Gray's beaked whale	*Mesoplodon grayi*			X	-
Strap-toothed whale	*Mesoplodon layardii*			X	-
Peruvian beaked whale	*Mesoplodon peruvianus*		X		-

Species		CCRA	ETPRA	ARA	Federal ESA/MMPA Status[1]
Common Name	**Scientific Name**				
Southern bottlenose whale	*Hyperoodon planifrons*			X	-
Pygmy or Dwarf sperm whale	*Kogia breviceps or K. sima*	X	X		-
Sperm whale	*Physeter macrocephalus*	X	X	X	Endangered
Humpback whale	*Megaptera novaeangliae*	X	X	X	Endangered
Blue whale	*Balaenoptera musculus*	X	X	X	Endangered
Fin whale	*Balaenoptera physalus*	X	X	X	Endangered
Sei whale	*Balaenoptera borealis*	X	X	X	Endangered
Bryde's whale	*Balaenoptera edeni*	X	X		-
Common minke whale	*Balaenoptera acutorostrata*	X	X		-
Antarctic minke whale	*Balaenoptera bonaerensis*			X	-
Gray whale	*Eschrichtius robustus*	X			Delisted[3]
Southern right whale	*Eubalaena australis*			X	Endangered (foreign)
Pinnipeds					
California sea lion	*Zalophus californianus*	X	X		-
Steller sea lion -eastern subspecies (DPS)	*Eumetopias jubatus monteriensis*	X			Delisted[4]
South American sea lion	*Otaria byronia*		X	X	-
Guadalupe fur seal	*Arctocephalus townsendi*	X	X		Threatened
Northern fur seal	*Callorhinus ursinus*				
-Pribilof Islands stock		X			Depleted
-San Miguel Island stock		X			-
South American fur seal	*Arctocephalus australis*			X	-
Antarctic fur seal	*Arctocephalus gazella*			X	-
Sub-Antarctic fur seal	*Arctocephalus tropicalis*			X	-
Northern elephant seal	*Mirounga angustirostris*	X	X		-
Southern elephant seal	*Mirounga leonina*			X	-
Harbor seal	*Phoca vitulina richardsii*	X			-
Leopard Seal	*Hydrurga leptonyx*			X	-
Weddell Seal	*Leptonychotes weddellii*			X	-
Crabeater Seal	*Lobodon carcinophagus*			X	-
Ross seal	*Ommatophoca rossii*			X	-
Fissipeds					
Sea otter					
-Northern subspecies	*Enhydra lutris kenyoni*	X			-[5]
-Southern subspecies	*Enhydra lutris nereis*	X			Threatened

[1]Denotes ESA listing as either endangered or threatened, or MMPA listing as depleted. By default, all species listed under the ESA as threatened or endangered are also considered depleted under the MMPA. All marine mammal stocks are considered protected under the MMPA.

[2]The northeastern offshore form of Pantropical spotted dolphin is listed as depleted under the MMPA

[3]The eastern North Pacific stock of gray whales was removed from the list of threatened and endangered species in 1994; the western North Pacific stock remains endangered.

[4]The eastern DPS of Steller sea lion was removed from the list of threatened and endangered species on November 4, 2013 (78 FR 66140).

[5]The northern sea otter is listed as a state endangered species by Washington State; the southwestern DPS, which occurs in Alaska is listed as threatened under the ESA.

3.2.2.1 Marine Mammal Acoustics and Hearing

Marine mammals rely on sound production and reception for social interactions (e.g., reproduction, communication), to find food, to navigate, and to respond to predators. General reviews of cetacean and pinniped sound production and hearing may be found in Richardson et al. (1995), Edds-Walton (1997), Wartzok and Ketten (1999), and Au (2000). Interfering with these functions through anthropogenic noise could result in potential adverse impacts.

Southall et al. (2007) provided a comprehensive review of marine mammal acoustics including designating functional hearing groups. Assignment was based on behavioral psychophysics (the relationship between stimuli and responses to stimuli), evoked potential audiometry, auditory morphology, and, for pinnipeds, whether they were hearing through air or water. Because no direct measurements of hearing exist for baleen whales, hearing sensitivity was estimated from behavioral responses (or lack thereof) to sounds, commonly used vocalization frequencies, body size, ambient noise levels at common vocalization frequencies, and cochlear measurements. Table 3.2-5 presents the functional hearing groups and representative species or taxonomic groups for each; most species found in the SWFSC project areas are in the first two groups, low frequency cetaceans (baleen whales) and mid frequency cetaceans (odontocetes).

Table 3.2-5 Summary of the five functional hearing groups of marine mammals.

Functional Hearing Group	Estimated Auditory Bandwidth	Species or Taxonomic Groups
Low Frequency Cetaceans **(Mysticetes–Baleen whales)**	7 Hertz (Hz) to 22kilohertz (kHz) (best hearing is generally below 10 kHz, higher frequencies result from humpback whales)	All baleen whales
Mid- Frequency Cetaceans **(Odontocetes—Toothed whales)**	150 Hz to 160 kHz (best hearing is from approximately 10-120kHz)	Includes species in the following genera: Steno, Tursiops, Stenella, Delphinus, Lagenodelphis, Lagenorhynchus, Lissodelphis, Grampus, Peponocephala, Feresa, Pseudorca, Orcinus, Globicephala, Physeter, Hyperoodon, Ziphius, Berardius, Mesoplodon
High-frequency Cetaceans **(Odontocetes)**	200 Hz to 180 kHz (best hearing is from approximately 10-150kHz)	Includes species in the following genera: Phocoena, Phocoenoides, Kogia, Cephalorhynchus
Pinnipeds in water	75 Hz to 75 kHz (best hearing is from approximately 1-30 kHz)	All seals, fur seals, sea lions
Pinnipeds in air	75 Hz to 30 kHz (best hearing is from approximately 1-16 kHz)	All seals, fur seals, sea lions

Source: based on Southall et al. 2007 and modified from DON 2008b.

3.2.2.2 Threatened and Endangered Marine Mammals

This section only discusses species listed as threatened and endangered under the ESA; Table 3.2-4 lists all marine mammal species encountered in the SFWSC California Current, Eastern Tropical Pacific, and Antarctic Reserves.

Killer whale

Status and trends: In 2005, NMFS listed the Puget Sound southern resident killer whale (SRKW) DPS as an endangered species under the ESA. The minimum population estimate of the SRKW DPS as reported in Carretta et al. (2011) is 85 whales based on direct counts of known individuals. The potential biological removal (PBR) level for this stock is calculated as the minimum population size (85) times one-half the default maximum net growth rate for cetaceans (half of four percent) times a recovery factor of 0.1, resulting in a PBR of 0.17 whales per year from the SRKW DPS. None of the other populations of killer whales that occur in SWFSC research areas are listed under the ESA.

Barlow and Forney (2007) estimated the density of killer whales in the CCE (California Current Ecosystem, as defined in the application for Letter of Authorization), regardless of ecotype, at 0.71 killer whales/1,000 km^2.

No defined ecotypes have been recognized for the ETP, although observed pursuit and predation on marine mammals would suggest the occurrence of transients in the area (Olson and Gerrodette 2008, Pitman et al. 2007, Rasmussen et al. 2004). Genetic analysis from biopsy samples indicate that the whales differ genetically from northeast Pacific resident killer whales (Pitman et al. 2007). The only available estimate of abundance for killer whales in the ETP is 8,500 (4,700-15,900; 95 percent confidence interval) based on surveys conducted 1986-1990 (Wade and Gerrodette 1993).

Information on the status, population trends, and distribution in the AMLR survey area are scant but suggest that killer whales are abundant. Line-transect surveys yielded estimates of 25,000 killer whales in the Southern Ocean (Ford 2009). During the 2008/2009 AMLR surveys to estimate abundance and map krill and fish, marine mammal observers recorded a density of 0.0015 killer whales/ km^2 within the survey area (Santora et al. 2009).

Distribution and habitat preferences: Killer whales are found in all oceans and are second only to humans as the most widely spread of all mammals (Ford 2009). They most commonly occur in coastal and temperate waters of high productivity. The range of SRKWs during the spring, summer, and fall includes the inland waters of Puget Sound, Strait of Juan de Fuca, and Southern Georgia Strait. The southern residents also occur in the coastal waters off the coast of Oregon, Washington, and Vancouver Island and in recent years off the central California coast and the Queen Charlotte Islands. As summarized by Carretta et al. (2011), most sightings of the SRKW stock have occurred in the summer in inland waters of Washington and southern British Columbia. The complete winter range of this stock is uncertain.

Killer whales are found throughout the ETP and occur year-round (Dalheim et al. 1982 cited in Olson and Gerrodette 2008). They have been sighted both offshore and nearshore, including off the coasts of Costa Rica and Panama (Hamilton et al. 2009, May-Collado et al. 2005, Rasmussen et al. 2004).

Behavior and life history: Killer whales are very social and the basic social unit is based on maternal relationship and linked by maternal decent. Females give birth between 11 and 16 years of age with a five-year interval between births. Gestation is 15-18 months and weaning is about 1-2 years after birth. Males attain sexual maturity at about 15 years of age. Life expectancy for females is about 50 years with a maximum of 80-90; males typically live to about 29 years of age (Ford 2009). Killer whales have no natural predators, but neonatal mortality is high with nearly 46 percent dying in the first 6 months (Ford 2009).

The SRKW DPS primarily feeds on salmon, especially Chinook salmon returning to rivers in Washington and southern British Columbia. Resident killer whale pods in Puget Sound exhibit cooperative food searching but perhaps not food capture (Hoelzel 1993). Transient killer whales feed on seals, sea lions, and young or smaller cetaceans (Ford 2009) with an optimal group size of at least three whales needed to efficiently chase and capture marine mammal prey (Baird et al. 1992).

Sperm whale

Status and trends: Sperm whales are listed as endangered under the ESA, and consequently the California to Washington stock is considered as a depleted and strategic stock under the MMPA. The most precise and recent estimate of sperm whale abundance for this stock is 971 (Coefficient of Variation = 0.33) based on ship surveys conducted in 2005 (Forney 2007) and 2008 (Barlow 2010). The minimum population estimate for sperm whales in this region is 751 whales with a calculated PBR of 1.5 sperm whales per year. The annual rate of kill and serious injury (0.4 per year) is less than the calculated PBR for this stock (1.5). Total human-caused mortality is greater than 10 percent of the calculated PBR and, therefore, cannot be considered to be approaching zero mortality and serious injury (M&SI) rate.

Barlow and Forney (2007) estimated the density of sperm whales in the CCE at 1.70 whales/1000 km^2.

Sperm whales in the ETP were considered one stock for the purposes of estimating abundance. Gerrodette and Forcada (2002) estimated sperm whale abundance in the ETP in 2000 as 4,145 individuals (354-12,114; 95 percent confidence interval). This was down from an estimated 26,652 in 1999 and was the lowest estimate derived between 1986 and 2000 (the highest was 49,653). Reasons for differences in estimates include the likelihood of missing sperm whales on prolonged dives, difficulty in accurately estimating group size, and the possibility that whales, whose range extends beyond the survey boundaries, move readily into or out of the survey area (Gerrodette and Forcada 2002).

There is no information on status and trends of sperm whales within the SWFSC AMLR survey area. Female and young sperm whales are not often seen in higher latitudes; males can be found over almost any ice-free deep water area including waters within the SWFSC AMLR survey area (Whitehead 2009). However, there are no estimates of sperm whale density within the survey area.

Distribution and habitat preferences: As described by Carretta et al. (2011, and citations therein), populations of sperm whales exist in waters of the CCRA throughout the year. They are distributed across the entire North Pacific and into the southern Bering Sea in summer, but the majority are thought to be south of 40^{o} N in winter. Sperm whales are found year round in California waters, but they reach peak abundance from April through mid-June and from the end of August through mid-November.

Recent summer/fall surveys in the ETP show that although sperm whales are widely distributed in deep waters of the area, their relative abundance decreases towards the middle of the tropical Pacific (near the International Whaling Commission stock boundary at 150° W) and tapers off northward towards the tip of Baja California. Sperm whales in the ETP are predominantly females and immature animals. They are capable of extensive movements which they adapt over an array of temporal and spatial scales relative to the distribution of resources. Movements of 1,000 kilometers (e.g., between the Galápagos Islands and mainland Ecuador or Panama) are common (Whitehead et al. 2008). Males are rare in the area, primarily due to their high-latitude non-breeding distribution and late age at which they return to the breeding areas (Whitehead et al. 2008).

Behavior and life history: Females reach sexual maturity at about age 9 when roughly 9 meters long and they give birth about every 5 years; gestation is 14-16 months (Whitehead 2009). Sperm whales consume numerous varieties of deep water fish and cephalopods.

Humpback whale

Status and trends: The humpback whale is listed as endangered under the ESA throughout its range. In the North Pacific, there are at least three separate populations, all of which migrate between specific summer/fall feeding areas and winter/spring calving and mating areas.

The California/Oregon/Washington stock spends the winter in coastal waters of Mexico and Central America, and the summer along the West Coast from California to British Columbia. The Central North Pacific stock spends winters in Hawaii and summers in Alaska, and its distribution may partially overlap with that of the California/Oregon/Washington stock off the coast of Washington and British Columbia (Clapham 2009). Finally, the Western North Pacific stock spends winters near Japan and probably migrates to the Bering Sea and Aleutian Islands in summer. There is some mixing between these populations, though they are still considered distinct stocks. The California/Oregon/Washington stock and the central North Pacific stocks occur in SWFSC CCE research areas.

The minimum estimate for humpback whales in the California/Oregon/Washington population based on line-transect and mark-recapture methods is 1,878, and the population is thought to be growing at about 6-7 percent per year (Calambokidis et al. 2009, Carretta et al. 2011). The PBR level for this stock is calculated as the minimum population size (1,878) times one half the estimated population growth rate for this stock times a recovery factor of 0.1, resulting in a PBR of 22.5. Because this stock spends approximately half its time outside the U.S. EEZ, the PBR allocation for U.S. waters is 11.3 whales per year. The estimated annual M&SI due to entanglement (3.2/year), other anthropogenic sources (zero), plus ship strikes (0.4/year) in California is less than the PBR allocation of 11.3 for U.S. waters. Based on strandings and at sea observations, annual humpback whale M&SI in commercial fisheries is greater than 10 percent of the PBR; therefore, total fishery M&SI is not approaching zero M&SI rate. However, the stock appears to be increasing in abundance (Carretta et al. 2011).

The minimum population estimate for the Central North Pacific stock of humpback whales, calculated from counts of unique individuals, is 5,833 whales. Using a maximum net productivity rate of 0.07, and a recovery factor of 0.3, the PBR for the central North Pacific stock is calculated to be 61.2 whales.

Barlow and Forney (2007) estimated the density of humpback whales in the CCE at 0.83 whales/1,000 km^2.

Humpback whales wintering in the coastal regions of the ETP - notably Costa Rica to Peru - are from both the northern and southern hemispheres. Costa Rica is unique as a region of geographic overlap for stocks of humpback whales that feed off California (California/Oregon/Washington stock) and off the Antarctic Peninsula and southern Chile (Breeding Stock G) (Acevedo and Smultea 1995, Calambokidis et al. 2000, Félix and Botero-Acosta 2011, Rasmussen et al. 2007). Peak numbers occur off Costa Rica during January to March and August to October, the northern and southern hemisphere humpback whale wintering seasons, respectively (May-Collado et al. 2005, Rasmussen et al. 2004).

No abundance estimates have been calculated for humpback whales in the ETP.

In the Southern Hemisphere, humpbacks feed in circumpolar waters around the Antarctic and migrate to relatively discrete breeding grounds in tropical waters to the north (Clapham 2009). There is no information on the status and population trends for humpback in the Antarctic, however, during the 2008/2009 AMLR surveys to estimate abundance and map krill and fish, marine mammal observers recorded a density of 0.036 humpback whales/ km^2 within the survey area (Santora et al. 2009).

Distribution and habitat preferences: Humpback whales are found in all oceans of the world and migrate from high latitude feeding grounds to low latitude calving areas. They are typically found in coastal or shelf waters in summer and close to islands and reef systems in winter (Clapham 2009). Humpbacks primarily occur near the edge of the continental slope and deep submarine canyons, where upwelling concentrates zooplankton near the surface for feeding. They often feed in shipping lanes which makes them susceptible to mortality or injury from large ship strikes (Douglas et al. 2008).

Behavior and life history: Humpback whales are known for their spectacular aerial behaviors and complex songs of males. They breed in warm tropical waters after an 11 month gestation period; calves feed independently after about 6 months. Humpback whales feed on euphausiids and various schooling fishes, including herring, capelin, sand lance, and mackerel (Clapham 2009).

Blue whale

Status and trends: Blue whales are listed as endangered under the ESA. The best estimate of blue whale abundance in the U.S. West Coast feeding stock component of the eastern North Pacific stock is 2,497 (Coefficient of Variation = 0.24) (Carretta et al. 2011). Barlow and Forney (2007) estimated the density of blue whales in the CCE at 1.36 whales/1,000 km^2. The minimum population is approximately 2,046 blue whales with a calculated PBR of 12.2 (Carretta et al. 2011). Because whales in this stock spend approximately three quarters of their time outside the U.S. EEZ, the PBR allocation for U.S. waters is one-quarter of this total, or 3.1 whales per year. The annual incidental mortality and injury rate (1.0/year) from ship strikes is less than the calculated PBR for this stock. To date, no blue whale mortality has been associated with California gillnet fisheries; and the total fishery M&SI rate is approaching zero.

Blue whales in the ETP also belong to the eastern North Pacific stock (Carretta et al. 2010, Stafford et al. 1999). The most recent estimate of abundance for blue whales in the ETP is 1,415 (1,078-2,501; 95 percent confidence interval) (Wade and Gerrodette 1993).

There is no information on status and trends of blue whales within the SWFSC AMLR survey area. In the Southern Ocean, where the blue whale was historically most abundant, it is rare today with abundance estimates of 1,700 whales and discrete feeding stocks (Sears and Perrin 2009).

Distribution and habitat preferences: The blue whale has a worldwide distribution in circumpolar and temperate waters. Seasonal migrations of blue whales are driven by food requirements. Poleward movements in the spring allow the whales to take advantage of high zooplankton production in summer, while movement toward the subtropics in the fall allows blue whales to reduce their energy expenditure while fasting and to avoid ice entrapment. The eastern North Pacific Stock of blue whales ranges from the northern Gulf of Alaska to the ETP (Carretta et al. 2011). Most of this stock is believed to migrate south to spend the winter and spring in high productivity areas off Baja California, in the Gulf of California, and on the Costa Rica Dome (a large, 300-500 km^2, relatively stationary eddy centered near 9° N and 89° W).

Behavior and life history: Blue whales reach sexual maturity at 5-15 years of age; length at sexual maturity in the Northern Hemisphere for females is 21-23 meters and for males it is 20-21 meters (Sears and Perrin 2009). Females give birth about every 2-3 years in winter after a 10-12 month gestation; longevity is thought to be at least 80-90 years (Sears and Perrin 2009). Blue whales occur primarily in offshore deep waters (but sometimes near shore, e.g. the deep waters in Monterey Canyon, CA) and feed almost exclusively on euphausiids.

Fin whale

Status and trends: Fin whales are listed as endangered under the ESA, and consequently the California to Washington stock is considered as a depleted and strategic stock under the MMPA. The best estimate of fin whale abundance in California, Oregon, and Washington waters out to 300 nm is 3,044 (Coefficient of Variation = 0.18) whales, the geometric mean of line transect estimates from summer/autumn ship surveys conducted in 2005 (Forney 2007) and 2008 (Barlow 2010). The minimum population estimate is 2,624 fin whales with a calculated PBR of 16 whales per year. Barlow and Forney (2007) estimated the density of fin whales in the CCE at 1.84 whales/1,000 km^2. The total incidental mortality due to fisheries (zero) and ship strikes (1.0/year) is less than the calculated PBR (16). Total fishery mortality is less than 10 percent of PBR and the M&SI rate may be approaching zero.

Fin whales sightings are rare in the ETP (Carretta et al. 2010, Wade and Gerrodette 1993). Only one fin whale was recorded north of the study area along the coast of Baja California between 1986 and 1990 (Wade and Gerrodette 1993) and 10 out of 13 fin whales sighted during surveys from 1998 to 2008 were also along the Baja coast (Jackson et al. 2004, 2008, Kinzey et al. 1999, 2000, 2001).

Population status and trends information for fin whales in the SWFSC AMLR survey area are lacking. However, during the 2008/2009 AMLR surveys to estimate abundance and map krill and fish, marine mammal observers recorded a density of 0.084 fin whales/ km^2. within the survey area (Santora et al. 2009).

Distribution and habitat preferences: Fin whales are distributed widely in the world's oceans and occur in both the Northern and Southern Hemispheres between 20–75^o latitude (DON 2008b). In the northern hemisphere, they migrate from high Arctic feeding areas to low latitude breeding and calving areas. The North Pacific population summers from the Chukchi Sea to California, and winters from California southward.

Behavior and life history: Fin whales become sexually mature between 6 to 10 years of age, and reproduce primarily in the winter. Gestation lasts about 11 months and nursing occurs for 6 to 11 months (Aguillar 2009). Fin whales feed on planktonic crustaceans, including *Thysanoessa* sp. and *Calanus* sp., as well as schooling fish including herring, capelin and mackerel (Aguilar 2009).

Sei whale

Status and trends: Sei whales are listed as endangered under the ESA, and consequently the eastern North Pacific stock is automatically considered as a depleted and strategic stock under the MMPA. The best estimate of abundance for California, Oregon, and Washington waters out to 300 nm is 126 (Coefficient of Variation = 0.53) sei whales, the unweighted geometric mean of the 2005 and 2008 estimates (Barlow and Forney 2007, Forney 2007, Barlow 2010). Barlow and Forney (2007) estimated the density of sei whales in the CCE at 0.09 whales/1,000 km^2. The minimum population estimate is 83, with a calculated PBR of 0.17 sei whales per year. Total estimated fishery mortality is zero and therefore is approaching zero M&SI rate. The total incidental mortality due to ship strikes is greater than the calculated PBR (0.17).

The estimated pre-whaling population of sei whales in the Southern Hemisphere was about 100,000; in 1980 the population was thought to be 24,000 whales (Horwood 2009). Sei whales are occasionally seen during transit of Drake's Passage, the sub-antarctic and around South America, however the population status and trends in this area are not known.

Distribution and habitat preferences: As summarized in Horwood (2009) and DON (2008a,b), sei whales have a worldwide distribution but are found primarily in cold temperate to subpolar latitudes rather than in the tropics or near the poles (Horwood 2009). Sei whales spend the summer months feeding in subpolar higher latitudes and return to lower latitudes to calve in the winter. There is some evidence from whaling catch data of differential migration patterns by reproductive class, with females arriving at and departing from feeding areas earlier than males. For the most part, the location of winter breeding areas is unknown.

Behavior and life history: Sei whales mature at about 10 years for both sexes. They are most often found in deep, oceanic waters of the cool temperate zone. They appear to prefer regions of steep bathymetric relief, such as the continental shelf break, canyons, or basins situated between banks and ledges. On feeding grounds, the distribution is largely associated with oceanic frontal systems (Horwood 2009). In the North Pacific, sei whales feed along the cold eastern currents (Perry et al. 1999). Prey includes calanoid copepods, krill, fish, and squid. The dominant food for sei whales off California during June through August is the northern anchovy, while in September and October they eat mainly krill.

Southern Right Whale

Status and trends: Southern right whales are listed as endangered under the ESA and designated as depleted under the MMPA. The total abundance of Southern right whales in 1997 was 7,571 whales with those in some areas increasing at 7-8 percent annually. Assuming continued increase during the period from 1997 to the present, the total abundance could currently exceed 15,000 animals (Kenney 2009). Abundance in the CCAMLR survey area during 2000, which included the Scotia Sea and Antarctica

Peninsula, was estimated to be 1,755 (Coefficient of Variation = 61.67) right whales (Reilly et al. 2004). Estimates of status and trends specific to the SWFSC AMLR survey area are not available.

Distribution and habitat preferences: Southern right whales are found in the middle latitudes of the Southern Ocean between approximately 20^{o} and 60^{o} S. Multiple stocks have been hypothesized to reside near Argentina/Brazil, South Africa, east Africa, western Australia, southeastern Australia, New Zealand, and Chile. They migrate annually between high-latitude feeding grounds and low-latitude calving and breeding grounds. Feeding grounds for this species appears to be offshore, pelagic regions in areas of high productivity (Kenney 2009). Calving often occurs in shallow coastal waters and bays.

Behavior and life history: Right whales have a three year reproductive cycle; mating likely occurs in or near the calving grounds. DON (2008a) summarized the literature on northern right whale foraging behavior; it is that likely southern right whale foraging behavior is similar. Dives of 5-15 minutes or longer have been reported, but can be much shorter when feeding. Foraging dives in the feeding high-use areas are frequently near the bottom and the average depth of a dive was strongly correlated with both the average depth of peak copepod abundance and the average depth of the mixed layer. Killer whales and large sharks are likely predators of Southern right whales.

Steller Sea Lion: Eastern DPS

Status and trends: The two separate stocks, or DPSs, of Steller sea lions recognized in U.S. waters are the eastern stock, which includes animals east of Cape Suckling, AK (144^{o} W) to California, and a western stock that extends from west of Cape Suckling to Russia (Loughlin 1997). Only the eastern stock occurs in SWFSC research areas. In November 1990, NMFS listed Steller sea lions as threatened under the ESA (55 FR 49204). In 1997, the western population was listed as endangered (62 FR 24345, June 1997), while the eastern stock retained a threatened classification (Allen and Angliss 2011). In November 2013, NOAA delisted the eastern stock, by removing it from the ESA list of threatened and endangered species; the endangered status for the western stock remains unchanged. NMFS intends to implement a Post-Listing Monitoring Plan for the next ten years to ensure continued recovery of the eastern stock of Steller sea lions (78 FR 66140, November 4, 2013).

Based on extrapolations from non-pup and pup surveys, the total population of the eastern stock of Steller sea lions is estimated to be within the range of 58,334-72,223 with a minimum population estimate of 52,847 and a PBR of 2,378 (Allen and Angliss 2011). Overall the stock has been increasing at about 3.1 percent per year since the 1970s with the population more than doubling in size by 2004, principally in Southeast Alaska (Pitcher et al. 2007). The recent status review (NMFS 2013) shows the population has met recovery criteria outlined in the recovery plan developed by NOAA fisheries in 1992 and revised in 2008.

Distribution and habitat preferences: The eastern stock of Steller sea lion is present year round within the CCRA, with peak numbers in late summer, fall, and winter (Carretta et al. 2011). There are six major haulouts (used by >50 animals) and three active rookeries in California, seven major haulouts and two rookeries in Oregon, and two major haulout sites along the outer coast of Washington (Pitcher et al. 2007). Telemetry studies show that in winter adult females may travel far out to sea into water greater than 1,000 meters deep (Merrick and Loughlin 1997), and juveniles less than 3 years of age travel nearly as far (Loughlin et al. 2003). Sea lions commonly occur near and beyond the 200 meter depth contour. Some individuals may enter rivers in pursuit of prey.

Behavior and life history: Steller sea lions breed from late May to early July throughout the range at rookeries located on remote islands and rocks. One pup is born annually after a 9 month gestation period. Steller sea lions are opportunistic predators, feeding primarily on a wide variety of fishes and cephalopods. Some of the more important prey species include Pacific whiting, walleye pollock, Atka mackerel, Pacific herring, capelin, Pacific sand lance, Pacific cod, and salmon (Loughlin 2009).

Guadalupe fur seal

Status and trends: Guadalupe fur seals are listed as a threatened species under the ESA, and consequently their stocks are automatically considered as depleted and strategic under the MMPA. The state of California lists the Guadalupe fur seal as a fully protected mammal and it is also listed as a threatened species in the Fish and Game Commission California Code of Regulations. The population was estimated by Gallo (1994) to be about 7,408, derived by multiplying the number of pups (counted and estimated) by a factor of 4.0. The minimum size of the population in Mexico can be estimated using an actual count of 3,028 hauled out seals with a PBR of 91 Guadalupe fur seals. There is insufficient information to determine whether the fishery mortality in Mexico exceeds the PBR for this stock. The total U.S. fishery M&SI for this stock is less than 10 percent of the calculated PBR and, therefore, can be considered to be approaching zero M&SI rate. The population is growing at approximately 13.7 percent per year.

Distribution and habitat preferences: Guadalupe fur seals pup and breed mainly at Isla Guadalupe, Mexico (Arnould 2009; Carretta et al. 2011 and citations therein). The population is considered to be a single stock because all individuals are recent descendants from one breeding colony at Isla Guadalupe, Mexico. Individuals have been sighted as far north as central California, and as far south as Zihuatanejo, Mexico. Guadalupe fur seals are seasonally present in low numbers in California waters.

Behavior and life history: Definitive data are lacking on life history of Guadalupe fur seals, but most species in the genus reach sexual maturity at 3-5 years of age; males also mature at about the same age but are unable to attain reproductive status (obtain a reproductive territory) until 7-10 years of age. Guadalupe fur seals pup in June-July. Southern fur seals, including the Guadalupe fur seal, feed on a variety of prey including fish, cephalopods and crustaceans, depending on prey abundance and location. Most southern fur seals forage in upwelling zones, oceanic fronts, or continental shelf-edge regions (Arnould 2009). Specific foraging and dive information is not known for the Guadalupe fur seal. But other species in this genus forage mainly in the surface mixed layer (<50-60 meters) at night (Arnould 2009).

Sea Otter: Southern and Northern Subspecies

Status and trends: Three subspecies of sea otters are recognized: *E.l. lutris* (which occurs primarily in Russia), *E.l. kenyoni* (the Northern subspecies which occurs primarily in Alaska and Washington state), and *E.l. nereis* (the Southern subspecies which occurs in central California). The Southern subspecies of sea otters is listed as threatened under the ESA. The 2009 spring survey of sea otters in central California found 2,654 otters, 3.8 percent lower than the 2008 count and the 3-year average was 2813, a decline of -0.46 percent from 2008.

Although otters off Washington State are descended from the Amchitka Island sea otters and are thus related to the southwest Alaska DPS recently listed as threatened under the ESA, they are geographically isolated from the southwest Alaska population by hundreds of kilometers and are not included in the listing. In Washington state, 65 sea otters were counted in 1985, increasing to 276 sea otters in 1991 and 814 sea otters in 2005 (Jameson and Jeffries 2005). Lairdre et al. (2002) estimated the carrying capacity of sea otters in Washington at 1,836 individuals.

Distribution and habitat preferences: Sea otters are non-migratory, full time residents in Pacific coastal areas. They rarely wander more than a few miles from their established feeding grounds (Kenyon 1981). Otters prefer a protected inshore area with a rocky bottom and an abundance of kelp (Riedman 1990).

Behavior and life history: Sea otters pup in late winter and early spring, and the pups are weaned in late summer and early fall. They forage on a variety of marine invertebrates, including sea urchins, throughout the entire depth range from intertidal areas out to at least 40 meters (Estes et al. 2009). Feeding occurs both at day and night. Sea otters are preyed upon by white sharks, killer whales, and, infrequently, Steller sea lions.

3.2.2.3 Non-ESA Listed Marine Mammals that have been taken during the course of historical SWFSC research activities.

Pacific white-sided dolphin

Status and trends: Pacific white-sided dolphins are not listed as threatened or endangered under the ESA nor as depleted under the MMPA. The 2005-2008 geometric mean abundance estimates for California, Oregon and Washington waters based on the two most recent ship surveys is 26,930 with a minimal population estimate of 21,406 dolphins. Barlow and Forney (2007) estimated the density of Pacific white-sided dolphins in the CCE at 20.93 dolphins/1,000 km^2. The PBR is 193 animals. No long-term trends in the abundance of Pacific white-sided dolphins in California, Oregon and Washington are suggested based on historical and recent surveys (Carretta et al. 2011). The average annual human-caused mortality in 2000-2006 (1.4 animals) is estimated to be less than the PBR (193), and therefore they are not classified as a strategic stock under the MMPA. The total fishery M&SI for this stock is less than 10 percent of the calculated PBR and, therefore, can be considered to be approaching zero M&SI rate.

Distribution and habitat preferences: As summarized in Carretta et al. (2011, and citations therein), Pacific white-sided dolphins are endemic to temperate waters of the North Pacific Ocean, and are common both on the high seas and along the continental margins. Off the U.S. West Coast, Pacific white-sided dolphins have been seen primarily in shelf and slope waters. Sighting patterns from recent aerial and shipboard surveys conducted in California, Oregon and Washington suggest seasonal north-south movements, with animals found primarily off California during the colder water months and shifting northward towards Oregon and Washington as water temperatures increase in late spring and summer.

Behavior and life history: As summarized from Black (2009, and citations therein) calving occurs from May to September. Age and length of maturation varies by area with females becoming sexually mature at 8-11 years with a 4 to 5 year calving interval. Prey species include cephalopods (30 species known to be consumed) and schooling fishes (at least 60 species) (Black 2009).

Northern right-whale dolphin

Status and trends: Northern right-whale dolphins in California, Oregon and Washington are not listed as threatened or endangered under the ESA, nor as depleted under the MMPA. A multi-year average abundance estimate is the most appropriate for management within U.S. waters; the 2005-2008 geometric mean abundance estimate for California, Oregon and Washington waters based on the two ship surveys is 8,334 (Coefficient of Variation = 0.40) northern right-whale dolphins with a minimum population estimate for 2005-2008 of 6,019 dolphins; the PBR is 48 dolphins per year (Carretta et al. 2011). Barlow and Forney (2007) estimated the density of northern right-whale dolphins at 9.75 dolphins/1,000 km^2.

The average annual human-caused mortality in 2002-2006 (4.8 animals) is estimated to be less than the PBR (48), and therefore they are not classified as a "strategic" stock under the MMPA. The total fishery M&SI for northern right-whale dolphins is less than 10 percent of the calculated PBR and, therefore, can be considered to be approaching zero M&SI rate (Carretta et al. 2011).

Distribution and habitat preferences: Northern right-whale dolphins occur in the survey area year-round, but their abundance and distribution vary seasonally. This species is most abundant off central and northern California in nearshore waters in winter. They occur off Oregon and Washington except in winter; peak abundance occurs along the continental slope in fall (Carretta et al. 2011; DON 2008b). Right-whale dolphins prefer cool-temperate and subarctic waters in the North Pacific. They tend to be offshore oceanic cetaceans with rare inshore sightings (Lipsky 2009).

Behavior and life history: Sexual maturity occurs at about 10 years of age. Although calving seasonality is unknown, small calves are seen in winter and early spring. They tend to be gregarious and travel in groups of up to 2,000-3,000 in the North Pacific. Their diet consists primarily of squid and mesopelagic fish.

California sea lion

Status and trends: California sea lions in the U.S. are not listed as endangered or threatened under the ESA or as depleted under the MMPA. Based on extrapolations from pup counts, the population is estimated at 238,000 sea lions, and it is growing at 5.6 percent per year (Carretta et al. 2011). The minimum population estimate for the U.S. stock is 141,842 sea lions. The calculated PBR for this stock is 8,511 animals (Carretta et al. 2011). California sea lions are not considered a strategic stock under the MMPA because total human-caused mortality is likely to be less than the PBR (8,511). The total fishery M&SI rate for this stock is likely above 10 percent of the calculated PBR and, therefore, cannot be considered to be approaching a zero M&SI rate.

Distribution and habitat preferences: California sea lions breed in three geographic regions which are used to separate the subspecies into three stocks: (1) the U.S. stock begins at the U.S./Mexico border and extends northward into Canada; (2) the Western Baja California stock extends from the U.S./Mexico border to the southern tip of the Baja California Peninsula; and (3) the Gulf of California stock includes the Gulf of California from the southern tip of the Baja California peninsula (Carretta et al. 2011). The primary rookeries are located on the California Channel Islands of San Miguel, San Nicolas, Santa Barbara, and San Clemente. As summarized in Carretta et al. (2011) and DON (2008b, and references therein) their distribution shifts to the northwest in fall and to the southeast during winter and spring, probably in response to changes in prey availability.

Behavior and life history: California sea lion numbers ashore increase rapidly in May when males establish breeding territories. Birth to a single pup occurs from May through June and pups are weaned in about 10-12 months (Heath and Perrin 2009). California sea lions feed primarily on Pacific whiting, Pacific herring, salmonids, dogfish sharks, and squid.

Northern fur seal

Status and trends: Northern fur seals are divided into two stocks in U.S. waters: Eastern Pacific stock (Pribilof Islands and Bogoslof Island) and San Miguel Island stock. The Pribilof Islands northern fur seal population was designated as depleted pursuant to the MMPA in 1988 because it declined to less than 50 percent of levels observed in the late 1950s and there was no compelling evidence that the northern fur seal carrying capacity of the Bering Sea had changed substantially (NMFS 2007). The San Miguel Island stock is not designated as depleted. The minimum population estimate for the Pribilof Islands stock is 642,265 fur seals and for the San Miguel Island stock it is 5,395 fur seals. The calculated PBR for the San Miguel Island stock is 324 fur seals per year; the calculated PBR for the Pribilof Islands stock is 13,809 fur seals per year (Carretta et al. 2011; Allen and Angliss 2011).

Distribution and habitat preferences: NMFS (2007) summarized northern fur seal distribution. They are endemic to the North Pacific Ocean. During the winter the southern limit of their range extends across the Pacific Ocean from southern California to the Okhotsk Sea and Honshu Island, Japan. In the spring most northern fur seals migrate north to breeding colonies in the Bering Sea. The largest breeding colonies are located on St. Paul and St. George islands in the Pribilof Islands and compose approximately 74 percent of the worldwide fur seal population. Other breeding colonies are located in the Commander Islands (Russia) in the western Bering Sea and on Robben Island (Russia) in the Okhotsk Sea that compose approximately 15 and 9 percent of the population, respectively. Small breeding colonies are also located on the Kuril Islands in the western North Pacific, Bogoslof Island in the central Aleutian Islands, and on San Miguel Island off the southern California coast. Northern fur seals are primarily pelagic in the winter months, but occasionally haul-out onto land for brief periods. The subpolar continental shelf and shelf break from the Bering Sea to California are feeding grounds while fur seals are at sea.

Behavior and life history: Northern fur seals feed on schooling fish and gonatid squid, although the species consumed vary with location and season (Sinclair et al. 1996).

From November to March Northern fur seals remain north of about 35° N latitude without coming ashore. In March and April they gather along continental shelf breaks and begin to migrate to their respective breeding islands (Gentry 2009). Males come ashore and acquire breeding territories in late May and June and most pups are born in July, nursed for about 4 months and weaned in October or November. They are a highly migratory species and typically return to their natal sites to breed.

3.2.3 Birds

3.2.3.1 Threatened and Endangered Species

The ESA allows the USFWS to list bird species as endangered or threatened regardless of which country the species lives in. Although greater legal protections are given to ESA-listed species within the U.S. EEZ, the law also protects listed species wherever they occur from potentially adverse interactions with people and entities subject to U.S. jurisdiction, such as the SWFSC and its researchers. Table 3.2-6 identifies the ESA-listed species occurring within the SWFSC CCRA and ETPRA. No ESA-listed species are likely to encounter SWFSC research activities in the ARA. The brown pelican (*Pelecanus occidentalis*) was delisted in 2009 due to recovery (74 FR 59444).

Table 3.2-6 ESA-listed Birds Occurring in the SWFSC Research Areas.

Species		CCRA	ETPRA	Federal ESA Status
Common Name	Scientific Name			
Short-tailed albatross	*Phoebastria albatrus*	X		Endangered
Hawaiian dark-rumped petrel	*Pterodroma sandwichensis*		X	Endangered
Galapagos petrel	*Pterodroma phaeopygia*		X	Threatened (foreign)
Newell's shearwater	*Puffinus auricularis newelli*		X	Threatened
Humboldt penguin	*Spheniscus humboldti*		X	Threatened (foreign)
Galapagos penguin	*Spheniscus mendiculus*		X	Endangered (foreign)
California least tern	*Sterna antillarum browni*	X		Endangered
Marbled murrelet	*Brachyramphus marmoratus*	X		Threatened

<u>California Current</u>

<u>Short-tailed albatross</u>

The short-tailed albatross is the largest of the three albatross species found in the North Pacific Ocean. The species used to be the most abundant albatross in the North Pacific but was almost exterminated by feather and meat hunters on its Japanese breeding grounds in the early 1900s. The short-tailed albatross was listed as endangered by the USFWS in 2000 and a Final Recovery Plan was published in 2008 (USFWS 2008). Conservation efforts have helped the population grow at near-maximum rates but the total population is still less than 3,000 birds (USFWS 2009). Major threats to this species include natural threats to their nesting habitat on volcanic islands, mortality in longline fisheries, and ingestion of plastic debris (USFWS 2008).

California least tern

The least tern is the smallest member of the gull family. The West Coast population of least tern (California least tern) was listed as endangered by the USFWS in 1970, and a recovery plan was published in 1980 (USFWS 1985). Major threats to this species include human use and development of nesting habitat and predation on adults, eggs, and young by birds and mammals, and habitat loss due to encroachment of vegetation (USFWS 1985, USFWS 2006).

Marbled murrelet

The marbled murrelet is a small seabird that occurs from Alaska to northern Mexico. The southern population was listed as threatened in Washington, Oregon, and California in 1992 due to habitat loss from logging and coastal development, susceptibility to oil spills, and mortality in gill-net fisheries (USFWS 1997b).

Eastern Tropical Pacific

Hawaiian dark-rumped petrel

The Hawaiian dark-rumped petrel occurs in the central subtropical Pacific and nests only in the Hawaiian Islands. This species was listed as an endangered species by the USFWS in 1967 due to its limited distribution and the marginal status of known breeding populations. The Hawaiian dark-rumped petrel and Newell's shearwater recovery plan was finalized in 1983 (USFWS 1983). Major threats to this species include attraction to and disorientation by artificial lights leading to exhausted birds landing in dangerous situations and colliding with power lines and other structures, habitat destruction, and predation by non-native terrestrial mammals (USFWS 2011).

Galapagos petrel

The Galapagos petrel is endemic to the Galapagos Islands, Ecuador and breeds in the archipelago. This species was listed under the ESA as a foreign threatened species in 2010 (75 FR 235). It has been classified as critically endangered by the International Union for Conservation of Nature (IUCN) since 1994 due to extreme declines in population in the past three generations. Major threats include predation, habitat degradation, and mortality in fishing nets (IUCN 2011).

Newell's shearwater

Newell's shearwaters occur in the central subtropical Pacific and breed exclusively in the Hawaiian Islands (Ainley at al. 1997). This species was listed as threatened in 1982 due to limited distribution and the marginal status of known breeding populations (USFWS 1983). Major threats to this species include predation on nesting grounds by non-native terrestrial mammals, human disturbance, and destruction of nesting habitat. The Newell's Shearwater depends on tuna to force prey within its reach. These tuna are targeted in commercial fisheries which decrease their abundance and cause foraging shearwaters to exert more energy to find schools of tuna (Ainley et al. 1997).

Humboldt penguin

The Humboldt penguin occurs in the coastal areas of Peru and Chile, with some occurring in Colombia and Ecuador. This species was listed under the ESA as a foreign threatened species in 2010 (75 FR 45497). Humboldt penguin was classified by the IUCN in 2002 as vulnerable due to a reduction in the number of breeding colonies of these birds (IUCN 2011b). Major threats include nesting habitat loss and degradation from guano mining and invasive species, pollution, competition with fisheries for prey species, and entanglement and drowning in gill nets and long line fishing gear (UNEP WCMC 2003). One study found that 8 of 19 tagged birds were found dead due to entanglement in gill nets (Wallace et al. 1999).

Galapagos penguin

The Galapagos penguin is endemic to the Galapagos Islands and was listed as a foreign endangered species in 1970 (35 FR 8941) due to its very restricted breeding range and declining population. This is the most northern breeding penguin, nesting on the equator, but it relies on the cold currents around the Galapagos to support rich prey fish populations. The major conservation concerns include introduced predators on nest islands and the adverse effects of El Nino events on forage fish, resulting in major population declines of the penguins in 1982–83 and 1997–98 (Boersma 1998, Vargas et al. 2005).

3.2.3.2 Other Bird Species

There are many seabird species that occur in the three SWFSC fisheries research areas that may potentially interact with research vessels and gear. However, birds have never been caught incidentally in SWFSC fisheries surveys. The following accounts give brief overviews of the marine bird communities in the research areas. Additional information of the natural history, habitats, and conservation status of marine birds in each research area can be found in the first references cited in each section, which are incorporated by reference.

California Current

The California Current Ecosystem supports over 150 species of breeding and migrating seabirds, including sea ducks, loons, grebes, albatross, petrels, shearwaters, storm-petrels, tropicbirds, boobys, cormorants, pelicans, phalaropes, gulls, terns, murres, murrelets, auklets, and puffins (Mills et al. 2005). All species likely to occur in the California Current research area are protected by the Migratory Bird Treaty Act (16 U.S.C. 703 *et. seq.*) as well as conservation laws in Canada and Mexico. Some species travel long distances over the ocean and have many potentially adverse interactions with humans and their activities, such as commercial and recreational fisheries and oil spills from transport vessels and offshore oil wells. Human activities on land can also affect them at sea or at inland nest sites, including agricultural and urban runoff contamination and land clearing for resource development (Mills et al. 2005). However, natural factors such as changes in ocean currents, prey availability, and severe weather can drive population fluctuations for many species (Ainley and Hyrenbach 2007). The impacts of climate change on weather, ocean chemistry, and oceanographic patterns and the ecological effects on different bird species is a topic of considerable interest and research (Sydeman et al. 2009).

Eastern Tropical Pacific

The ETP supports about 100 species of seabirds (Balance et al. 2006). The most common seabirds found in the ETP include a variety of shearwaters, tropicbirds, boobies, terns, frigatebirds, petrels, phalaropes, gulls, noddy's, and jaegers (Olson et al. 2001). A study of the ecology of seabird communities in the ETP selected 10 of the most abundant species as "indicator species" for the ETP environment (Balance et al. 2002). These species represented a wide range of the different foraging strategies used by seabirds. Four of these species were highly dependent on tunas and dolphins to chase small schooling fish from deeper waters up to the surface where the birds could prey on them. These were considered "tuna-obligate" species: Juan Fernandez petrel (*Pterodroma externa*), wedge-tailed shearwater (*Puffinus pacificus*), red-footed booby (*Sula sula*), and sooty tern (*Sterna fuscata*). ETP tuna purse seine fishermen will often target aggregations of birds knowing that there may be schools of tuna below. Despite such close associations between seabirds and tuna, seabirds have not been observed to be caught in purse seines during tuna fishing operations in the ETP and observer reports indicate that birds very rarely become caught in cables or the power block of tuna purse seine vessels (Olsen et al. 2001).

The remaining six indicator species were not dependent upon tuna for successful foraging and were considered "tuna-independent" species (Balance et al. 2002). Four species, wedge-rumped storm-petrel (*Oceanodroma tethys*), Leach's storm-petrel (*Oceanodroma leucorhoa*), northern phalarope (*Phalaropus lobatus*), and red phalarope (*P. fulicarius*) are closely associated with oceanographic features (fronts) that consistently concentrate planktonic prey and other associated free-swimming prey. The Tahiti petrel (*Pseudobulweria rostrata*) specialized in scavenging squid floating on the surface while the white-winged petrel (*Pterodroma leucoptera*) took mainly myctophids (lanternfish) during twilight or night time. There were consistent distribution patterns on a large scale (e.g. around oceanographic fronts) but great variability over time in smaller areas as seabirds moved large distances to find the best foraging sites (Balance et al. 2002). The Tahiti petrel showed evidence of population decline but none of the other species had noticeable population trends and there was no distinction in this regard between tuna-obligate and tuna-independent species (Balance et al. 2002).

Antarctic

The most common seabirds found in the ARA include a variety of petrels, albatross, shearwaters, fulmars, prions, terns, skuas, jaegars, sheathbills, gulls, shags, and penguins (CCMALR 2006). The most common species seen during AMLR surveys include cape petrel (*Daption capense),* chinstrap penguin (*Pygocelis antarctica),* southern fulmar (*Fulmarus glacialoides),* prions (*Pachyptila spp.),* blue petrel (*Halobaena caerulea),* white-chinned petrel (*Procellaria aequinoctialis),* and black-browed albatross (*Thalassarche melanophrys)* (Van Cise 2009). During the summer months the birds feed on zooplankton, krill, cephalopods, and fish (Woehler and Croxall 1997).

Seabirds found in Antarctica may be breeding later in response to climate change. This observed trend is due to a reduction (12-20 percent) in the sea ice, which has been linked to a decline in krill and other marine organisms' numbers and the late break-up of sea ice (Barbraud and Weimerskirch 2006).

The CCAMLR Working Group on Incidental Mortality Associated with Fishing identifies 20 species of seabirds that are most at risk from longline fisheries. Albatross, petrels and shearwaters are sensitive to mortality from fishing due to a low reproductive rate, delayed maturity, and the importance of high adult survival rates for population stability (Bartle 1990). Albatross and petrels are attracted to vessels in the longline tuna fishery and trawl fisheries. Shearwaters are more likely to be incidentally caught in near shore set nets (Taylor 2000).

Gulls, terns, skuas and jaegars populations are most likely to be affected by changes in prey availability while sheathbills could be affected by entanglement in fishing related marine debris coming onshore (Jouventin et al. 1996). Penguins are susceptible to capture in near shore set nets, and also commercial and recreational gill nets. Cormorants and shags are susceptible to capture in near shore nets and effects from prey reduction due to competition with commercial fisheries (Brothers et al. 1999, Norman 2000).

3.2.4 Sea Turtles

Five species of sea turtles can be found within the area of the proposed SWFSC research activities: leatherback, olive ridley, green, loggerhead, and hawksbill sea turtles. The SWFSC research activities cover an extremely large area therefore it is likely that all life history phases and associated size classes for these particular species occur within the SWFSC research area. Additional background information on the range-wide status of these species has been published in a number of documents, including sea turtle status reviews and biological reports (NMFS and USFWS 1995, Hirth 1997, USFWS 1997a, Marine Turtle Expert Working Group 1998, 2000, NMFS and USFWS 2009), as well as recovery plans for the leatherback sea turtle (NMFS and USFWS 1992, 1998a), olive ridley sea turtle (NMFS and USFWS 1998b), green sea turtle (NMFS and USFWS 1991, 1998c), loggerhead sea turtle (NMFS and USFWS

1998d), and hawksbill sea turtle (NMFS and USFWS 1998e). A synopsis of the biological data on leatherback sea turtles was released in 2012 (NMFS and USFWS 2012). The synopsis is current with peer reviewed literature published to early 2009.

3.2.4.1 Threatened and Endangered Species

All of the sea turtles found in the area of the SWFSC research activities are listed as threatened or endangered under the federal ESA. The information presented in the following species accounts is primarily from the NOAA Fisheries Office of Protected Resources (OPR) website (NOAA 2011g), available online at: http://www.nmfs.noaa.gov/pr/species/turtles/.

Table 3.2-7 ESA-listed Sea Turtles found within the CCRA and ETPRA.

Common Name	Scientific Name	Status
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Olive ridley sea turtle	*Lepidochelys olivacea*	Endangered
Green sea turtle	*Chelonia mydas*	Endangered
Loggerhead sea turtle	*Carretta carretta*	Endangered
Hawksbill sea turtle	*Eretmochelys imbricate*	Endangered

<u>Leatherback Sea Turtles</u>

Leatherback sea turtles are widely distributed throughout the oceans of the world and are found in waters of the Atlantic, Pacific, Caribbean, and the Gulf of Mexico (Ernst and Barbour 1972). The leatherback sea turtle is the largest living turtle and ranges farther than any other sea turtle species, exhibiting broad thermal tolerances that allow it to forage into the colder waters (NMFS and USFWS 1995). They can consume twice their own body weight in prey per day, feeding exclusively on soft-bodied invertebrates like jellyfish and tunicates. Sea nettle jellyfish and other species of the genus *Chrysaora* are preferred prey for leatherback sea turtles. The Pacific Ocean leatherback population is generally smaller in size than that in the Atlantic Ocean. In the Pacific, the IUCN notes that most leatherback nesting populations have declined more than 80 percent. In other areas of the leatherback's range, observed declines in nesting populations are not as severe, and some population trends are increasing or stable.

Critical habitat for the leatherback turtle was designated in areas adjacent to St. Croix, U.S. Virgin Islands in 1979. However, in 2007, NMFS received a petition to expand the designation. In January 2010, NMFS responded to the petition and formally proposed to expand the current designated critical habitat to include an estimated 70,600 square miles off of the western coast of the U.S. In January 2012, NMFS made a final determination and designated two areas as critical habitat for leatherbacks off the West Coast (77 FR 4170). One area extends from Point Arena to Point Arguello along the California coast east of the 3,000 meter depth contour (16,910 square miles) and the second extends from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 meter depth contour (Figure 3.2-3).

The boundaries of the critical habitat areas were determined by two primary elements that are essential for the conservation of leatherbacks: occurrence of prey species (primarily jellyfish) and migratory pathways to foraging areas. NMFS did not consider commercial fishing, fishing gear, or vessel traffic as potential threats to the leatherback in the critical habitat expansion (75 FR 319). There are no potential fisheries that would target jellyfish, and the bycatch of jellyfish in existing fisheries is limited. For migratory corridors, NMFS determined that only permanent or long-term structures would be considered an impediment to the passage of the turtles.

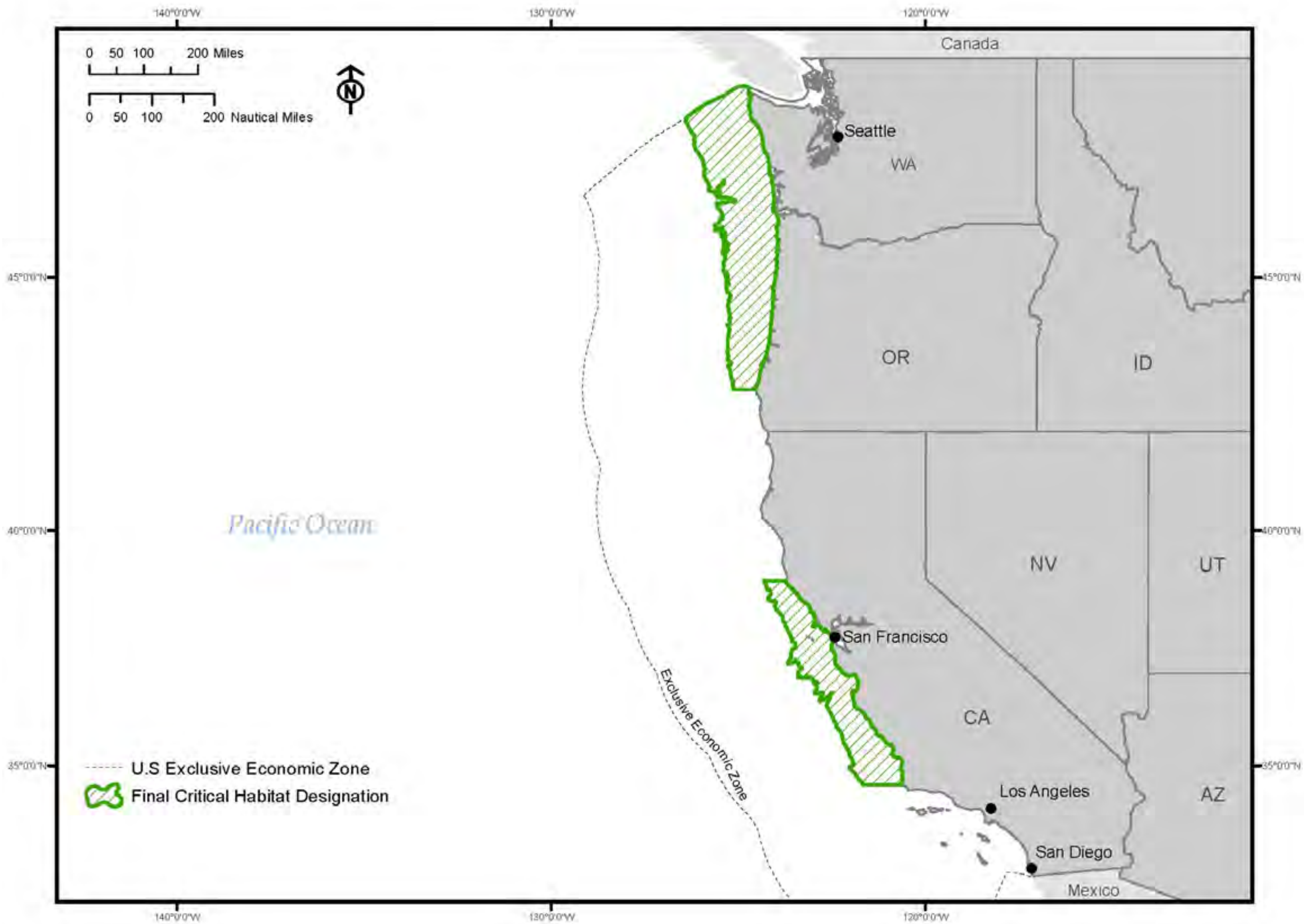


Figure 3.2-3 Designated Critical Habitat for the Leatherback Sea Turtle

Declines in the leatherback population have resulted from fishery interactions as well as exploitation of the eggs (Ross 1996). Eckert and Lien (1999) and Spotila et al. (1996) reported that adult mortality has also increased significantly, particularly as a result of driftnet and longline fisheries. Zug and Parham (1996) attributed the sharp decline in leatherback populations to the combination of the loss of long-lived adults in fishery related mortality, and the lack of recruitment, stemming from elimination of annual influxes of hatchlings because of egg harvesting. Leatherbacks are also susceptible to entanglement in lobster and crab pot gear.

Olive Ridley Sea Turtle

Olive ridley sea turtles migrate annually between pelagic foraging areas and coastal nesting areas. Trans-Pacific ships have observed olive ridleys over 2,400 miles (4,000 kilometers) from shore. Olive ridleys are globally distributed in the tropical regions of the South Atlantic, Pacific, and Indian Oceans. In the Eastern Pacific, they occur from Southern California to Northern Chile. In the eastern Pacific, arribadas (massive synchronized nesting events) occur from June through December on certain beaches on the coasts of Mexico, Nicaragua, and Costa Rica and on a single beach in Panama.

The breeding population of Olive ridley sea turtle on Mexico's Pacific coast is listed as endangered under the ESA. All other olive ridley sea turtle populations are listed as threatened under the ESA. Degradation of nesting beaches, ongoing directed harvest, and bycatch in fisheries have all contributed to the decline of the species. In the eastern Pacific Ocean, killing sea turtles and collecting their eggs has occurred for hundreds of years. However, Eguchi et al. (2007) suggest reviewing that status, as their best estimate of abundance of olive ridleys in the ETP is 1.39 million and the population is still increasing, indicating that the protection programs that began in the 1990s are effective.

Green Sea Turtle

Green sea turtles are distributed globally. In the eastern North Pacific, green turtles have been sighted from Baja California to southern Alaska, but most commonly occur from San Diego south. In the central Pacific, green turtles occur around most tropical islands, including the Hawaiian Islands. Adult green turtles that feed throughout the main Hawaiian Islands undergo a long migration to French Frigate Shoals in the Northwest Hawaiian Islands, where the majority of nesting and mating occurs (NMFS and USFWS 1998c).

Green sea turtle populations are currently listed as threatened and endangered by the IUCN. Only the breeding populations in Florida and the Pacific coast of Mexico are listed as ESA endangered. All remaining populations of green sea turtles are listed as ESA threatened. Impacts to the green sea turtle population are similar to those discussed above for other sea turtles species. As with the other species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like dredging, pollution, and habitat destruction account for an unknown level of other mortality. Removal of green sea turtles has been recorded by sea sampling coverage in the pelagic driftnet, pelagic longline, sea scallop dredge, southeast shrimp trawl, and summer flounder bottom trawl fisheries.

Loggerhead Sea Turtle

Loggerhead sea turtles occur throughout the temperate and tropical regions of the Pacific, Atlantic, and Indian Oceans in a wide range of habitats. These include open ocean, continental shelves, bays, lagoons, and estuaries (NMFS and USFWS 1991 and 1995; Witherington et al. 2006). Loggerhead sea turtles are primarily benthic feeders, opportunistically foraging on crustaceans and mollusks (Wynne and Schwartz 1999; Witherington et al. 2006). Under certain conditions, they may also scavenge fish (NMFS and USFWS 1998d).

The loggerhead sea turtle is the most abundant of the sea turtles listed as threatened or endangered in the U.S. waters. In the eastern Pacific, loggerheads have been reported as far north as Alaska, and as far south as Chile. In the U.S., occasional sightings are reported from the coasts of Washington and Oregon, but most records are of juveniles off the coast of California. The West Coast of Mexico, including the Baja Peninsula, provides critically important developmental habitats for juvenile loggerheads.

In September of 2011 NMFS and the USFWS determined that the loggerhead sea turtle is composed of nine DPS listed as threatened or endangered. In the Pacific Ocean two were named: the North Pacific Ocean population and the South Pacific Ocean population; both are listed as endangered. As of yet there is no critical habitat associated with these DPS (76 FR 58868).

Loggerheads face threats on both nesting beaches and in the marine environment. The greatest cause of decline and the continuing primary threat to loggerhead turtle populations worldwide is incidental capture in fishing gear, primarily in longlines and gillnets, but also in trawls, traps and pots, and dredges. The main anthropogenic threats impacting loggerhead nesting habitat include the destruction and modification of coastal habitats worldwide. Beachfront lighting, placement of erosion control structures and other barriers to nesting, vehicular and pedestrian traffic, sand extraction, beach erosion and pollution, beach sand placement, removal of non-native vegetation and planting of non-native vegetation all represent serious threats to loggerhead nesting habitat (NMFS and USFWS 2009). Directed harvest for loggerheads still occurs in many places (e.g., Cuba and Mexico) and is a serious and continuing threat to loggerhead recovery.

Hawksbill Sea Turtle

The hawksbill sea turtle is uncommon in the waters of the continental U.S. Hawksbills prefer coral reefs, such as those found in the Caribbean and Central America. Hawksbills feed primarily on a wide variety of sponges but also consume bryozoans, coelenterates, and mollusks. Hawksbill turtles use different habitats at different stages of their life cycle, but are most commonly associated with healthy coral reefs. Oceanic stage juveniles are believed to occupy the "pelagic" environment. In the Pacific, the pelagic habitat of hawksbill juveniles is unknown. After a few years in the pelagic zone, small juveniles recruit to coastal foraging grounds; their size at recruitment is approximately 15 inches (38 centimeters) in carapace length in the Pacific. This shift in habitat also involves a shift in feeding strategies, from feeding predominantly at the surface to feeding below the surface primarily on animals associated with coral reef environments. Here, juveniles begin feeding on a varied diet. In the Indo-Pacific, hawksbills continue eating a varied diet that includes sponges, other invertebrates, and algae (NOAA 2011g).

Hawksbills nest sporadically in the southern part of the Baja peninsula, and juveniles and sub-adults forage along the coast along the Pacific Rim. The largest concentrations of nesting hawksbills in the Pacific occur on remote oceanic islands of Australia and in the Indian Ocean (e.g., Republic of Seychelles). In the U.S. Pacific, hawksbills nest only on main island beaches in Hawaii, primarily along the east coast of the island of Hawaii. Hawksbill nesting has also been documented in American Samoa and Guam (NOAA 2011g).

Hawksbills face threats on both nesting beaches and in the marine environment with the primary global threat to hawksbills being the loss of coral reef communities. In the Pacific, directed harvest of nesting females and eggs on the beach and hawksbills in the water is still widespread. Directed mortality is a major threat to hawksbills in American Samoa, Guam, the Republic of Palau, the Commonwealth of the Northern Mariana Islands, the Federated States of Micronesia, and the Republic of the Marshall Islands (NMFS and USFWS 1998e). In addition to directed harvest, increased human presence is a threat to hawksbills throughout the Pacific. In particular, increased recreational and commercial use of nesting beaches, beach camping and fires, litter and other refuse, general harassment of turtles, and loss of nesting habitat from human activities negatively impact hawksbills. Incidental capture in fishing gear (primarily in gillnets) and vessel strikes also adversely affect the species' recovery (NOAA 2011g).

3.2.5 Invertebrates

3.2.5.1 Threatened and Endangered Species

Two invertebrate species found within the SWFSC region are listed as endangered under the ESA: the black abalone (*Haliotis cracherodii*), and the white abalone (*Haliotis sorenseni*). Brief descriptions are given for each of these species including habitat, distribution, and factors leading to population decline.

Black abalone

The black abalone is a large marine gastropod mollusk found in rocky intertidal and subtidal habitats where the bedrock provides deep crevices for shelter. The range of the black abalone is from about Point Arena in northern California to Bahia Tortugas and Isla Guadalupe, Mexico. They are rare north of San Francisco and south of Punta Eugenia. The black abalone has been listed by the ESA as endangered since January, 2009 (74 FR 1937). A lethal disease, withering syndrome, is thought to have caused mass mortalities of 95 percent or greater in virtually all investigated locations. The disease is most prevalent in the southern portion of the black abalone range, where the water temperature is warmer or where water temperatures are elevated by thermal discharge of power plants. Overfishing is also a primary factor leading to the decline of black abalone, which were fished intermittently from the 1950s up to their listing under the ESA in 2009. Other factors responsible for decline include illegal harvest, habitat destruction, natural predation, and competition (NOAA 2009b).

White abalone

The white abalone is an herbivorous, marine, rocky benthic, broadcast spawning gastropod that is found in open low and high relief rock or boulder habitat that is interspersed with sand channels. The historic range of white abalone extended from Point Conception, California, to Punta Abreojos, Baja California, Mexico. The current range is limited to along the mainland coast in Santa Barbara County and at some of the offshore islands and banks in the middle portion of the range. No recent information on current range is available for Baja California (NOAA 2008). White abalone is currently listed as endangered throughout its range (66 FR 29054). The most significant threat to white abalone is the long-term effects that overfishing has had on the species. Commercial fisheries in California were closed in 1996, which proved to be inadequate for the recovery of the species. Based on commercial fishery data, the population of white abalone in Mexico is thought to be depleted, but the species status in Mexico remains largely unknown. White abalone are also vulnerable to various bacterial and parasitic infections (NOAA 2008). This species is currently protected by the ESA and a recovery plan was finalized by USFWS in 2008.

3.2.5.2 Target Species

Market squid (*Doryteuthis opalescens*) and Antarctic krill (*Euphausia superba*) are the only invertebrate species within the SWFSC research areas that are considered ‘target’ species for the purposes of this Final PEA.

Market Squid

Market squid inhabit the California Current and Eastern Tropical Pacific research areas from Baja Mexico to Alaska. They generally live within 200 miles of shore, and their life cycles involve four stages: eggs, paralarvae, juveniles, and adults. Market squid have a lifespan of 4 to 10 months, and have a mixed coloration of milky white and iridescent purple. Color changes occur rapidly in response to environmental conditions. Squid have eight arms and two longer feeding tentacles. Males are larger and more robust than females. Similar to most squid species, market squid possess an ink sac, which serves as a defense mechanism by expelling ink to confound predators (CDFG 2005b).

Market squid are less than 3 millimeters long at hatching and grow to an average mantle length of 152 millimeters at the time of spawning. Adult market squid move off the continental shelf by day and can be found to depths of 500 meters; they return to the surface at night to hunt. At some point the squid move towards shore to spawn where aggregations can reach millions of individuals. Market squid are terminal spawners; spawning occurs at the end of their lifespan. In California, commercial fisheries target adult market squid during spawning events in limited geographic areas. The distribution of market squid in known fishing areas is dramatically affected by environmental conditions, especially during El Niño events when landings are minimal (CDFG 2005b).

Antarctic Krill

Antarctic krill are small shrimp-like crustaceans that feed on phytoplankton and algae from the lower surfaces of pack ice. Antarctic krill can be found in surface waters, where phytoplankton is most abundant. It is uncommon to find this species below 100 meters. Antarctic krill are distributed throughout the Antarctic region, but are most heavily concentrated around the polar front where the Southern Ocean meets the other major oceans. Most krill are found within the boundaries of minimal and maximum annual sea ice, and around South Georgia. The circumpolar biomass of krill is estimated to be 60-155 million metric tons (Quetin and Ross 2009). Antarctic krill are widely recognized as a major link between primary producers and several species of Antarctic consumers including baleen whales, penguins, seals, sea birds, squid, and fishes, and thus krill are a vital component of the Antarctic food web (Lascara et al. 1999, Quetin and Ross 2009). In the 1960s, krill became a commercially harvested species, and continues to be harvested by several nations. Concern over population decline prompted the creation of the Biological Investigations of Marine Antarctic Systems and Stocks program in the 1970s (Lascara et al. 1999), and the species is also studied by NMFS and AMLR. The CCAMLR manages the Antarctic krill fishery using a sophisticated and comprehensive system (NMFS and PFMC 2008).

3.2.5.3 Other Species

The following species shown in Table 3.2-8 are not listed as threatened or endangered under the ESA, nor are they targeted by commercial fisheries in the SWFSC research areas. However, these species have been encountered during SWFSC research surveys (SWFSC 2011).

Table 3.2-8 Other Invertebrate Species found within SWFSC Research Areas.

Common Name	Scientific Name
Abraliopsis felis	*Abraliopsis felis*
Crystal Jelly	*Aequorea aequorea*
Moon Jellyfish	*Aurelia aurita*
Chiroteuthis calyx	*Chiroteuthis calyx*
Pacific Sea Nettle	*Chrysaora jellyfish*
Sandpaper Squid	*Cranchia scabra*
Humboldt Squid	*Dosidicus gigas*
Krill	*Euphausiacea*
Rex Sole	*Glyptocephalus zachirus*
Armhook Squid	*Gonatopsis*
Boreopacific Armhook Squid	*Gonatopsis borealis*
Heteropoda	*Heteropod*
Comb Jelly	*Hormiphora cucumaris*

Common Name	Scientific Name
Lechia Dislocate	*Lechia pacifica (dislocata)*
Opulescent Market Squid	*Doryteuthis opalescens*
Octopus (unidentified)	*Octopodidae*
Octopus Squid	*Octopoteuthis deletron*
Boreal Clubhook Squid	*Onychoteuthis borealijaponicus*
Eggyolk Jelly	*Phacellophora camtchatica*
Jewel Squid	*Pterygioteuthis gemmata*
Jellyfish (unidentified)	*Scyphozoa*
Shrimp spp (unidentified)	*Sergestid*
Hairysnail spp (unidentified)	*Trichotropidae*
Green Abalone	*Haliotis fulgens*
Pink Abalone	*Haliotis corrugata*
Pinto Abalone	*Haliotis kamtschatkana*
Antarctic Coral	*Flabellum curvatum*
Antarctic Coral	*Flabellum thouarsii*

Pacific Krill

Two species of krill, *Euphausia pacifica* and *Thysanoessa spinifera*, found in the CCRA have the potential to become fishery targets. Krill is found near the surface, where phytoplankton is most abundant. *E. pacifica* ranges through the subarctic Pacific, from the Gulf of Alaska to 25 N latitude, while *T. spinifera* occurs from the southeastern Bering Sea south to northern Baja California. Krill provide a critical link between phytoplankton and upper level predators, including species that are commercially important fish or ecologically important protected marine mammals and birds. There are international markets for krill and krill products, although no fisheries in the EEZ are authorized (NMFS and PFMC 2008). The PFMC in cooperation with NMFS have implemented a ban on commercial fishing for all species of krill in West Coast federal waters. The krill prohibition was adopted as Amendment 12 to the Coastal Pelagic Species Fishery Management Plan. The krill harvest prohibition was originally proposed to the PFMC and NMFS by NOAA's Office of National Marine Sanctuaries.

3.3 SOCIAL AND ECONOMIC ENVIRONMENT

Activities associated with the intent and implementation of fisheries research has several implications for the social and economic environment affected by SWFSC fisheries research. These include providing guidance for federally managed commercial and recreational fisheries, providing information associated with international treaty obligations, and direct and indirect expenditures on goods and services associated with fisheries research.

The 1996 amendments to the MSA require assessment, specification, and description of the effects of conservation and management measures on participants in fisheries, and on fishing communities (NMFS 2007b). The eighth National Standard for Fishery Conservation and Management in the MSA states:

> *Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing*

communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

Other laws and policies also require attention to potential social and economic effects on communities. This includes Executive Order 12898 on environmental justice, which directs agencies to assess actions that may disproportionately affect low income and minority populations (Norman et al. 2007). For these reasons, the NMFS Economics and Social Science Program conducts community studies and develops statistical methodologies and economic models to identify and describe communities substantially engaged in fishing. This information is ultimately used by fishery managers, whose decisions balance the needs of a variety of fisheries communities and users.

NMFS provides an annual report, *Fisheries Economics of the United States* (NMFS 2010) which provides an annual analysis of states' economic participation in fisheries. NMFS also provides *Fishing Communities of the United States* (NMFS 2009) which estimates community engagement and dependence on managed fisheries. Factors included in the estimations include commercial market conditions, recreational fishing expenditures and levels of participation, key species, and community profiles. The profiles are developed with data about the home ports of vessels' participation in a particular fishery, the residence of commercial or recreational fishing participants, port landings, and the location of processing and service facilities.

There are ongoing efforts to refine 2000 U.S. Census data via demographic and economic statistics, community surveys and harvest data collected from other federal and state sources, as well. Most U.S. and state community fisheries data are not collected at the community level, so it must be geographically disaggregated from more global statistics. NMFS helps sponsor studies such as *West Coast Marine Fishing Communities,* which profile fishery communities at the county level (Langdon-Pollock 2004). In addition, the community profiles contain an emphasis on social and cultural factors that could influence economic behavior, and fishing groups' reactions to management actions.

SWFSC research is conducted in three oceanographic areas; the California Current, Eastern Tropical Pacific, and Antarctic marine ecosystems. Activities in the California Current influence the communities on the coasts of Washington, Oregon, and California. Research activities in the California Current are provided by both the Southwest Fisheries Center, which concentrates in waters off the California Coast, and the Northwest Fisheries Science Center, which operates primarily off the Oregon and Washington coasts. It should be noted that there are complex economic and demographic interactions with U.S. ports in other research areas, especially the Northern Pacific Region (Alaska).

Research voyages and field stations in the Antarctic and/or Eastern Tropical Pacific ecosystems have limited interaction with foreign ports, and therefore have minor social and economic influence there. The categorization of indirect influences there is primarily biological, and related to the health of global fisheries ecosystems, especially for migratory species.

3.3.1 Commercial Fisheries

Table 3.3-1 shows landings and revenue data for 2000 to 2010 for the Pacific region. Key commercial species for the region include albacore tuna, crab, flatfish, hake, rockfish, sablefish, salmon, sardines, shrimp, squid, and other shellfish. Squid and sardines accounted for the largest volume of landings in California. The largest volume of landings for Oregon and Washington included hake and sardines.

Table 3.3-1 Commercial Landings, Revenue, and Top Species for California, Washington, and Oregon 2007-2010.

All Species			Top Species					
	Pounds	Revenue	Pounds	Revenue	Price per Pounds	Top Species	Top Species Percent of All Species (Pounds)	Top Species Percent of All Species (Revenue)
California								
2007	348,825,756	$127,579,646	178,480,103	$8,218,158	$0.05	Pacific sardine	46.38%	6.44%
2008	323,884,364	$120,860,944	126,944,832	$7,575,420	$0.06	Pacific sardine	39.19%	6.27%
2009	373,369,978	$150,382,503	203,866,868	$56,524,336	$0.28	California market squid	54.60%	37.59%
2010	437,868,856	$176,151,276	288,474,809	$71,160,775	$0.25	California market squid	65.88%	40.40%
Oregon								
2007	253,543,186	$97,298,426	90,036,691	$4,551,001	$0.05	Pacific sardine	35.51%	4.68%
2008	195,688,351	$103,042,323	55,510,987	$6,829,815	$0.12	Pacific hake	28.37%	6.63%
2009	198,894,579	$104,706,112	53,466,222	$3,782,855	$0.07	Pacific hake	26.88%	3.61%
2010	201,478,532	$104,653,225	57,016,705	$5,413,957	$0.09	Pacific hake	28.30%	5.17%
Washington								
2007	194,449,356	$216,118,553	91,272,225	$7,120,781	$0.08	Pacific hake	46.94%	3.29%
2008	173,176,427	$232,841,042	67,158,518	$7,249,021	$0.11	Pacific hake	38.78%	3.11%
2009	163,937,071	$227,773,331	36,378,355	$2,333,951	$0.06	Pacific hake	22.19%	1.02%
2010	189,486,419	$255,332,411	58,899,671	$4,104,643	$0.07	Pacific hake	31.08%	1.61%

Source: (NOAA 2011f)

Fisheries Economics of the United States 2010 analyzed data for 2009 (NMFS 2010). In that year, squid accounted for 51 percent of 2009 landings, but only 14 percent of revenue. For 2009, California had the largest number of seafood industry jobs (120,583) and seafood sales in the U.S. Washington had the fourth largest number of jobs (57,643) nationwide and was third in sales. Oregon seafood industry jobs were estimated at 13,754 (NMFS 2010). Washington had the highest landings revenue in the Pacific region with $228 million. California ($150 million) and Oregon ($102 million) followed. California contributed the most pounds landed (372 million pounds), followed by Oregon (198 million pounds) and Washington (164 million pounds). Fishermen in the Pacific region landed 894 million pounds of finfish and shellfish in 2009. This was 32 percent less than in 2000. The decrease was in the finfish category, with shellfish on the increase (NMFS 2010).

Key commercial species, accounting for 91 percent of landings revenue for the Pacific region, include albacore tuna, crab, flatfish, hake, rockfish, sablefish, salmon, sardines, shrimp, squid, and other shellfish (NMFS 2010). Hake and squid accounted for 51 percent of 2009 landings, but only 14 percent of revenue.

The most active West Coast commercial fishing ports, in landings of fish and shellfish, from 2000 to 2010 were: Los Angeles and Port Hueneme-Oxnard-Ventura, California; Astoria and Newport, Oregon; and Westport, Washington. Table 3.3-2 shows the landings data.

Table 3.3-2 Top Commercial Landings Locations in California, Oregon and Washington 2000-2010.

Year	U.S. Rank	Port	Millions of Pounds	Millions of Dollars
2000	7	Los Angeles, CA	254.7	$38.10
	9	Port Hueneme-Oxnard-Ventura, CA	162.2	$20.20
2001	7	Los Angeles, CA	219.1	$29.80
	10	Port Hueneme-Oxnard-Ventura, CA	104.8	$12.60
2002	8	Los Angeles, CA	170.1	$20.90
	10	Astoria, OR	106.9	$23.70
2003	9	Astoria, OR	114.1	$25.60
	12	Los Angeles, CA	88.7	$16.50
2004	9	Astoria, OR	135.8	$19.90
	11	Newport, OR	111.2	$29.60
2005	9	Los Angeles, CA	139.7	$26.60
	11	Westport, WA	122.8	$36.70
2006	8	Los Angeles, CA	164.5	$30.20
	9	Astoria, OR	164.2	$33.00
2007	10	Los Angeles, CA	141.3	$18.70
	11	Westport, WA	120	$32.00
2008	9	Los Angeles, CA	123.6	$22.70
	11	Westport, WA	111.1	$43.40
2009	9	Port Hueneme-Oxnard-Ventura, CA	141.3	$42.70
	11	Westport, WA	111.1	$43.40
2010	7	Los Angeles, CA	186.8	$37.80
	14	Astoria, OR	100.9	$30.50

Source: (NOAA 2011f)

3.3.2 Recreational Fisheries

NMFS estimates recreational fishing data annually, based on a variety of sources. For the U.S. West Coast, data are partially derived from mail and phone surveys, with contacts sampled from saltwater and freshwater fishing licenses. NMFS uses an input/output economic model to estimate patterns in direct, indirect, and induced effects (Gentner and Steinback 2008).

In the Pacific region in 2009, 1.8 million recreational anglers fished in 6.3 million trips. Over 64 percent of total anglers in 2009 were residents of a coastal county. Employment was primarily generated by expenditures on recreational fishing trips (private or rental boat, for-hire boat, or shore-based trips) and expenditures on durable equipment. Gentner and Steinback (2008) estimated the economic effects of recreational fishing sales at the state level for 2006, shown in Table 3.3-3.

Table 3.3-3 Estimated Recreational Fishing Expenditure Impacts, 2006 (in thousands, except for jobs).

	Sales	Direct Impact	Indirect Impact	Induced Impact	Total Impact	Jobs	Taxes
California	$3,026,230	$2,023,316	$795,299	$880,561	$3,699,176	18,300	$534,006
Oregon	$253,090	$160,290	$55,754	$67,535	$293,578	2,527	$40,806
Washington	$1,358,002	$664,283	$225,489	$237,148	$1,126,920	11,025	$170,789

Source: (Gentner and Steinback 2008)

Key Pacific region recreational species include albacore and other tunas, barracuda, bass, bonito, croakers, flatfishes, greenlings, mackerel, rockfishes and scorpionfishes, salmon, sculpins, and surfperches. Barracuda, bass, and bonito were the most commonly caught group over the last 10 years, averaging 3.9 million fish annually, with an average of 66 percent released rather than harvested. In 2009, however, the catch declined by 76 percent. In 2009 the largest key species groups caught were rockfish and scorpionfish. 2.7 million rockfish and scorpionfish were caught, primarily off California, and 74.3 percent were harvested (NMFS 2010).

3.3.3 Fishing Communities

In 2000, 1,004 communities in the U.S. had economic interaction with Pacific West Coast fisheries, as evidenced by permits, vessel registrations, location of landings, and seafood processing plants. NMFS has identified and profiled 125 fishing ports on the U.S. West Coast with significant engagement in commercial and/or recreational fisheries (Norman et al. 2007). They were primarily selected because of pounds and value of commercial fish landed, and vessel statistics. As shown in Figure 3.3-1, this includes 53 communities in California, 32 in Oregon, and 40 in Washington. Many are home ports for fishing vessels that spend part of the year fishing in Alaska, evident in that they hold both Pacific and North Pacific permits (NMFS 2009).

3.3.3.1 California Fishing Communities:

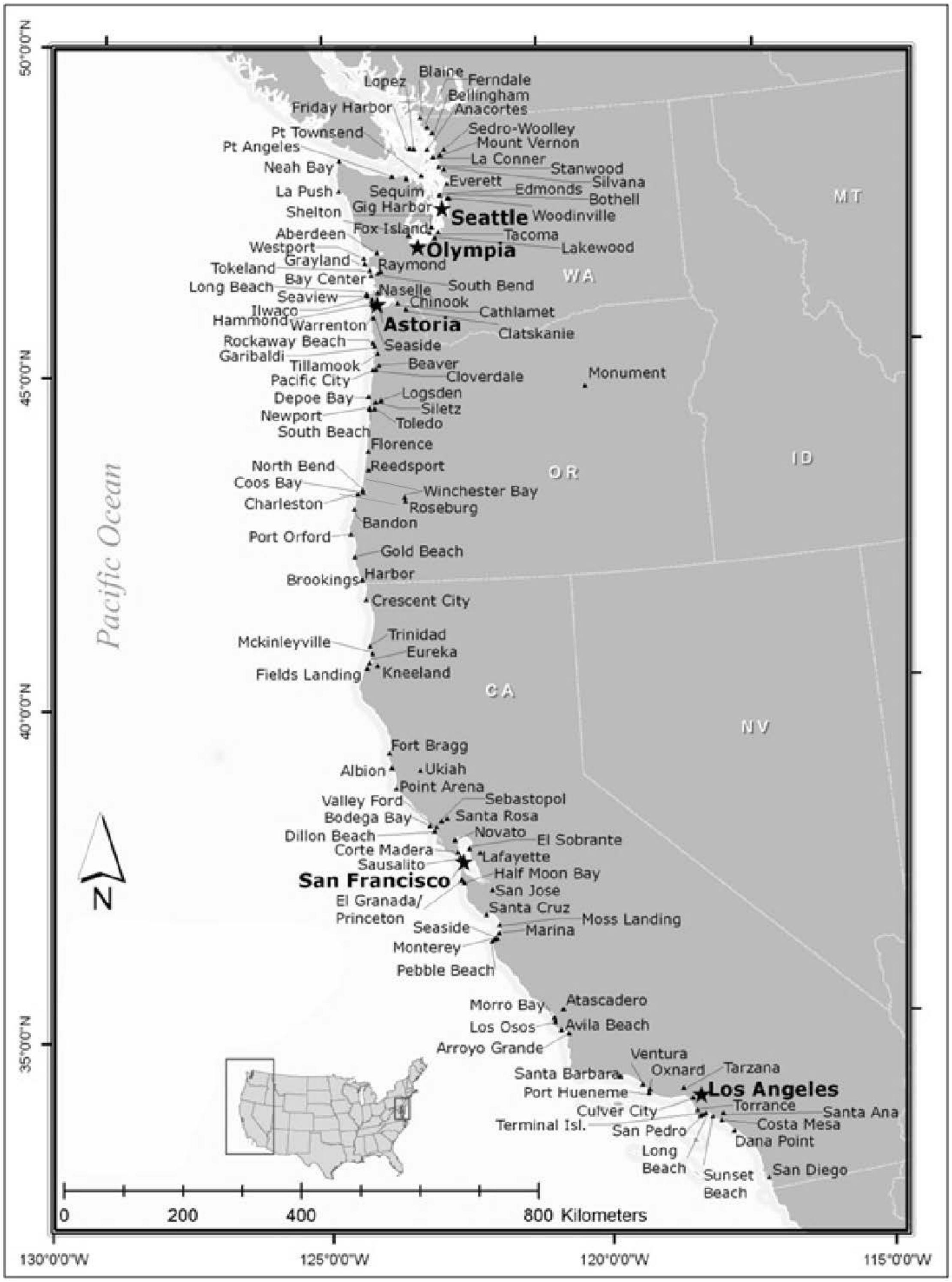
Albion, Arroyo Grande, Atascadero, Avila Beach, Bodega Bay, Corte Madera, Costa Mesa, Crescent City, Culver City, Dana Point, Dillon Beach, El Granada, El Sobrante, Eureka, Fields Landing, Fort Bragg, Half Moon Bay, Kneeland, Lafayette, Long Beach, Los Angeles, Los Osos, Marina, McKinleyville, Monterey, Morro Bay, Moss Landing, Novato, Oxnard, Pebble Beach, Point Arena, Port Hueneme, Princeton, San Diego, San Francisco, San Jose, San Pedro, Santa Ana, Santa Barbara, Santa Cruz, Santa Rosa, Sausalito, Seaside, Sebastopol, Sunset Beach, Tarzana, Terminal Island, Torrance, Trinidad, Ukiah, Valley Ford, and Ventura.

3.3.3.2 Oregon Fishing Communities:

Astoria, Bandon, Beaver, Brookings, Charleston, Clatskanie, Cloverdale, Coos Bay, Depoe Bay, Florence, Garibaldi, Gold Beach, Hammond, Harbor, Logsdon, Monument, Newport, North Bend, Pacific City, Port Orford, Reedsport, Rockaway Beach, Roseburg, Seaside, Siletz, Sisters, South Beach, Tillamook, Toledo, Warrenton, and Winchester Bay.

3.3.3.3 Washington Fishing Communities:

Aberdeen, Anacortes, Bay Center, Bellingham, Blaine, Bothell, Cathlamet, Chinook, Edmonds, Everett, Ferndale, Fox Island, Friday Harbor, Gig Harbor, Grayland, Ilwaco, La Conner, La Push, Lakewood, Long Beach, Lopez, Mount Vernon, Naselle, Neah Bay, Olympia, Port Angeles, Port Townsend, Raymond, Seattle, Seaview, Sedro-Woolley, Sequim, Shelton, Silvana, South Bend, Stanwood, Tacoma, Tokeland, Westport, and Woodinville.



Source: (Norman et al. 2007)

Figure 3.3-1 U.S. West Coast Fishing Communities.

Each community profile contains a description of people and place, infrastructure, and economic involvement in the fisheries. The 2000 median population for the top fishing communities combined was 84,038. The communities tend to be smaller in population, though some large cities, such as Los Angeles and Seattle, dominate because of centralized vessel services and fish processing facilities located there (NMFS 2009). Fifty-five percent of Washington's profiled communities had a population less than 5,000. Correspondingly, 71 percent of Oregon and 27 percent of California communities also had populations less than 5,000 (Norman et al. 2007).

NMFS estimated economic indicators for fishing communities, based largely on 2000 U.S. Census data (NMFS 2009). However, economic indicators have changed since 2000. For example, in 2000, state unemployment percentages were 5.0 in California, 4.7 in Washington, and 5.0 in Oregon. By 2011, unemployment rates rose to 12.4, 9.2, and 10.4 percent, respectively, more than doubling in California and Oregon. Nationwide, 2011 unemployment in the Agriculture, Forestry, Fishing and Hunting sector was almost double that of unemployment overall, at 16 percent (USDOL 2011).

In 2000, the percentage of California households below the poverty level was 10.6. Most of NMFS California fishing communities had similar rates, with the exception of Crescent City (33.7), Point Arena (24.1), and San Pedro (13.2). Oregon's poverty level rate was 7.9, and all fishing communities exceeded that rate except Depoe Bay at 5.5 percent. Washington's level was 7.3 percent, with La Push and Neah Bay exceeding that at 20.0 and 26.3 percent (NMFS 2009).

3.3.4 SWFSC Operations

The SWFSC's operations have a direct economic influence on the U.S. communities and ports in which they operate. Their current operating budget is approximately $50 million annually of which approximately 25 percent is transferred on an annual basis and is considered non-permanent funding. These funds are distributed among five research divisions and the corporate services that support them. The SWFSC headquarters, The Torrey Pines Court Laboratory, and The La Jolla Shores Drive Laboratory are located in La Jolla, California. The Fisheries Ecology Division is based in Santa Cruz, California, adjacent to UC Santa Cruz's Long Marine Laboratory, and the Environmental Research Division is based in Pacific Grove, California. The SWFSC operates three field stations in California located in Arcata, Granite Canyon, and Piedras Blancas. On the Antarctic Peninsula, the SWFSC's Antarctic Ecosystem Research Division maintains two field stations located at Cape Shirreff on Livingston Island and at Copacabana in Admiralty Bay on King George Island. The ETPRA includes waters extending from Mexico to Peru.

Approximately $22 million is spent on the collection of survey data. These costs include ship time, aircraft time, equipment and logistics costs, contracts and overtime for U.S. government employees. Approximately 60 percent of this is spent on surveys in the California Current, 15 percent is spent on surveys in the ETP, and 35 percent is spent on surveys in the Scotia Sea (SWFSC personal communication 2012). California assesses taxes on oceanographic research vessels at 4 percent of their full cash value (Norman et al. 2007).

Voyages supporting data collection have only limited influence on the economies of ports of call in Mexico and South America. For example, during the 2009/2010 Antarctic research season, the R/V Moana Wave made three calls to Punta Arenas, Argentina, spending 10 days in port, for the purpose of transferring supplies to South Shetland Islands in support of 35 scientists and technicians at Cape Shireff (Van Cise 2010).

ENVIRONMENTAL EFFECTS CHAPTER 4

4.1 INTRODUCTION AND ANALYSIS METHODOLOGY

This chapter presents an analysis of the potential direct and indirect effects of the alternatives on the physical, biological, and social environments consistent with Section 1502.16 of the Council on Environmental Quality (CEQ) National Environmental Policy Act (NEPA) regulations (40 Code of Federal Regulations [CFR] Part 1500) and NOAA Administrative Order 216-6 (Environmental Review Procedures for Implementing the National Environmental Policy Act). Four alternatives have been brought forward for detailed analysis (see Chapter 2):

- The Status Quo Alternative, where fisheries and ecosystem research programs conducted and funded by the Southwest Fisheries Science Center (SWFSC) would be performed as they were from 2008-2012. This is considered the No Action Alternative for ongoing programs under NEPA.
- The Preferred Alternative, where the SWFSC would receive MMPA incidental take authorization and conduct research programs similar to the recent past with some new research activities, and would implement required new protocols intended to mitigate impacts to protected species in addition to those described under the Status Quo Alternative.
- The Modified Research Alternative, where the SWFSC would conduct fisheries and ecosystem research with scope and protocols modified to minimize risks to protected species.
- The No Research Alternative, where the SWFSC would no longer conduct or fund fieldwork in marine waters for the fisheries and ecosystem research considered in the scope of this Final PEA. This is also considered a No Action Alternative under another interpretation of NEPA.

In addition to a suite of fisheries and ecological research conducted or funded by the SWFSC as the primary federal action under the Status Quo Alternative, the Preferred Alternative and the Modified Research Alternative would also include issuance of five-year regulations and subsequent letters of authorization (LOAs) under Section 101(a)(5)(A) of the MMPA for the incidental, but not intentional, taking of marine mammals as the secondary federal action.

As was discussed in Chapter 1 of this Programmatic Environmental Assessment (PEA), the National Marine Fisheries Service (NMFS) is fundamentally a science-based agency, its primary mission being the stewardship of living marine resources through science-based conservation management. The first three alternatives evaluated in this Final PEA clearly enable the SWFSC to collect additional scientific information that otherwise would not be fully replaced by other sources while the fourth alternative considered does not. In NMFS view, the inability to acquire scientific information essential to managing fisheries on a sustainable basis and rebuilding overfished stocks would ultimately imperil the agency's ability to meet its mandate to promote healthy fish stocks and restore the nation's fishery resources. Similar concerns apply to the conservation and management of protected species, their habitats, and other marine ecosystem components. However, there are several plausible scenarios (such as federal budget cuts, legal actions against NMFS, or natural disasters affecting SWFSC facilities) where the research activities of the SWFSC could be severely curtailed or eliminated for a period of time. The No Research Alternative therefore allows NMFS to examine the effects on the human environment of discontinuing federally funded fisheries and ecosystem research in the SWFSC research areas.

The authors of the sections in this chapter are subject matter experts. They developed a discussion of the effects on each resource component based on their best professional judgment; relying on the collective knowledge of other specialists in their respective fields and the body of accepted literature. The impact assessment methodology consists of the following steps:

1) Review and understand the proposed action and alternatives (Chapter 2).
2) Identify and describe:
   a) Direct effects that would be "caused by the action and occur at the same time and place" (40 CFR § 1508.8(a)), and
   b) Indirect effects that would be "caused by the action and (would occur) later in time or farther removed in distance, but are still reasonably foreseeable" (40 CFR § 1508.8(b)).
3) Compare the impacts to the baseline conditions described in Chapter 3 and rate them as major, moderate, or minor. In order to help consistently assess impacts and support the conclusions reached, the authors developed a criteria table that defines impact ratings for the resource components (Table 4.1-1). The criteria provide guidance for the authors to place the impacts of the alternatives in an appropriate context, determine their level of intensity, and assess the likelihood that they would occur. Although some evaluation criteria have been designated based on legal or regulatory limits or requirements (see description of criteria for marine mammals below), others are based on best professional judgment and best management practices. The evaluation criteria include both quantitative and qualitative analyses, as appropriate to each resource. The authors then determine an overall rating of impacts to a given resource by combining the assessment of the impact components.

   As described in Section 1.4, the purpose of an EA is to determine whether significant environmental impacts could result from a proposed action. If significant impacts are discovered, an Environmental Impact Statement would need to be developed. If no significant impacts are discovered, NMFS can document the decision on the proposed action with a Finding of No Significant Impact. NOAA Administrative Order 216-6 provides guidance on how the agency should make determinations of significance in NEPA documents. Consistent with these guidelines, any overall rating of effects on the physical, biological, or social and economic environment that is considered "major" according to the criteria described in Table 4.1-1 would be considered "significant" from a NEPA perspective.

Table 4.1-1 Criteria for Determining Effect Levels

Resource Components	Assessment Factor	Effect Level		
		Major	**Moderate**	**Minor**
Physical Environment	Magnitude or intensity	Large, acute, or obvious changes that are easily quantified	Small but measurable changes	No measurable changes
	Geographic extent	> 10% of project area (widespread)	5-10% of project area (limited)	0-5% of project area (localized)
	Frequency and duration	Chronic or constant and lasting up to several months or years (long-term)	Periodic or intermittent and lasting from several weeks to months (intermediate)	Occasional or rare and lasting less than a few weeks (short-term)
	Likelihood	Certain	Probable	Possible
Biological Environment	Magnitude or intensity	Measurably affects population trend For marine mammals, mortality and serious injury greater than or equal to 50% of PBR[1]	Population level effects may be measurable For marine mammals, mortality and serious injury between 10% and 50% of PBR	No measurable population change For marine mammals, mortality and serious injury less than or equal to 10% of PBR
	Geographic extent	Distributed across range of a population	Distributed across several areas identified to support vital life phase(s) of a population	Localized to one area identified to support vital life phase(s) of a population or non-vital areas
	Frequency and duration	Chronic or constant and lasting up to several months or years (long-term)	Periodic or intermittent and lasting from several weeks to months (intermediate)	Occasional or rare and lasting less than a few weeks (short-term)
	Likelihood	Certain	Probable	Possible
Social and Economic Environment	Magnitude or intensity	Large, acute, or obvious changes that are easily quantified	Small but measurable changes	No measurable changes
	Geographic extent	Affects region (multiple states)	Affects state	Affects local area
	Frequency and duration	Chronic or constant and lasting up to several months or years (long-term)	Periodic or intermittent and lasting from several weeks to months (intermediate)	Occasional or rare and lasting less than a few weeks (short-term)
	Likelihood	Certain	Probable	Possible

[1]Potential Biological Removal (PBR).

Impact Criteria for Marine Mammals

The impact criteria for the magnitude of effects on marine mammals have been developed in the context of two important factors derived from the Marine Mammal Protection Act (MMPA). The first factor is the calculation of Potential Biological Removal (PBR) for each marine mammal stock. The MMPA defined PBR at 16 U.S.C. § 1362(20) as, "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population." PBR was intended to serve as an upper limit guideline for fishery-related mortality for each species. Calculations of PBR are stock-specific and include estimates of the minimum population size, reproductive potential of the species, and a recovery factor related to the conservation status of the stock (e.g., whether the stock is listed under the Endangered Species Act (ESA) or depleted under the MMPA). NMFS and USFWS are required to calculate PBR (if possible) for each stock of marine mammals they have jurisdiction over and to report PBR in the annual marine mammal stock assessment reports (SARs) mandated by the MMPA. The PBR metric has been used extensively to assess human impacts on marine mammals in many situations involving mortality and serious injury (M&SI) and is a recognized and acceptable metric used by NMFS Office of Protected Resources in the evaluation of commercial fisheries incidental takes of marine mammals in US waters.

The second factor is the categorization of commercial fisheries with respect to their adverse interactions with marine mammals. Under Section 118 of the MMPA, NMFS must classify all US commercial fisheries into one of three categories based on the level of marine mammal M&SI that occurs incidental to each fishery, which it does in the List of Fisheries (LOF) published annually. Category III fisheries are considered to have a remote likelihood of or no known incidental M&SI of marine mammals. Category II fisheries are those that have occasional incidental M&SI of marine mammals. Category I fisheries are those that have frequent incidental M&SI of marine mammals. A two-tiered classification system is used to develop the LOF, with different thresholds of incidental M&SI compared to the PBR of a given marine mammal stock.

However, the LOF criteria is primarily used for managing commercial fisheries based on their actual levels of marine mammal M&SI and is not necessarily designed to assess impacts of projected scientific research takes on a given marine mammal stock. Because the analysis of direct impacts of SWFSC research on marine mammals in this Final PEA is based on projected takes rather than actual takes, we use a similar but not identical model to the LOF criteria.

In spite of fundamental differences between SWFSC research activities and commercial fishing practices, it is appropriate to assess the impacts of incidental takes due to research in a manner similar to what is done for commercial fisheries for two reasons:

- SWFSC research activities are similar to many commercial fisheries in the fishing gear and types of vessels used, and
- SWFSC research plays a key role in supporting commercial fisheries.

As part of the NEPA impact assessment criteria (Table 4.1-1), if the projected annual M&SI of a marine mammal stock from all SWFSC research activities, as requested in their MMPA LOA application, is less than or equal to 10 percent of PBR for that stock, the effect would be considered minor in magnitude for the marine mammal stock, similar to the LOF's Category III fisheries that have a remote likelihood of M&SI with marine mammals with no measurable population change. Projected annual M&SI from SWFSC research activities between 10 and 50 percent of PBR for that stock would be moderate in magnitude for the marine mammal stock, similar to the LOF's Category II fisheries that have occasional M&SI with marine mammals where population effects may be measurable. Projected annual M&SI from SWFSC research activities greater than or equal to 50 percent of PBR would be major in magnitude for the marine mammal stock, similar to the LOF's Category I fisheries that have frequent M&SI with marine mammals which measurably affect a marine mammal stock's population trend. Note that NEPA requires several other components to be considered for impact assessments (see Table 4.1-1); the magnitude of impact is not necessarily the same as the overall impact assessment in a NEPA context.

In the MMPA LOA application, SWFSC estimated takes for each marine mammal stock are grouped by gear type (i.e., trawl gear and longline gear) with the resulting take request not apportioned by individual research activities (e.g., by survey). This precludes impact analysis at the individual activity or project level within the Final PEA.

NMFS recognizes that in addition to SWFSC, more than one of its other regional FSCs may interact with the same stocks of marine mammals in the Pacific, namely the Northwest Fisheries Science Center

(NWFSC), Alaska Fisheries Science Center (AFSC), and Pacific Islands Fisheries Science Center (PIFSC), and that the collective impact from all of these FSCs on marine mammal stocks should be considered. The NWFSC, AFSC, and PIFSC are currently working on their own NEPA and MMPA compliance processes but have not yet developed estimates of future marine mammal incidental takes. Because the SWFSC projected takes include estimates for species that it has not taken historically, and the other three FSCs may do the same, the analysis of combined impacts based on projected takes from all FSCs cannot be completed at this time. However, historical data on incidental takes from these three other FSCs will be considered along with the contribution of the SWFSC in the Cumulative Effects section of this Final PEA (Chapter 5). From 2008 through 2012, the only shared marine mammal stock that has been incidentally caught by both the NWFSC and the SWFSC is California sea lions (n = 3 for NWFSC and n = 21 for SWFSC). The only shared marine mammal stock that has been incidentally caught by both the AFSC and the SWFSC is the Eastern Pacific stock of northern fur seal (n = 1 for AFSC and n=1 for SWFSC). Because both of these stocks have large PBRs, NMFS does not anticipate incidental takes from NWFSC and AFSC research activities to substantially increase the collective impacts on marine mammal stocks shared with the SWFSC. The PIFSC has no history of incidental takes of marine mammals. When the NWFSC, AFSC, and PIFSC submit their LOA applications and supporting NEPA analyses, the total projected takes for shared stocks from all FSCs will be analyzed within those documents.

The contribution of SWFSC research activities to overall impacts on marine mammals will be aggregated with past, present, and reasonably foreseeable future impacts on marine mammals from commercial fisheries and other factors external to SWFSC research activities in the Cumulative Effects analysis in Chapter 5. NMFS will report all sources of M&SI in the annual marine mammal stock assessment reports (SARs), including any incidental M&SI takes that may occur from any of the FSCs. The cumulative effects analysis will use the same impact assessment criteria and thresholds as described in Table 4.1-1, only they will be applied to collective sources of M&SI and other types of impacts on marine mammals.

4.2 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 1 – STATUS QUO ALTERNATIVE (NO-ACTION).

This section presents an analysis of the potential direct and indirect effects of Alternative 1 – Status Quo Alternative on the physical, biological, and social environment. Under this Alternative, fisheries research programs conducted and funded by the SWFSC would be performed as they have been over the previous five years. Potential direct and indirect effects were evaluated according to the criteria described in Table 4.1-1. A summary of the impact rating determinations for all topics evaluated under Alternative 1 is presented below in Table 4.2-1.

Table 4.2-1 Alternative 1 Summary of Effects

All conclusions refer to adverse effects unless noted.

RESOURCE	Physical Environment	Special Resource Areas	Fish	Marine Mammals	Birds	Sea Turtles	Invertebrates	Social and Economic
SECTION #	**4.2.1**	**4.2.2**	**4.2.3**	**4.2.4**	**4.2.5**	**4.2.6**	**4.2.7**	**4.2.8**
Research Area								
California Current	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Moderate-*beneficial*
Eastern Tropical Pacific	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor-*beneficial*
Antarctic	Minor	Minor	Minor	Minor	Minor	N/A	Minor	Minor-*beneficial*

4.2.1 Effects on the Physical Environment

The SWFSC conducts research in three distinct areas, the California Current Research Area (CCRA), Eastern Tropical Pacific Research Area (ETPRA), and the Antarctic Research Area (ARA). This section describes effects on the physical environment that would result from SWFSC research activities in these three areas under Alternative 1. These potential effects would generally include:

- Physical damage to benthic (seafloor) habitat
- Removal of organisms that produce structure.

Refer to Appendix A for a detailed description of the SWFSC research vessels and survey gear specifications.

Physical Damage to Benthic (Seafloor) Habitat

Physical impacts to seafloor habitat from SWFSC research would be limited; minimal bottom contact with two longline surveys in the CCRA and a bottom trawl survey occurring once every three years in the ARA (see Table 2.2-1). One of the longline surveys in the CCRA (sablefish) involves two or three 75-hook bottom longline sets per month and the other survey (thresher sharks) involves bottom contact only by small anchors for pelagic longline sets. The ARA bottom-trawl survey has historically involved 75 30-minute bottom trawls per survey. Under Alternative 1, it is assumed that a similar amount of survey effort would continue in the future.

Fishing gear that contacts the seafloor can physically damage seafloor habitat. Physical damage may include furrowing and smoothing of the seafloor as well as the displacement of rocks and boulders, and such damage can increase with multiple contacts in the same area (Morgan and Chuenpagdee 2003; Stevenson et al. 2004). In general, physical damage to the seafloor recovers within 18 months through the action of water currents and natural sedimentation, with the exception of rocks and boulders which may be permanently displaced (Stevenson et al. 2004). Seafloor composition is highly variable both within and between the SWFSC research areas. Silt, sand, clay, and gravel are abundant at particular sites within each research area. With the exception of rock and boulder displacement, any physical impacts to benthic habitat resulting from SWFSC survey activities would be expected to recover within 18 months.

Bottom-contact trawl gear can also increase turbidity and alter the chemical composition of water near the seafloor. However, these effects would be short-term, minor in magnitude, and limited in geographic extent.

The area of benthic habitat affected by SWFSC research each year would be a very small fraction of the total of the research areas. Direct and indirect effects would be localized, short-term in duration, and result in no measurable changes to seafloor habitat. Considering the small area affected and the limited magnitude of the physical effects, the overall effects of surveys on benthic habitat in the CCRA and ARA would be minor adverse.

Removal of Organisms That Produce Structure

Organisms such as cold water corals create structure on the seafloor that may provide important habitats for many organisms, including fish (Auster and Langton 1999, Cairns and Bayer 2009). Cold water corals are generally slow growing, fragile and long lived, which makes them particularly vulnerable to damage. Bottom contact fishing gear can break or disrupt corals, thereby reducing structural complexity, which may reduce species diversity of the corals and other animals that utilize this habitat (Freiwald et al. 2004).

The removal of structural organisms may only be reversible through natural recovery that may occur over hundreds of years (Freiwald et al. 2004). Cold-water corals such as *Flabellum thouarsii* and *Flabellum curvatum* are known to occur in the SWFSC ARA, although their exact distribution and abundance are poorly understood (Cairns 1982; Waller et al. 2008). Effects of SWFSC research activities on organisms that produce structure would be independent of seasonal considerations because the organisms are not mobile and take long periods to recover.

Under Alternative 1, the SWFSC would implement as standard operating procedure numerous measures to reduce the likelihood, magnitude, and geographic extent of potential impacts to seafloor structural organisms. Rocky areas that are more likely to support corals would be avoided by using sonar to examine the bottom contours before surveys are conducted (Jones et al. 2009; Lockhart et al. 2009). Bottom trawl surveys would only be conducted on suitable benthic substrates, e.g. sand, silt, or gravel bottoms. Given the selection for bottom substrates and avoidance of coral areas, the removal of benthic organisms that produce structure for other species is unlikely. Effects would be considered minor adverse due in part to the small areal extent of surveys using bottom trawl. Effects resulting from the removal of organisms that produce structure would be limited to the ARA because the SWFSC does not use bottom trawl equipment in the CCRA and ETPRA. Direct and indirect effects would be localized, short-term in duration, and result in no measurable changes. Overall, impacts to seafloor structural organisms in the ARA would be considered minor adverse under the Status Quo Alternative according to the criteria in Table 4.1-1.

4.2.2 Effects on Special Resource Areas

Section 3.1.2 describes the special resource areas that occur in the same geographic areas as the SWFSC fishery research activities. This section describes the general types of effects that SWFSC fishery research activities under Alternative 1 may have on the following categories of special resource areas:

- Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC)
- Closed Areas
- Marine Protected Areas (MPAs) and National Marine Sanctuaries.

4.2.2.1 Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC)

Section 3.1.2.1 describes the areas designated as EFH within the SWFSC research areas. EFH applies to federally managed fish species in both state and federal jurisdictional waters throughout the range of the species within U.S. waters. Overlapping EFH areas for numerous federally-managed species, including over 82 species covered by the Pacific Coast Groundfish FMP, have been identified in areas where SWFSC research surveys occur (Pacific Fisheries Management Council [PFMC] 2008). As shown in Figure 3.1-3, when these EFHs areas are combined, groundfish EFH includes all waters less than 3,500 meters in depth from the mean higher high water line, and the upriver extent of saltwater intrusion in river mouths, to the seaward boundary of the U.S. Exclusive Economic Zone (EEZ) along the coasts of California, Oregon, and Washington (PFMC 2008). Where a species' range extends beyond U.S. waters, EFH stops at the boundary. HAPC are discrete subsets of EFH that provide important ecological functions or are especially vulnerable to degradation. Thus, no EFH or HAPC exist within the ARA, or in the portion of the ETPRA that lies outside of the U.S. EEZ.

Because the SWFSC does not employ bottom trawl or bottom contact equipment within the CCRA, which is the only SWFSC research area where federally designated EFH exists, no direct impacts to EFH or HAPC benthic habitat are expected according to the criteria in Table 4.1-1. Limited impacts to pelagic habitats may result from the use of active acoustic equipment within closed areas, however the duration of those impacts would be considered short-term and limited to the time over which the surveys occur, and the magnitude of such impacts would be minor adverse because the effects would not result in measurable changes to the environment. Given the small areas affected by SWFSC research activities within EFH and HAPC areas, effects would be considered localized in geographic extent. Such effects would be minor in intensity and short term in duration. No measurable changes to EFH or HPAC are expected to result from

SWFSC research activities. Under the Status-Quo Alternative, the overall effects of fisheries research on EFH and HAPC are considered minor adverse according to the criteria in Table 4.1-1.

Direct and indirect effects of SWFSC research activities on biological resources within EFH and HAPC areas are most accurately captured in the assessments of species groups, which are evaluated in Sections 4.2.3-4.2.7.

4.2.2.2 Closed Areas

California Current Research Area

Several SWFSC fisheries research surveys are partially conducted in closed fishing areas within the CCRA, such as the Coastal Pelagic Species (CPS) Survey, Juvenile Rockfish Survey, and Juvenile Salmon Survey (Table 2.2-1). These surveys use a combination of near-surface and midwater trawl gear, as well as various plankton nets, water sampling devices and acoustic survey equipment to collect information about species and their habitats. Survey activities that may occur within closed areas in the CCRA would have no direct impact on benthic habitats because the equipment used for these activities generally does not contact the seafloor The duration of any impacts to pelagic habitats, however unlikely, would generally not extend beyond duration of the survey period. Limited effects may result from the use of active acoustic equipment within closed areas, however the duration of those impacts would be considered short-term and limited to the time over which the surveys occur, and the magnitude of such impacts would be minor because the effects would not result in measurable changes to the environment. Effects of surveys on populations of individual species occurring within closed areas are addressed in the species specific sections of this report. In summary, the effects of SWFSC survey activities on closed areas within the CCRA are expected to be minor adverse according to the criteria in Table 4.1-1.

Eastern Tropical Pacific Research Area

The National Oceanic and Atmospheric Administration (NOAA) has not designated closed areas within the ETPRA. SWFSC research activities may occur within reserves, marine parks, and World Heritage Sites established by foreign governments within the ETPRA. For the purposes of this Final PEA, these areas are considered MPAs, and the impacts of SWFSC survey activities on these areas are discussed in Section 4.2.2.3.

Antarctic Research Area

Closed areas within the ARA include those established by the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) conservation measures, as discussed in the *Schedule of Conservation Measures in Force 2010/11 Season* (CCAMLR 2010). Taking of all finfish, other than for scientific research purposes, is prohibited in CCAMLR statistical subareas 48.1 and 48.2, which overlap with the SWFSC ARA (see Section 3.1.2.3). An additional series of closed areas have been proposed as a management tool to determine the efficacy of small scale management units in the Antarctic krill fishery (Constable et al. 2000; Hill et al. 2009). Under Alternative 1, the survey equipment used in Antarctic closed areas would include various small, towed, fine-mesh nets designed to sample larval and juvenile fish and small pelagic invertebrates, water sampling devices, video recording equipment, and acoustic survey equipment, none of which would result in lasting impacts to the environment within closed areas. Although changes to the environment within closed areas resulting from the use of such equipment would be measureable during the survey activity, the duration of those effects would be short-term, localized and result in no measurable changes to closed areas within the ARA from survey activities.

SWFSC occasionally uses a hard-bottom trawl in order to collect information about demersal fish and benthic invertebrates within the ARA (Jones et al. 2009; Lockhart et al. 2009). Such surveys would occur once every three years and have historically involved 75 bottom trawl hauls per survey. Under Alternative 1, it is assumed that a similar amount of survey effort would continue in the future. Bottom trawl surveys are conducted on the South Orkney Island shelf using a random, depth-stratified survey design, and stations are positioned to account for as wide a geographic range as time, sea conditions, and ice conditions permit (Jones et al. 2009). In all cases, hauls are taken only after initial acoustic reconnaissance is conducted to verify bottom conditions suitable for trawling. Bottom trawl surveys are only conducted on suitable benthic substrates, e.g., sand, silt or gravel bottoms with few large rocks or sharp surfaces that may damage the gear. Rocky areas that are more likely to support corals are avoided by using sonar to examine the bottom contours before surveys are conducted (Jones et al. 2009; Lockhart et al. 2009). The effects of SWFSC bottom trawl surveys on closed areas in the ARA may include furrowing and smoothing of the seafloor, and re-suspension of bottom sediments. Given the selection for bottom substrates and avoidance of coral areas, the removal of benthic organisms that produce structure for other species within fishery closed areas is unlikely. As discussed in Section 4.2.1, bottom contact fishing gear can increase turbidity and alter the chemical composition of the water column near the seafloor. However, these effects are temporary and localized. Given the small number of survey stations in closed fishing areas and the minor magnitude and localized nature of the effects, these effects are considered minor adverse for research activities conducted using gear types similar to the ones currently in use. Under Alternative 1, the adverse impacts of SWFSC research activities on closed areas within the ARA would be minor adverse due to the short-term and infrequent nature of the survey activities, and the localized areal extent of the impacts.

4.2.2.3 Marine Protected Areas

Over 300 MPAs encompass a large fraction of the area where SWFSC research surveys are conducted (see Section 3.1.2.4). They include: California's State Marine Reserves (SMR), State Marine Parks (SMP), State Marine Conservation Areas (SMCA), and State Marine Recreational Management Areas (SMRMAs); Oregon's MPAs; Washington's MPAs; Wildlife Refuges; National Parks; and National Marine Sanctuaries, as well as Marine World Heritage Sites and Marine Management Areas established outside of the U.S. EEZ by international agencies and foreign governments. MPAs vary widely in the level and type of legal protection afforded to the sites' natural and cultural resources and ecological processes. Considering the wide range of conservation goals and varying degrees of legal protection associated with individual MPAs in the SWFSC research areas (see Section 3.1.2.4), it is impractical to assess the impacts of SWFSC research activities to those areas on a case-by-case basis. Locations of randomized sampling sites vary from year to year, and impacts of research surveys within particular MPAs would vary substantially over space and time. In general, the impacts to each of the MPAs are a subset of the impacts to specific physical, biological, and socioeconomic resources that are addressed in the resource specific sections of this Final PEA.

National Marine Sanctuaries

National Marine Sanctuaries are MPAs with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or aesthetic qualities. The SWFSC CCRA includes areas designated in each of the five West Coast National Marine Sanctuaries: Channel Islands, Cordell Bank, Gulf of the Farallones, Monterey Bay and Olympic Coast. Section 304(d) of the National Marine Sanctuaries Act (NMSA) requires interagency consultation between the NOAA Office of National Marine Sanctuaries and federal agencies taking actions that are "likely to destroy, cause the loss of, or injure a sanctuary resource." Sanctuary consultation requires the federal action agency to submit a "sanctuary resource statement," which describes the agency action and its potential effects on sanctuary resources. Sanctuary resource statements are not necessarily separate documents prepared by the federal agency, and may consist of documents prepared in compliance with other statutes such as the NEPA. The following analysis describes the potential effects of SWFSC research activities on each of the five West Coast National Marine Sanctuaries, and provides the requisite information for a sanctuary resource statement pursuant to section 304(d) of the NMSA.

Several SWFSC fisheries research surveys occur partially within the boundaries of the West Coast National Marine Sanctuaries, including the Collaborative Optical Acoustical Survey Technology (COAST) surveys, California Cooperative Oceanic Fisheries Investigation (CalCOFI) surveys, Central California Sharks surveys, Cowcod surveys, Juvenile Rockfish surveys, Juvenile Salmon surveys, Leatherback Use of Temperate Habitat surveys, Juvenile Shark surveys, Pacific Ocean Observing System (PacOOS) surveys, CPS surveys, Highly Migratory Species (HMS) surveys, and Thresher Shark surveys (Table 4.2-2). These surveys use a combination of near-surface and midwater trawl gear, as well as various plankton nets, water sampling devices and acoustic survey equipment to collect information about species and their habitats.

Table 4.2-2 Number and percentage of SWFSC survey stations from 2007-2011 conducted within Pacific coast National Marine Sanctuaries.

Table indicates the number and percentage of survey stations (tows or longline sets) that have occurred within each of the Sanctuaries in the five-year period from 2007 through 2011. See Table 2.2-1 for information on the gear types and seasonality of each survey. Blank cells indicate that no survey effort occurs within the National Marine Sanctuary.

Survey Name	Total # Stations in survey	Olympic Coast NMS		Cordell Banks NMS		Gulf of the Farallones NMS		Monterey Bay NMS		Channel Islands NMS		Combined percentage of survey effort occurring in NMS
		# within NMS	% of total	# within NMS	% of total	# within NMS	% of total	# within NMS	% of total	# within NMS	% of total	
CalCOFI	1705					4	<1	45	3	17	1	4
Coastal Pelagic Species	671	12	2			4	1	28	4			7
Juvenile Rockfish	752			46	6	99	13	298	40	14	2	61
Juvenile Salmon	125			10	8	28	22	6	5			35
PacOOS	65							10	15			15
Highly Migratory Species	215*							10	5	10	5	10
Thresher Shark	308									2	1	1
COAST	1580									328	21	21
Habitat Surveys	255*					4	2	24	9	25	10	21
Marine Mammal Surveys	24994	387	2	92	0.37	160	0.64	689	3	247	0.99	6

*** includes only survey segments occurring partially within NMS.**

The types of effects on National Marine Sanctuaries resulting from SWFSC research are substantially the same as those discussed for physical, biological, and socioeconomic resources elsewhere in this Final

PEA. These effects primarily involve the removal of fish and invertebrates in the water column through sampling with pelagic sampling equipment, adverse interactions with protected species, and the risk of accidental spills or contamination from vessel operation. Survey activities that may occur within National Marine Sanctuaries would not have an impact on benthic habitats because SWFSC does not use bottom contact trawl equipment within the sanctuaries Near-surface and midwater trawl gear, as well as various plankton nets, water sampling devices, and acoustic survey equipment would result in temporary impacts to pelagic habitat within the National Marine Sanctuaries (NMS). Presence of pelagic sampling equipment may result in short-term disturbance or displacement of pelagic species within NMS. The duration of impacts to pelagic habitats within NMS would generally not extend beyond the duration of the survey period. Localized disturbance may result from the use of active acoustic equipment within NMS, however the duration of those impacts would be considered short term and limited to the time over which the surveys occur, and the magnitude of such impacts would be minor because the effects would not result in measurable changes to the environment. Effects of surveys on populations of individual species occurring within NMS are addressed in the species specific sections of this report.

Amounts of biomass removed from sanctuaries are small, and the effects of biomass removal on biological populations, habitats, and biogeochemical cycles would be minor adverse. Table 4.2-3 shows mean annual biomass removal from NMS resulting from previous SWFSC surveys. Under Alternative 1, similar levels of research effort and biomass removal would continue. SWFSC would conduct a relatively small amount of research within National Marine Sanctuaries, and that research effort would result in the removal of very small amounts of biomass.

Table 4.2-3 Mean annual biomass removal from National Marine Sanctuaries from SWFSC surveys

Biomass removal from sanctuaries was calculated for species for which the average annual total catch (both within and outside of sanctuaries) exceeded 1000 kilograms (kg). Biomass removal was calculated by multiplying the total catch of each species for each survey by the fraction of survey effort occurring within each NMS for each survey. The table shows mean annual biomass removal from sanctuaries in kilograms combined for all surveys.

Biomass Removal (kg)					
Species	**Olympic Coast NMS**	**Cordell Banks NMS**	**Gulf of the Farallones NMS**	**Monterey Bay NMS**	**Channel Islands NMS**
Anchovy (*Engraulis mordax*)	7.68	48.75	131.26	132.35	7.02
Pacific hake (*Merluccius productus*)	13.43	11.52	29.52	107.97	4.37
Pacific sardine (*Sardinops sagax*)	7.51	180.82	506.65	178.59	8.67
Albacore (*Thunnus alalunga*)	0.00	0.00	0.10	1.12	0.42
Common Mola (*Mola mola*)	0.00	0.00	0.32	3.57	1.35
Shortfin mako shark (*Isurus oxyrinchus*)	0.00	0.00	0.00	0.00	25.50
Blue shark (*Prionace glauca*)	0.00	0.00	0.17	1.91	11.79
Common Thresher	0.00	0.00	0.16	1.80	20.81

Shark (*Alopias vulpinus*)					

SWFSC survey activities within NMS may result in adverse interactions with protected species, including marine mammals. Adverse interactions with marine mammals may include disturbance from vessels and active acoustic equipment and incidental take. Historically there has been one California sea lion taken within the Gulf of the Farallones NMS (2011) and three California sea lions taken within the Channel Islands NMS (2008). Within the Monterey Bay NMS there have been two Pacific white-sided dolphins taken (2010 and 2011) and nine California sea lions taken in one set (2008). A leatherback sea turtle was also accidentally captured within the Monterey Bay NMS, then released alive and apparently unharmed. Similar levels of interaction with protected species would be expected to result from the SWFSC research activities included under Alternative 1. Mitigation measures intended to mitigate adverse interactions with protected species are described in the subsequent sections of this document.

There are many MPAs outside of the NMS system that are managed for sustainable production and/or have restrictions for commercial or recreational fishing which encompass a large fraction of the area where SWFSC research surveys are conducted (NOAA 2010c). These particular MPAs are managed by NMFS. SWFSC survey activities provide essential information related to the science-based management, conservation, and protection of living marine resources and ecosystem services within these areas. The information developed from SWFSC research activities is essential to the development of a broad array of fisheries, habitat, and ecosystem management actions taken not only by NMFS, but also by other federal, state, and international authorities. Adverse effects on these MPAs resulting from SWFSC research activities are expected to be minor, localized in areal extent, short-term in duration, and result in no measurable changes to the physical environment. However, development of sound science-based management practices are dependent upon the data generated from SWFSC research surveys, while recognizing they result in unavoidable adverse effects described above. The overall direct and indirect effects of Alternative 1 on MPAs are therefore considered minor adverse according to the criteria described in Table 4.1-1.

4.2.3 Effects on Fish

This section describes the effects of fishery research activities under Alternative 1 on fish species in the SWFSC fisheries research areas of the CCRA, ETPRA, and ARA. The potential effects of research vessels, survey gear, and other associated equipment on fish species found in the research areas include:

- Mortality from surveys
- Disturbance and changes in behavior due to sound sources
- Contamination from discharges

Mortality from surveys

Direct mortality of fish occurs as a result of fisheries research surveys and tagging activities. Fish are caught in a variety of gear types however; these surveys provide important data regarding abundance and distribution, necessary for managers to maintain healthy populations and rebuild overfished/depressed stocks. Fisheries research surveys are also used to determine biomass estimates, abundance, and distribution of depressed and overfished stocks; these surveys also sample closed areas where depressed and overfished stocks are known to concentrate. The SWFSC also conducts surveys to provide indices of juvenile abundance that are used to identify and characterize the strength of year classes before fish are large enough to be harvested by commercial or recreational fisheries. Stock assessments based on accurate abundance and distribution data are essential to developing effective management strategies.

The SWFSC is made up of five research divisions that generate the scientific information necessary for the conservation and management of the region's fish, marine mammals and turtles, seabirds, and invertebrates. They also conduct research on the impacts of environmental variability and climate change on marine ecosystems, and on fishery and conservation socio-economics. For more details regarding each of the five research divisions, see Chapter 1. Descriptions of the SWFSC vessel surveys, including type and frequency of fishing gear used are described in Table 2.2-1.

In terms of the amount of fish killed during research, the CPS survey, the Juvenile Salmon survey, Juvenile Rockfish survey, CPS survey, and CalCOFI surveys account for the greatest numbers of fish and weight of fish killed during research. The HMS survey, Swordfish Tagging using Deep-set Buoy Gear, and Thresher Shark survey primarily involve catching fish for tagging and then releasing them. The most extensive surveys conducted are the pelagic trawl surveys conducted throughout the CCRA.

Disturbance and changes in behavior due to sound sources

There are several potential mechanisms by which noise sources from research activities could disturb fish and alter behavior, including the physical movement of marine vessels and fishing gear through the water, gear contact with the substrate, and operational sounds from engines, hydraulic gear, and acoustic devices. In addition to fishing gear noise, commercial and recreational vessels are a common part of the ambient noise in the marine environment. At present, there are thousands of commercial, recreational, and fishing vessels in the SWFSC fishery research areas that contribute to background vessel noise.

Noise from active acoustic devices used on vessels conducting fisheries research could potentially cause effects to fish in the SWFSC research areas. The LOA application (Appendix C, Section 6.2) provides a description of the types of acoustic devices used on SWFSC research vessels. Fish with a swim bladder (or other air bubble) that is near, or connected to, the auditory structures likely have the best hearing sensitivity among fish, with a presumed functional hearing range of approximately 50 hertz to 4 kilohertz (Popper and Fay 2011). Herring are in this category of fish, which are specialized to hear high frequency sounds that are within the range of acoustic devices used in research. These types of fish are likely to detect acoustic devices, but only if they are relatively near the source. Because vessels are usually moving while using acoustic gear, the source of potentially disturbing sounds would be localized and the behavioral response of fish would likely be limited to temporary avoidance behavior.

Globally, approximately 25,000 fish species have a swim bladder (or other air cavity) that is not near the ear (for example, salmonids). These species probably detect some pressure from large physical disturbances of the water or vessel traffic, but functional hearing is most likely in the 30 hertz to 500 hertz range (Popper and Fay 2011) and higher frequency acoustic devices used in research are unlikely to be audible. Any acoustical effect that is audible and that would cause avoidance disturbance, would be minor in intensity, occur over a local geographic extent, and the duration would be temporary.

Any resulting impacts to fish are expected to be localized, short-term, and unlikely to have any measurable effect on the population. In summary, the potential for SWFSC research to affect the behavior of fish is considered to be minor adverse according to the criteria in Table 4.1-1. This determination is applicable for all fish species, in all three research areas, and under all of the action alternatives, so this topic will not be discussed further.

Contamination from discharges

Contamination from spills and discharges can accumulate in the seafloor and marine life and have a toxic effect on the plants, animals, and humans through the food chain (NOAA 2010d). While there are no intentional discharges of pollutants from SWFSC or any other fisheries research vessels, there is the potential for accidental spills to occur. Discharge from vessels, whether accidental or intentional, may include sewage, ballast water, fuel, oil, miscellaneous chemicals, garbage, and/or plastics.

These chemicals include hydraulic fluids or fuel from a damaged vessel due to a collision or accident. Such an event would have a low probability of occurrence. Use of anti-fouling agents to prevent the accumulation of microorganisms, plants, algae, or animals on the hulls of vessels and other submerged surfaces may contribute low levels of dissolved metals or organic compounds to the environment. The modern antifouling agents used on SWFSC research vessels are not expected to result in any adverse effects to fish.

NOAA vessels are fully equipped to respond to emergencies, including fuel spills, and crews receive extensive safety and emergency response training. These precautionary measures help reduce the likelihood of fuel spills and increase the chance that they would be responded to and contained quickly. Additionally, all NOAA and ocean going vessels are subject to the regulations of MARPOL 73/78, the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (NOAA 2010 b). MARPOL includes six Annexes that cover discharge of oil, noxious liquid substances, harmful packaged substances, sewage, garbage, and air pollution (International Maritime Organization [IMO] 2010). Adherence to these regulations minimizes or negates the likelihood of discharges of potentially harmful substances into the marine environment. Annex V specifically prohibits plastic disposal anywhere at sea and severely restricts discharge of other garbage (IMO 2010).

Oil spill prevention training and equipment may be more variable on commercial fishing vessels used in cooperative research, although all vessels are required to comply with U.S. Coast Guard (USCG) regulations on spills.

Discharge of contaminants from SWFSC vessels and SWFSC chartered vessels is possible, but unlikely, and if it occurs, would be isolated in both time and location and would likely be small in volume. Any resulting impacts to fish would be localized, short-term in duration, and not result in any measurable effects on the population. Therefore, effects from spills and discharges on fish are considered minor adverse according to the criteria in Table 4.1-1. As the potential effects of discharges, regulations governing discharges, and the likelihood of discharges is universal across the three research areas, this will not be discussed further in this analysis.

1.2.3.1 California Current Research Area

ESA-listed Species

The SWFSC does some directed research on ESA-listed Pacific salmon and only a few listed species have been caught incidentally in the CalCOFI, CPS, Juvenile Salmon, and Juvenile Rockfish surveys. There are no records of incidental catch of bocaccio, green sturgeon, yelloweye rockfish, or totoaba and no anticipated effect on these species under the Status Quo Alternative.

Four species of salmon have been caught in offshore research surveys. Of these salmon species, chum and sockeye salmon are rarely captured in research activities (average less than 1 kg per year). Chinook and coho salmon catch incidental to offshore surveys average 705 kg and 132 kg, respectively, each year. Juvenile Salmon Surveys, conducted since 2010, have accounted for an average biomass removal of 15 kg and 176 kg per year for coho and Chinook salmon, respectively. All juvenile salmon captured in these surveys are sacrificed for genetic analysis to determine Pacific salmon stock of origin. Pacific salmon are only assigned a specific stock of origin (i.e. ESU) when genetic test confidence levels are equal to or greater than a 90%, an approximate threshold. Genetic tests have been inconclusive for juvenile steelhead trout tissue samples however the average biomass removal of 5 kg per year is considered minimal. Table 4.2-4 shows the mean biomass removal of ESA listed Pacific salmon ESU's from Juvenile Salmon surveys. No genetic analysis is conducted on Pacific salmon captured in CalCOFI research surveys.

Table 4.2-4 Mean biomass removal of ESA listed Pacific salmon ESU's from SWFSC Juvenile Salmon surveys.

Biomass removal was calculated by multiplying the mean average weight (0.15 kg) times the number of juvenile salmon harvested per ESU. Biomass removal estimates are limited to 2010 and 2011 surveys where genetic test confidence levels equal or exceed 90%.

ESU	ESA Status	Biomass Removal (kg)
Chinook Salmon		
California Coastal	Threatened	9.15
Central Valley Fall and Late Fall Run	Species of Concern	202.8
Snake River Fall Run	Threatened	0.45
Central Valley Spring Run	Threatened	6.0
Upper Columbia River Spring Run	Endangered	0.15
Upper Willamette River	Threatened	0.15
Puget Sound	Threatened	0.15
Lower Columbia River	Threatened	0.75
Sacramento River Winter Run	Endangered	0.75
Coho Salmon		
Central California Coastal	Endangered	3.15
Southern Oregon/Northern California Coasts	Threatened	14.25
Lower Columbia River	Threatened	6.45
Oregon Coast	Threatened	1.65

An average of 156 kg of canary rockfish are caught each year under the Status Quo Alternative. Compared to the estimated 2011 spawning biomass of 6,458 metric tons (mt) (Wallace and Cope 2011), mortality from SWFSC research accounts for a very small fraction of the population (0.002%) and is considered minor adverse. No genetic tests have been conducted on canary rockfish to determine what proportion, if any, belong to the Puget Sound/Georgia Basin threatened DPS. Pacific eulachon (< 1 kg per year) and steelhead trout (3.4 kg per year) are rarely encountered; these levels of mortality are considered minor for these species. Effects on ESA-listed fish species are expected to be occasional or rare, short-term in frequency and duration, localized, and result in no measurable population level effects. Therefore, overall effects on ESA-listed fish species are considered to be minor adverse according to the criteria in Table 4.1-1.

Target Species

Table 4.2-5 shows the average SWFSC research catch of target species in the CCRA over the past five years compared to the Allowable Biological Catch (ABC) or other metric for commercial harvests of these species. Only species that have been caught in quantities exceeding 100 kg per year are shown. In all cases for which there are fishing metrics for comparison, the SWFSC research catch represents much less than 0.1% of the ABC or other metric for the target species. For all target species in the CCRA, mortality from SWFSC research surveys is not expected to result in any measurable changes at the population level under the Status Quo Alternative and is therefore considered minor adverse.

Table 4.2-5 Relative Size of SWFSC Research Catch in California Current Research Area compared to Commercial Allowable Biological Catch (ABC).

Only target species caught in excess of 100 kg per year are shown.

Species	Stock Status	Average SWFSC Research Catch per year (kg) (2007-2011 data)	ABC Commercial Catch Reference Value (kg)	Average SWFSC Research Catch, Compared to ABC Reference Value (percentage)
Blue shark	Not overfished	900	N/A	N/A
Common Mola	Monitored	1,135	N/A	N/A
Common thresher shark	Not overfished	2,200	N/A	N/A
Jack mackerel	Monitored	392	31,000,000	0.0003%
Jacksmelt	Monitored	330	N/A	N/A
North Pacific albacore tuna	Not overfished	1,589	405,000,000	0.0039%
Northern anchovy	Monitored	1,201	34,750,000	0.0003%
Pacific hake (whiting)	Not overfished	1,045	2 million metric tons (mt) (2011 spawning biomass)	<0.0001%
Pacific mackerel	Not overfished	7,534	42,375,000	0.0178%
Pacific sardine	Not overfished	1,564	84,681,000	0.0019%
Shortbelly rockfish	Not overfished	412	23,500,000	<0.0001%
Shortfin mako shark	Not overfished	2,500	N/A	N/A
Spiny dogfish	Not overfished	189	1,584,000	0.0001%
Yellowtail rockfish	Not overfished	117	4,320,000	<0.0001%

Prohibited and Highly Migratory Fish Species

Prohibited species (as defined in section 3.2.1.3) that occur within the CCRA include the great white shark, basking shark, megamouth shark, Pacific halibut, and Pacific salmon. The effects of SWFSC research catches of Pacific salmon are described in the ESA-listed species section above. None of the other prohibited species have been taken during SWFSC surveys in the past five years. The effects of SWFSC research on prohibited species are expected to be localized, rare and short-term in frequency and duration, and result in no measurable population level effects. Therefore, effects are considered minor adverse under the Status Quo Alternative according to the criteria in Table 4.1-1.

HMS in the Pacific Region include tunas (North Pacific albacore, yellowfin, bigeye, skipjack, and northern bluefin); sharks (common thresher, shortfin mako, and blue); billfish/swordfish (striped marlin and Pacific swordfish); and dorado, also known as dolphinfish or mahi-mahi (PFMC 2011). Several of these HMS are also considered target species for research and commercial fisheries. The level of HMS catch is small compared to known harvests in commercial and recreational fisheries, and, in the case of the North Pacific albacore tuna, a fraction (0.0003%) of the ABC (Table 4.2-5). Dorado are rarely caught and two Pacific swordfish have been killed in SWFSC research surveys. The effects of SWFSC research on HMS are considered minor adverse under the Status Quo Alternative.

4.2.3.2 Eastern Tropical Pacific Research Area

Under Alternative 1, SWFSC research activities would result in the removal of very small quantities of fish from the ETPRA, primarily larval and juvenile size classes caught in plankton nets. Overall catch of fish is approximately 1 kg per year under the Status Quo Alternative, which would not result in any measurable changes to fish populations in the Eastern Tropical Pacific (ETP). Effects are expected to be localized, short-term and therefore considered minor adverse for all fish species in the ETP.

4.2.3.3 Antarctic Research Area

In the ARA, SWFSC surveys are primarily focused on Antarctic krill, which are discussed within Section 4.2.7. The SWFSC also conducts periodic bottom trawl surveys in the South Orkney Islands area to monitor the recovery of several finfish that were overfished in the 1970s and 1980s. These surveys are only conducted every two or three years as funds and charter vessels become available. During the last research survey, conducted during the 2008-2009 season, only seven species were caught in totals greater than 100 kg Table 4.2-6. Although no commercial fisheries metrics have been determined for these species for many years, given the very small catches of all species and the periodic frequency of the finfish survey, the effects of SWFSC research mortality on fish species in the ARA is considered minor adverse according to the criteria in Table 4.1-1.

Table 4.2-6 SWFSC Research Catch in the Antarctic Research Area during bottom trawl surveys.

Data from Van Cise (2009). No information is available on current stock size or status for any species.

Species	SWFSC Research Catch per survey (kg) (2008-2009 data)
Blackfin icefish	1,920
Mackerel icefish	575
Ocellated icefish	618
Humped rockcod	2,628
Grey rockcod	505
Black rockcod	110
South Georgia icefish	656

4.2.3.4 Conclusion

The overall effects of SWFSC research activities on fish populations found in the CCRA, ETPRA, and ARA are considered minor adverse under the Status Quo Alternative since they are short-term in duration, of localized geographic extent, and are unlikely to result in measurable population change.

4.2.4 Effects on Marine Mammals

Section 3.2.2 describes the marine mammals that are likely to overlap with fishery research activities in the three SWFSC research areas. This section describes the potential effects of the SWFSC research activities on marine mammals under the Status Quo Alternative, including the mitigation measures that have been implemented in the past to reduce those effects. Because the secondary federal action considered in this Final PEA is the promulgation of regulations and subsequent Letters of Authorization under Section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA), this section provides more information and analysis for effects on marine mammals than is presented for the analysis of effects on other resources, consistent with the needs of the MMPA authorization process.

The potential effects of research vessels, survey gear, sonar and other active acoustic devices, and other associated equipment on marine mammals include:

- Disturbance and behavioral responses due to acoustic equipment and vessel noise
- Injury or mortality due to ship strikes and gear interaction
- Changes in food availability due to research survey removal of prey and discards
- Contamination from discharges

The first part of the analysis in this section provides information on the mechanisms for these different types of effects. It also provides an analysis of some effects common to all three research areas. For some types of effects, the level of impact is similar for all species of marine mammals and the analysis is not repeated in the following subsections.

The second part of the analysis provides information on the effects of the SWFSC research activities on marine mammal species in each separate research area, including information needed for the MMPA authorization process. An application for promulgation of regulations and issuance of Letters of Authorization (referred to as the LOA application) for incidental take of marine mammals must include estimates of the numbers of animals that may be taken by serious injury or mortality, harassment that has the potential to injure (Level A harassment takes), and harassment that has the potential to disturb (Level B harassment takes). The SWFSC LOA application (Appendix C) only concerns the Preferred Alternative because that is the SWFSC's proposed action. However, the analysis of takes in the LOA application is based on essentially the same scope of research activities as the Status Quo Alternative and is therefore helpful in describing the potential effects of the Status Quo Alternative. For those research areas and marine mammal species where the effects of the Status Quo are considered the same or very similar to the Preferred Alternative, analysis provided in the LOA application is summarized and referenced in this section. Where the scope of activities differs between the Status Quo and Preferred Alternatives (e.g., in the ETP), the analysis of effects from the LOA application are summarized and referenced in the Preferred Alternative (Section 4.3.4). The following analysis focuses on the types of research gear most likely to have adverse interactions with marine mammals.

Disturbance and behavioral responses due to acoustic equipment

Several mechanisms exist by which research activities have the potential to disturb marine mammals and alter behavior, including the physical presence of marine vessels and fishing gear combined with operational sounds from engines, hydraulic gear, and acoustical devices used for navigation and research. The impacts of anthropogenic noise on marine mammals have been summarized in numerous articles and reports including Richardson et al. (1995), NRC (2005), and Southall et al. (2007). Marine mammals use hearing and sound transmission to perform vital life functions. Sound (hearing and vocalization/ echolocation) serves four primary functions for marine mammals, including: 1) providing information about their environment, 2) communication, 3) prey detection, and 4) predator detection. Introducing sound into their environment could disrupt those behaviors. The distances to which anthropogenic sounds are audible depend upon source levels, frequency, ambient noise levels, the propagation characteristics of the environment, and sensitivity of the marine mammal (Richardson et al. 1995).

In assessing potential effects of noise, Richardson et al. (1995) suggested four criteria for defining zones of influence:

- Zone of audibility – the area within which the marine mammal might hear the sound. Marine mammals as a group have functional hearing ranges of 10 hertz (Hz) to 180 kilohertz (kHz), with highest sensitivities to sounds near 40 kHz (Ketten 1998, Kastak et al. 2005, Southall et al. 2007).
- Zone of responsiveness – the area within which the animal reacts behaviorally or physiologically. The behavioral responses of marine mammals to sound depend on: 1) acoustic characteristics of the noise source; 2) physical and behavioral state of animals at time of exposure; 3) ambient acoustic and ecological characteristics of the environment; and 4) context of the sound (e.g., whether it sounds similar to a predator) (Richardson et al. 1995, Southall et al. 2007). Temporary behavioral effects, however, often merely show that an animal heard a sound and may not indicate lasting consequences for exposed individuals (Southall et al. 2007).

  All of these factors that may affect the response of a marine mammal to a given noise can never be determined ahead of time. In lieu of having this information, NMFS uses a standardized noise level to help determine how many animals may be disturbed (harassed) by a given activity during the MMPA authorization process. NMFS currently uses a sound threshold of 160 decibels (dB) referenced to one micro pascal (re 1µPa) for the types of sound produced by the active acoustic sources considered here to determine the onset of behavioral harassment for marine mammals (Level B harassment takes) (NMFS 2005). Any animal exposed to impulse noises above this level is assumed to respond in a way consistent with the definition of a behavioral “take” under the MMPA, although NMFS acknowledges that some marine mammals may react to sounds below this threshold or may not react to sounds above this threshold.
- Zone of masking – the area within which the noise may interfere with detection of other sounds, including communication calls, prey sounds, or other environmental sounds.
- Zone of hearing loss, discomfort, or injury – the area within which the received sound level is potentially high enough to cause discomfort or tissue damage to auditory or other systems. NMFS considers exposure of marine mammals to this level of sound to be Level A harassment and has regulated some industrial and military activities to reduce the risk of such exposures.

The SWFSC has been using a variety of sonar and other acoustic systems during its research cruises to characterize marine habitats and fish aggregations and to monitor gear deployments. This acoustic equipment sends pulses of sound into the marine environment which provide information as they reflect back to the ship and are recorded (see Appendix A). The sounds produced by equipment used by the SWFSC range from 18-333 kHz and from 206 dB to 225 dB re 1µPa (Appendix C, Section 6.2). The LOA application (Appendix C, Section 7.2) categorized these acoustic sources based on operating frequency and output characteristics. Category 1 active acoustic sources include short range echosounders and acoustic Doppler current profilers (ADCPs). These have output frequencies >300 kilohertz (kHz), are generally of short duration, and have high signal directivity. Category 2 active acoustic sources include various single, dual, and multi-beam echosounders, devices used to determine trawl net orientation, and current profilers of lower output frequencies than category 1 sources. Output frequencies of category 2 sources range from 12 to 200 kHz, have short ping durations, and are usually highly directional for mapping purposes.

Although these acoustic systems have been used for years and may have been a source of disturbance for nearby marine mammals, no direct observations of disturbance have been documented, primarily because any such disturbance, if it occurred, would have taken place under water. For animals at the surface, it is very difficult to determine whether observed changes in behavior were caused by a given sound source or by the physical presence of the vessel. In many cases it is likely to be a combination of visual and acoustic components that causes a disturbance. It may also be difficult to determine if an animal has actually changed its behavior to avoid a disturbance or if it is moving for other reasons (e.g., to pursue nearby prey). For these reasons there have been no records or documentation of how many animals may have been disturbed by vessels and/or acoustic equipment during research cruises in the past.

NMFS regulations for implementing the MMPA distinguish between Level B harassment that causes behavioral changes in the affected marine mammals and Level A harassment that has the potential to cause injury. Animals exposed to intense sounds may experience reduced hearing sensitivity for some period of time following exposure. This change in hearing threshold is known as noise induced threshold shift (TS). The amount of TS incurred is influenced by amplitude, duration, frequency content, temporal pattern, and energy distribution of the noise (Richardson et al. 1995, Southall et al. 2007). It is also influenced by characteristics of the animal, such as hearing range of the species, behavior, age, history of noise exposure, and health. The magnitude of TS generally decreases over time after noise exposure and if it eventually returns to zero, it is known as 'temporary threshold shift' (TTS). If TS does not return to zero after some time (generally on the order of weeks), it is known as 'permanent threshold shift' (PTS). Sound levels associated with TTS onset are generally considered to be below the levels that would cause PTS, which is considered to be auditory injury.

The current NMFS policy regarding Level A harassment is that cetaceans should not be exposed to impulsive sounds greater than 180 dB re 1 µPa and that pinnipeds should not be exposed to impulsive sounds greater than 190 dB re 1µPa (NMFS 2000). However, these criteria were established before information was available about minimum received levels of sound that would cause auditory injury in marine mammals. They are likely lower than necessary and are intended to be precautionary estimates above which physical injury may occur (Southall et al. 2007).

Southall et al. (2007) assessed the potential for discrete sound exposures to produce TTS and PTS in marine mammals and concluded that, for the kinds of relatively brief exposures associated with transient sounds such as the active acoustic sources used by the SWFSC for research, received sound pressure levels in the range of approximately 180-220 dB re 1µPa are required to induce the onset of TTS levels for most pinnipeds and odontocete cetaceans. Southall et al. (2007) also provided some frequency weighting functions for different marine mammal groups to account for the fact that impacts of noise on hearing depend in large part on the overlap between the range of frequencies in the sound source and the hearing range of the species. Based on the Southall et al. (2007) results, Lurton and DeRuiter (2011) modeled the potential impacts (PTS and behavioral reaction) of conventional echosounders on marine mammals. They estimated PTS onset at typical distances of 10 to 100 meters for the kinds of acoustic sources used in fisheries surveys considered here. They also emphasized that these effects would very likely only occur in the cone ensonified below the ship and that behavioral responses to the vessel at these extremely close ranges would very likely influence the probability of animals being exposed to these levels.

Animals are likely to avoid a moving vessel, either because of its physical presence or because of behavioral harassment resulting from exposure to sound from active acoustic sources. It is unlikely that animals would remain in the presence of a harassing stimulus absent some overriding contextual factor. Because of this likely avoidance behavior, as well as the source characteristics (i.e., intermittent pulsing and narrow cones of ensonification), the SWFSC has determined that the risk of animals experiencing repetitive exposures at the close range or of the duration necessary to cause PTS is negligible. The SWFSC therefore does not anticipate causing any Level A harassment by acoustic sources of marine mammals and the LOA application includes no such take estimates. The potential for this type of impact on marine mammals will not be discussed further in this Final PEA.

However, the SWFSC anticipates that the use of active acoustic equipment in its research activities could cause Level B harassment of marine mammals. In its LOA application for the Preferred Alternative

(Appendix C), the SWFSC estimates the numbers of marine mammals that may be exposed to sound levels of 160 dB or above due to the use of acoustic sonars during research cruises (Level B harassment takes). The LOA application used the operational conditions and scope of work conducted in the past five years to estimate what may occur in the future under the Preferred Alternative. The Preferred Alternative would add longline sampling to an existing survey in the ETP but would otherwise be the same as the Status Quo Alternative as far as potential acoustic disturbance is concerned. The estimates of Level B harassment takes by acoustic sources presented in the LOA application therefore also represent potential numbers of animals affected under the status quo conditions.

As explained in the LOA application, these estimates attempt to quantify a very dynamic situation that has a great deal of unavoidable uncertainty regarding the propagation of sound in the water and distribution of marine mammals over very large areas. The scientific description of sound generated by sonar gear and its propagation through water is complicated, especially considering a sound source that is moving (on a vessel) through waters of different depths and properties (e.g., salinity and temperature) that affect sound transmission. The LOA application provides details on the assumptions that were made about the source levels and acoustic properties of sonar pulses, the directionality of the sound, and propagation/attenuation properties that were used to calculate an "ensonified zone" considered loud enough to harass marine mammals. One part of the SWFSC Level B harassment take calculation used a model of sound propagation from typical sonar equipment used during research to estimate the shape and dimensions of a typical ensonified zone ≥ 160 dB re 1 μPa, which was multiplied by the distance research ships travel with active sonar gear to derive an estimated total volume ensonified to the Level B harassment take guidelines.

Another aspect of this Level B harassment take estimation process subject to large uncertainty concerns the distribution and abundance of marine mammals in the area. No species is distributed evenly throughout its range; they are typically patchy in distribution with strong seasonal variations and preferences for certain zones within the water column. Although some preferred habitats and general distributions are known, there is no way to know exactly how many animals will be in any area at any point in the future. The estimation process therefore uses average density of each species within the different research areas to estimate how many may be affected within the ensonified volume. One refinement that has been built into the Level B harassment take model is to categorize each marine mammal species according to its typical dive depth range, which affects the size of the ensonified zone they may be exposed to. The estimation process is admittedly subject to great uncertainty and there is no way to assess how "realistic" these estimates are in terms of the number of animals that would be disturbed by the activity. However, the development of the Level B harassment take model was conservative in the sense that assumptions were made that would tend to overestimate the size of the ensonified volume and the number of animals affected (Appendix C, Section 6.2).

This Final PEA (and the LOA application) must also assess what the likely biological effects may be for these estimated Level B harassment takes by acoustic sources. The LOA application (Appendix C, Section 7.2) provides an analysis of the potential effects of acoustic equipment used in SWFSC research on marine mammals (and other species). The analysis in this Final PEA is a summary of the LOA application analysis and will be provided in the subsections on cetaceans and pinnipeds because of their different hearing ranges and frequencies used for communication, which determines what the effects of different acoustical equipment might be. This effort to examine the biological importance of acoustic disturbance requires knowledge about whether animals can perceive the sonar signals, their potential reactions to various types of sounds, and the conditions under which particular sound sources may lead to biologically meaningful effects (i.e., interference with feeding opportunities or critical social communication). Unfortunately, many key aspects of marine mammal behavior relevant to this discussion are very poorly known. Most of the data on marine mammal hearing and behavioral reactions to sounds comes from relatively few captive, trained animals and likely does not reflect the diversity of behaviors in wild animals. Some behavioral reactions, if they occur in one or more species, could substantially reduce the numbers of animals exposed to high sound levels (e.g., swimming away from an approaching ship before sound levels reach the 160 dB level). Industrial projects such as seismic exploration for oil and gas and pile driving in relation to coastal developments are typically required to monitor marine mammal behavioral responses in relation to percussive industrial sounds but there have been few efforts to document behavioral responses to acoustic equipment commonly used in fisheries research.

Injury or mortality due to ship strikes and entanglement in gear

The Pacific coast of the U.S. includes numerous shipping lanes, active ports, and vessel traffic. Vessel collisions with marine mammals, or ship strikes, can lead to death by massive trauma, hemorrhaging, broken bones, or propeller wounds (Knowlton and Kraus 2001). Large whales, such as fin whales, are occasionally found draped across the bulbous bow of large ships upon arriving in port. Massive propeller wounds can be immediately fatal. If more superficial, the whales may survive the collisions (Silber et al. 2009). Jensen and Silber (2003) summarized large whale ship strikes world-wide and found that most collisions occurred in the open ocean involving large vessels. Commercial fishing vessels were responsible for four of 134 records (3%), and one collision (0.75%) was reported for a research vessel. Vessel speed appears to be key in determining the frequency and severity of ship strikes, with the potential for collision increasing at ship speeds of 15 knots (kts) and greater (Laist et al. 2001, Vanderlaan and Taggart 2007). In the relatively few recorded cases of ship strikes at speeds below 15 kts, the chance of mortality declines from approximately 80% at 15 kts to approximately 20% at 8.6 kts (Vanderlaan and Taggart 2007).). Certain areas with high densities of whales and high vessel traffic (e.g., Stellwagen Bank National Marine Sanctuary and North Atlantic right whales) have been subject to mandatory ship speed restrictions of less than ten knots to reduce the risk of ship strikes. Relatively high rates of blue whale and other large whale mortalities from ship strikes have occurred along the California coast in recent years and have led to increased efforts to map high risk traffic zones and develop mitigation technologies and strategies (Abramson et al. 2010). Voluntary ship speed restrictions in the Santa Barbara Channel have not been very effective in reducing average ship speeds in this high-risk ship strike area but adaptive management strategies with real-time monitoring of whale presence and ship locations may be more effective in reducing risks of ship strikes (Abramson et al. 2010). Reducing the co-occurrence of whales and vessels may be the only sure way to reduce ship strikes, but this is not always feasible (Silber et al. 2009).

No collisions with large whales have been reported from any fisheries research activities conducted or funded by the SWFSC in any of the three research areas. Transit speeds vary from 6-14 kts but average 10 kts. The vessel's speed during active sampling is typically 2-4 kts due to sampling design but these much slower speeds essentially eliminate the risk of ship strikes.

Given the relatively slow speeds of research vessels, the presence of bridge crew watching for obstacles at all times (including marine mammals), the presence of marine mammal observers on some surveys, and the small number of research cruises, ship strikes with marine mammals during the research activities described in this Final PEA would be considered rare in frequency, localized in geographic scope, and unlikely to occur within the next five years. The potential for fisheries research vessels to cause serious injury or mortality to any cetaceans or pinnipeds due to ship strikes is considered minor adverse throughout the three SWFSC research areas using vessel types and protocols currently in use. This potential effect of research will not be discussed further in the following analysis.

In contrast to the unlikely risk of ship strikes, there is a well-documented history of marine mammals being injured and killed due to capture and entanglement in trawl and longline fishing gear during SWFSC research activities (Tables 4.2-7 and 4.2-8). Four different species have been incidentally caught in SWFSC trawl gear in the past five years. Pacific white-sided dolphins have been caught most frequently, with 13 incidents involving 32 animals. California sea lions have been incidentally taken in seven incidents involving 17 animals. Northern fur seals have been caught three times, each time involving one animal. Northern right-whale dolphins have been caught only once but that incident involved six animals. In addition, five California sea lions have been caught on longline gear, one animal each on five separate occasions.

The number of marine mammal takes during SWFSC fisheries research has varied substantially over the past five field seasons. After many years with no or very rare takes of marine mammals, the 2008 field season ended with a large number of marine mammals being taken (43 total, with 38 killed), including several "disaster sets" where multiple animals were taken at once, primarily with the Nordic 264 trawl during the CPS survey (also known as Sardine Survey). The CPS survey was suspended in 2008 due to the high number of takes and the SWFSC convened a panel of experts to examine the problem and develop more effective mitigation measures and formalized procedures (Hewitt 2009). Most of the mitigation measures that are part of the Status Quo Alternative have been implemented since 2009 as a result of that expert review, including development and deployment of a marine mammal excluder device (MMED) for the Nordic 264 trawl.

It is not clear why the number of takes was so high in 2008 or whether the mitigation measures implemented since then have actually been effective at reducing the number of takes. The record of takes in 2008, both in terms of the number of incidents and the total number of animals involved, was substantially higher than the previous year (2007) and subsequent years (2009-2012), which are similar in scope to each other (Table 4.2-7). The number of marine mammal takes has declined since 2009 relative to the 2008 season but takes have not been eliminated. There are many variables that influence the effectiveness of visual monitoring at any one time, including the lighting and sea state and the capabilities of the person assigned to watch, so it is impossible to determine an overall measure of effectiveness, such as how many animals may have been avoided with visual monitoring compared to having no monitors. It is also difficult to scientifically determine the effectiveness of gear modifications, such as the excluder device, because potential interactions would occur underwater and out of sight. The value of implementing some mitigation measures is therefore based on general principles and best available information even if their effectiveness at reducing takes has not been scientifically demonstrated.

Figures 4.2-1 and 4.2-2 show the spatial distribution of cetaceans and pinnipeds respectively that have been taken in SWFSC surveys from 2008-2012. The distribution of takes is fairly uniform and is almost entirely off the coast of California, which is where the CPS survey effort is most intensive and where the Juvenile Rockfish and Juvenile Salmon surveys are conducted. These three surveys account for all of the animals taken in trawl gear. The HMS and Thresher Shark surveys also take place off the coast of California and account for the captures of marine mammals (all pinnipeds) on longline gear. Although some trawl sets have taken more than one animal at a time, there does not appear to be any "hot spots" where marine mammal takes are concentrated. Rather, takes have been dispersed over a large area offshore of California where most of the fisheries research takes place.

Tables 4.2-7 and 4.2-8 indicate the date and time for all historical takes of marine mammals in trawl gear and longline gear respectively. Similar to the spatial distribution of the takes, there does not appear to be any obvious pattern of animals being taken only in particular seasons or times of day. In most years there are too few incidents to establish any trend. In 2008, takes occurred throughout the spring, summer, and early fall, which reflects when the surveys were conducted. Most takes occurred during the night, reflecting the higher number of takes during the CPS, which is conducted primarily at night.

The MMPA authorization process requires the applicant (SWFSC) to estimate how many marine mammals may be captured or entangled in the future under the proposed set of conditions. As is the case for Level B harassment takes by acoustic sources, the LOA application (Appendix C, Section 6.1) describes the methodology used to estimate the species and numbers of animals that may be taken by Level A harassment and serious injury or mortality during future research conducted under the Preferred Alternative. For the four species that have been taken historically during SWFSC research, the LOA application uses the calculated average annual numbers of takes that have occurred in the past five years and "rounds up" this annual average to the next highest number of animals. Since the LOA application requests takes for a five-year period, this intentionally inflated annual average is multiplied by five to produce an estimate higher than the historic average take for each species that has been taken incidentally during SWFSC research. This methodology has been used in order to ensure accounting for the maximum amount of potential take in the future.

The LOA application also includes estimates for future incidental takes of a number of species that have not been taken historically but exist in the same areas and show similar types of behaviors as species that have been taken in the past. For these analogous and potentially vulnerable species, the SWFSC believes that the risk of future takes is low (i.e., that they would be rare events) but there is a potential for more than one animal to be caught at a time in trawls. For species that are considered analogous (i.e., similar behaviors, distribution, and abundance) to one of the four species that have been taken historically, the LOA application estimates the take of these analogous species based on the maximum number of similar animals that have been taken in any one incident historically. For example, five dolphin species were deemed to have a similar vulnerability to trawl gear as the Pacific white-sided dolphin. The maximum take of Pacific white-sided dolphins was 11 individuals in one trawl set in 2008; the LOA application therefore requests 11 takes for each of the five similar dolphin species over the five-year LOA period under the assumption that one incidence of capture is possible during that time, and that as many as 11 animals could be taken in such an incident. Nine California sea lions were taken in one trawl in 2008; the LOA application requests nine takes each of two similar pinniped species (Steller sea lions and harbor seals) over the five-year LOA period. In addition, the SWFSC has included estimates of a small number of less abundant cetaceans that may be taken in trawl and longline gear based on records of incidental takes in commercial fisheries that use similar gear and in similar areas as research activities. See Appendix C, Section 6.1, for a more detailed explanation of the LOA application estimation methodology.

The LOA application estimates of take are based on the scope of research and mitigation measures proposed under the Preferred Alternative. However, as was the case with the Level B harassment take analysis, the estimates of Level A harassment, serious injury, and mortality takes in the LOA application are relevant to the discussion of effects from the Status Quo Alternative for the CCRA and ARA and will be reported in this section. The analysis is different in the ETPRA because the LOA application includes a new longline survey that has not been conducted under the status quo conditions. The estimated takes in the ETPRA will be discussed under the Preferred Alternative (Section 4.3.4). The analysis of gear interaction effects is limited to the gear types that have a history of marine mammal takes in either SWFSC research or similar commercial fisheries in the research areas. Gear types and other scientific equipment that have no history of takes or adverse interactions with marine mammals and are very unlikely to result in takes in the future (e.g., small-mouthed nets designed to sample plankton and larval fish, CTD rosettes, and ROVs), are not discussed further.

Table 4.2-7 Historical takes of marine mammals in trawl gear during SWFSC surveys from 2008 through 2012

All takes have occurred in the CCRA. Data are from NMFS Protected Species Incidental Take database.

Survey Name	Protected Species Taken	Trawl Gear	Date (Time) Taken	# Killed	# Released Alive Injured[1]	# Released Alive Uninjured[1]	Total Taken
2012							
Coastal Pelagic Species (CPS)	Pacific white-sided dolphin	Nordic 264	Aug 24 (5:30 am)	2	0	0	2
CPS	Pacific white-sided dolphin	Nordic 264	Aug 18 (10:35 pm)	1	0	0	1
CPS	Pacific white-sided dolphin	Nordic 264	June 29 (11:20 am)	0	0	1	1
2011							
Juvenile Salmon (JS)	Pacific white-sided dolphin	Nordic 264	Sept 10 (5:30 pm)	6	0	0	6
JS	California sea lion	Nordic 264	Sept 9 (1:25 am)	1	0	0	1
CPS	Pacific white-sided dolphin	Nordic 264	April 3 (10:19 pm)	1	0	0	1
2010							
Juvenile Rockfish (JR)	Pacific white-sided dolphin[2]	Modified Cobb	Sept 10 (4:15 pm)	1	0	0	1
CPS	Pacific white-sided dolphin	Nordic 264	April 25 (12:30 am)	1	0	0	1
CPS	Pacific white-sided dolphin	Nordic 264	April 18 (8:20 am)	0	1	0	1
2009							
JR	California sea lion	Modified Cobb	May 25 (11:00 pm)	0	0	1	1
CPS	Pacific white-sided dolphin	Nordic 264	May 1 (4:00 am)	0	0	3	3
2008							
CPS	California sea lion	Nordic 264	Aug 14 (4:03 am)	9	0	0	9
CPS	Northern right whale dolphin	Nordic 264	Aug 9 (10:41 am)	6	0	0	6
CPS	Pacific white-sided dolphin	Nordic 264	Aug 9 (10:41 am)	11	0	0	11
CPS	Northern fur seal (SMI stock)	Nordic 264	Aug 3 (10:35 am)	1	0	0	1
CPS	Northern fur seal (SMI stock)	Nordic 264	July 31 (9:38 am)	1	0	0	1
CPS	California sea lion	Nordic 264	July 28 (7:38 am)	1	0	0	1
CPS	Pacific white-sided dolphin	Nordic 264	July 19 (3:05 am)	1	0	0	1

Survey Name	Protected Species Taken	Trawl Gear	Date (Time) Taken	# Killed	# Released Alive Injured[1]	# Released Alive Uninjured[1]	Total Taken
JR	California sea lion	Modified Cobb	June 15 (12:30 am)	1	0	2	3
CPS	Northern fur seal (EP stock)	Nordic 264	April 27 (2:36 am)	1	0	0	1
CPS	California sea lion	Nordic 264	April 27 (11:27 am)	1	0	0	1
CPS	Pacific white-sided dolphin	Nordic 264	April 26 (8:22 am)	2	0	0	2
CPS	Pacific white-sided dolphin	Nordic 264	April 21 (12:56 am)	1	0	0	1
CPS	California sea lion	Nordic 264	April 18 (5:46 am)	1	0	0	1
Total				**50**	**1**	**7**	**58**

[1] The determination of whether an animal was injured or not was made by the Chief Scientist or Officer in Charge on board the survey vessel and based on visible injuries only.

[2] This take occurred during gear trial operations outside of the typical survey season and using non-standard survey protocols.

Table 4.2-8 Historical takes of marine mammals in longline gear during SWFSC surveys from 2008 through 2012.

All takes have occurred in the CCRA.

Survey Name	Protected Species Taken	Trawl Gear	Date (Time) Taken	# Killed	# Released Alive Injured	# Released Alive Uninjured	Total Taken
2012							
Highly Migratory Species (HMS)	California sea lion	Longline	June 23 (0:40 am)	0	1	0	1
2010							
HMS	California sea lion	Longline	July 27 (6:00 pm)	0	1	0	1
2009							
Thresher Shark	California sea lion	Longline	Sept 18 (4:00 pm)	0	0	1	1
2008							
HMS	California sea lion	Longline	Sept 15 (midnight)	0	0	1	1
HMS	California sea lion	Longline	Sept 6 (midnight)	0	0	1	1
Total				**0**	**2**	**3**	**5**

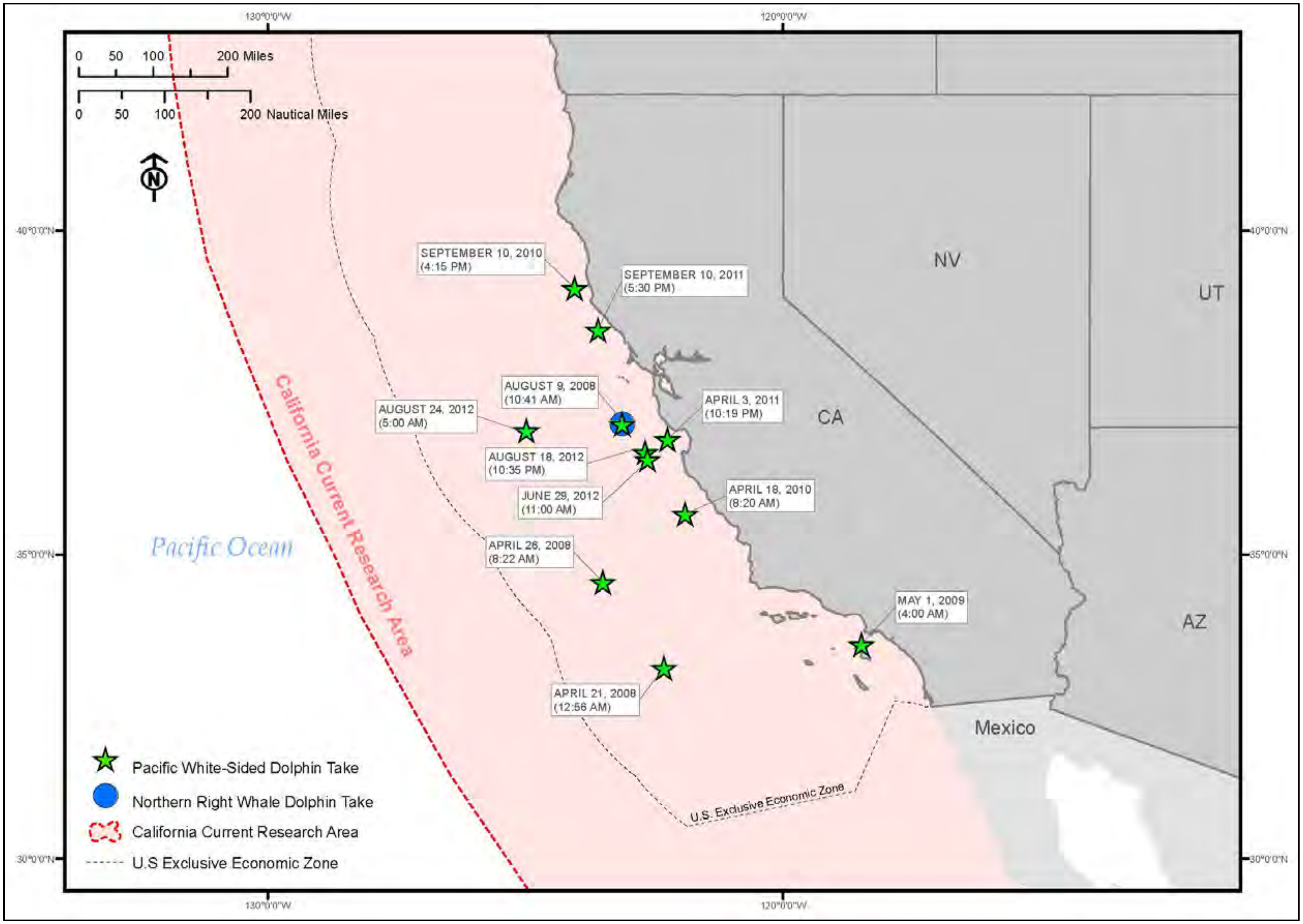


Figure 4.2-1 Location of Cetacean Takes during SWFSC Research, 2008-2012.

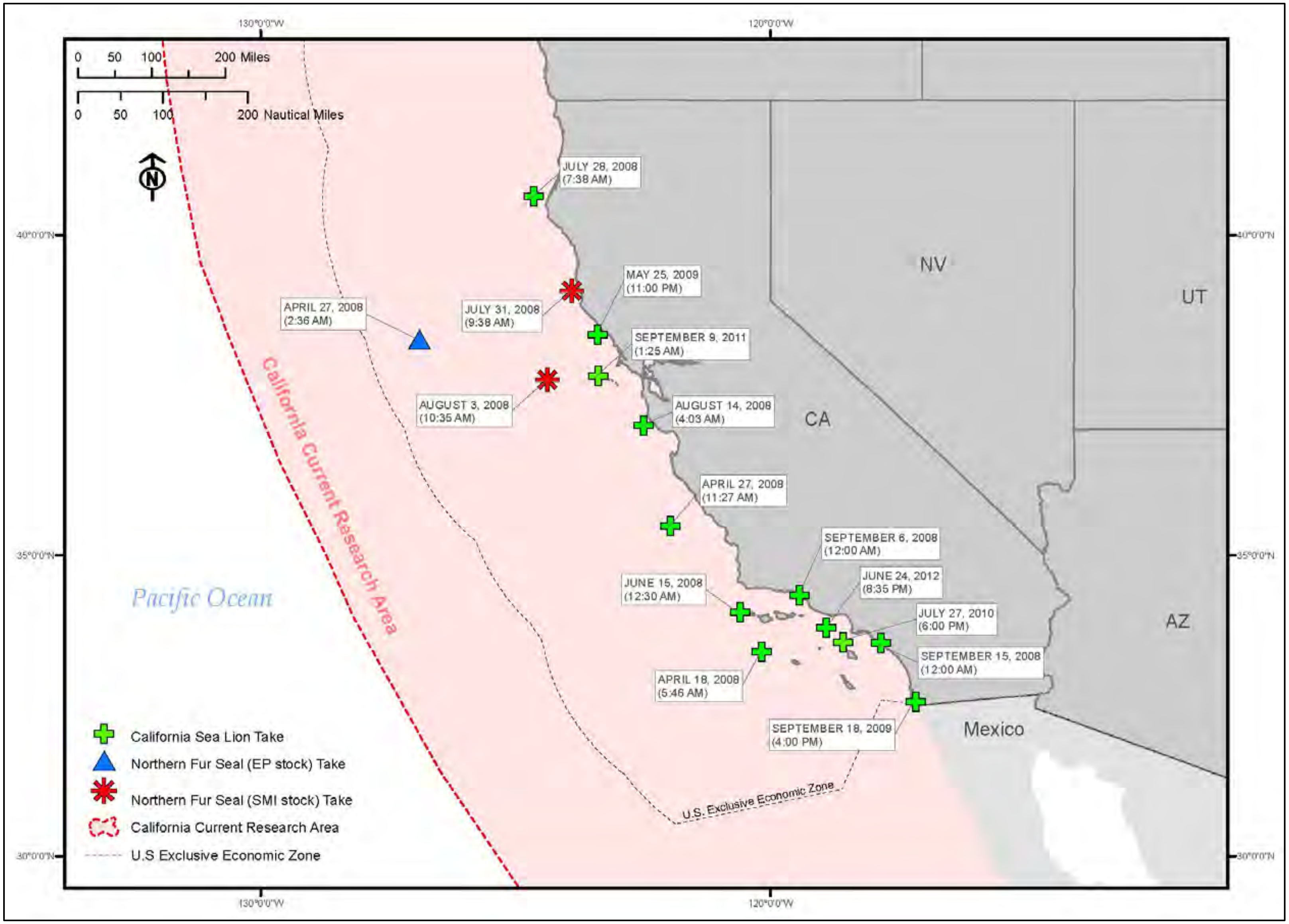


Figure 4.2-2 Location of Pinniped Takes during SWFSC Research, 2008-2012.

Changes in food availability due to research survey removal of prey and discards

Prey of marine mammals varies by species, season, and location and, for some, is not well documented. There is some overlap in prey of marine mammals in the CCRA and the species sampled and removed during SWFSC research surveys. The species of primary concern in regard to this overlap are the small, energy-rich, schooling species such as Pacific sardine, anchovies, and jack mackerel. However, the total amount of these species taken in research surveys is very small relative to their overall biomass in the area (See Section 4.2.3 for more information on fish caught during research surveys). The average annual catch of Pacific sardines in the course of all SWFSC research surveys in the past five years is about 1,565 kgs (1.565 metric tons [mt]). This research catch is a very small fraction (0.0001 percent) of the estimated biomass for Pacific sardines, 157 million mt (Hill et al. 2011), and is negligible compared to the combined commercial harvest for sardines (145,861 mt) off the coasts of British Columbia south to Baja, Mexico (2010 data, Hill et al. 2011). The average annual catch of anchovies in the course of all SWFSC research surveys in the past five years is about 1.2 mt. Biomass estimates are not available for this species but the overfishing level has been set at 139,000 mt and commercial harvests off the U.S. Pacific coast are about 2,093 mts per year (2010 data, Hill et al. 2011). For jack mackerel, average combined SWFSC research catch (0.39 mt) compares to an overfishing level of 126,000 mt and commercial harvests of about 309 mt (2010 data, Hill et al. 2011). There are other species of fish and invertebrates taken in research surveys that are used as prey by marine mammals but, as exemplified by these three species, the proportions of research catch compared to biomass and commercial harvest is very small (Section 4.2.3).

In addition to the small total biomass taken, some of the size classes of fish targeted in research surveys are very small (e.g., juvenile rockfish only centimeters long) and these small size classes are not known to be prey of marine mammals in the CCRA. Research catches are also distributed over a wide area because of the random sampling design covering large sample areas. Fish removals by research are therefore highly localized and unlikely to affect the spatial concentrations and availability of prey for any marine mammal species. This is especially true for pinnipeds in the California Current, which are opportunistic predators that consume a wide assortment of fish and squid, and judging by their increasing populations and expanding ranges in the Pacific Northwest (Caretta et al. 2011), food availability does not appear to be a limiting factor (Baraff and Loughlin 2000, Scordino 2010). The overall effect of research catches on marine mammals through competition for prey is therefore considered minor adverse for all species in the CCRA.

Under the Status Quo, SWFSC research catches in the ETP are limited to tiny amounts of plankton (about 20 kgs total) and juvenile fish (about 1 kg total) collected over vast areas of the ocean. The effects on marine mammals are therefore considered minor adverse for all species in the ETP. The addition of a few longline sets under the Preferred Alternative would likely take some species and size classes used by marine mammals but the effort would be so small and distributed over such a large area that it would not change this minor conclusion.

In the ARA, SWFSC surveys are primarily focused on Antarctic krill, which are a key component of the food web for numerous marine mammals (including southern fur seals and baleen whales) as well as penguins and other birds. Acoustic data are used to measure abundance and distribution of krill but very small amounts of krill and zooplankton are also captured in small-mesh nets (IKMT) for biometric data. Krill abundance and distribution is driven by weather and oceanographic forces and varies tremendously over space (patchy distribution) and over time. Biomass estimates are only available in the few places where research occurs (South Shetland Islands and Elephant Island). Estimates of krill biomass in each of three monitored areas have averaged between .5 and 2.5 million mts in the past few years (Van Cise 2009). The amount of krill and other zooplankton collected during research is a negligible fraction of overall biomass and would not affect the abundance or availability of prey to any marine mammals.

The SWFSC also conducts periodic bottom trawl surveys in the South Orkney Islands area to monitor the recovery of several finfish that were overfished in the 1970s and 1980s. These surveys are only conducted every two or three years as funds and appropriate charter vessels become available. During the last survey (2008-2009 season), a total of 7.7 mt of fish were collected from 65 species (Van Cise 2009). This data has been used to estimate densities of the different species in the area, with the most common species caught having densities up to 7 mt per square nautical mile (nm^2). It is not known how important these species or size classes taken during research are to marine mammals in the area. However, given the periodic nature of the surveys and the relatively small amount of fish removed from the system over a large area, it is unlikely to affect the distribution or availability of prey for any marine mammal species.

The potential for SWFSC research to affect the availability of prey to marine mammals is considered to be negligible for all species, all three research areas, and under all of the action alternatives and it will not be discussed further.

Contamination from discharges

Discharge from vessels, whether accidental or intentional, potentially includes sewage, ballast water, fuel, oil, miscellaneous chemicals, garbage, and plastics. Impacts to marine mammals in the vicinity of the discharge range from superficial exposure to ingestion and related effects. Even at low concentrations that are not directly lethal, some contaminants can cause sub-lethal effects on sensory systems, growth, and behavior of animals, or may be bioaccumulated (DOE 2008).

All NOAA vessels and SWFSC chartered vessels are subject to the regulations of MARPOL 73/78, the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (NOAA 2010). MARPOL includes six annexes that cover discharge of oil, noxious liquid substances, harmful packaged substances, sewage, garbage, and air pollution (IMO 2010). Adherence to these regulations minimizes or negates the likelihood of discharges of potentially harmful substances into the marine environment. Annex V specifically prohibits plastic disposal anywhere at sea and severely restricts discharge of other garbage (IMO 2010). Discharge of contaminants from SWFSC vessels and SWFSC chartered vessels is possible, but unlikely, and if it occurs, would be isolated in both time and location.

Discharge of contaminants from SWFSC vessels and SWFSC chartered vessels is possible, but unlikely to occur in the next five years. If an accidental discharge does occur, it is likely to be a rare event and the potential volume of material is likely to be small and localized. The potential impacts to marine mammals would be similarly short-term, localized, and likely affect a small number of animals. The overall impact of accidental contamination of marine mammals would therefore be considered minor adverse. As the potential effects of discharges, regulations governing discharges, and the likelihood of discharges is universal across the three research areas, this will not be discussed further in this analysis.

4.2.4.1 California Current Research Area

ESA-listed Species

The endangered marine mammals that occur in the CCRA include blue, fin, sei, humpback, and sperm whales and the Southern resident Distinct Population Segment (DPS) of killer whales. Threatened species include Guadalupe fur seals. All of these species are under the jurisdiction of NMFS in regard to compliance with the MMPA and ESA. In addition, the Southern subspecies of sea otters are listed as threatened under the ESA and are under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS).

Disturbance and Behavioral Responses Due to Acoustic Equipment

The LOA application (Appendix C) includes calculations of the number of marine mammals that may be exposed to sound levels above 160 dB from all acoustic devices used during SWFSC research activities. Those calculations include a number of assumptions and elements with large variables over time and space (e.g., the densities of marine mammals and the propagation of sound under different conditions). The Final PEA reports the results of those estimates in Table 4.2-9 below, but see Appendix C for a discussion about the derivation and concerns about the accuracy of these estimates. The likely impact on ESA-listed species from the different types of acoustic devices is discussed below.

Table 4.2-9 Estimated Level B harassment takes of marine mammals by acoustic sources during SWFSC research in the California Current Research Area.

Species (Common name)	Estimated take by acoustic sources (numbers of animals)
Harbor porpoise	682
Dall's porpoise	1,365
Pacific white-sided dolphin	378
Risso's dolphin	188
Bottlenose dolphin	32
Short-beaked common dolphin	5,592
Long-beaked common dolphin	348
Striped dolphin	301
Northern right whale dolphin	176
Killer whale	13
Short-finned pilot whale	12
Cuvier's beaked whale	146
Baird's beaked whale	34
Mesoplodont beaked whales	40
Pygmy sperm whale	42
Dwarf sperm whale	42
Sperm whale[1]	65
Humpback whale[1]	14
Blue whale[1]	24
Fin whale[1]	33
Sei whale[1]	1
Common minke whale	13
Gray whale	346
California sea lion	5,363
Steller sea lion (Eastern DPS)	1,141
Guadalupe fur seal[1]	134
Northern fur seal	11,791
Northern elephant seal	4,743
Harbor seal	993

[1] ESA-listed species

The output frequencies of Category 1 active acoustic sources (short range echosounders, Acoustic Doppler Current Profilers) are >300 kHz and are generally short duration signals with high signal directivity (Appendix C, Section 6.2). The functional hearing range of baleen whales is 7 Hz-22 kHz, with highest sensitivity generally below 10 kHz, which is well below the frequency range of Category 1 sources so they are less likely to be detected by blue, fin, sei, or humpback whales (Figure 4.2-3). Sperm and killer whales are in the mid-frequency hearing group with a range of 150 Hz-160 kHz, with highest sensitivity from 10-120 kHz. The functional underwater hearing range of pinnipeds is 75 Hz-75 kHz, with highest sensitivity from 1-30 kHz. The functional hearing ranges of these species also fall below the output frequency of Category 1 acoustic sources; effects are expected to be temporary, if they occur, and are considered minor adverse.

Category 2 active acoustic sources (various single, dual, and multi-beam echosounders, devices used to determine trawl net orientation, and several current profilers) have frequencies of 12-200 kHz, short ping durations, and are usually highly directional. These are unlikely to be heard by most baleen whales, but are within the range of hearing for sperm and killer whales. Most Category 2 acoustic sources are also not likely to be audible to most pinnipeds. If detected, short term avoidance is the most likely response, which would tend to reduce the exposure of animals to high sound levels (Appendix C, Section 7.2).

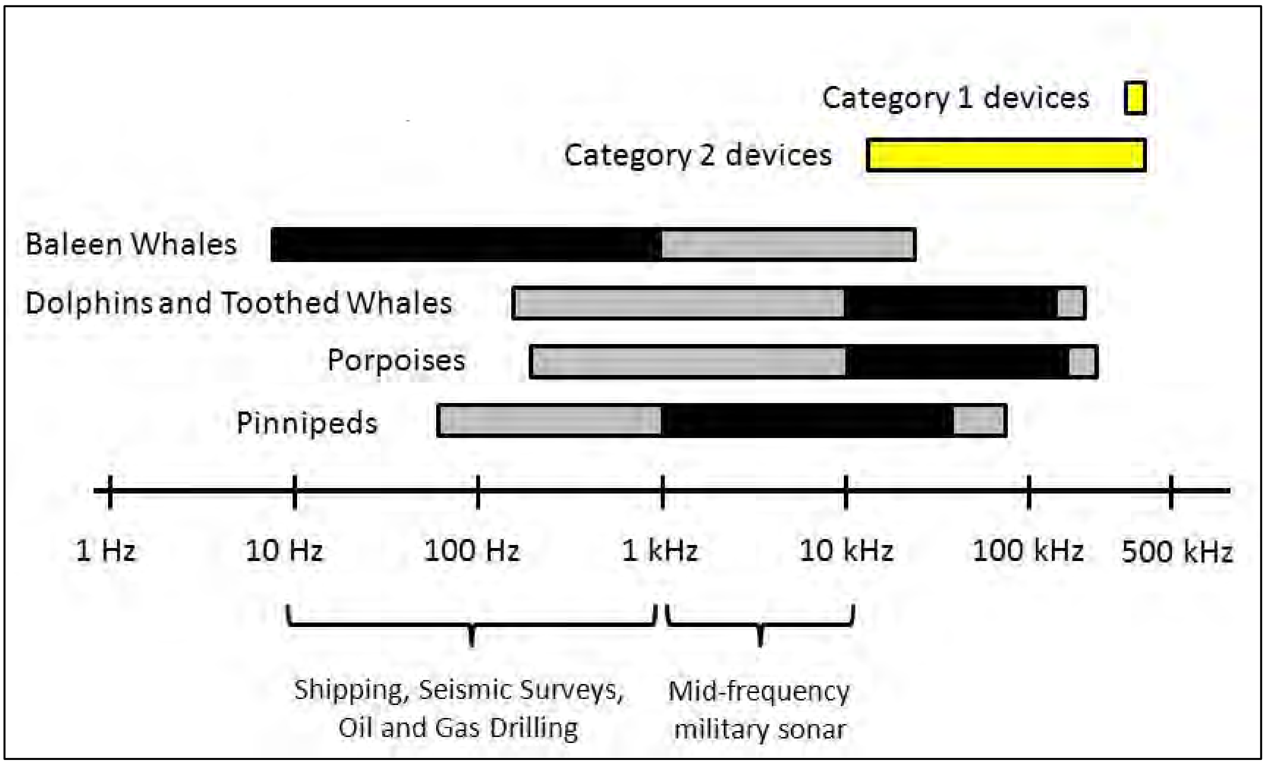


Figure 4.2-3 Typical frequency ranges of hearing in marine mammals.

This figure shows hearing ranges for different marine mammal groups (gray and black bars) relative to the frequency outputs of the two categories of acoustic devices used in SWFSC research (yellow bars), as identified in Appendix C, Section 6.2. Black bars indicate the most sensitive hearing ranges of different marine mammals. Brackets indicate frequency ranges of several industrial sound sources as well as U.S. Navy mid-frequency active sonar for comparison. Data on hearing ranges is from Southall et al. (2007) and modified from DON (2008b). The functional hearing range of sea otters in water has not been determined.

The anticipated effects of active acoustic sources used during SWFSC fisheries research on threatened and endangered marine mammals are likely to occur infrequently, although they may occur over a large geographic area. Most of the frequencies are well above detection ranges for ESA-listed whales, although some category 2 sound sources are within the range of hearing for sperm whales, killer whales, and pinnipeds. However, the sounds most likely to be audible are of short duration and restricted to areas close to the research vessel (i.e., 10s of meters to a few 100s of meters). To date, there have been no reports or anecdotal observations of sounds from SWFSC research activities disturbing or causing behavioral changes in threatened or endangered species.

Sounds originating from vessels may affect large whales through masking of biologically important sounds, particularly for low frequency baleen whales (Clark et al. 2009). The biological significance of masking from vessel noise is not known for any species but presumably the effects could include a decreased ability to detect sounds used in communication, predator avoidance, and orientation. However, the relatively small number of SWFSC research vessels in the CCRA is likely to only result in temporary and minimal effects from acoustic masking as vessels pass through an area (Appendix C, Section 7.2).

The potential effects from the use of active acoustic devices during research activities would be small in magnitude and short-term in duration, although they would be dispersed over a wide geographic area and be likely to occur under the Status Quo Alternative. The overall impacts of acoustic disturbance to ESA-listed marine mammals throughout the CCRA are therefore considered to be minor adverse.

Injury and Mortality due to Entanglement in Fishing Gear

Tables 4.2-5 and 4.2-6 indicate the history of marine mammal takes by all SWFSC research activities in the CCRA. There have been no entanglements or takes of ESA-listed marine mammals in SWFSC fisheries research from NOAA vessels or NOAA chartered vessels. Table 4.2-10 includes estimates of the number of marine mammals that may be caught in research gear with resulting Level A harassment takes and serious injury or mortality takes. For species that have not been taken historically, the LOA application estimates future takes based on an assessment of whether similar species have been taken by SWFSC research or by commercial fisheries using gear similar to gear used in research.

Given the lack of historical takes in the CCRA, the relatively small number of longline sets used during SWFSC research, and the mitigation measures described in Section 2.2, the SWFSC considers the risk of taking ESA-listed cetaceans to be very low (i.e., a rare event unlikely to occur in the next five years). None of the ESA-listed cetaceans are expected to experience any adverse interactions with SWFSC research surveys in the CCRA that result in injury, serious injury, or mortality. The overall impacts on these species through gear interactions would therefore be considered minor adverse under the criteria described in Table 4.1-1.

Other ESA-listed species

The LOA application does not include any projected takes of Guadalupe fur seals in the CCRA based on a lack of historical takes in fishing gear and other characteristics of this species (Appendix C). For similar reasons, the SWFSC also does not anticipate any future takes of southern sea otters, which are under the jurisdiction of the USFWS and are not covered in the LOA application to NMFS. The potential risk of injury or mortality to these ESA-listed species is considered very low and the overall impacts are considered minor adverse under the Status Quo Alternative.

Other Cetaceans

The Common minke whale and the gray whale are the only baleen whales included in this section that are not ESA-listed. The remaining cetaceans are toothed whale species (i.e., odontocetes), including two species of porpoises, seven species of dolphins, non-ESA-listed killer whales, short-finned pilot whale, three or more species of beaked whales, and Pygmy and Dwarf sperm whales (Table 3.2-4).

Disturbance and Behavioral Responses Due to Acoustic Equipment

The analysis of acoustic effects on these species is similar to that discussed for ESA-listed killer whales and sperm whales above. Table 4.2-9 provides summaries of the numbers of each species that could be taken by acoustic disturbance during SWFSC research activities in the CCRA. See Appendix C for a discussion about the derivation and concerns about the accuracy of these estimates. The likely impact on cetaceans from the different types of acoustic devices is discussed below.

The mid-frequency odontocetes have a functional hearing range of 150 Hz to 160 kHz, with highest sensitivity from 10-120 kHz. The high-frequency odontocetes have a functional hearing range of 200 Hz to 180 kHz, with highest sensitivity from 10-150 kHz. The output frequencies of Category 1 active acoustic sources (>300 kHz) are above the functional hearing range of baleen whales and cetaceans in the mid- and high-frequency hearing groups (Figure 4.2-3). Because they would not be able to hear them, cetaceans are not expected to be affected by Category 1 sound sources (Appendix C, Section 6.2).

Category 2 active acoustic sources are unlikely to be heard by most baleen whales, but are within the range of hearing for various odontocetes, especially high frequency hearing harbor and Dall's porpoise. Some of these devices are used on trawl nets during fishing so their use is intermittent, localized and directional, and they are deployed on moving sources. The sounds could be loud to cetaceans in close proximity to the sound source but physical damage is unlikely, although Temporary Threshold Shift could occur if animals remained close to the source (tens to a few hundred meters) for prolonged periods (Appendix C, Section 6.2). The short duration of most research tows (< 30 minutes) should minimize that likelihood. If detected, short term avoidance is the most likely response (Appendix C, Section 6.2).

Potential disturbance from active acoustic equipment used during research would not have any measurable effect on the population of any cetacean and would therefore be considered minor in magnitude. Such disturbance is likely to occur wherever survey vessels use the equipment, but cetaceans would only be close enough to a vessel to be affected on a rare or intermittent basis and any behavioral changes would be temporary. The overall impact of active acoustic sound sources on non ESA-listed cetaceans throughout the CCRA is therefore considered to be minor adverse according to the criteria in Table 4.1-1.

Injury or Mortality Due To Entanglement in Gear

Table 4.2-7 shows the history of marine mammal takes by all SWFSC research activities in the CCRA, including two species of cetaceans, Pacific white-sided dolphin and northern right whale dolphin. Measures to mitigate the risk of entanglements are described in Section 2.2.1. The SWFSC LOA application (Appendix C) includes estimates of the potential number of other cetaceans that may interact with research gear based on their similarity to these two species and historical takes in commercial fisheries operating in similar areas and using similar gear types (Table 4.2-10). Note that the LOA application does not request authorization to take all species of marine mammals that occur in the CCRA; only those species listed in Table 4.2-10 are considered to have a reasonable risk of adverse interactions with gear used for SWFSC research. As described earlier, the LOA application has used conservative procedures to estimate potential future takes of marine mammals. The SWFSC considers these estimates to be greater than what is likely to occur in the future, especially for species that have never been taken in the past and that are infrequently encountered during research surveys.

Table 4.2-10 Potential number of non ESA-listed marine mammal takes in the California Current Research Area.

This table summarizes information presented in the LOA application (Appendix C) on the potential takes by Mortality and Serious Injury (M&SI) and Level A harassment in the CCRA over the next five years using trawl and longline gear types. Some stocks have been combined. All population estimates, Potential Biological Removal (PBR) values, and total annual mortality and serious injury data are from the most recent stock assessment report (Carretta et al. 2011). The average annual mortality and serious injury data includes known interactions with commercial fisheries and ship strikes and, for Pacific white-sided dolphins and Northern right-whale dolphins, includes the contribution of SWFSC and NWFSC incidental takes due to fisheries research. Note that PBR is an annual measure of mortality. The LOA application estimates potential takes for the five-year period and these have been averaged for an annual take estimate that can be compared with PBR.

Species	Minimum Population Estimate	PBR (animals per year)	Average Annual M&SI from all sources	Total Historical SWFSC Takes (2008-2012)	Potential M&SI and Level A Take average per year (total for five-year period)	
					Trawl	Longline
Harbor porpoise	37,535 (four stocks)	669	8.6		**1** (5)	
Dall's porpoise	32,106	257	0.4		**1** (5)	
Pacific white-sided dolphin	21,406	193	15.1	32 (trawl)	**7** (35)	
Risso's dolphin	4,913	39	1.6		**2.2** (11)	**0.2** (1)
Bottlenose dolphin	684 (CA/OR/WA offshore stock)	5.5	0.2		**1.6** (8)	
	290 (California coastal stock)	2.4	0.2		**0.6** (3)	
	974 (All stocks combined)	7.9				**0.2** (1)
Striped dolphin	8,231	82	0		**2.2** (11)	**0.2** (1)
Short-beaked common dolphin	343,990	3,440	64		**2.2** (11)	**0.2** (1)
Long-beaked common dolphin	76,224	610	13.8		**2.2** (11)	**0.2** (1)
Northern right-whale dolphin	6,019	48	4.8	6 (trawl)	**2** (10)	
Undetermined delphinid species					**0.2** (1)	
Short-finned pilot whale	465	4.6	0			**0.2** (1)
Pygmy sperm whale and Dwarf sperm whale	271	3	0			**0.2** (1)
	No estimate	NA	0			
California sea lion	153,337	9,200	431	17 (trawl) 5 (longline)	**4** (20)	**1** (5)
Steller sea lion	34,485	1,552	65.1		**1.8** (9)	**0.2** (1)
Northern fur seal	Eastern Pacific stock 642,265	13,809	500[1]	1 from EP stock(trawl)	**1** (5)	
	San Miguel Is. stock 5,395	324	1.2	2 from SMI stock (trawl)		

Species	Minimum Population Estimate	PBR (animals per year)	Average Annual M&SI from all sources	Total Historical SWFSC Takes (2008-2012)	Potential M&SI and Level A Take average per year (total for five-year period)	
					Trawl	Longline
Harbor seal	26,667 (CA stock) No current estimate for WA stocks	1,600	47.8		**1.8** (9)	
Northern elephant seal	74,913	4,382	10.4		**1** (5)	
Undetermined pinniped species					**0.2** (1)	**0.2** (1)

[1] Data on mortality and serious injury rate of northern fur seal, EP stock, is from the Alaska Stock Assessment Report (Allen and Angliss 2011) and primarily involves subsistence harvest by Alaska Natives.

No non-ESA-listed baleen whales are anticipated to be taken in SWFSC research activities under the Status Quo Alternative in the next five years. The LOA application requests takes for one "undetermined delphinid species" in trawl gear for the five-year LOA period. This request is made to account for similar looking dolphin and porpoise species that may be caught or entangled in gear but free themselves or are released before they can be identified or photographed by research personnel. In its LOA application, the SWFSC analyzes the potential impact of these "undetermined" takes by adding them to each of the delphinid species for which it estimates Level A harassment, serious injury, and mortality takes. When applied to the nine dolphin and porpoise species listed in Table 4.2-10, the total estimated average annual take in the next five years is less than 10 percent of PBR (Table 4.2-10**)** for all but one species (the exception is for bottlenose dolphins, see below) and this level of mortality, if it occurred, would be considered minor in magnitude. For the other non-delphinid cetaceans, the estimated average annual take in the next five years is also less than 10 percent of PBR (Table 4.2-10**)** and this level of mortality, if it occurred, would be considered minor in magnitude. These potential mortalities would be rare or infrequent events and most would be unlikely to actually occur in the next five years. Any actual take would occur in a localized area, but as explained for Steller sea lions, cetaceans generally travel through large geographic areas so the potential loss of an animal would affect more than a localized population. The overall impact of the potential takes of these species, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1.

Bottlenose dolphin

The estimated potential take of bottlenose dolphins is divided between two stocks for trawl gear based on the relative frequency of trawl sets in nearshore waters and sets made further offshore. The coastal stock of bottlenose dolphin (PBR = 2.4) is generally only found within 1 km of shore (Carretta et al. 2011). The CA/OR/WA offshore stock is larger and has a PBR of 5.5. The LOA application estimates that less than two bottlenose dolphins from the CA/OR/WA offshore stock could be taken each year in trawl gear (1.6 average, eight takes per five-year period). In addition, less than one bottlenose dolphin from the coastal stock could be taken each year in trawl gear (0.6 average, three takes per five-year period). To account for the "undetermined delphinid species" take requested by the SWFSC, the LOA application applies one take per five-year period in trawl gear to each of these bottlenose stocks; the total estimated take would be nine takes per five-year period for the CA/OR/WA offshore stock (1.8 takes per year average) and four takes per five-year period for the coastal stock (0. 8 takes per year average). Takes of real animals occur to whole animals, of course, not fractions of animals. However, for the purpose of determining the potential magnitude of effect in this NEPA analysis, we compare the average annual take estimates to PBR, which is also an annual metric. For both of these stocks, this level of take in trawl gear, if it occurred, would be greater than 10 percent and less than 50 percent of PBR and would be considered moderate in magnitude according to the criteria described in Table 4.1-1. The LOA application also estimates that one bottlenose dolphin from "all stocks" could be taken in longline gear in a five-year period (0.2 takes per year average). The LOA application assumes that this estimated take on longline gear would occur from the CA/OR/WA offshore stock based on the location of most longline sampling efforts. When added to the estimated takes from trawl gear, the combined take from the CA/OR/WA offshore stock from both trawl and longline gear would be 2.0 dolphins per year, which would be greater than 10 percent and less than 50 percent of PBR for the stock and would be considered moderate in magnitude according to the criteria described in Table 4.1-1.

The estimated takes of bottlenose dolphins are based on their similarity with Pacific white-sided dolphins, specifically one interaction in 2008 that involved the entanglement and death of 11 Pacific white-sided dolphins in a Nordic 264 trawl (Table 4.2-7). Since that time, additional mitigation measures have been implemented, including incorporation of a MMED in the Nordic 264, and the risk of taking this species in such numbers should be reduced. The estimated take on longline gear is based on infrequent takes of dolphins in commercial fisheries; none have been taken during SWFSC research. Given the implementation of mitigation measures since 2008 and the fact that the SWFSC has never taken bottlenose dolphins in the past, the SWFSC considers the risk of taking bottlenose dolphins to be very low (i.e., a rare event unlikely to occur in the next five years), although there is a chance that more than one animal could be taken in any one interaction. Given the frequency and likelihood components of the NEPA analysis, the overall impact of the Status Quo Alternative on bottlenose dolphins would be considered minor adverse according to the criteria described in Table 4.1-1.

Pinnipeds

There are five species of non-ESA-listed pinnipeds commonly found in the CCRA that may interact with SWFSC research: California sea lion, Steller sea lion, Northern fur seal (two stocks), harbor seal (several stocks), and Northern elephant seal (Table 3.2-4).

Disturbance and Behavioral Responses Due to Acoustic Equipment

The analysis of acoustic effects on these species is similar to that discussed for ESA-listed Guadalupe fur seals above. Table 4.2-9 provides summaries of the numbers of each species that could be taken by acoustic disturbance during SWFSC research activities in the CCRA.

The anticipated effects of active acoustic sources used during SWFSC fisheries research on pinnipeds are likely to occur over a large geographic area under the Status Quo Alternative. However, most of the frequencies are well above detection ranges for pinnipeds, although some category 2 sound sources are within the hearing range of pinnipeds. The sounds most likely to be audible are of short duration and restricted to areas very close to the research vessel so potential interactions are likely to be intermittent and infrequent. To date, there have been no reports or anecdotal observations of sounds from SWFSC research activities disturbing or causing behavioral changes in pinnipeds or other marine mammal species. The overall impacts of acoustic disturbance to pinnipeds throughout the CCRA are therefore considered to be minor adverse according to the criteria described in Table 4.1-1.

Injury and Mortality Due to Entanglement in Fishing Gear

Table 4.2-7 shows the history of pinniped takes by all SWFSC research activities in the CCRA, including California sea lions and northern fur seals from both the San Miguel Island and Eastern Pacific stocks. Measures to mitigate the risk of entanglements are described in Section 2.2.1. The SWFSC LOA application (Appendix C) includes calculations of the number of these and other pinnipeds that may interact with research gear based on their similarity to these two species and historical takes in commercial fisheries operating in similar areas and using similar gear types (Table 4.2-10). As described in the ESA-listed species section above, the SWFSC does not think this many pinnipeds would actually be taken in the next five years but has chosen to use a conservative estimation procedure to ensure accounting for the maximum amount of potential take.

California sea lions

A total of 17 California sea lions have been caught in trawl gear during SWFSC surveys from 2008-2012, with 14 mortalities and three animals being released without apparent injury. The majority of these takes (nine sea lions) occurred during one set during a CPS survey in 2008. Most of the mortalities occurred during the CPS survey but one occurred during a Juvenile Salmon survey and another occurred during a Juvenile Rockfish survey. All of the mortalities occurred using the Nordic 264 trawl except the one mortality in the Juvenile Rockfish survey, which uses the modified Cobb trawl. The LOA application uses the historical record to estimate an average of four takes per year in trawl gear for the next five years under the status quo conditions (20 serious injury/mortality or Level A harassment takes in trawl gear in the five-year period). Additional mitigation measures have been implemented since 2008, including development and incorporation of a marine mammal excluder device for the Nordic 264 trawl and use of acoustic pingers on all trawls. These new procedures and equipment are expected to minimize the risk of sea lions being taken in trawl gear at the rates they were in 2008. However, the SWFSC is taking a conservative approach to the LOA application estimates and, because this Final PEA supports that LOA application, the following analysis is based on these estimated take numbers.

In addition to the animals caught in trawl gear, five California sea lions have been caught on longline gear in the 2008-2012 period. Two of these animals were injured but released while the other three were released without apparent injury. There have been no documented mortalities on longline gear during SWFSC research but these historical takes have been used to estimate future takes on longline gear in the LOA application. Based on these historical records, the LOA application estimates an average of one take of California sea lions per year (five total for the five-year period) by either serious injury/mortality or Level A harassment from longline gear.

The LOA application requests takes for one "undetermined pinniped" in trawl gear and one in longline gear for the five-year LOA period. This request is made to account for animals that may be caught or entangled in gear but free themselves or are released before they can be identified or photographed by research personnel. In its LOA application, the SWFSC analyzes the potential impact of these "undetermined" takes by adding them to each of the pinniped species for which it estimates Level A harassment, serious injury, and mortality takes. When applied to California sea lions, the total estimated takes of 5.4 California sea lions per year (4.2 takes per year average in trawl gear and 1.2 takes per year average in longline gear), if they occurred, would be much less than 10 percent of PBR (PBR = 8,511) and would therefore be considered minor in magnitude. Given the implementation of new mitigation measures, including a MMED for the Nordic 264 trawl, future mortalities of California sea lions would be considered rare or infrequent events and would be unlikely to actually occur at this estimated rate in the next five years. Any actual take would occur in a localized area, but these animals travel over large geographic areas so the potential loss of an animal would affect more than a localized population. The overall impact of potential takes of this species in SWFSC research gear, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1.

Northern fur seals

A total of three Northern fur seals have been caught and killed in trawl gear during SWFSC surveys from 2008-2012. Two of these animals were from the San Miguel Island stock and one was from the Eastern Pacific stock. All of the mortalities occurred during the CPS survey using the Nordic 264 trawl. The LOA application uses this historical record to estimate an average of one take per year in trawl gear for the next five years under the status quo conditions (five serious injury/mortality or Level A harassment takes in the five-year period). To account for the "undetermined pinniped species" takes requested by the SWFSC, the LOA application applies one take per five-year period in trawl gear to Northern fur seals. The total estimated take of this species would therefore be six takes per five-year period in trawl gear (1.2 takes per year average). This level of mortality, if it occurred, would be much less than 10 percent of PBR even if all of them came from the smaller San Miguel Island stock (PBR = 324) and would therefore be considered to be minor in magnitude. Given the implementation of new mitigation measures, including a MMED for the Nordic 264 trawl, future mortalities of fur seals would be considered rare or infrequent events and would be unlikely to actually occur at this estimated rate in the next five years. Given the historical record and geographic overlap with the majority of SWFSC research activities, most of these potential takes would likely involve the more geographically restricted San Miguel Island stock. The overall impact of potential takes of this species in SWFSC research trawl gear, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1.

Other pinnipeds

There have been no historical takes of Steller sea lions, harbor seals, or Northern elephant seals in SWFSC research. The LOA application estimates the potential number of Steller sea lion and harbor seal takes based on their similarity in distribution and behavior to California sea lions. For Northern elephant seals, the estimated takes are based on historical takes in commercial fisheries operating in similar areas and using similar gear types. The estimated take of Steller sea lions and harbor seals is two animals per year in trawl gear (10 animals in the five-year LOA period, including one take in trawl gear to account for the "undetermined pinniped species" in the LOA application take request) compared to PBRs of 1,552 and 1,600 respectively. The estimated take of Northern elephant seals is 1.2 animals per year in trawl gear (six animals in the five-year LOA period, including one take in trawl gear to account for the "undetermined pinniped species") compared to a PBR of 4,382. For all of these species, the estimated annual take, if it occurred, would be much less than 10 percent of PBR and would therefore be considered minor in magnitude. Considering the fact that none of these species have been taken in research trawls in the past, these potential mortalities would be considered rare events and would be unlikely to actually occur in the next five years. The overall impact of potential takes of these species in SWFSC research trawl gear, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1.

Sea Otters

There are two subspecies of Northern sea otter in the CCRA. The ESA-listed Southern subspecies is discussed above. The Washington subspecies is discussed in this section. This population inhabits nearshore waters along the coast of Washington and Puget Sound. These areas are either not covered by SWFSC research activities (Puget Sound) or are much closer to shore than research vessels typically travel or sample. The SWFSC does not anticipate any future Level B or Level A takes of sea otters from this population based on a lack of historical takes and very little spatial overlap between sea otter habitat and SWFSC research activities under the Status Quo Alternative.

4.2.4.2 Eastern Tropical Pacific Research Area

The SWFSC research activities in the ETP have no history of taking marine mammals. Under the Status Quo Alternative there is very little fishing gear deployed in the ETP, with efforts focused more on conducting visual transects for marine mammals and birds. The only nets deployed are very small (< 2 m^2 openings), fine meshed, and designed to capture plankton, or larval fish and invertebrates. These sampling methods have no record of previous adverse interactions with marine mammals and are not likely to do so in the future. The risk of injury or mortality due to entanglement is therefore considered minor adverse under the status quo conditions for all species. The potential effects due to use of active acoustic equipment are discussed below.

ESA-listed Species

The endangered marine mammals that occur in the ETP include blue, fin, sei, humpback, and sperm whales (Table 3.2-4). The only threatened species in the ETP is the Guadalupe fur seal. The LOA application calculates the numbers of each species that may be exposed to sound levels of >160 dB from active acoustics used in ETP research based on status quo conditions (Table 4.2-11).

The analysis of potential disturbance effects from acoustic sources is the same as described for these species in the CCRA above. The potential effects of disturbance due to research activities would be minor in magnitude, temporary in duration, likely to occur throughout the ETPRA, and would have overall minor adverse effects on all ESA-listed marine mammals throughout the ETP under the Status Quo Alternative.

Table 4.2-11 Estimated Level B harassment takes of marine mammals by acoustic sources during SWFSC research in the Eastern Tropical Pacific Research Area.

Species (Common name)	Estimated take by acoustic sources (numbers of animals)	Species (Common name)	Estimated take by acoustic sources (numbers of animals)
Dusky dolphin	18	**Cuvier's beaked whale**	24
Fraser's dolphin	121	**Longman's beaked whale**	1
Risso's dolphin	46	**Mesoplodont beaked whales**	30
Bottlenose dolphin	139	**Dwarf sperm whale**	14
Short-beaked common dolphin	1,300	**Sperm whale**[1]	4
Long-beaked common dolphin	173	**Humpback whale**[1]	1
Rough-toothed dolphin	45	**Blue whale**[1]	2
Striped dolphin	401	**Fin whale**[1]	0
Spinner dolphin	442	**Sei whale**[1]	0
Pantropical spotted dolphin	1,088	**Bryde's whale**	4
Killer whale	3	**Common minke whale**	0
Pygmy killer whale	17	**Guadalupe fur seal**[1]	66
False killer whale	17	**California sea lion**	1,442
Short-finned pilot whale	723	**South American sea lion**	1,442
Melon-headed whale	19	**Northern elephant seal**	3,248

[1] ESA-listed species

Other Cetaceans

In addition to the ESA-listed species, there are two other species of baleen whales and at least 23 other odontocetes in the ETP. Table 4.2-11 shows the estimated Level B harassment takes by acoustic sources of these species under the status quo conditions. The analysis of potential disturbance effects from acoustic sources is the same as described for other cetacean species in the CCRA above. The potential effects of disturbance due to research activities would be minor in magnitude, temporary in duration, likely to occur throughout the ETPRA, and would have overall minor adverse effects on all cetaceans throughout the ETP under the Status Quo Alternative.

Pinnipeds

In addition to the ESA-listed Guadalupe fur seal, there are three other species of pinnipeds in the ETP, including California sea lion, South American sea lion, and Northern elephant seal. Table 4.2-11 shows the estimated Level B harassment takes by acoustic sources of these species under the status quo conditions. The analysis of potential disturbance effects from acoustic sources is the same as described for pinniped species in the CCRA above. The potential effects of disturbance due to research activities would be minor in magnitude, temporary in duration, likely to occur throughout the ETPRA, and would have overall minor adverse effects on all pinnipeds throughout the ETP under the Status Quo Alternative.

4.2.4.3 Antarctic Research Area

The SWFSC conducts a variety of directed research projects on marine mammals in the Scotia Sea and Antarctic islands but there have been no incidental takes of marine mammals in fishing gear during fisheries research surveys under the Status Quo scope of research.

ESA-listed Species

The ESA-listed marine mammals that occur in the ARA are the same endangered whale species listed in the ETP: blue, fin, sei, humpback whales, and sperm whales (Table 3.2-4). There are no ESA-listed pinniped species in the ARA.

Disturbance and Behavioral Responses Due to Acoustic Equipment

The LOA application calculates the numbers of each species that may be exposed to sound levels of >160 dB from active acoustics used in ARA research based on status quo conditions (Table 4.2-12). The analysis of potential disturbance effects from acoustic sources is the same as described for these species in the CCRA above. The potential effects of disturbance due to research activities would be minor in magnitude, temporary in duration, likely to occur throughout the ARA, and would have overall minor adverse effects on all ESA-listed marine mammals throughout the ARA under the Status Quo Alternative.

Table 4.2-12 Estimated Level B harassment takes of marine mammals during SWFSC research in the Antarctic Research Area.

Species (Common name)	Estimated take by acoustic sources (numbers of animals)	Estimated incidental take due to the presence of the vessel[1]
Spectacled porpoise	12	
Hourglass dolphin	12	
Killer whale	11	
Long-finned pilot whale	43	
Arnoux's beaked whale	37	
Southern bottlenose whale	37	
Sperm whale[2]	3	
Humpback whale[2]	92	
Blue whale[2]	0	
Fin whale[2]	114	
Antarctic minke whale	6	
Southern right whale	1	
Antarctic fur seal	136	417
Southern elephant seal	3	3
Leopard Seal	1	4
Weddell Seal	1	3
Crabeater Seal	2	5

[1] Behavioral disturbance of pinnipeds hauled out on ice by AMLR survey vessel activities.

[2] ESA-listed species.

Injury or Mortality Due To Entanglement in Gear

There have been no records of ESA-listed species being taken by entanglement in any gear types used during SWFSC research in the ARA and no serious injuries or mortalities are expected to occur under the status quo conditions.

Other Cetaceans

In addition to the ESA-listed whales, there is one other species of baleen whale and at least 16 other odontocetes in the ARA.

Disturbance and Behavioral Responses Due to Acoustic Equipment

Table 4.2-12 shows the estimated Level B harassment takes by acoustic sources of these species under the status quo conditions. The analysis of potential disturbance effects from acoustic sources is the same as described for other cetacean species in the CCRA above. The potential effects of disturbance due to research activities would be minor in magnitude, temporary in duration, likely to occur throughout the ARA, and would have overall minor adverse effects on all cetaceans throughout the ARA under the Status Quo Alternative.

Injury or Mortality Due To Entanglement in Gear

There have been no records of non ESA-listed cetaceans being taken by entanglement in any gear types used during SWFSC research in the ARA and no injuries, serious injuries, or mortalities are expected to occur under the status quo conditions.

Pinnipeds

There are nine species of pinnipeds in the ARA (Table 3.2-4).

Disturbance and Behavioral Responses Due to Acoustic Equipment and Vessels

Table 4.2-12 shows the estimated Level B harassment takes by acoustic sources of these species under the status quo conditions. The analysis of potential disturbance effects from acoustic sources is the same as described for pinniped species in the CCRA above. In addition, the LOA application estimates the number of pinnipeds hauled out on ice that may be disturbed by the passing of SWFSC research vessels (Level B harassment). Behavioral disturbance may include visible reactions of hauled out animals to the ship, such as some animals leaving haulout locations and entering the water. The LOA application estimates the number of each pinniped species that may be disturbed based on their density estimates, the length of transits through Antarctic waters by research vessels, and an assumed “disturbance zone” of 100 m on either side of the vessel. These estimated Level B harassment takes are included in Table 4.2-12. The potential effects of disturbance due to research activities would be minor in magnitude, temporary in duration, likely to occur throughout the ARA, and would have overall minor adverse effects on all pinnipeds throughout the ARA under the Status Quo Alternative.

Injury or Mortality Due To Entanglement in Gear

There have been no records of pinnipeds being taken by entanglement in any gear types used during SWFSC research in the ARA and no injuries, serious injuries, or mortalities are expected to occur under the status quo conditions.

4.2.4.4 Conclusion

The potential direct and indirect effects of SWFSC research activities on marine mammals have been considered for each of the three SWFSC research areas (CCRA, ETPRA, and ARA) and for all gear types used in research under the Status Quo Alternative. Every species in these research areas may be exposed to sounds from active acoustic equipment used in SWFSC research. However, many of the acoustic sources are likely not audible to many species and for the other species it would likely cause temporary and minor changes in behavior for nearby animals as the ships pass through any given area. The potential for temporary threshold shifts in hearing is low for high frequency cetaceans (porpoises) and very low to zero for other species. The potential for hearing loss or injury to any marine mammal is essentially zero. Because of the minor magnitude of effects and the short-term duration of acoustic disturbance, the overall effects of acoustic disturbance are considered minor adverse for all species and in all three research areas.

There have been two species of cetaceans (Pacific white-sided dolphin and Northern right whale dolphin) and two species of pinnipeds (California sea lion and Northern fur seal) that have been caught in research gear in the past five years, all in the CCRA. These historic data and other data on mortalities in similar commercial fisheries have been used to estimate the potential for mortalities in the next five years under the status quo conditions, which include a suite of mitigation measures that have already been implemented for SWFSC surveys using pelagic trawl and longline gear. Future takes, if they occur, would likely not be as high as the estimates because they are based on a conservative approach to ensure accounting for the maximum amount of potential take. The estimated potential takes in the CCRA for these species are still below 10 percent of PBR for most species and would be considered to have minor magnitudes of effect on the population level. For two species in the CCRA (Risso's dolphin and bottlenose dolphin), estimated takes would be greater than 10 percent and less than 50 percent of PBR and would be considered to have moderate magnitudes of effect on the population level. However, given the lack of historical takes of these species, the relatively small number of research trawls and longline sets used during SWFSC research, and the mitigation measures described in Section 2.2, the SWFSC considers the risk of taking these species at the estimated rate to be very low. Marine mammals generally travel through large geographic areas so the potential loss of one animal would not likely have localized effects. The overall impact of the potential takes of these species in the CCRA, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1. Given the type of research gear and protocols used in the ETPRA and ARA under the status quo conditions, no marine mammals are expected to be caught in those research areas.

Given the very small amounts of fish and invertebrates removed from the ecosystem during scientific sampling, the dispersal of those sampling efforts over large geographic areas, and the short duration of sampling efforts, the overall risk of causing changes in food availability for marine mammals is considered minor adverse for all three research areas. Also, given the crew training, required emergency equipment, and adherence to environmental safety protocols on NOAA research vessels and NOAA chartered vessels, the risk of altering marine mammal habitat through contamination from accidental discharges into the marine environment is considered minor adverse for all three research areas.

4.2.5 Effects on Birds

This section describes the effects of the status quo SWFSC research activities on seabirds. The potential effects of research vessels, survey gear, and other associated equipment on seabirds include:

- Injury or mortality due to ship strikes and entanglement in gear
- Changes in food availability due to survey removal of prey and discards
- Contamination or degradation of habitat

Injury and Mortality Due to Ship Strikes and Entanglement in Fishing Gear

There are several potential mechanisms for SWFSC research activities to cause injury or mortality to seabirds. Many seabirds are attracted to fishing vessels in order to forage on bait, offal, discards, and natural prey disturbed by the fishing operation. This attraction to fishing vessels creates the opportunity for birds to inadvertently collide with cables or lines and other structures on the vessel as well as being caught in the fishing gear. Bird strikes are probably most numerous during the night and during storms or foggy conditions when bright deck lights are on, which can cause the birds to become disoriented (NMFS

2004). However, such collisions with gear or vessels are hard to detect, especially without a dedicated research effort to monitor bird interactions.

In some parts of the world, mortality of seabirds in commercial fishing gear, especially longlines and gillnets, is a major conservation concern for albatross, gulls, and other species that follow commercial fishing vessels. Diving birds are vulnerable to getting caught in gill nets and other fishing gear near the surface as it is being set or hauled in. In the California Current, commercial fisheries using set and drift gillnets and longline gear have the worst records of taking seabirds and a number of species are considered to have population-level effects as a result (Mills et al. 2005). In the Southern Ocean and many areas of the ETP, longline fisheries for various species have had severe effects on several species of albatross and other tubenoses (Brothers at al. 1999).

Changes in Food Availability

Fishing activities can have potentially adverse effects on seabirds through changing the abundance or distribution of their prey species. A recent study (Cury et al. 2011) examined data from the past 450 years and all of the world's oceans and found that when prey abundance (small fish and invertebrates) dropped below one third of maximum documented biomass, seabird reproductive success declined significantly. This held true for species all over the world. Many factors influence the abundance and distribution of seabird prey, including strong roles for oceanographic and weather fluctuations, but commercial fisheries are also a factor. Although it is very difficult to demonstrate the indirect effects of fishing for other species and size classes on the availability of prey for seabirds, directed fishing on small schooling fish (e.g., sardines and anchovies) and invertebrates (e.g., krill) have played major roles in driving seabird prey populations below the "one third" limit in many areas (Cury et al. 2011).

Fishing activities may also have beneficial effects on seabirds through the provisioning of offal and discards that would otherwise be unavailable to birds. In some areas with intensive fishing efforts, offal may provide a substantial portion of the total food consumed by scavenging species such as gulls (Tasker and Furness 1996). However, while scavenging may benefit individual birds, it also places them in danger from entanglement and incidental mortalities in fishing gear.

Contamination or Degradation of Habitat

Contamination from spills and discharges can accumulate in the seafloor and marine life and have a toxic effect on the plants, animals and humans through the food chain (NOAA 2010d). While there are no intentional discharges of pollutants from SWFSC or any other fisheries research vessels, there is the potential for accidental spills to occur. Discharge from vessels, whether accidental or intentional, may include sewage, ballast water, fuel, oil, miscellaneous chemicals, garbage, and plastics.

All NOAA and ocean-going vessels are subject to the regulations of MARPOL 73/78, the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (NOAA 2010 b). MARPOL includes six annexes that cover discharge of oil, noxious liquid substances, harmful packaged substances, sewage, garbage, and air pollution (IMO 2010). Adherence to these regulations minimizes or negates the likelihood of discharges of potentially harmful substances into the marine environment. Annex V specifically prohibits plastic disposal anywhere at sea and severely restricts discharge of other garbage (IMO 2010).

NOAA vessels are operated by the NOAA Commissioned Officer Corps, one of the seven uniformed services of the United States (U.S.). All NOAA vessels are fully equipped to respond to emergencies, including fuel spills, and crew receive extensive safety and emergency response training. These precautionary measures help reduce the likelihood of fuel spills occurring and increase the chance that they would be responded to and contained quickly. Oil spill prevention training and equipment may be more variable on commercial fishing vessels that are chartered for research purposes but all vessels are required to comply with USCG regulations on spills. Discharge of contaminants from vessels used during research surveys is possible, but unlikely, and if it occurs, would be isolated in both time and location and likely small in volume.

4.2.5.1 California Current Research Area

Seabirds occur throughout the year in all areas of the California Current concurrent with SWFSC research activities. Fisheries research surveys use several gear types that have been demonstrated to result in seabird mortality in commercial fisheries of the Pacific, including longlines and pelagic trawls (Mills et al. 2005). However, there are no records of any bird mortalities due to interactions with fishing gear or ship strikes during SWFSC fisheries and ecological research activities. The lack of seabird mortalities during pelagic trawl research may be due in part to the short tow times for research surveys relative to typical commercial fishing efforts and also to the much smaller number of vessels and gear sets involved in research. On NOAA vessels or chartered vessels, any seabird mortalities during survey efforts would be recorded. As stated earlier, it is usually very difficult to detect seabird collisions with gear or vessels but there are no records of any bird mortalities due to ship strikes during SWFSC conducted fisheries research activities. There is still a potential for mortality to occur from gear interaction or ship strikes but they are likely to be rare events that would not affect seabird populations.

The short duration of fisheries research tows, the dispersal of research effort over wide areas of sea, and the relatively small number of research surveys over time makes it very unlikely that the abundance or distribution of seabird prey would be affected by research activities. This is especially true for the small size classes of fish and pelagic invertebrates favored by most seabirds because of their large biomass and the minimal amounts taken in research samples (Sections 4.1.3 and 4.1.7). For the same reasons, the amount of food made available through research activities is unlikely to have more than temporary and highly localized beneficial effects on seabirds. The potential effects of research on seabirds through changes in food availability are therefore considered minor adverse.

The potential for research vessels to cause degradation of seabird habitat and prey through contamination would only be through accidental spills and discharges. Given the crew training previously discussed and the small number of fisheries research vessels, these would likely be limited in scope, infrequent, and localized and would therefore considered minor adverse.

4.2.5.2 Eastern Tropical Pacific Research Area

The SWFSC research activities in the ETP have no history of taking seabirds. Under the Status Quo scope of research there is very little actual fishing activity in the ETP, with efforts focused more on conducting visual transects for marine mammals and birds. This means there is very little or no offal or bait to attract birds and a relatively small risk of birds inadvertently striking the vessels or gear. The risk of injury or mortality is therefore considered minor adverse. Given the minimal amount of biomass removed by research and the fact that these surveys are conducted from only one or two NOAA vessels, the potential effects from changes in prey availability or contamination in the ETP are also considered minor adverse.

4.2.5.3 Antarctic Research Area

The SWFSC research activities in the ARA have not resulted in any seabird mortalities.. The gear types that have been used in these surveys (small plankton nets, similar nets to sample krill and juvenile fish, and bottom snapper trawls) have not been implicated in seabird mortalities in commercial fisheries as has longline gear and gill nets. Given the minimal amount of biomass removed by research, the potential effects on seabirds from changes in prey availability are considered minor adverse. These surveys are conducted on large charter vessels that must pass health, safety, and emergency preparedness requirements similar to those on NOAA vessels. With only one or two vessels being used in any given year, the risk of contamination in the Antarctic is also considered minor adverse.

4.2.5.4 Conclusion

The overall effects on seabirds from SWFSC research activities under the Status Quo Alternative are expected to be short-term and rare in frequency and duration, localized in geographic extent, and would not result in any measurable changes to seabird populations; effects are therefore considered minor adverse according to the criteria in Table 4.1-1. This conclusion holds for each of the three SWFSC research areas and for all gear types used in research.

4.2.6 Effects on Sea Turtles

Section 3.6 describes the populations of sea turtles that are likely to overlap with SWFSC fishery research activities in the CCRA and ETPRA. This section describes the potential effects of SWFSC research activities on sea turtles under the Status Quo Alternative, including mitigation measures that have been implemented to reduce adverse effects.

Five species of sea turtles can be found within the CCRA and ETPRA: leatherback, olive ridley, green, loggerhead, and hawksbill sea turtles. All five species of sea turtles are listed as endangered under the ESA. Direct and indirect effects of SWFSC research activities on sea turtles may include:

- Disturbances and changes in sea turtle behavior due to physical movements and sounds
- Injury or mortality due to ship strikes and gear interaction
- Changes in food availability due to survey removal of prey
- Contamination or degradation of sea turtle habitat

Mitigation measures implemented under the Status Quo Alternative are intended to reduce the potential for adverse interactions with sea turtles, and are described in Section 2.2.1.

Disturbance and Changes in Behavior Due to Physical Movements and Sound Sources

Impact producing factors that could potentially disturb sea turtles and cause changes in behavior include the physical presence of marine vessels and fishing gear, operational sounds from engines and hydraulic equipment, and active acoustic devices used for navigation and research.

There are no experimental or systematic observational data on auditory or behavioral responses of sea turtles to high frequency sound sources typically used for acoustic fisheries research and navigation (Appendix C, Section 6.2). Based on the auditory capabilities of sea turtles at low frequencies, active acoustic sources used in SWFSC fisheries research operations are unlikely to be audible to sea turtles and therefore are unlikely to have adverse effects on sea turtles (Appendix C, Section 6.2). Sea turtles may be disturbed or displaced from their normal behavior or movements by passing vessels or fishing gear in the water. Given the small number of research vessels and their dispersal over a wide area, behavioral disturbances resulting from SWFSC research activities proposed under Alternative 1 would be isolated in geographic extent and short-term in nature, lasting only a few minutes as the research vessel passes. Such disturbances would not result in measureable changes to sea turtle foraging success or survival at the population level. Therefore, the effects would be minor adverse using gear types and mitigation measures similar to those currently in use.

Injury or Mortality Due to Ship Strikes and Entanglement in Gear

The two main mechanisms for research activities to cause injury or mortality to sea turtles are ship strikes and entanglement in fishing gear. Sea turtles come to the surface to breathe, and also to rest, making them susceptible to ship strikes. However, there are no reported incidents of collisions with sea turtles by NMFS research vessels in the CCRA or ETPRA. As described in Section 2.2.1, vessel speeds are restricted on research cruises in part to reduce the risk of ship strikes with marine mammals and sea turtles. Transit speeds vary from 6-14 kts, but average 10 kts. The vessel's speed during active sampling is typically 2-4 kts due to sampling design, and these slower speeds are assumed to minimize the risk of collisions with sea turtles. Given the relatively slow speeds of research vessels, the presence of dedicated watches during survey activities, and the small number of research cruises, collisions with sea turtles resulting from the research activities considered under the Status Quo Alternative are considered unlikely. Therefore, the effects of collisions with sea turtles are considered minor adverse throughout the CCRA and ETPRA using vessel types and mitigation measures similar to those currently in use.

In the CCRA, there has been one incident of sea turtle entanglement resulting from SWFSC research using a standard Nordic 264 trawl configured for surface fishing. During the 2011 SWFSC Juvenile Salmon Survey, a Pacific leatherback sea turtle was incidentally caught due west of Pigeon Point, San Mateo County, California. Once the net was pulled onto the deck of the research vessel, it became apparent that the leatherback sea turtle had been caught, along with a large haul of jellyfish. The crew immediately loosened the net around the turtle's head to allow breathing during extraction from the net. The turtle was breathing while in the net, and the crew opened the net and extracted the turtle within three minutes. Once out of the net, the turtle showed no signs of severe injuries, and was released alive. The turtle was subsequently observed swimming and breathing normally at the surface behind the vessel. Mitigation measures in use at the time of the sea turtle interaction included a sea turtle watch (3-4 observers) before and during the trawl.

Sea turtle interactions with longline gear include entanglement in lines and being caught by hooks as a result of depredation by sea turtles on the bait or caught fish. These types of adverse interactions may result in serious injuries or even mortalities to the sea turtle species involved. Loggerhead and leatherback sea turtles have been identified as being at particular risk of population decline as a result of incidental take by longline pelagic fisheries (Lewison et al. 2004) However, there have been no recorded incidents of sea turtle interactions with SWFSC research longline gear in the CCRA. Under Alternative 1, the SWFSC would continue to use circle hooks and finfish bait to minimize the risk of catching sea turtles. In addition, the SWFSC would continue to use shallow pelagic sets to sample sharks with gangions long enough to allow a hooked turtle to reach the surface. Longline gear for Highly Migratory Species surveys would be set at depths greater than 50 ft. Given the lack of historical interactions under the same conditions, the potential for future interactions is considered small and unlikely to affect any populations of sea turtles. The effects of longline surveys on sea turtle populations are therefore considered minor adverse based on the criteria in Table 4.1-1.

Mitigation measures implemented under the Status Quo Alternative would be intended to reduce the potential for adverse interactions with sea turtles. Operational procedures and monitoring methods described in Section 2.1.1 would include visual scans for sea turtles, and would preclude trawl and longline surveys in areas where turtles are observed. However, the efficacy of these mitigation measures may be limited by the fact that turtles in the water may be difficult to see. Mitigation measures limiting tow duration to 30 minutes would decrease the potential for turtle mortality to result from interaction with trawl gear. Short tow durations would ensure that any turtles captured in trawl nets would be removed from the net in a timely manner, thereby decreasing the potential for drowning. In addition, MMEDs similar to those required under Alternative 1 have been shown to be effective for reducing adverse interactions between sea turtles and trawl gear (http://www.nmfs.noaa.gov/pr/species/turtles/teds.htm). In summary, there has been one recorded incident of sea turtle entanglement resulting from SWFSC research activities. In that instance, the turtle was released alive. There have been no reported interactions resulting in sea turtle mortality. Based on this information, minor adverse effects are expected to occur using gear types and mitigation measures similar to those currently in use; these effects would be rare and short-term in frequency and duration, and would not result in measurable changes to sea turtle population levels in any of the SWFSC research areas.

Changes in food availability due to survey removal of prey

Western Pacific leatherback turtles (*Dermochelys coriacea*) forage seasonally on dense aggregations of jellyfish off the West Coast of the United States (Graham 2009). All life stages consume gelatinous organisms such as jellyfish and tunicates (Eckhert et al. 2012). Several species of jellyfish, including the two common large jellyfish species, *Chrysaora fuscescens* and *Aurelia labiata*, are frequently caught as a result of SWFSC fisheries research activities in the CCRA. Regurgitated stomach contents and observations of actively foraging individuals in the study area indicate *Chrysaora fuscescens* is more frequently consumed by leatherbacks than other scyphozoan species (Graham 2009).

The average annual catch of *Chrysaora fuscescens* in the course of all SWFSC research surveys over the past five years is about 18,473 kg, and the estimated total average annual catch of *Aurelia labiata* is 2,623 kg (Table 4.2-13). Catches of jellyfish from the Juvenile Salmon Surveys far exceed those from other SWFSC surveys. An average of 17,866 kg of *Chrysaora fuscescens* are caught annually during Juvenile Salmon Surveys, 99 percent of which are caught from within designated critical habitat for leatherback sea turtles. These surveys also catch an average of 2,529 kg of *Aurelia labiata* each year, of which 62 percent (1,575 kg) are caught from within designated critical habitat for leatherback sea turtles (See section 3.2.4). Although the total biomass of jellyfish species in SWFSC research areas is difficult to estimate, a mean areal density of 251,522 ± 57,504 jellyfish per square nautical mile (jellies / nm^2), has been calculated in the central California foraging area of leatherback turtles based on acoustic backscatter survey data (Graham 2009). Thus, due to the extremely high densities of jellyfish encountered in leatherback foraging areas, the amount of jellyfish removed as a result of SWFSC surveys would have only minor adverse effects on the availability of jellyfish as a food source for leatherback sea turtles.

Contamination or Degradation of Habitat

The only potential mechanisms for SWFSC research activities to cause contamination or degradation of sea turtle habitat would involve accidental spills and discharges. All NOAA vessels are subject to the regulations of MARPOL 73/78, the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (NOAA 2010b). MARPOL includes six annexes that cover discharge of oil, noxious liquid substances, harmful packaged substances, sewage, garbage, and air pollution (IMO 2010). Adherence to these regulations would avoid or minimize the likelihood of discharges of potentially harmful substances into the marine environment. Annex V specifically prohibits plastic disposal anywhere at sea and severely restricts discharge of other garbage (IMO 2010). Discharge of contaminants from SWFSC vessels and SWFSC chartered vessels is unlikely. Any contamination or degradation of sea turtle habitat resulting from SWFSC research activities proposed under Alternative 1 would be isolated in both time and location, and would not result in measureable changes to sea turtle populations in the CCRA or ETPRA. No measureable changes in contamination or degradation of sea turtle habitat are expected to result from SWFSC research activities. Such effects are unlikely and are therefore considered to be minor adverse based on the criteria in Table 4.1-1.

4.2.7 Effects on Invertebrates

This section describes the potential effects of SWFSC research activities on invertebrates under the Status Quo Alternative. The potential effects of research vessels, survey gear, and other associated equipment on invertebrates would include:

- Targeted and incidental capture of invertebrates resulting from surveys
- Physical damage to infauna and epifauna
- Contamination or degradation of habitat

In all instances, the numbers and biomass of invertebrates captured as a result of SWFSC surveys would be minor in magnitude. Because SWFSC surveys do not utilize bottom-contact trawl gear in the CCRA or

ETPRA, physical damage to infaunal and epifaunal communities would not occur in those areas. The SWFSC periodically uses bottom-contact trawl equipment to sample benthic invertebrates and fish in the ARA. Contamination or degradation of invertebrate habitat are unlikely to occur in any of the SWFSC research areas due to standard operating procedures and mitigation measures intended to eliminate adverse impacts to invertebrate habitat. Potential effects are discussed below for each of the SWFSC research areas.

4.2.7.1 California Current Research Area

SWFSC research activities would result in the targeted and incidental capture of several invertebrate species in the CCRA, including Market Squid, Humboldt Squid, euphausids, and several species of jellyfish. The equipment used for research in the CCRA includes near-surface and midwater trawl gear, as well as various plankton nets, water sampling devices and acoustic survey equipment. Because SWFSC surveys do not utilize bottom-contact trawl gear in the CCRA, adverse effects on benthic invertebrates are considered unlikely.

Table 4.2-13 shows the mean annual catch of marine invertebrates in the CCRA for species with a mean annual catch in excess of 20 kg. The amounts of invertebrates caught in research samples are very low relative to both their biomass and the amounts of these species that are harvested in commercial fisheries. For example, the California market squid FMP sets a seasonal catch limit of 107,048 mt (118,000 mt) to prevent the market squid fishery from over-expanding (CDFG 2005b). In contrast, the mean annual catch of market squid resulting from all SWFSC research activities in the CCRA is 470 kg, equivalent to less than one one-thousandth of one percent (0.00001) of the seasonal catch limit for commercial fisheries.

Commercial fisheries do not currently exist for the other invertebrates listed in Table 4.2-13, so comparisons to commercial catch limits are unavailable. Several species of jellyfish, including the two common large jellyfish species, *Chrysaora fuscescens* and *Aurelia labiata*, occur in samples from the surveys shown in Table 4.2-13. Catches of jellyfish from the Juvenile Salmon Surveys far exceed those from other survey types due to the locations of the surveys, gear characteristics, and survey techniques. Juvenile Salmon Surveys extend from central Oregon (Newport) to central California (Pillar Point), and in general they catch large numbers of jellyfish only south of Fort Ross, California. Jellyfish are consistently abundant in the Gulf of the Farallones and just north of Point Reyes near Tomales Bay, and mostly within 5 miles of shore or less. In this region, jellyfish catch occasionally exceeds 5,000 kg in only a few minutes of trawling with a 264 Nordic rope trawl. Not all jellyfish catches are weighed, but the weights given in Table 4.2-13 include estimates for the large hauls. Jellyfish are also encountered in the Juvenile Rockfish Surveys but have not been routinely weighed. Overall, the amounts of invertebrates removed as a result of the SWFSC research activities proposed under Alternative 1 would be small relative to invertebrate population sizes, and this removal would not result in measureable changes to invertebrate populations within the CCRA. Effects to invertebrate populations resulting from SWFSC research activities under Alternative 1 would be minor in magnitude and intensity, localized in small sample areas, and short-term in duration. The effect of these activities on invertebrate populations would be minor adverse according to the criteria in Table 4.1-1.

Table 4.2-13 Mean annual catch of marine invertebrates in the California Current Research Area.

Table shows estimated mean annual catch for species with a mean annual catch in excess of 20 kg from all SWFSC research surveys combined.

Species	Scientific Name	Survey name	Mean Annual Catch (kg)

Species	Scientific Name	Survey name	Mean Annual Catch (kg)
Market Squid	*Doryteuthis opalescens*	CalCOFI CPS Survey Juvenile Rockfish Survey Juvenile Salmon Survey	470
Humboldt squid	*Dosidicus gigas*	CalCOFI	80
Euphausiid	Euphausiacea	CPS Survey Juvenile Rockfish Survey	991
Sea nettle jellyfish	*Chrysaora fuscescens*	CalCOFI CPS Survey Juvenile Rockfish Survey Juvenile Salmon Survey Habitat Survey	18,473
Moon jellyfish	*Aurelia labiate*	CalCOFI CPS Survey Juvenile Rockfish Survey Juvenile Salmon Survey Habitat Survey	2,623
Fried-egg jellyfish	*Phacellophora camtschatica*	CalCOFI Juvenile Salmon Survey Juvenile Rockfish Survey	33
Unidentified salp	unknown	CalCOFI Juvenile Salmon Survey	24

4.2.7.2 Eastern Tropical Pacific Research Area

Under Alternative 1, SWFSC research activities would result in removal of very small amounts of invertebrates from the ETPRA. Zooplankton and phytoplankton would be removed from the ETPRA as a result of surveys using various small, towed, fine-mesh nets designed to sample larval and juvenile fish and small pelagic invertebrates as part of the Stenella Abundance Research (STAR) surveys (See Appendix A for descriptions of Oozeki, IKMT, MOCNESS, and Tucker nets). The total biomass of invertebrates removed as a result of these surveys was 19.80 kg during the 2006 STAR survey, and similar amounts of invertebrates would be expected to be removed from the ETPRA annually under Alternative 1. The effects of this removal on populations of invertebrates in the ETPRA would be minor in magnitude. Because the SWFSC does not employ bottom-contact gear in the ETPRA, no direct impacts to benthic invertebrates are expected. The effects of other activities, such as the use of active acoustic devices, water sampling devices, and expendable bathythermographs would also be minor with regard to invertebrate populations in the ETPRA. Research activities in the ETPRA would likewise have minor adverse impacts upon invertebrate habitat. Overall, SWFSC research activities in the ETPRA do not involve any mechanism for effects on invertebrates at the population level; the effects on populations of invertebrates in the ETPRA resulting from SWFSC survey activities would therefore be minor adverse based on the criteria in Table 4.1-1.

4.2.7.3 Antarctic Research Area

In the ARA, SWFSC surveys are primarily focused on Antarctic krill, which are a key component of the Antarctic food web. Acoustic data are the principal source of information used to measure the abundance and distribution of krill. In addition, very small amounts (10s of kgs) of krill and zooplankton are captured in small-mesh nets to facilitate physiological studies and collection of biometric data. Estimates of krill abundance in the ARA are only available in the few places where research occurs. Estimates of krill biomass in the Elephant Island, West, and South Areas around the Shetland Islands, Antarctica are shown in Figure 4.2-4 (AMLR 2010). In comparison to the data presented in Figure 4.2-4, the amounts of krill and other zooplankton collected during the course of SWFSC research activities are minor fractions of overall biomass and would not affect Antarctic krill or other zooplankton at the population level.

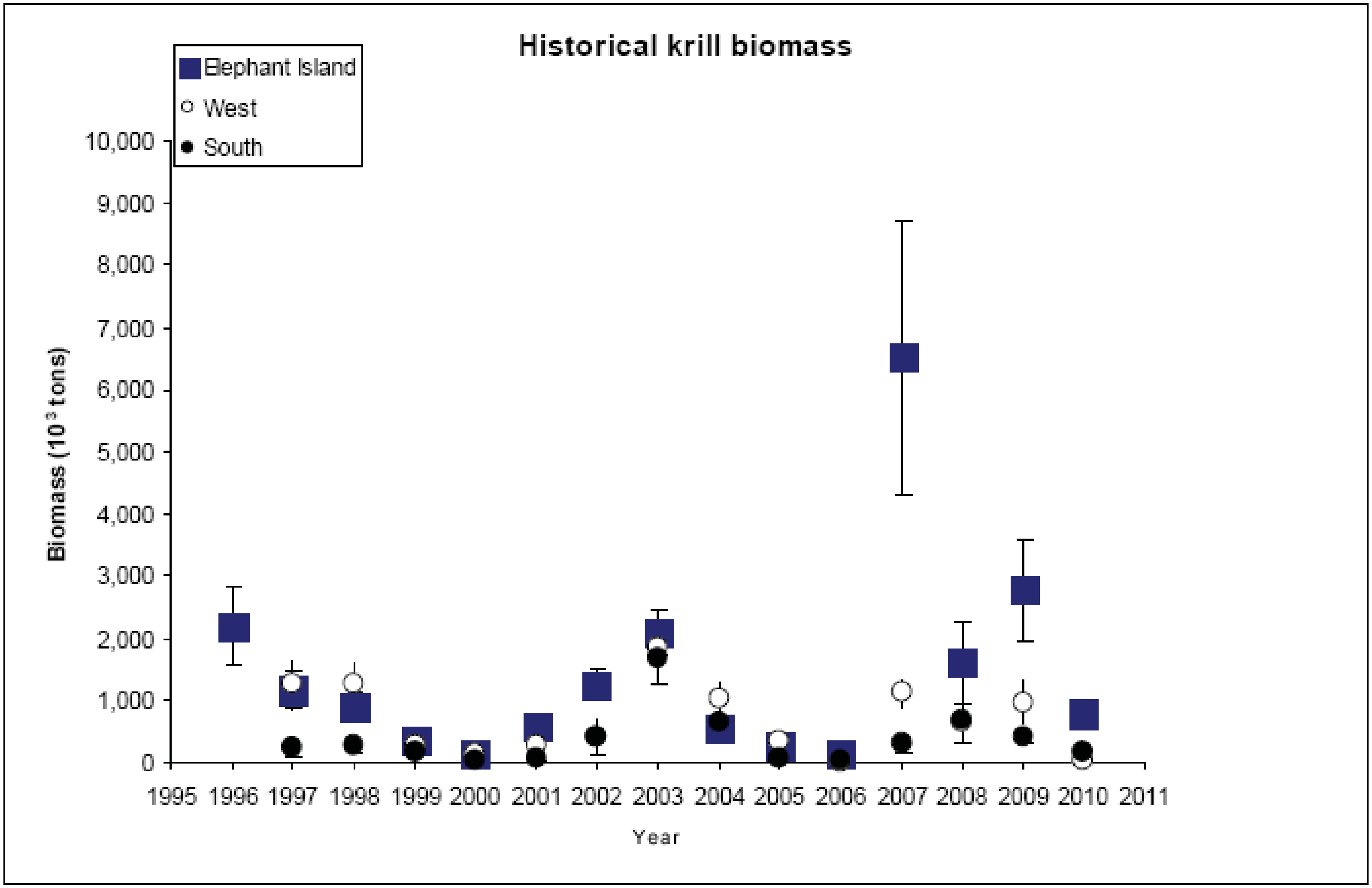


Figure 4.2-4 Historical krill biomass values around the Shetland Islands, Antarctica.

Data for the Elephant Island area and the west and south areas around the Shetland Islands from 1996-2010; biomass values in 10^3 metric tons (from Cossio and Reiss 2011; 2009-2010 AMLR Field Season Report).

SWFSC Antarctic survey data are occasionally augmented with information from bottom trawl surveys used to quantify benthic invertebrates and fish (see Table 2.2-1). Such surveys would occur once every three years and have historically involved 75 bottom trawl hauls per survey. Under Alternative 1, it is assumed that a similar amount of survey effort would continue in the future. The effects of SWFSC bottom trawl surveys on benthic invertebrates in the ARA may include removal of infauna and epifauna from sand, silt, or gravel substrates. Bottom contact fishing gear can break or disrupt corals and other benthic invertebrates, thereby reducing structural complexity, which may reduce species diversity of the corals and other animals that utilize the habitat (Freiwald et al. 2004). Cold-water corals such as *Flabellum thouarsii* and *Flabellum curvatum* are known to occur in the SWFSC ARA, although their exact distribution and abundance are poorly understood (Cairns 1982; Waller et al. 2008). Cold water corals are generally slow growing, fragile, and long lived, which makes them particularly vulnerable to damage. The disturbance of these organisms may only be reversible through natural recovery that may occur over hundreds of years (Freiwald et al. 2004). Thus, the duration of impacts to benthic invertebrates resulting from bottom trawl survey activities in the ARA could be long-term. However, under Alternative 1, SWFSC would implement as standard operating procedure numerous measures to reduce the likelihood, magnitude, and geographic extent of such impacts. Bottom-contact trawl gear would be deployed only after initial acoustic reconnaissance is conducted to verify bottom conditions suitable for trawling. Bottom trawl surveys would only be conducted on suitable benthic substrates, e.g., sand, silt or gravel bottoms. Rocky areas that are more likely to support corals would be avoided by using sonar to examine the bottom contours before surveys are conducted. Given the selection for bottom substrates and avoidance of coral areas, impacts to slow-growing corals in the ARA would be possible but unlikely, and such impacts would not affect Antarctic corals at the population level. The effects of SWFSC research activities on benthic invertebrates in the ARA may also include impacts to non-coral infauna and epifauna from sand, silt, or gravel substrates. These effects would be minor in magnitude due to the small areal extent and intermittent nature of surveys using bottom trawl and other bottom contact equipment.

Information collected from the SWFSC Antarctic survey program provide the only datasets available for quantification of abundance and distribution of demersal finfish, their prey, and habitat characteristics, and represent the only comprehensive dataset of composition and spatial distribution of benthic invertebrate megafauna communities in the in the Southern Scotia Arc (Subarea 48.1 & 48.2). In addition, SWFSC activities represent the only scientific survey conducted along the Antarctic Peninsula, and fulfill U.S. commitments to CCAMLR and obligations under the Antarctic Treaty. The scientific information gleaned from SWFSC survey activities is used to inform Antarctic conservation measures which are implemented to protect and conserve biological resources, including invertebrates in the ARA. Under Alternative 1, the beneficial effects of science-based management supported by SWFSC research would at least partially countervail adverse effects resulting from the survey activities. Although impacts of SWFSC research activities on slow growing corals could be long term, the overall magnitude and geographic extent of impacts to invertebrates within the ARA would be minor adverse due to the infrequent nature of the survey activities, and the localized areal extent of the impacts.

4.2.8 Effects on the Social and Economic Environment

Section 3.3 describes the interaction of the SWFSC with the social and economic environment of the CCRA, ETPRA, and the ARA. This section describes the effects of the fishery research alternatives on socioeconomic resources. Major factors that could be influenced by changes to the SWFSC program include:

- Collection of scientific data used in sustainable fisheries management
- Economic support for fishing communities
- Collaborations between the fishing industry and fisheries management
- Fulfillment of obligations to communities specified by laws and treaties

Collection of scientific data used in sustainable fisheries management

Long-term standardized resource surveys conducted by NOAA fishery research vessels are fundamental elements of stock assessments in the Southwest research regions. The extended time-series of data helps identify trends that inform fisheries management planning. This information is essential to establishing species-specific sustainable harvest limits on an annual basis. Harvest limits that are set too high may lead to overfishing of specific stocks and more restrictive management measures in the future to rebuild those stocks. Harvest limits that are set too low do not allow a maximum sustainable harvest that benefits commercial and recreational fisheries and the communities and services that support them. In addition, the predictability and reliability of long term data sets and the harvest limits they support is essential for economic stability in the fisheries over time.

Economic support for fishing communities

The SWFSC's roughly $50 million in annual operations costs (J. Rusin 2011, pers. comm.) have a primary and secondary economic influence on the communities and ports in which they operate. These funds are distributed among U.S. research stations located in LaJolla, Santa Cruz, Pacific Grove, Arcata, Granite Canyon, and Piedras Blancas, California. The operating budget directly supports employees and operations of facilities. Approximately $22 million is spent annually on the collection of at-sea survey data, extending from Oregon to Antarctica (J. Rusin 2011, pers. comm.). This includes ship and aircraft time, equipment and logistics costs, contracts, crew wages, and taxes and fees. NOAA ships, charters, and research vessels operate from several home ports, and are serviced in many others. The SWFSC also leases vessels and equipment from local suppliers. Some commercial fishing operations are compensated for participation in cooperative research projects through grants or shares in fishing quotas that they sell on the market.

Collaborations between the fishing industry and fisheries management

Cooperative research is an important element in establishing communication, trust, and information exchanges between scientists, fisheries managers, and the fishing industry. Cooperative research is used to: a) increase the precision and expand the scope of resource surveys; b) provide supplemental information about fishing operations; c) incorporate fishing expertise into the design and implementation of research; and d) build mutual understanding and respect among scientists and people in the fishing industry. Collaboration in the development of new gear and techniques encourages participation in developing sustainable fishing practices and contributes to a broader understanding of management for marine resources.

Fulfillment of obligations to communities specified by laws and treaties

A list of applicable laws is shown in Chapter 6. These obligations include the 1996 amendment to the MSA, which requires assessment, specification, and description of the effects of conservation and management measures on participants in fisheries, and on fishing communities (NMFS 2007b); and Executive Order (EO) 12898 on environmental justice, which directs agencies to assess actions that may disproportionately affect low income and minority populations. The fisheries research programs conducted in the CCRA, ETPRA, and ARA help fulfill these obligations under the MSA.

4.2.8.1 California Current Research Area

Under the Status Quo Alternative, the SWFSC would continue current research operations, at current levels, with current research methods. Data collected and analyzed would continue to contribute to fisheries management. While difficult to quantify, the direct effect of fisheries research would be to inform forecasting the future productivity and sustainability of fisheries and setting harvest limits. Collaboration with other agencies, and the commercial fishing industry would continue, comprising a coordinated approach to fisheries management.

Community and port spending would continue at current levels, which would have primary and secondary beneficial economic effects in communities. The majority of SWFSC spending occurs in support of facilities and employees in California, and in research in California Current waters. About $5 million is dedicated to at-sea survey expenditures in the CCRA (J. Rusin 2011, pers. comm.).

NMFS conducts community studies and develops statistical methodologies and economic models for identifying and describing communities substantially engaged in fishing. This information is ultimately utilized by fishery managers, whose decisions balance the needs of a variety of fisheries communities and users. This supports responsibilities outlined in the MSA (NMFS 2007b) and EO 12898 on environmental justice.

The Status Quo Alternative assumes the continued direct effects of SWFSC spending, research activity, collaboration with fisheries managers, and sustained evaluation of the economic health of fishing communities. The direct effects are noticeable in the economy, affect a large geographic area, and have been continued over a long period. Indirect effects include the effects of the data on sustainable fisheries management decisions, which are difficult to quantify. The Status Quo Alternative would continue to have, overall, moderate beneficial direct and indirect effects on the social and economic environment of communities associated with the CCRA.

4.2.8.2 Eastern Tropical Pacific Research Area

The total budget for ship, crew support, and equipment is approximately $1 million per year for SWFSC research in the ETPRA (J. Rusin 2011, pers. comm.). The majority of these funds are spent on crew, vessel operation and maintenance, and providing supplies and services associated with research cruises, and accrue in the home port. Voyages supporting data collection have a minimal influence on the economies of ports of call in Mexico and South America. The SWFSC does not have economic obligations to non-U.S. communities, but research contributes to an understanding of factors important to global marine resources, and collaboration with researchers in other countries. Several international treaties govern research in the ETP, as well, as described in Chapter 6. SWFSC ETP activity could indirectly benefit the productivity of U.S. fisheries. In Alternative 1, research would continue for the long-term, and effects would be expected to occur as before, and affect a large geographical area. The overall direct and indirect effect of the Status Quo Alternative on communities associated with the ETPRA would be beneficial and minor.

4.2.8.3 Antarctic Research Area

On the Antarctic Peninsula, the SWFSC's Antarctic Ecosystem Research Division (AERD) maintains two field stations located at Cape Shirreff on Livingston Island and at Copacabana in Admiralty Bay on King George Island. Research surveys account for approximately $3 million in expenditures annually (J. Rusin 2011, pers. comm.). As with the ETPRA, the majority of these funds are spent on crew, vessel operation and maintenance, and providing supplies and services associated with research cruises, and accrue in the home port. SWFSC vessels make few visits to other ports of call, but occasionally stop in Punta Arenas, Argentina, for example, so this activity has a minor influence on the economies of ports of call. The SWFSC does not have economic obligations to non-U.S. communities, but research contributes to an understanding of factors important to global marine resources, and collaboration with researchers in other countries. Several international treaties govern research in the ETP, as well, as described in Chapter 6. SWFSC Antarctic activity could indirectly benefit the productivity of U.S. fisheries. The research would continue for the long-term, and effects would be expected to occur as before, and affect a large geographical area. The overall direct and indirect effect of the Status Quo Alternative for the Antarctic region would be beneficial and minor.

4.2.8.4 Conclusion

Overall direct and indirect effects of SWFSC operations would be beneficial and moderate for the CCRA because of contributions to local economies, collaboration with other researchers, contributions to fisheries management, and fulfillment of obligations to communities under U.S. laws. Direct and indirect contributions to the productivity of fisheries are not easily measurable. Overall direct and indirect effects of the ETPRA and ARA would be beneficial and minor because of lower expenditures and infrequent interaction with U.S. and foreign port and fishing communities.

4.3 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 2 – PREFERRED ALTERNATIVE.

This section presents an analysis of the potential direct and indirect effects of Alternative 2 – Preferred Alternative on the physical, biological, and social environment. Under this Alternative, the SWFSC would conduct a new suite of research activities and implement new mitigation measures in addition to the Status Quo program to comply with the requirements of the MMPA and ESA compliance process. The new suite of research activities is a combination of past research and additional, new research. Potential direct and indirect effects were evaluated according to the criteria described in Table 4.1-1. A summary of the impact rating determinations for all topics evaluated under Alternative 2 is presented below in Table 4.3-1.

Table 4.3-1 Alternative 2 Summary of Effects

All conclusions refer to adverse effects unless noted.

RESOURCE	Physical Environment	Special Resource Areas	Fish	Marine Mammals	Birds	Sea Turtles	Invertebrates	Social &Economic
SECTION #	***4.3.1***	***4.3.2***	***4.3.3***	***4.3.4***	***4.3.5***	***4.3.6***	***4.3.7***	***4.3.8***
Research Area								
California Current	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Moderate-*beneficial*
Eastern Tropical Pacific	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor-*beneficial*
Antarctic	Minor	Minor	Minor	Minor	Minor	N/A	Minor	Minor-*beneficial*

4.3.1 Effects on the Physical Environment

The effects of the Preferred Alternative (Alternative 2) on the physical environment would be substantially similar to those of the Status Quo Alternative (Alternative 1- see Section 4.2.1). Mitigation measures for protected species required under Alternative 2, such as the use of MMEDs, video sampling with an open cod end, and retrospective analysis of factors influencing incidental take of protected species, would not measurably influence the effects of the research activities on physical properties of the environment. Likewise, the implementation of procedures for handling of incidentally captured marine mammals would not influence the impacts of the activities on physical properties of the environment. The addition of a new survey in the ETPRA to monitor the abundance and distribution of HMS is included in Alternative 2 (see Table 2.3-1). This survey would involve deployment of pelagic longline gear, bongo plankton nets, CTD sensors, and water sampling equipment, as well as collection of acoustic data. These survey activities would result in minor effects on physical properties of the environment in addition to the effects described under Alternative 1. Therefore, the overall effects of Alternative 2 on the physical environment would be substantially similar to those described for Alternative 1; due to their minor intensity and localized areal extent, the overall impacts to the physical environment would be minor adverse in each of the SWFSC research areas.

4.3.2 Effects on Special Resource Areas

4.3.2.1 California Current Research Area

Special resource areas within the CCRA include EFH and HAPC areas, closed areas, and MPAs, including National Marine Sanctuaries. Mitigation measures for protected species required under Alternative 2, such as the use of MMEDs, video sampling with an open codend, and retrospective analysis of factors influencing incidental take of protected species, would decrease the potential for adverse effects to special resource areas within the CCRA relative to Alternative 1. The mitigation measures included under Alternative 2 include the use of new equipment and techniques designed to reduce potentially adverse impacts on protected species. These mitigation measures could decrease the potential for adverse impacts to biological resources within special resource areas, but would not result in substantial differences in the impacts to non-biological resources in special resource areas relative to Alternative 1. Direct effects of SWFSC research activities on biological resources within special-fishery related areas are most accurately captured in the assessments of species groups, which are evaluated in Sections 4.3.3-4.3.7. Although some reduction in potential for adverse interactions with protected species within special resource areas relative to Alternative 1 may result from the mitigation measures described under Alternative 2, the overall magnitude and nature of the impacts of Alternative 2 on special resource areas in the CCRA would be substantially similar to those described for Alternative 1 (see Section 4.2.2). Impacts to EFH, HAPC, and closed areas would be minor and adverse.

Adverse effects to MPAs resulting from SWFSC research activities would be minor in magnitude, localized in geographic extent, and short-term in duration. It is important to note that sound science-based management practices are partially dependent upon the data generated from SWFSC research surveys. MPAs are, by definition, managed more carefully than other special resource areas, and therefore MPAs depend more heavily on the data collected during SWFSC surveys to sustain the habitats and resources that they are designed to protect through the implementation of sound science-based management practices.

The overall effects of SWFSC survey activities on MPAs, including National Marine Sanctuaries, would be minor adverse using the gear types, survey techniques, and mitigation measures described under Alternative 2.

4.3.2.2 Eastern Tropical Pacific Research Area

Special resource areas within the ETPRA include reserves, marine parks, and World Heritage Sites established by foreign governments. For the purposes of this Final PEA, these areas are considered MPAs, and the impacts of SWFSC survey activities on these areas resulting from the actions described under Alternative 2 would be substantially similar to those described under Alternative 1 in Section 4.2.2.2. In general, the impacts to each of the MPAs are a subset of the impacts to specific physical, biological, and socioeconomic resources that are addressed in the resource specific sections of this Final PEA. An additional survey proposed under Alternative 2 to monitor the abundance and distribution of HMS could result in increased potential for adverse impacts to biological resources within ETP special resource areas relative to Alternative 1(see Section 4.2.6- Effects on Sea Turtles). The magnitude and likelihood of such effects would depend largely upon the proximity of the new HMS survey to special-fishery related areas. However, implementation of mitigation measures, such as the use of circle-hooks to minimize adverse interactions with sea turtles, would mitigate impacts to biological resources. Other mitigation measures for protected species required under Alternative 2, such as the use of MMEDs, video sampling with an open codend, and retrospective analysis of factors influencing incidental take of protected species, would decrease the potential for adverse effects to special resource areas within the

ETPRA relative to Alternative 1. These mitigation measures could decrease the potential for adverse impacts to biological resources within special resource areas, but would not result in substantial differences in the impacts to non-biological resources in special resource areas relative to Alternative 1. Adverse effects on MPAs resulting from SWFSC research activities would be minor in magnitude, localized in geographic extent, and short-term in duration and frequency.

It is important to note that sound science-based management practices are partially dependent upon the data generated from SWFSC research surveys. MPAs are, by definition, managed more carefully than other special resource areas; and, therefore, MPAs depend more heavily on the data collected during SWFSC surveys to sustain the habitats and resources that they are designed to protect.

The overall effects of SWFSC survey activities on MPAs in the ETPRA would be minor adverse using the gear types and mitigation measures described under Alternative 2.

4.3.2.3 Antarctic Research Area

Closed areas within the ARA include those established by CCAMLR conservation measures, as discussed in the *Schedule of Conservation Measures in Force 2010/11 Season* (CCAMLR 2010). An additional series of closed areas have been proposed as a management tool to determine the efficacy of small scale management units in the Antarctic krill fishery (Constable et al. 2000; Hill et al. 2009). Under Alternative 2, the impacts of SWFSC research activities on Antarctic special resource areas would be substantially the same as those described under Alternative 1 (see Section 4.2.2.3). Although mitigation measures required under Alternative 2 could theoretically decrease the likelihood of adverse impacts to protected species within Antarctic closed areas, historically there have been no adverse interactions between protected species and SWFSC research activities in those areas. Therefore, in practice the mitigation measures described under Alternative 2 are not expected to have a measureable influence on the effects of SWFSC research activities on protected species in the ARA, and effects would be substantially similar to those resulting from the actions described under Alternative 1. Under Alternative 2, the adverse impacts of SWFSC research activities on closed areas within the ARA would be minor adverse due to the short-term and infrequent nature of the survey activities, and the localized areal extent of the impacts.

4.3.3 Effects on Fish

Under the Preferred Alternative, the SWFSC would conduct a new longline survey in the ETPRA and implement new mitigation measures to reduce potential effects on protected species in addition to the research activities and mitigation measures included in the Status Quo program. The effects of the Preferred Alternative on fish would be similar to those described for the Status Quo Alternative in the CCRA and ARA, Section 4.2.3. The proposed longline survey in the ETPRA would be used by the SWFSC to monitor the abundance and distribution of HMS in the ETPRA. Given the small amount of effort during the new longline survey (60 sets) over a very large area, the resulting fish mortality would likely be very small and not result in any measurable changes to fish populations. The effects of the new longline survey would be both localized at a small number of sample sites and temporary in any one location (2-4 hr soak times); the effects to fish in the ETPRA would be minor adverse.

4.3.4 Effects on Marine Mammals

The direct and indirect effects of the Preferred Alternative on marine mammals are very similar to those described for the Status Quo (Section 4.2.4). The differences involve:

- The development of new equipment, techniques, and analyses that may become additional mitigation measures if development efforts are successful
- The implementation of a new training program regarding appropriate responses to protected species interactions, and

- The addition of a longline survey in the ETPRA

The following analysis draws heavily on the analysis provided under the Status Quo Alternative (Section 4.2.4) but focuses on the difference that may result from the new research elements and mitigation measures added under the Preferred Alternative.

The Preferred Alternative is the SWFSC research program and suite of mitigation measures that are being proposed in the MMPA LOA application (Appendix C). The analysis of effects in the LOA application was based primarily on the history of past environmental effects under the status quo conditions, which cover the years 2008-2012. However, especially with regard to mitigation measures for marine mammal interactions, the status quo reflects a dynamic situation in that the SWFSC is continually monitoring their effects and exploring ways to effectively reduce and document those adverse interactions while fulfilling their mission to collect scientific information for fisheries and natural resource management. The Status Quo Alternative therefore reflects the mitigation equipment and procedures as they were implemented at the end of 2012 while the Preferred Alternative includes several ongoing efforts to develop new mitigation measures.

The potential effects of the Preferred Alternative on marine mammals involve adverse interactions with research vessels, survey gear, sonar and other active acoustic devices, and other associated equipment, including:

- Disturbance and behavioral responses due to acoustic equipment
- Injury or mortality due to ship strikes and entanglement in gear
- Changes in food availability due to research survey removal of prey and discards
- Contamination from discharges

These mechanisms of potential effects are discussed in the Status Quo Alternative (Section 4.2.4), most of which will not be repeated here. The mechanism in the first bullet, acoustic disturbance, would be the same for the Preferred Alternative as it is for the Status Quo Alternative because there are no new acoustic sound sources that would be introduced (the new longline survey in the ETPRA would be conducted in conjunction with existing cruises that already use acoustic equipment), and no new mitigation measures are being proposed that would address potential effects due to acoustic disturbance. Although every species of marine mammal in the three research areas may be exposed to sounds from active acoustic equipment used in SWFSC research, many of the acoustic sources are likely not audible to many species and the others would likely cause temporary and minor changes in behavior for nearby animals as the ships pass through any given area. The overall effects from acoustic disturbance are considered minor adverse for all species and in all three research areas. The potential effects from changes in food availability and contamination were also considered to be minor adverse for all species of marine mammals in all three research areas in which the SWFSC operates and will not be discussed further. The following discussion will therefore focus on the potential effects from entanglement or incidental capture in fishing gear used in SWFSC research, especially with regard to incremental changes between the Status Quo Alternative and the Preferred Alternative.

In addition to the mitigation measures that have been implemented in recent years under the Status Quo Alternative, the Preferred Alternative includes several new measures that may further reduce the risk of future marine mammal takes. First, the SWFSC would continue to design and develop MMEDs for use on Modified Cobb trawl gear. Most takes of California sea lions have occurred in surveys using Nordic 264 trawl gear, which already have been outfitted with MMEDs, but there are two historical records of sea lions being caught during the Juvenile Rockfish Survey in Modified Cobb trawl gear. One incident (in 2009) involved a single sea lion that was released alive and apparently uninjured. The other incident occurred in 2008 and involved three sea lions caught in one set. Two animals were released alive and apparently uninjured but one animal was killed. It is not clear how effective any new excluder devices may be in reducing potential mortalities but the SWFSC is committed to pursuing further development and testing of such devices on the premise that they have a reasonable chance of reducing mortalities in the future. If all development concerns can be addressed, the new excluder devices would be installed on Modified Cobb trawl gear as soon as practicable.

The second new element in the Preferred Alternative involves a retrospective analysis of factors influencing incidental take of protected species. The SWFSC would commit its scientists to provide a thorough scientific exploration of past marine mammal bycatch in its fisheries research surveys. The goal would be to better understand what factors might increase the likelihood of take and then focus future research on reducing or eliminating "high-risk" factors, if they exist, in a way that enables scientifically important surveys to continue with minimized risk to protected species.

The third new element in the Preferred Alternative that is intended to help mitigate adverse interactions with marine mammals (and other protected species) is the development of a formal information exchange program for Chief Scientists and research crews to share their experiences with protected species encounters during research work and to improve decision-making regarding avoidance of adverse interactions. As described in Section 2.2.1, there are many situations where professional judgment is used to decide the best course of action for avoiding marine mammal interactions when research gear is in the water. The intent of this mitigation measure would be to draw on the collective experience of people who have been making those decisions, provide a forum for the exchange of information about what went right and what went wrong, and try to determine if there are any “rules-of-thumb” or key factors to consider that would help in future decisions regarding avoidance practices. The SWFSC would coordinate not only among its staff and vessel captains but also with those from other Fisheries Science Centers with similar experience.

In addition, Chief Scientists and appropriate members of SWFSC research crews would participate in the Protected Species training program offered by the regional commercial fisheries Observer Program. The Observer Program provides this training for NMFS-certified observers placed on board commercial fishing vessels and the SWFSC research crews would be trained using the same monitoring, data collection, and reporting protocols. All SWFSC research crew members that may be assigned to monitor for the presence of marine mammals during future surveys would be required to attend an initial training course and refresher courses annually or as necessary. The existing Observer Program training includes topics such as crew responsibilities, monitoring and sighting protocols, species identification, decision-making factors for avoiding take, procedures for handling and documenting protected species caught in fishing gear, and reporting requirements. The implementation of this training program would formalize and standardize the information provided to all crew that might experience protected species interactions during research activities. Although the potential effectiveness of this measure to reduce future takes of protected species cannot be quantified at this time, the SWFSC would implement this training program on the assumption it would provide tangible conservation benefits.

4.3.4.1 California Current Research Area

ESA-listed Species

The endangered marine mammals that occur in the CCRA include blue, fin, sei, humpback, and sperm whales and the Southern resident DPS of killer whales. Threatened species include Guadalupe fur seals. All of these species are under the jurisdiction of NMFS in regard to compliance with the MMPA and ESA. In addition, the Southern subspecies of sea otters are listed as threatened under the ESA and are under the jurisdiction of USFWS.

There have been no entanglements or takes of ESA-listed marine mammals in SWFSC fisheries research from NOAA vessels or NOAA chartered vessels (Table 4.2-5) and the LOA application does not include any estimated takes of these species. Given the relatively small amount of SWFSC research using trawl gear, the mitigation measures in place, and the lack of historical takes, the SWFSC does not expect to have any adverse interactions with ESA-listed cetaceans during research surveys in the CCRA under the Preferred Alternative.

The LOA application does not include any projected takes of ESA-listed Guadalupe fur seals and southern sea otters based on a lack of historical takes and other characteristics of these species that are not similar to species that have a history of takes (Appendix C). Based on that analysis, the potential risk of injury or mortality to these ESA-listed species is considered minor adverse.

Other Cetaceans

No baleen whales have had adverse interactions with SWFSC research activities in the past, and none are anticipated to be taken in SWFSC research activities under the Preferred Alternative in the next five years. For all but one species of odontocetes (see bottlenose dolphin below) that are considered to have a reasonable risk of adverse interactions with research gear (i.e., those that have requested takes in the LOA application), the estimated average annual take in the next five years is less than 10 percent of PBR (Table 4.2-10) and this level of mortality, if it occurred, would be considered minor in magnitude. These potential mortalities would be rare or infrequent events and most would be unlikely to actually occur in the next five years. Any actual take would occur in a localized area but cetaceans generally travel through large geographic areas so the potential loss of an animal would affect more than a localized population. The overall impact of the potential takes of these species, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1.

Bottlenose dolphin

The estimated potential take of bottlenose dolphins is divided between two stocks for trawl gear based on the relative frequency of trawl sets in nearshore waters and sets made further offshore. The coastal stock of bottlenose dolphin (PBR = 2.4) is generally only found within 1 km of shore (Carretta et al. 2011). The CA/OR/WA offshore stock is larger and has a PBR of 5.5. The LOA application estimates that less than two bottlenose dolphins from the CA/OR/WA offshore stock could be taken each year in trawl gear (1.6 average, 8 takes per five-year period). In addition, less than one bottlenose dolphin from the coastal stock could be taken each year in trawl gear (0.6 average, 3 takes per five-year period). Takes of real animals occur to whole animals, of course, not fractions of animals. However, for the purpose of determining the potential magnitude of effect in this NEPA analysis, we compare the average annual take estimates to PBR, which is also an annual metric. For both of these stocks, this level of take in trawl gear, if it occurred, would be greater than 10 percent and less than 50 percent of PBR and would be considered moderate in magnitude according to the criteria described in Table 4.1-1. The LOA application also estimates that one bottlenose dolphin from either stock could be taken in longline gear in a five-year period (0.2 per year). The LOA application does not specify from which stock the estimated take on longline gear would occur. If this potential take occurred to an animal from the smaller coastal stock, the combined take of this stock from both trawl and longline gear would be 0.8 per year, which would still be greater than 10 percent and less than 50 percent of PBR for the stock and would be considered moderate in magnitude. If the potential longline take occurred to an animal from the CA/OR/WA offshore stock, the combined take of this stock from both trawl and longline gear would be 1.8 per year, which would also be greater than 10 percent and less than 50 percent of PBR for the stock and would be considered moderate in magnitude according to the criteria described in Table 4.1-1.

These estimated takes are based on similarities with Pacific white-sided dolphins, specifically one interaction in 2008 that involved the entanglement of 11 Pacific white-sided dolphins in a Nordic 264 trawl (Table 4.2-7). Since that time, additional mitigation measures have been implemented, including incorporation of a MMED in the Nordic 264, and the risk of taking this species in numbers should be reduced. The estimated take on longline gear is based on infrequent takes of dolphins in commercial fisheries; none have been taken during SWFSC research. Given the implementation of mitigation measures, and the fact that the SWFSC has never taken bottlenose dolphins in the past, the SWFSC considers the risk of taking bottlenose dolphins to be very low (i.e., a rare event unlikely to occur in the next five years), although there is a chance that more than one animal could be taken in any one interaction. Given the frequency and likelihood components of the NEPA analysis, the overall impact of the Preferred Alternative on bottlenose dolphins would be considered minor adverse according to the criteria described in Table 4.1-1.

Pinnipeds

There are five species of non ESA-listed pinnipeds commonly found in the CCRA that may interact with SWFSC research: California sea lion, Steller sea lion, Northern fur seal (two stocks), harbor seal (several stocks), and Northern elephant seal (Table 4.2-9).

The analysis of historical takes and estimated takes for pinnipeds in the LOA application is the same as presented in the Status Quo Alternative (Section 4.2.4). The SWFSC expects each of the new research and training programs included in the Preferred Alternative to further reduce the risk of adverse pinniped interactions with research activities but the Final PEA bases the analysis of effects on the estimated takes of these species in the LOA application (Appendix C).

Based on historical takes during SWFSC research surveys, the LOA application estimates an average total take of five California sea lions per year (20 in trawl gear and five in longline gear over the five-year period) under the Preferred Alternative. If this level of mortality or serious injury occurred it would be much less than 10 percent of PBR (8,511) and would therefore be considered minor in magnitude. Given the implementation of new mitigation measures, including a MMED for the Nordic 264 trawl, future mortalities of California sea lions would be considered rare or infrequent events and would be unlikely to actually occur at this estimated rate in the next five years. Any actual take would occur in a localized area, but these animals travel over large geographic areas so the potential loss of an animal would affect more than a localized population. The overall impact of potential takes of this species in SWFSC research gear, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1.

The LOA application estimates an average of one Northern fur seal take per year (five takes in a five-year period) based on historical records of SWFSC takes during past research activities. This level of mortality would be much less than 10 percent of PBR even if all of them came from the smaller San Miguel Island stock (PBR = 324) and would therefore be considered minor in magnitude. Given the implementation of new mitigation measures, including a MMED for the Nordic 264 trawl, future mortalities of fur seals would be considered rare or infrequent events and would be unlikely to actually occur at this estimated rate in the next five years. Given the historical record and geographic overlap with the majority of SWFSC research activities, most of these potential takes would likely involve the more geographically restricted San Miguel Island stock. The overall impact of potential takes of this species in SWFSC research trawl gear, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1.

There have been no historical takes of Steller sea lions, harbor seals, or Northern elephant seals in SWFSC research. The LOA application estimates the potential number of Steller sea lion and harbor seal takes based on their similarity in distribution and behavior to California sea lions. For Northern elephant seals, the estimated takes are based on historical takes in commercial fisheries operating in similar areas and using similar gear types. The estimated take of Steller sea lions and harbor seals is 1.8 animals per year in trawl gear (nine animals in the five-year LOA period) compared to PBRs of 1,552 and 1,600 respectively. The estimated take of Northern elephant seals is one animal per year in trawl gear compared to a PBR of 4,382. For all of these species, the estimated annual take, if it occurred, would be much less than 10 percent of PBR and would therefore be considered minor in magnitude. Considering the fact that none of these species have been taken in research trawls in the past, these potential mortalities would be considered rare events and would be unlikely to actually occur in the next five years. The overall impact of potential takes of these species in SWFSC research trawl gear, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1.

Sea Otters

There are two subspecies of Northern sea otter in the CCRA. The Southern subspecies is discussed in the ESA-listed species section above. The Washington subspecies is discussed in this section. This population inhabits nearshore waters along the coast of Washington and Puget Sound. These areas are either not covered by SWFSC research activities (Puget Sound) or are much closer to shore than research vessels typically travel or sample. The SWFSC does not anticipate any future Level B or Level A takes of sea otters from this population based on a lack of historical takes and very little spatial overlap between sea otter habitat and SWFSC research activities under the Preferred Alternative.

4.3.4.2 Eastern Tropical Pacific Research Area

The SWFSC research activities in the ETPRA have no history of taking marine mammals under the status quo scope of research, which includes only very small nets and other oceanographic instruments that have essentially no risk of taking marine mammals. However, the Preferred Alternative would add a new pelagic longline component to sample highly migratory fish (e.g., tuna and swordfish). Because there has been no history of SWFSC marine mammal takes in the ETPRA, the LOA application used data from commercial longline fisheries in the ETPRA to estimate which species may be vulnerable to take in future SWFSC research using longline gear. Under the Preferred Alternative, the SWFSC would implement all of the mitigation measures designed to reduce adverse interactions with longline gear as they currently use in longline surveys in the CCRA (see Section 2.2.1). In addition, the new information exchange and training programs proposed for the Preferred Alternative would be applied to longline efforts in the ETPRA, applying lessons learned in other areas on similar surveys to reduce the risk of adverse interactions with marine mammals in the ETPRA.

ESA-listed Species

The endangered marine mammals that occur in the ETPRA include blue, fin, sei, humpback, and sperm whales (Table 3.2-4). The only threatened species in the ETPRA is the Guadalupe fur seal. Given the rarity of these species in the research area, the small number of research longline sets that would be made under the Preferred Alternative, and the mitigation measures that would be implemented, the SWFSC would not anticipate any takes of ESA-listed species in the ETPRA and the LOA application (Appendix C) does not include estimates takes for any of these species under the Preferred Alternative.

Other Cetaceans

In addition to the ESA-listed species, there are two other species of baleen whales and at least 23 other odontocetes in the ETPRA. Table 4.3-2 shows the estimated number of cetaceans that may be taken in the ETPRA under the Preferred Alternative based on historical takes in analogous commercial fisheries. Considering the small number of longline sets that are being proposed in the area and the mitigation measures included in the Preferred Alternative, the risk of taking any marine mammals is considered very small and the LOA application includes only one take per five-year period (average of 0.2 takes per year) for those species that are considered susceptible to entanglement in longline gear. The PBR metric is not required to be calculated for species outside the U.S. EEZ but the SWFSC calculated PBR for these species for the purposes of this analysis using accepted calculations for minimum population estimates (Nmin) and PBR (NMFS 2005). For all of these cetacean species, the loss of one animal per five-year period would be much less than 10 percent of PBR (Table 4.3-2) and this level of mortality, if it occurred, would be considered minor in magnitude. Given the relatively small number of research longline sets proposed under the Preferred Alternative and the mitigation measures described in Section 2.2, the SWFSC considers the risk of taking these cetacean species to be very low (i.e., a rare event unlikely to occur in the next five years). The overall impact of these potential takes on these species, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1.

Table 4.3-2 Potential takes of non-ESA-listed marine mammals in the ETPRA.

This table shows the potential number of non ESA-listed marine mammals that could be taken by M&SI and Level A harassment in the ETPRA over the next five years using longline gear. There have been no historical takes from SWFSC research in the ETPRA. The SWFSC has calculated PBR for these species for the purposes of this analysis using accepted calculations for minimum population estimates (Nmin) and PBR (NMFS 2005).

Species	Population Estimates (from ETPRA surveys in 2006[1] unless noted)	PBR (animals per year)	Potential M&SI and Level A Take in Longline Gear Average per year (total for five year period)
Risso's dolphin	110,457	831	**0.2** (1)
Short-beaked common dolphin	3,127,203	25,133	**0.2** (1)
Long-beaked common dolphin	55,000 (off Mexico, NA for other areas)	2,787	**0.2** (1)
Striped dolphin	964,362	8,116	**0.2** (1)
Pantropical spotted dolphin	>1.7 million (all stocks)	14,558	**0.2** (1)
Bottlenose dolphin	335,834	2,850	**0.2** (1)
Rough-toothed dolphin	89,653	897	**0.2** (1)
False killer whale	39,800 [2]	244	**0.2** (1)
Short-finned pilot whale	589,315 [3]	4,751	**0.2** (1)
Dwarf sperm whale	11,200 [2]	88	**0.2** (1)
California sea lion	105,000	1,050	**1** (5)
South American sea lion	150,000	1,500	**1** (5)
Unidentified pinniped species			**0.2** (1)

[1] data from 2006 (Gerrodette et al. 2008)
[2] data from 1986 to 1990 (Wade and Gerrodette 1993)
[3] data from 2000 (Gerrodette and Forcada 2002)

Pinnipeds

In addition to the ESA-listed Guadalupe fur seal, there are three other species of pinnipeds in the ETPRA: California sea lion, South American sea lion, and Northern elephant seal. (Table 4.3-2) shows the estimated number of pinnipeds that may be taken in the ETPRA under the Preferred Alternative based on takes in analogous commercial fisheries. Considering the small number of longline sets that are being proposed in the area and the mitigation measures included in the Preferred Alternative, the risk of taking pinnipeds on longline gear is considered very small and the LOA application includes only one take per year (five takes per five-year period) for each of the two sea lion species plus one take per five-year period for "undetermined pinniped species" (average 0.2 animals per year). The request for undetermined species takes is made to account for animals that may be caught or entangled in gear but free themselves or are released before they can be identified or photographed by research personnel. Adding one take per five-year period to each sea lion species to account for these undetermined takes, the total estimated average annual take for each species would be much less than 10 percent of PBR (Table 4.3-2) and this level of mortality, if it occurred, would be considered minor in magnitude. The SWFSC considers the risk of taking these species to be very low (i.e., a rare event unlikely to occur in the next five years). The overall impact of these potential takes on these species, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1.

4.3.4.3 Antarctic Research Area

The Preferred Alternative includes the same scope of research and mitigation measures in the ARA as described for the Status Quo (Section 4.2.4.3), with the addition of the new information exchange and training programs for minimizing adverse interactions with marine mammals. The direct and indirect effects on marine mammals would therefore be very similar to those described for the Status Quo Alternative, which were minor adverse for all species.

4.3.5 Effects on Birds

The effects of the Preferred Alternative on birds are very similar to those described for the Status Quo (Section 4.2.5), especially for the CCRA and ARA. The only difference concerns the addition of a longline survey in the ETP. The Preferred Alternative also includes a number of mitigation measures and research projects intended to help reduce adverse interactions with marine mammals and other protected species. Although these measures would likely raise awareness about potential interactions with ESA-listed seabird species, they are unlikely to change the actual effects of SWFSC research activities on seabirds, which are minor.

In the ETP, the addition of a longline survey adds to the risk of incidentally capturing seabirds, especially species accustomed to following fishing boats such as albatross and gulls. However, given the relatively small amount of effort (60 sets per year) and standard best practices of sinking baited hooks as fast as possible, the risk of seabird mortality in this new survey is considered very small. If mortalities were to occur, they would likely be rare occurrences and unlikely to have any measurable effect on the populations of seabirds in the ETP.

The overall effects of SWFSC research activities on birds under the Preferred Alternative are considered minor adverse according to the criteria in Table 4.1-1. This conclusion holds for each of the three SWFSC research areas and for all gear types used in research.

4.3.6 Effects on Sea Turtles

The effects of the Preferred Alternative (Alternative 2) on sea turtles would be similar in nature and magnitude to those of the Status Quo Alternative (Alternative 1- see Section 4.2.6). Direct and indirect effects of SWFSC research activities on sea turtles may include: disturbances or changes in sea turtle behavior due to physical movements and sounds, injury or mortality due to ship strikes, gear interaction, and contamination or degradation of sea turtle habitat. These mechanisms are described in Section 4.2.6.

Mitigation measures for protected species required under Alternative 2, such as the use of MMEDs for Modified Cobb trawl gear and retrospective analysis of factors influencing incidental take of protected species, could potentially decrease the likelihood of adverse impacts to sea turtles. Although no adverse interactions have occurred in the past between sea turtles and SWFSC surveys using Modified Cobb trawl gear, MMEDs required as a mitigation measure under Alternative 2 are also likely to be effective for excluding turtles from mid-water trawl equipment. Likewise, retrospective analysis of factors influencing incidental take of protected species would theoretically reduce the potential for adverse interactions between sea turtles and trawl gear. In addition, the implementation of procedures for handling of incidentally captured protected species may decrease the potential for adverse impacts to sea turtles. However, considering that there have been no reported instances of SWFSC survey activities resulting in sea turtle mortality, the mitigation measures described under Alternative 2 would not result in substantial changes to the overall level of impact on sea turtles.

The addition of a new survey in the ETPRA to monitor the abundance and distribution of HMS would involve deployment of pelagic longline gear, bongo plankton nets, CTD sensors, and water sampling equipment, as well as collection of additional acoustic data. This survey would involve approximately 60 longline sets annually in the ETPRA with a soak time of approx. 2-4 hours per set, and would pose a small additional risk of adverse effects to turtles. However, there have been no reported adverse interactions between sea turtles and SWFSC longline survey activities, due in part to the fishing depth at which SWFSC research longline sets are deployed and where the survey activities are conducted. Sets targeting HMS would be deployed at depths greater than 50 ft. The use of circle hooks and finfish bait (instead of squid) would be standard operating procedures for SWFSC longline surveys, and would minimize the risk of sea turtle bycatch or entanglement.

The additional longline survey activity described under Alternative 2 would result in negligible impacts to sea turtles in addition to those described under Alternative 1. Therefore, the overall effects of Alternative 2 on sea turtles would be substantially the same as those resulting from Alternative 1; minor adverse effects are expected to occur using the gear types and mitigation measures described under Alternative 2; these effects would be isolated and infrequent, and would not impact sea turtles at the population level in any of the SWFSC research areas.

4.3.7 Effects on Invertebrates

The effects of the Preferred Alternative (Alternative 2) on invertebrates would be substantially similar to those of the Status Quo Alternative (see Section 4.2.7). Mitigation measures for protected species required under Alternative 2, such as the use of MMEDs, video sampling with an open codend, and retrospective analysis of factors influencing incidental take of protected species, would not measurably influence the effects of the research activities on invertebrates. Likewise, the implementation of procedures for handling of incidentally captured marine mammals would not influence the impacts of the activities on invertebrates. The addition of a new survey in the ETPRA to monitor the abundance and distribution of HMS would involve deployment of pelagic longline gear, bongo plankton nets, CTD sensors, and water sampling equipment, as well as collection of additional acoustic data. This survey activity would result in negligible effects on invertebrates in addition to the effects described under Alternative 1. Therefore, the overall effects of Alternative 2 on invertebrates would be substantially the same as those resulting from Alternative 1; the effects would be minor adverse in the ARA, CCRA and ETPRA.

4.3.8 Effects on the Social and Economic Environment

The effects of the Alternative 2, the Preferred Alternative, on social and economic conditions of the study area are very similar to that of Alternative 1 (see Section 4.2.8). The addition of a survey in the ETPRA would not be expected to measurably increase effects above the status quo for social and economic conditions. The overall direct and indirect effects of Alternative 2 would be beneficial and minor for the ETPRA and ARA, and remain moderate for the CCRA.

4.4 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 3 – MODIFIED RESEARCH ALTERNATIVE.

This section presents an analysis of the potential direct and indirect effects of Alternative 3 – Additional Mitigation Alternative on the physical, biological, and social environment. Under this Alternative, the SWFSC would conduct a new suite of research activities and implement new mitigation measures in addition to the Status Quo program. The new suite of research activities is a combination of past research and additional, new research, as described for the Preferred Alternative. Potential direct and indirect effects were evaluated according to the criteria described in Table 4.1-1. A summary of the impact rating determinations for all topics evaluated under Alternative 3 is presented below in Table 4.4-1.

Table 4.4-1 Alternative 3 Summary of Effects

All conclusions refer to adverse effects unless noted.

RESOURCE	Physical Environment	Special Resource Areas	Fish	Marine Mammals	Birds	Sea Turtles	Invertebrates	Social & Economic
SECTION NUMBER	***4.4.1***	***4.4.2***	***4.4.3***	***4.4.4***	***4.4.5***	***4.4.6***	***4.4.7***	***4.4.8***
Research Area								
California Current	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Moderate-*beneficial*
Eastern Tropical Pacific	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor
Antarctic	Minor	Minor	Minor	Minor	Minor	N/A	Minor	Minor

4.4.1 Effects on the Physical Environment

The continuation of federal fisheries research with scope and protocols modified to minimize risks to protected species (Alternative 3) would result in effects on the physical environment substantially similar to those of the Status Quo Alternative (see Section 4.2.1). Additional mitigation measures for protected species required under Alternative 3, such as the use of advanced monitoring methods for the detection of marine mammals, operational restrictions, and acoustic and visual deterrents for protected species would not measurably influence the effects of the research activities on physical properties of the environment. Temporal or geographic restrictions on SWFSC research activities intended to reduce adverse impacts to protected species (i.e., time /area restrictions) proposed as mitigation measures under Alternative 3 could potentially alter the spatiotemporal distribution of impacts to the physical environment; however, overall impacts to the physical environment would remain substantially similar to those described under Alternative 1. Likewise, avoidance of federal and state MPAs, proposed as a mitigation measure under Alternative 3, could potentially alter the spatiotemporal distribution of impacts to the physical environment, but would not result in substantial changes to the overall level of impacts to the physical environment compared to Alternative 1. Therefore, the overall adverse effects of Alternative 3 on the physical environment would be substantially similar to those described for Alternative 1; due to their minor intensity and limited areal extent, the overall impacts to the physical environment would be minor adverse in each of the SWFSC research areas.

Refer to Appendix A for a detailed description of the SWFSC research vessels and survey gear.

4.4.2 Effects on Special Resource Areas

4.4.2.1 California Current Research Area

Mitigation measures required under Alternative 3 include the avoidance of federal and state Marine Protected Areas (MPAs). This measure could disallow or restrict SWFSC trawl surveys in federal and/or state MPAs. An MPA is defined by EO 13158 as “any area of the marine environment that has been reserved by federal, state, tribal, territorial, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein.” In accordance with this definition, MPAs encompass a large fraction of the area where research surveys are conducted. They include: California’s State Marine Reserves (SMR), State Marine Parks (SMP), State Marine Conservation Areas (SMCA), and State Marine Recreational Management Areas (SMRMAs); Oregon’s MPA’s; Washington’s MPA’s; Wildlife Refuges; National Parks; and National Marine Sanctuaries, as well as Marine World Heritage Sites and Marine Management Areas established outside of the U.S. EEZ, can be found on the List of National System MPAs (NOAA 2012). This list also includes Habitat Closed Areas and Closed Areas. Prohibition or restriction of SWFSC trawl surveys in MPAs would decrease the potential for direct adverse impacts to special resource areas within the CCRA relative to Alternative 1; however countervailing indirect effects resulting from this mitigation measure would potentially include major adverse impacts resulting from a lack of the data needed to support science-based management of MPAs.

Additional mitigation measures described under Alternative 3 include the use of advanced monitoring methods for the detection of marine mammals, operational restrictions, acoustic and visual deterrents for protected species, and time/area closures for research activities. These mitigation measures would potentially alter the spatiotemporal distribution of impacts to special resource areas within the CCRA and would affect the magnitude, extent, frequency, and likelihood of impacts to biological resources within special resource areas. Direct effects of SWFSC research activities on biological resources within special-fishery related areas are most accurately captured in the assessments of species groups, which are evaluated in Sections 4.4.3-4.4.7.

The direct effects of Alternative 3 on special resource areas in the CCRA would be minor in magnitude, localized in geographic extent, and short-term in duration and frequency. However, indirect effects resulting from mitigation measures prohibiting research in protected areas included under Alternative 3 would include impacts resulting from a lack of the data needed to support science-based management of MPAs. MPAs are, by definition, managed more carefully than other special resource areas; MPAs depend more heavily on the data collected during SWFSC surveys to sustain the habitats and resources that they are designed to protect through the implementation of sound science-based management practices. Overall effects of Alternative 3 on special resource areas in the CCRA are considered moderate and adverse.

4.4.2.2 Eastern Tropical Pacific Research Area

Special resource areas within the ETPRA include reserves, marine parks, and World Heritage Sites established outside of the U.S. EEZ by international agencies and foreign governments (see Section 3.1.2.4 and Table 3.1-1). These areas meet the operational definition of MPAs, as defined by EO 13158. Thus, mitigation measures required under Alternative 3 could disallow or restrict SWFSC trawl surveys in these areas. Prohibition or restriction of SWFSC trawl surveys in MPAs would decrease the potential for direct adverse effects to special resource areas within the ETPRA relative to Alternative 1.

Additional mitigation measures described under Alternative 3 include the use of advanced monitoring methods for the detection of marine mammals, operational restrictions, acoustic and visual deterrents for protected species, and time/area closures for research activities. These mitigation measures would potentially alter the spatiotemporal distribution of impacts to special resource areas within the ETPRA, and would affect the magnitude, extent, frequency, and likelihood of impacts to biological resources within special resource areas. Direct effects of SWFSC research activities on biological resources within special-fishery related areas are most accurately captured in the assessments of species groups, which are evaluated in Sections 4.4.3-4.4.7.

Overall, the direct effects of Alternative 3 on special resource areas in the ETPRA would be minor in magnitude, localized geographic extent, and short-term in duration and frequency. However, indirect effects resulting from mitigation measures prohibiting research in protected areas included under Alternative 3 would include impacts resulting from a lack of the data needed to support science-based management of MPAs. MPAs are, by definition, managed more carefully than other special resource areas; MPAs depend more heavily on the data collected during SWFSC surveys to sustain the habitats and resources that they are designed to protect through the implementation of sound science-based management practices. Overall effects of Alternative 3 on special resource areas in the ETPRA are considered moderate and adverse.

4.4.2.3 Antarctic Research Area

Mitigation measures required under Alternative 3 include the avoidance of federal and state MPAs. In the ARA, specific mechanisms exist under the Antarctic Treaty System and CCAMLR for protection of sensitive marine areas. The entire Antarctic region is protected to some degree by the Antarctic Treaty System and CCAMLR; all marine areas south of the 60°S parallel fulfill the operational definition of MPAs. Therefore, under Alternative 3, SWFSC trawl surveys could be disallowed or restricted in the ARA. Such a restriction would eliminate minor impacts to special resource areas resulting from Antarctic trawl surveys, but would also preclude the collection of the only datasets available for quantification of temporal changes in the abundance and distribution of demersal finfish and benthic invertebrate megafauna in the Southern Scotia Arc (Subarea 48.1 & 48.2). Mitigation measures described under Alternative 3 could result in indirect effects to Antarctic special resource areas due to a lack of the scientific information needed to inform Antarctic conservation measures which are implemented to protect and conserve biological resources within special resource areas. In addition, mitigation measures described under Alternative 3 would preclude fulfillment of U.S. commitments to CCAMLR and obligations under the Antarctic Treaty. Overall effects of Alternative 3 on special resource areas in the ARA are considered moderate and adverse.

4.4.3 Effects on Fish

Under the Modified Research Alternative, the SWFSC would implement additional mitigation measures while conducting the same scope of research as described under the Preferred Alternative. Some of the additional mitigation measures for protected species that would be considered could reduce the overall research fishing effort (e.g., time/area restrictions). Such measures could restrict the ability of the SWFSC to sample at the times and places as laid out in their research plan, so fish catches and activity levels could be reduced or research vessels could extend their time at sea, in order to reach their research goals.

Temporal or geographic restrictions on SWFSC research activities intended to reduce adverse impacts to protected species could potentially alter the spatial/temporal distribution of impacts to fish; however, overall impacts to fish would remain substantially similar to those described under the Status Quo Alternative. Likewise, avoidance of federal and state MPAs, proposed as a mitigation measure under Alternative 3, could potentially alter the spatial-temporal distribution of impacts to fish, but would not result in substantial changes to the overall level of impacts as compared to the Status Quo Alternative. Therefore, the overall effects of Alternative 3 on fish would be substantially similar to those described for the Status Quo Alternative; the effects would be minor adverse in the CCRA, ETPRA, and ARA.

4.4.4 Effects on Marine Mammals

The Modified Research Alternative includes the same scope of research in all three of the SWFSC research areas (CCRA, ETPRA, and ARA) as the Preferred Alternative, including the same mitigation measures currently implemented or to be implemented, and intended to reduce potentially adverse interactions with marine mammals and other protected species. The Modified Research Alternative differs from the Preferred Alternative in that it also includes a suite of mitigation measures that the SWFSC is not proposing to implement as part of the proposed action in the SWFSC LOA application (Appendix C). The SWFSC considers the suite of mitigation measures to be implemented under the Preferred Alternative to represent the optimal mix of efficacy and practicability to reduce the risk of adverse interactions with protected species during the conduct of its research program. However, NMFS Office of Protected Resources (OPR) must consider a broad range of mitigation measures under the MMPA authorization and ESA consultation processes, and these additional measures will be considered in this alternative. These additional mitigation measures focus on reducing the likelihood of injury, serious injury, and mortality from interaction with fisheries research gear and are described in Section 2.4 of this Final PEA. They involve:

- The use of additional personnel and equipment/technologies to improve detection of marine mammals, especially at night or other low-visibility conditions.
- Operational restrictions on survey activities at night or other low-visibility conditions.
- The use of additional acoustic or visual deterrents to keep marine mammals away from research gear.
- The incorporation of high-resolution, high-speed video cameras into trawl nets with open cod ends.
- Temporal or geographic restrictions to avoid known concentrations of marine mammals or federal and state MPAs.
- Use of decoy vessels to distract marine mammals away from research sets.

All of the additional mitigation measures concern trawl surveys using the Nordic 264 and modified Cobb pelagic trawl gear (CCRA only) and longline surveys (CCRA and ETPRA), as these gear types have been involved with all past adverse interactions with marine mammals and are considered the highest risk for future interactions. The analysis of effects for the ARA is therefore the same as described for the Status Quo and Preferred Alternatives and will not be discussed further.

None of the additional mitigation measures directly concern the reduction of noise from acoustic devices (Level B harassment take), reducing the numbers of fish and invertebrates caught in research samples, or reducing the risk of accidental contamination from spills. The analyses of effects through these mechanisms (disturbance or changes in habitat quality) are the same as described for the Status Quo and Preferred Alternatives and will not be discussed further. The following analysis will therefore focus on the potential for the additional mitigation measures to reduce the risk of injury, serious injury, and mortality through entanglement in fishing gear or ship strikes.

The potential direct and indirect effects of this alternative on marine mammals would be the same as described for the Preferred Alternative (Section 4.2.4) except for the potential of the additional mitigation measures to reduce those effects of injury, serious injury, and mortality through entanglement in fishing gear or ship strikes. Scientists at the SWFSC continually review their procedures to see if they can do their work more efficiently and with fewer incidental effects on the marine environment, including effects on marine mammals. Many of the additional mitigation measures included in this alternative have been discussed and considered in the past by SWFSC scientists; however, any changes to operational procedures or the equipment used during surveys must also be considered from the standpoint of how they affect the integrity of the scientific data collected, the cost of implementing equipment or operational changes, and the safety of the vessel and crew. It is not possible to quantify how much any one of these measures (or some combination of them) may reduce the risk of future takes relative to the Status Quo or Preferred Alternatives. Any revisions to the estimated takes of each species to directly compare with the Status Quo or Preferred Alternatives would be based on speculation. This analysis will therefore provide a qualitative discussion of the potential for each additional mitigation measure to reduce takes and other effects on marine mammals as well as how each measure may affect practicability, data integrity, and other aspects of the survey work.

4.4.4.1 Trawl Surveys

The surveys that use the Nordic 264 pelagic trawl gear occur only in the CCRA and include the CPS Survey, Juvenile Salmon Survey, and habitat surveys for sea turtles and adult rockfish. The only survey that uses the modified Cobb trawl gear is the Juvenile Rockfish Survey in the CCRA.

Monitoring methods

Visual observations (using bridge binoculars as needed) by the officer on watch, Chief Scientist (CS) or other designated scientist, and crew standing watch are currently the primary means of detecting protected species in order to avoid potentially adverse interactions. However, there are other detection methods that have been tested or used in commercial fisheries, naval exercises, and geotechnical exploration that could be considered. These additional types of detection methods would be intended to be used in specific circumstances, such as operating at night or in low visibility conditions.

Visual surveillance by dedicated Protected Species Observers (PSO)

This measure would require the SWFSC to use trained protected species observers whose dedicated job is to detect the presence of marine mammals and other protected species within the survey area and communicate their presence to ship operations personnel. This dedicated PSO position would be in addition to having marine mammal and/or bird biologists on board whose job is to conduct abundance and distribution surveys (not all surveys include marine mammal or bird survey components). Considerations include the use of dedicated observers for all surveys or during trawl surveys of particular concern.

Under the Preferred Alternative, at least one member of the crew would be assigned to be the marine mammal observer at least 30 minutes prior to the vessel arriving on station or otherwise deploying trawl gear. This crew member would not have any other duties while assigned to be the marine mammal observer. Currently, not all crew members have received formal training in marine mammal identification or marine mammal mitigation procedures, although they are briefed on what they are looking for and may have considerable experience with the task. However, the Preferred Alternative does include a new program to refine and formalize the training and decision-making process for all Chief Scientists, bridge crew, and deck crew that may be assigned to the marine mammal observer post in the future. This new program would provide the same types of training for all appropriate crew members as PSOs trained for that specific task. This training would be provided by the commercial fisheries Observer Program staff at NMFS using the same course materials and reporting forms as used to train PSOs for applicable commercial fisheries. The difficulty in having crew members assigned only to PSO duties is that most vessels have limited carrying capacity for personnel and any berths given to PSOs would mean a reduction in personnel available to help with other research or vessel duties. This could compromise crew safety or the amount of research that could be conducted. By providing formal PSO training for crew already trained in other skills, the SWFSC believes it can provide the same quality of visual monitoring for marine mammals and other protected species as would occur with dedicated PSOs while maintaining the flexibility to fulfill all other crew duties.

Use of underwater video systems to monitor trawl gear

Underwater video technology may allow the SWFSC to determine the frequency of marine mammal interactions with the trawl gear and evaluate the effectiveness of MMEDs or other efforts to mitigate entanglement interactions. Underwater video systems have been used for these purposes in several fisheries, both in the U.S. and abroad (Northridge 2003, Lyle and Wilcox 2008, Dotson et al. 2010). Northridge (2003) describes a twin camera system used to monitor the grid and escape hole of an MMED and quantify the frequency and outcome of marine mammal interactions with trawl gear. The system used LED lighting and two Simrad SIT cameras. Video images were carried by cable from the cameras to the wheelhouse for continuous display and recording (Northridge 2003). Similarly, Lyle and Wilcox (2008) used a low-light black and white digital camera with a 90-degree wide-angle lens coupled to a commercially available hard drive unit to monitor interactions involving marine mammals and other megafauna. SWFSC scientists have successfully used underwater video gear to monitor the position of an MMED and its effect on the configuration of a Nordic 264 trawl net during research activities (Dotson et al. 2010).

Underwater video equipment may provide useful information about the efficacy of additional mitigation measures but the video equipment itself is unlikely to influence bycatch rates of protected species. In order to directly reduce takes of marine mammals, a video system to detect marine mammals underwater would have to be linked to a means of avoiding entanglement in gear. However, ships with deployed trawl nets cannot "swerve" to avoid a marine mammal for two reasons: 1) all marine mammals can swim faster than the tow speed so trying to move gear away from an animal that is likely attracted to fish in the net would be ineffective, and 2) changing the vessel direction suddenly risks tangling the gear, making it difficult and dangerous to retrieve, delaying retrieval and making the risk of marine mammal entanglement worse.

An alternative strategy would be to incorporate high-resolution, high-speed video cameras into trawl nets with open cod ends for the purpose of sampling fish without capturing them. The idea is that fish entering the trawl could be identified and counted through review of the video images but they would pass through the open cod end. This technique would potentially allow any incidentally captured marine mammals or other protected species to pass through the open cod end as well. Such an approach would be appropriate for swept area surveys designed to determine the density of fish but it would not be appropriate for surveys designed to determine the reproductive condition of adult fish (e.g., CPS surveys) or the growth rates of fish (e.g., Juvenile Salmon Surveys) as these measurements require the dissection of specimens. It would also be inappropriate for surveys targeting very small fish (e.g., Juvenile Rockfish Surveys) because species identification often requires microscopic analysis. Although this technique holds promise for reducing the risk of marine mammal interactions, the SWFSC is not proposing to conduct any surveys with trawl gear under the Modified Research Alternative that would be appropriate for an open cod end.

Use of passive acoustic monitoring

Passive acoustic monitoring involves the detection of animals by listening for the sounds that they produce (Barlow and Gisiner 2006). Use of passive acoustic monitoring may aid in the detection of marine mammals present in survey areas, and could potentially be used to inform decisions about when to implement appropriate modifications of fishing operations to prevent adverse interactions with marine mammals. Marine mammal calls can be reliably detected using hydrophones mounted on ships, autonomous underwater gliders, buoys, moorings, or bottom-founded installations. However, not all marine mammals vocalize and the vocalization rates of marine mammals may vary in a complex fashion depending upon environmental factors, including long periods of silence (Barlow and Gisiner 2006). While detection of a marine mammal call indicates the presence of a marine mammal, the absence of marine mammal calls does not necessarily indicate the absence of marine mammals. In addition, if the intent is to locate marine mammals so that they can be avoided, hydrophones in multiple locations combined with real-time processing are required to allow triangulation of the acoustic signal. This may be more practicable for planning large-scale activities at a set time and place rather than directing specific locations for research sampling, which involves continuous movement of a vessel from widely spaced sampling stations. Taking the time to set up a triangulated hydrophone system in an area prior to each 20-minute trawl would greatly lengthen the time and cost of collecting a certain amount of sample data. In summary, passive acoustic monitoring may be useful for detecting underwater marine mammals that could potentially interact with research activities but it would have substantial costs in terms of the research data collected and it would not guarantee the avoidance of all adverse interactions; passive acoustics inevitably overlooks those marine mammals that are not vocalizing and marine mammals may move into an area after trawl gear is deployed and still be at risk.

Use of aircraft or unmanned aerial or underwater gliders to expand detection of marine mammals

Currently, surveys using manned aircraft are routinely conducted to obtain unbiased estimates of marine mammal populations and their distributions. Aerial surveys provide reliable information about marine mammal populations because they are able to cover large areas over relatively short periods of time. In addition, airborne survey platforms generally do not influence the distribution or behavior of the marine mammals being counted, whereas many species of marine mammals are either attracted to or avoid seagoing vessels (Barlow and Gisiner 2006). The usefulness of manned aerial surveys for detection of marine mammals that could interact with fisheries research activities is limited by the range that the aircraft may travel from shore, flight time constraints, weather conditions, poor visibility in rough seas, logistical difficulties in matching a fast-moving airplane with a slow-moving research vessel, and considerable expense that would likely decrease the amount of ship-based research that could be conducted. Aerial surveys may be more practicable for planning large-scale activities at a set time and place rather than directing specific locations for research sampling, which involves continuous movement of a vessel from widely spaced sampling stations. Even with this capacity, the risk of marine mammal interactions would remain because any marine mammals that are not near the surface would not be detectable by airborne observers and, as with other extended detection methods, marine mammals may move into an area after trawl gear is deployed but before it is retrieved.

Unmanned aerial vehicles have the potential to overcome many of the limitations associated with manned aerial surveys for detection of marine mammals. Unmanned aerial systems range from inexpensive lightweight radio-controlled aircraft to complex autonomous aircraft developed for military applications. Unmanned aerial systems could be launched and retrieved from the research vessel, stream video data to observers onboard or at a shore station, and provide near-real-time data of marine mammals in proximity to fisheries research activities. Several systems are commercially available that have the ability to remain airborne for up to 24 hours and can be operated up to 150 kilometers (km.) from the control station. Several tests have successfully used unmanned aerial vehicles for marine mammal detection (NOAA 2006). However, these systems can only be operated in mild to moderate wind conditions, with increasing wind speeds strongly reducing their range and making recovery difficult.

Advantages associated with the use of unmanned aerial systems include ability to operate in areas far from shore, long flight times, increased safety of observers who can monitor the data from the ship or a shore based location, and decreased expense relative to surveillance conducted from manned aircraft. Unmanned aerial technologies are rapidly evolving; over the next 5 to 10 years, increased video resolution and advanced sensors are likely to increase the utility of these systems for monitoring marine mammals. However, approval from additional regulatory agencies, including the Federal Aviation Administration, would be required for operation of unmanned aerial vehicles for marine mammal monitoring or research purposes. Federal Aviation Administration approval has been very difficult to obtain, even in areas with very little air traffic, which currently limits the potential for using these systems over large areas.

Autonomous underwater gliders are highly successful platforms for the collection of oceanographic data and environmental characterization. Gliders offer an attractive platform for marine mammal detection due to their relatively low cost, low power consumption, and the ability to cover large areas of ocean during long-term deployments (Olmstead et al. 2010). Gliders have been used to locate and identify marine mammals using passive acoustic technology, and the U.S. Navy is conducting additional research and development using autonomous underwater gliders to support efforts to mitigate impacts from marine mammal interactions (Hildebrand et al. 2009). The use of underwater gliders to provide mitigation options for research activities is limited by the same issues as described above for other passive acoustic detection systems.

Use of infrared technologies

Infrared (IR) sensors may be useful for detection of marine mammals under certain circumstances. IR sensors used for marine mammal detection generally measure the spatial distribution of mid-wavelength IR radiation (3-5 µm). IR emissivity of an object in this waveband is closely correlated to the object's surface temperature, such that IR sensor arrays can detect slight variations in temperature across relatively large areas. This technology, also known as 'thermal imaging', could be useful to augment visual detection of marine mammals, particularly in conditions with low ambient light when visual detection of marine mammals would be difficult. IR image data also lends itself to automated image processing. With additional research and development, it is possible that an automated marine mammal detector could be designed to recognize the IR 'signatures' of certain marine mammals. However, several major drawbacks currently preclude such use of IR detection for automated marine mammal detection.

First, because emitted IR radiation is absorbed in the first few millimeters of water surrounding an object, IR technology is only able to detect animals at the surface, and only those parts that are above the surface of the water. Since water is virtually opaque to IR radiation, IR detection of marine mammals is also complicated by the thin film of water that covers the dorsal surfaces of marine mammals at the sea surface. The temperature measured by an IR sensor is the temperature of the water on the surface of the animal, which may only be a couple degrees above the surface water temperature (Cuyler et al. 1992, Kasting et al. 1989). Under ideal conditions (flat calm seas and close proximity to the IR detector), this slight temperature difference can be detected. However, waves cause the measured temperature of the sea surface to be much more variable and the thermal signature of the animal can easily be masked (Graber et al. 2011).

Second, the likelihood of detecting a temperature signature from a marine mammal falls off quickly with distance from the detector. In tests under ideal conditions, the ability of an IR system to detect killer whales, which present a large portion of their body and a tall dorsal fin above the surface of the water, was very poor beyond 100 meters (Graber et al. 2011). The ability of an IR system to detect much smaller targets like dolphins and porpoises would presumably be much less than it is for killer whales. Finally, considerable effort and time is required to process the video data so that the thermal signatures of animals can be distinguished from the surrounding water. This greatly reduces the effectiveness of the technique for real-time monitoring tied to potential mitigation. In summary, the logistical difficulties of using IR detectors in a real-life context on a research vessel would be overwhelming and currently preclude this potential tool as a practical element of mitigation.

Use of night vision devices

Like IR imaging devices, night vision devices may be used for detecting marine mammals at or above the water surface in low-light conditions. Unlike IR sensors, night vision devices operate by amplifying the signal produced when visible light interacts with a detector. Although night vision devices could potentially improve an observer's ability to detect a marine mammal under low light conditions, previous studies have shown that the effective range of detection for marine mammals using night vision devices is only about 100m (Calambokidis and Chandler 2000, Barlow and Gisner 2007). These devices work best when there is a little light on the water (from the moon or nearby land sources) but they must be directed away from deck lights because they are too bright. This means they could not be used to monitor trawl gear as it is being deployed or retrieved because of the deck lights used for crew safety. They also have a very narrow field of view, making broad area searches inefficient and unreliable, and if sea conditions are rough the many reflections off waves make it very difficult to distinguish objects in the water. Some observers found the devices disorienting and uncomfortable and all observers said it was very difficult to estimate distances while using the night vision devices (Calambokidis and Chandler 2000). Failure to detect marine mammals using such devices would not decrease the uncertainty about whether marine mammals are actually in the immediate area or not and would thus offer no help in deciding whether to deploy trawl gear or not.

Operational restrictions

This measure would require the SWFSC to suspend trawl operations at night or during periods of low visibility (including fog and high sea state) to minimize adverse interactions with marine mammals that would be difficult to detect by visual monitoring. Given the fact that many of the historical takes in SWFSC research trawls have occurred during hours of darkness, this measure has the potential to reduce the risk of adverse interactions with marine mammals. However, two of the three highest incidences of incidental take (involving multiple animals in one trawl) and 30 out of 49 fatalities have occurred during daylight hours (Table 4.2-7), so restricting operations to only daylight hours would not eliminate the majority of risk. In addition, restrictions on trawling at night would seriously hinder the ability of the SWFSC to sample important species such as sardines that aggregate near the surface at night but are otherwise dispersed at depth. If survey vessels had to stand down when they encountered fog or rough seas, survey periods would have to be extended or fewer stations would have to be sampled to accommodate such delays. This would mean substantially higher costs and/or decreased quality of data. Although visual monitoring is a reasonable and practicable precaution to undertake for trawl surveys, it clearly does not ensure that marine mammals would be detected or that entanglement can be prevented even if they are detected.

The SWFSC would investigate the use of video cameras to identify fish and their encounter rates in lieu of a closed cod end on pelagic trawls, thereby allowing protected species (and fish) to pass through the net rather than be captured. Such an approach would be appropriate for some swept area surveys designed to determine the density of fish but it would not be appropriate for surveys designed to determine the reproductive condition of adult fish (e.g., CPS surveys) or the growth rates of fish (e.g. Juvenile Salmon Surveys) as these measurements require the dissection of specimens. As was the case with the development of excluder devices, it is not clear how effective the video camera technique would be in actually reducing marine mammal takes. The SWFSC would experiment with this technique under the assumption it could be used to reduce the number of closed cod end trawls needed for scientific purposes and therefore reduce the risk of capturing marine mammals. While it would not be the primary objective, video camera data may also provide documentation of protected species interactions with trawl gear and may thus provide insight into the efficacy of other measures intended to reduce the adverse interactions with protected species (e.g. excluder devices or acoustic pingers).

Acoustic and visual deterrents

The SWFSC currently deploys acoustic pingers on all trawl gear to deter marine mammal interactions (Section 4.2.4). This measure would require the SWFSC to use additional acoustic deterrents, such as recordings of predator vocalizations (e.g., killer whale) to deter adverse interactions with trawl gear. This measure would also require the SWFSC to use visual deterrence techniques (e.g., lights, light sticks, reflective twine/rope) to reduce marine mammal adverse interactions with the gear.

An alternative approach to using pingers for acoustic deterrence of marine mammals involves the underwater broadcasting of pre-recorded predator sounds (e.g. killer whale calls) to scare animals away from the fishing operation. Jefferson and Curry (1996) concluded that this technique was largely ineffective for reducing marine mammal interactions with commercial fisheries based on their review of multiple studies. Gilman et al. (2006) concluded that marine mammals are likely to become habituated to predator calls broadcast in the vicinity of fishing operations.

Several methods have been suggested to help protected species detect the presence of fishing gear with the expectation that these methods would help animals avoid entanglement. Dense material, such as barium sulphate, can be incorporated into the rope and twine used for construction of fishing gear in order to increase the acoustic reflectivity of the gear (Gilman et al. 2006). The increased acoustic reflectivity would make the gear more apparent to cetaceans that use echolocation in the vicinity of the fishing gear. This measure would theoretically reduce rates of interaction or entanglement for animals that have trouble detecting the fishing gear in order to avoid it (Gilman et al. 2006). Similarly, phosphorescent or luminescent material can be incorporated into fishing gear to emit light underwater at wavelengths that are visible to protected species. However, it is not clear that such measures to enhance the acoustic or visual appearance of trawl nets would have the same effect on all species. For some species that are attracted to the fish in the net or the disturbance of potential prey as the net is towed through the water, efforts to increase the "visibility" of a net may increase the potential for adverse interactions rather than decrease those risks. Tests conducted by Wang et al. (2009) in a Mexican gillnet fishery suggest that the use of luminescent lightsticks and LEDs significantly decreased rates of green sea turtle bycatch in that fishery without impacting the catch of target species. In contrast, laboratory experiments performed by Wang et al. (2007) demonstrated that sea turtles are attracted to underwater illumination. Thus, the efficacy of such mitigation measures could be different under different conditions and for different species and should be examined on a case-by-case basis.

Temporal or geographic restrictions

Spatial-temporal restrictions can be a direct way of reducing adverse impacts to protected species if there are known overlaps in time and space of the survey's footprint with concentrations of protected species. This measure would require the SWFSC to identify areas and times that are most likely to result in adverse interactions with marine mammals (e.g., areas of peak abundance) and to avoid, postpone, or limit their research activity to minimize the risk of such interactions with marine mammals. This may include limits on specific locations, physical or oceanographic features, biologically important times, and/or gear types.

While the rationale for such restrictions is clear, the methods for identifying appropriate places and times for effective restrictions are not. The SWFSC has been conducting marine mammal surveys in all three research areas (many of which are included as part of this alternative) to monitor the changing patterns of marine mammal abundance and distribution. Although certain oceanographic conditions indicating high productivity can be remotely sensed, there is no catalog of areas with consistently "high concentrations" of animals at sea that could be used to define areas that should be "off limits" to research involving trawl gear. The abundance and distribution of marine mammals at sea are highly dynamic, varying among seasons and years, and are impacted to varying degrees by climate and oceanographic changes, so marine mammal survey information from the previous year or even the previous month may not reflect actual conditions when it is time to deploy trawl gear. It might be possible to conduct aerial surveys or passive acoustic surveys in an area prior to conducting trawls, but such surveys require time to process data before actual density information is available.

Even if recent marine mammal survey data are available, there is an open question about what standards of density should be used for limiting research. This is important to the potential effectiveness of such restrictions because it is not clear if marine mammal density is a key factor in the risk of catching animals in a research trawl. Marine mammals can all swim much faster than an active trawl tow (2-4 kts) so they can easily avoid such gear if they perceive it and choose to move. This is true no matter how many animals are in a given area. The risk of entanglement is likely much more influenced by the attraction of marine mammals to fish caught in the trawl or disturbed by it as the trawl passes by, which in turn may be influenced by the overall availability of prey and the nutritional status of the marine mammals. Even if there are only a few marine mammals in an area, the risk of entanglement could be high if they are very hungry and strongly attracted to fish in a trawl. Conversely, the risk of entanglement could be quite small even if there are many marine mammals in an area if they have been foraging successfully and are inclined to avoid the disturbance of a trawl operation.

In any case, under the Status Quo and Preferred Alternatives, the "move-on" rule is typically applied if any marine mammals are sighted from the vessel during the 30 minutes prior to deploying trawl gear and appear to be at risk of adverse interactions with the gear. If an area has a high density of marine mammals, they would likely be sighted within that 30 minute period and the station would be moved away or abandoned to avoid the marine mammals. In addition, under the Preferred Alternative, the SWFSC would undertake an extensive analysis of the factors that may have influenced past takes of marine mammals in research trawl gear with the intent of trying to identify conditions that may pose higher risk of entanglements in trawls, including spatial/temporal factors. If any such causal factors are identified, the SWFSC would use that analysis to make modifications to its sampling efforts as appropriate, potentially involving spatial/temporal restrictions similar to what is called for in this additional mitigation measure.

A special case of spatial/temporal restrictions would be for the SWFSC to avoid trawl survey work within federal and state MPAs (see Section 3.1.2). While the SWFSC has conducted survey work within some MPAs under the authority of special use permits, these permits primarily provide authority to scientifically sample fish in areas that are otherwise closed to fishing and do not concern the incidental take of marine mammals. The only areas that are protected specifically for marine mammals are coastal areas and islands used by pinnipeds for rookeries and haulouts and SWFSC surveys using trawl gear do not go close to shore. The SWFSC would continue to apply for special use permits to sample in MPAs as necessary to meet the scientific needs of their surveys and, if the managing agencies of any MPAs prohibit such sampling, the SWFSC would avoid those areas. However, as described above, the same concerns about the effectiveness of spatial/temporal restrictions as a mitigation measure would apply to MPAs. They may or may not have high concentrations of marine mammals relative to the surrounding areas but, given the uncertainty about what factors contribute to high risk of entanglement in trawl gear and the imposition of the “move-on” rule, the potential for actually reducing incidental take by avoiding certain areas is not clear. Such avoidance also comes at the cost of not sampling in areas that are important to different fish species or that were established to promote recovery of depleted stocks. Scientific sampling is often the only reliable way to track the status of these stocks and the effectiveness of the MPA in fulfilling its established goals.

4.4.4.2 Longline Gear

The surveys that use longline gear occur in the CCRA (HMS, Thresher Shark, and Habitat surveys) and the ETPRA (new HMS survey). The following additional mitigation measures could be applied to one or more of these longline surveys.

Monitoring methods

As is the case with surveys using trawl gear, longline surveys conducted under the Preferred Alternative use crew to visually monitor for marine mammals (using 7x bridge binoculars as needed) at least 30 minutes prior to setting longline gear. Whoever is assigned to the marine mammal observer post is dedicated to that task until the gear is deployed and does not have any other duties during the observation period. Under the Additional Mitigation Alternative, one mitigation measure would require the SWFSC to use trained PSOs whose dedicated job would be to monitor for the presence of marine mammals during all fishing operations. Considerations include the use of dedicated PSOs for all surveys or during longline surveys of particular concern.

As was described for trawl surveys, not all current crew members have received formal training in marine mammal identification or marine mammal mitigation procedures, although they are briefed on what they are looking for and may have considerable experience with the task. However, the customized protected species training program included in the Preferred Alternative would provide the same types of training for all appropriate crew members as PSOs trained for that specific task for commercial fisheries. The difficulty in having crew members assigned only to PSO duties is that all vessels used for longline surveys have limited carrying capacity for personnel and any berths given to PSOs would mean a reduction in personnel available to help with other research or vessel duties. This could compromise crew safety or the amount of research that could be conducted. By providing formal PSO training for crew already trained in other skills, the SWFSC believes it can provide the same quality of visual monitoring for marine mammals and other protected species as would occur with dedicated PSOs while maintaining the flexibility to fulfill all other crew duties.

Operational procedures

This measure would require use of a decoy research vessel playing pre-recorded longline fishing sounds to distract marine mammals away from research longline sets. There have been no attempts to test the effectiveness of this method but it is very likely that cetaceans would quickly learn to tell the difference between decoys and actual fishing operations (Gilman et al. 2006). Although the potential effectiveness is not clear, the additional cost of chartering another vessel to serve as a decoy would certainly compromise the research budget and restrict the amount of data that could be collected. In addition, a second vessel and broadcast fishing sounds would add to the amount of noise introduced to the marine environment, potentially increasing the number of animals taken by disturbance (Level B harassment takes) everywhere the survey was conducted.

Acoustic deterrents

This measure would require the SWFSC to use deterrents such as acoustic pingers or recordings of predator vocalizations (e.g., killer whales) to deter adverse interactions with longline gear. These methods have not been tested for use with longline gear (Gilman et al. 2006). The intent of pingers is to alert the animals to the presence of the fishing gear so they do not get entangled inadvertently. However, past takes of marine mammals in SWFSC longline surveys (all California sea lions) have involved animals hooked while depredating fish caught on the gear. Adding pingers to the longline may serve to attract animals rather than deter them (the "dinner bell" effect). As with trawl gear, attempts to scare animals off by playing killer whale recordings are likely to prove ineffective as animals learned they could safely ignore the hoax.

Visual deterrents

This measure would require the SWFSC to use visual deterrence techniques (e.g., lights, light sticks, reflective twine/rope, or marked lines) to make the longline gear more detectable thereby reducing the likelihood of hooking or entangling a marine mammal. This measure would theoretically reduce rates of interaction or entanglement for animals that have trouble detecting the fishing gear in order to avoid it (Gilman et al. 2006). Similarly, phosphorescent or luminescent material can be incorporated into fishing gear to emit light underwater at wavelengths that are visible to protected species. However, it is not clear that such measures to enhance the acoustic or visual appearance of longline gear would have the same effect on all species. For some species that are attracted to the fish caught on the longline, efforts to increase the "visibility" of a longline set may increase the potential for adverse interactions rather than decrease those risks. As mentioned above, the historical takes of sea lions in SWFSC longline surveys have all involved depredation rather than inadvertent entanglement in the ground mainline or gangions.

4.4.4.3 Summary and Conclusion

Of the potential techniques and procedures considered under this alternative to improve monitoring of trawl gear, three techniques appear to offer some promise in helping to detect marine mammals in conjunction with the current visual monitoring protocol. These include the use of underwater video technology, passive acoustic monitoring, and unmanned aerial or underwater surveillance vehicles. However, all three of these techniques have substantial limitations in terms of the conditions under which they may be useful (e.g., weather and sea state), the logistics of incorporating them into sampling procedures (e.g., timing of deployment, crew responsibilities, data processing, etc.), and how they might be incorporated into actual marine mammal take-avoidance decisions like the "move-on" rule. These three techniques deserve further examination to explore these limitations and to see how they may be applied under actual survey conditions, especially as technology changes and is improved. The other technological approaches considered, infra-red imaging and use of night vision devices, have severe limitations to their usefulness in a real-world situation and therefore offer no advantages for actual mitigation. The use of dedicated PSOs for monitoring is essentially what would occur under the Preferred Alternative once the crew and scientists of research surveys complete the new protected species training program. Whatever crew person is assigned to monitor for protected species before and during the time fishing gear is deployed would be dedicated only to that task, even if they have other duties while fishing gear is not being deployed.

Operational restrictions such as not allowing trawls to be set at night or in poor visibility conditions would certainly reduce the risk of taking marine mammals. However, such restrictions would have a serious impact on the ability of the SWFSC to collect certain kinds of research data and would have impacts to the cost and scope of research that could be conducted. The spatial/temporal restrictions that were considered to avoid high densities of marine mammals are similar in that they would reduce risk of take but also strongly impact the ability of the SWFSC to pursue certain scientific goals. Under the Preferred Alternative, the SWFSC would examine the conditions under which marine mammals are more likely to be caught in trawl gear and would make practicable adjustments to their sampling procedures to accommodate any high risk factors they discover, if any.

The use of additional acoustic and visual deterrents is worth exploring further, especially as new devices enter the market and are tried in other fisheries. However, the effectiveness of the devices considered in this alternative appears to be species specific; mitigation advantages for some species may lead to higher risk for other species. The effectiveness of these techniques is also likely to decrease with time as animals habituate to various devices and techniques.

The analysis of additional measures considered to decrease the risk of marine mammal takes in longline gear is similar to trawl gear. The use of PSOs would impose logistical difficulties on small longline vessels with limited crew quarters and, given the use of trained survey crew who are dedicated to the observation task before and during gear deployment, would offer no advantages for mitigation once the survey crew complete the new protected species training program. Decoy vessels, acoustic deterrents, and visual deterrents are all unlikely to provide consistent mitigation value and may increase the risk for certain species. New variations on these techniques may be developed in the future that address some of these concerns.

In conclusion, some elements of the Modified Research Alternative (trained PSOs, examining spatial/temporal risk factors) would offer mitigation advantages compared to the Status Quo Alternative. However, many of the additional mitigation measures considered in this alternative would compromise the ability of the SWFSC to conduct research important to its mission, and the SWFSC currently considers them to be impracticable to implement. Some concepts and technologies considered in the Modified Research Alternative are promising, and NMFS would continue to evaluate the potential for implementation if they become more practicable.

4.4.5 Effects on Birds

The effects of the Modified Research Alternative on birds are very similar to those described for the Status Quo (Section 4.2.5) and essentially the same as the Preferred Alternative (Section 4.3.5). The only major difference is regarding longline surveys, where SWFSC could potentially deploy streamer lines on each side of the baited longline to discourage seabirds from diving on baited hooks. This measure has proven to be effective in reducing seabird bycatch in other Pacific fisheries (Melvin et al. 2001).

The overall effects of SWFSC research activities on birds under the Modified Research Alternative are considered minor adverse for mortality or any alterations to their habitat. This conclusion holds for each of the three SWFSC research areas and for all gear types used in research.

4.4.6 Effects on Sea Turtles

Additional mitigation measures described under Alternative 3 are unlikely to decrease the potential for adverse impacts to sea turtles relative to Alternative 1. Under Alternative 3, the SWFSC would implement video sampling with an open codend as an additional mitigation measure. Underwater video technology may allow the SWFSC to determine the frequency of sea turtle interactions with trawl gear and evaluate the effectiveness of MMEDs or other devices intended to reduce entanglement or bycatch of protected species. This technology may provide useful information about the efficacy of some mitigation measures; however, the use of video equipment is unlikely to influence the impact of SWFSC research activities on sea turtles.

Passive acoustic monitoring involves the detection of animals by listening for the sounds that they produce (Barlow and Gisiner 2006). This technology is not expected to be effective for detection or avoidance of sea turtles because sea turtles vocalize only during copulation and nesting, and are the least vocal of living reptiles (Cook and Forrest 2005). Likewise, IR detection is unlikely to improve the ability to detect and avoid sea turtles in the water because water is effectively opaque to IR radiation. Although turtles come to the surface to breathe, only a very small area of a turtle is exposed above the sea surface. In addition, because turtles are ectothermic (cold-blooded) reptiles, temperature differences between the turtle and the surrounding water would be minimal and difficult to detect using IR-sensing devices. Similarly, sea turtles in the water would be extremely difficult to detect using night-vision technology.

Operational restrictions proposed under Alternative 3 would require the SWFSC to suspend trawl operations at night or during periods of low visibility (including fog and high sea state) to minimize adverse interactions with protected species including sea turtles, which would be difficult to detect by visual monitoring under low-visibility conditions. As discussed in Section 4.3.4, visual monitoring is a reasonable and prudent precaution to undertake for trawl surveys, but would not ensure detection of sea turtles, nor would it necessarily decrease the potential for adverse interactions between sea turtles and SWFSC research activities. Thus, the suspension of trawl activities during low-visibility conditions is not expected to influence overall effects of SWFSC research activities on sea turtles in the CCRA and ETPRA.

The effectiveness of visual deterrents for mitigation of sea turtle interactions with fishing gear is uncertain. Some data suggest that the use of luminescent lightsticks and LEDs may decrease rates of green sea turtle bycatch in longline gear (Wang et al. 2009). However, results from other studies demonstrate that sea turtles are attracted to underwater illumination (Wang et al. 2007).

The uses of aircraft or unmanned aerial or underwater gliders to detect sea turtles in the vicinity of SWFSC research operations are untested. While this mitigation could potentially be effective for detecting and subsequently avoiding sea turtles, the overall influence of the mitigation measure on the impacts to sea turtles is expected to be trivial.

Spatial-temporal restrictions are one of the most direct means of reducing adverse impacts to protected species. Where and when the gear is deployed and retrieved are critical variables for reducing the potential for adverse interactions with sea turtles. The implementation of time-area closures to restrict fishing activities at times and places turtles are most likely to be present in the highest numbers have been shown to be effective for reducing impacts to sea turtles in the Pacific Islands region (Kobayashi and Polovina 2005). Time-area restrictions proposed as mitigation measures under Alternative 3 could potentially alter the spatiotemporal distribution and overall level of impacts to sea turtles resulting from SWFSC research activities; if the species of interest has a predictable distribution in time and space, this would facilitate the designing of an effective time-area closure. However, the identification of specific sea turtle migratory pathways or high-residence areas and times is essential for the establishment of effective spatial-temporal restrictions to reduce adverse interactions with sea turtles.

Thus, additional mitigation measures described under Alternative 3 are unlikely to substantially decrease the potential for adverse impacts to sea turtles relative to Alternative 1. Time-area restrictions included as mitigation measures under Alternative 3 could result in decreased potential for adverse interactions with sea turtles relative to the Status Quo Alternative provided that the restrictions accurately address the spatiotemporal distribution of sea turtles in SWFSC research areas. However, considering that SWFSC research activities historically have not resulted in any sea turtle mortality, the implementation of such mitigation measures would not be expected to result in any substantial reduction in impacts to sea turtles. Thus, the overall level of effects on sea turtles resulting from the actions proposed under Alternative 3 would be substantially similar to those of the Status Quo Alternative. Minor adverse effects would occur using gear types and mitigation measures described under Alternative 3; these effects would be isolated and infrequent, and would not result in any measurable changes to sea turtles at the population level in any of the SWFSC research areas.

4.4.7 Effects on Invertebrates

The continuation of federal Fisheries Research with Additional Mitigation Measures for Protected Species (Alternative 3) would result in effects on invertebrates substantially similar to those of the Status Quo Alternative (see Section 4.2.7). Additional mitigation measures for protected species required under Alternative 3, such as the use of advanced monitoring methods for the detection of marine mammals, operational restrictions, and acoustic and visual deterrents for protected species would not measurably influence the effects of the research activities on invertebrates. Temporal or geographic restrictions on SWFSC research activities intended to reduce adverse impacts to protected species (i.e., time/area restrictions) proposed as mitigation measures under Alternative 3 could potentially alter the spatiotemporal distribution of impacts to invertebrates; however, overall impacts to invertebrates would remain substantially similar to those described under Alternative 1. Likewise, avoidance of federal and state MPAs, proposed as a mitigation measure under Alternative 3, could potentially alter the spatiotemporal distribution of impacts to invertebrates, but would not result in substantial changes to the overall level of impacts to invertebrates compared to Alternative 1. Therefore, the overall effects of Alternative 3 on invertebrates would be substantially similar to those described for Alternative 1; the effects would be minor adverse in the CCRA and ETPRA, and the ARA.

4.4.8 Effects on the Social and Economic Environment

The effects of Alternative 3 on social and economic factors depends on the extent that additional mitigation measures would be implemented. Some of the mitigation measures require additional equipment than is currently used, and additional trained observers, which could increase spending on wages, rentals, and equipment. Other measures could curtail research operations, for example, time/area closures, which may reduce some operation expenditures if surveys are reduced in scope but may also increase survey expenses if surveys need to be extended in time to compensate for restricted data collection opportunities. The consistency of data collected with changes in methodology has not been evaluated, so it is uncertain if contributions to fisheries management would be comparable to that at present. If the SWFSC could incorporate the additional mitigations measures to be compatible with their current program, the direct and indirect effects on social and economic conditions would continue to be beneficial and moderate in the CCRA and minor adverse in the ETPRA and ARA, as in the Status Quo Alternative.

4.5 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 4 – NO RESEARCH ALTERNATIVE

This section presents an analysis of the potential direct and indirect effects of Alternative 4 – the No Research Alternative – on the physical, biological, and social environment. Under the No Research Alternative, SWFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered in the scope of this Final PEA in marine waters of the CCRA, ETPRA, or ARA. This moratorium on fieldwork would not extend to research that is not in scope of this Final PEA, such as directed research on marine mammals and ESA-listed species covered under separate research permits and NEPA documents. NMFS would need to rely on other data sources, such as fishery-dependent data (i.e., harvest data), and state or privately supported data collection programs to fulfill its responsibility to manage, conserve, and protect living marine resources in the U.S.

The potential direct and indirect effects of implementing Alternative 4 were evaluated according to the criteria described in Table 4.1-1. A summary of the impact rating determinations for all topics evaluated under this Alternative are presented below in Table 4.5-1.

Table 4.5-1 Alternative 4 Summary of Effects

All conclusions refer to adverse effects.

Resource	Physical Environment	Special Resource Areas	Fish	Marine Mammals	Birds	Sea Turtles	Invertebrates	Social & Economic
SECTION NUMBER	***4.5.1***	***4.5.2***	***4.5.3***	***4.5.4***	***4.5.5***	***4.5.6***	***4.5.7***	***4.5.8***
Research Area								
California Current	Moderate	Moderate	Moderate	Minor	Minor	Minor	Moderate	Moderate
Eastern Tropical Pacific	Minor	Minor	Minor	Minor	Minor	Minor	Minor	Minor
Antarctic	Minor	Minor	Minor	Minor	Minor	N/A	Minor	Minor

4.5.1 Effects on the Physical Environment

Currently, the research conducted by SWFSC includes assessments of fisheries and marine habitat that are used to inform a wide range of plans, policies, and resource management decisions. Many of the plans, polices and decisions that are partially based upon SWFSC data are concerned with conservation of ecological properties of the environment and maintenance of the habitat that sustains living resources in the SWFSC research areas. For instance, SWFSC data on the physical environment are used to support the establishment and ongoing management of special resource areas, including closed areas, conservation areas, and MPAs, both inside and outside the U.S. EEZ. FMPs developed for the region are partially based on scientific advice derived from SWFSC data. These special resource areas and management plans strategically limit impacts to physical habitat such as disturbance of benthic habitat and removal of organisms that produce seafloor structure. Without a relatively continuous input of SWFSC data, management authorities would lose some of the information necessary to establish management measures in a meaningful fashion. The No Research Alternative would be expected to result in certain adverse effects due to the loss of scientific information used to support informed decision making and establish physical resource conservation measures. Currently, SWFSC directs a robust information stream which is used, at least partially, to manage and conserve the physical environment and habitat that sustains living marine resources in the CCRA, ETPRA, and ARA. In addition, SWFSC is the primary source of scientific advice to the U.S. Commissioner and delegation to CCAMLR, and research conducted by the SWFSC has been instrumental in the development and successful implementation of ecosystem-based management in Antarctica. The loss of information on physical resources under the No Research Alternative would affect a number of different federal and state resource management agencies to various degrees. The SWFSC research program is not the only source of information available to these resource managers but the No Research Alternative could lead to changes in some management scenarios based on greater uncertainty. Given the potential for resource management agencies to compensate for this loss of information to some extent, and the preference to avoid rapid, major changes in management strategies, the potential magnitude of effects on the physical environment would likely vary from minor to moderate and be limited in geographic extent over the next five years. Under the No Research Alternative, the overall impact of these indirect effects on physical resources would be considered adverse and moderate for the CCRA and minor adverse for the ETPRA and ARA according to the criteria in Table 4.1-1.

4.5.2 Effects on Special Resource Areas

The No Research Alternative (Alternative 4) would result in elimination of the minor adverse direct impacts to special resource areas described in Section 4.2.2 for the Status Quo Alternative. The potential adverse impacts to the benthic environment of special resource areas resulting from SWFSC research activities would likewise be eliminated under the No Research Alternative. However, the loss of scientific information currently provided by SWFSC survey activities under the Status Quo Alternative would make it increasingly difficult for fisheries managers to assess the efficacy of special resource areas in fulfilling the ecosystem functions for which they were designated. Furthermore, a loss of input from SWFSC research would handicap the maintenance and effective management of existing EFH, HAPC, and closed areas, and would encumber the designation of additional special resource areas in the future. The loss of information about special resource areas under the No Research Alternative would have various implications for different federal and state resource management agencies. The SWFSC research program is not the only source of information available to these resource managers but it could lead to changes in some management scenarios based on greater uncertainty (e.g., greater restrictions on commercial fisheries in MPAs). If the SWFSC discontinued collecting information on special resource areas, management authorities would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect ecological properties of the environment would become less effective. The indirect effects of these potential management implications would likely vary among research areas and the many special resource areas considered. Given the potential for resource management agencies to compensate for this loss of information to some extent and the tendency to avoid rapid, major changes in management strategies, the potential magnitude of effects on special resource areas would likely vary from minor to moderate and be limited to a few local areas within the CCRA over the next five years. Under the No Research Alternative, the overall impact of these indirect effects on special resource areas would be considered adverse and moderate for the CCRA and minor adverse for the ETPRA and ARA according to the effect levels criteria described in Table 4.1-1.

4.5.3 Effects on Fish

Under the No Research Alternative, the SWFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered in the scope of this Final PEA. Currently, the SWFSC collects data which are used to manage and conserve marine resources, including fish, their habitats, and the ecosystems that sustain the fish populations of the CCRP, ETRP, and ARA. Alternative 4 proposes no at-sea SWFSC research activities, so there would be no direct effects on fish. The lack of at-sea research activities would eliminate the risk of mortality from surveys and fish tagging activities, disturbance and changes in behavior due to sound sources, and potential contamination from vessel discharges. However, the loss of scientific information about these species is expected to make it increasingly difficult for fisheries managers to effectively monitor their status, set commercial harvest limits, or develop fishery regulations to protect vulnerable stocks, especially as information used in stock assessments gets older and less reliable.

The conservation and management of fishery resources is a core mission for NMFS and is listed among the ten National Standards set forth in the MSA. In carrying out Congress's mandate under the MSA, NMFS is responsible for ensuring that management decisions involving fishery resources are based on the highest quality, best available scientific information on the biological, social, and economic status of the fisheries. In the Southwest, this is achieved through the work of the SWFSC, which provides supporting scientific information with which NMFS uses for the basis of their fisheries management actions.

The information provided by the SWFSC is not solely intended to support current management decisions, but also to conserve resources and anticipate future trends, ensure future utilization opportunities, and assess the effectiveness of the agency's ongoing management efforts. In addition to assessing the status of stocks and examining potential effects of commercial fishing activities, NMFS uses SWFSC research data to support the development and implementation of FMPs. In NMFS view, the ability to acquire scientific information is essential to the agency's responsibility to manage our nation's fishery resources in support of and in cooperation with international treaty organizations and other nations.

Under the No Research Alternative, the loss of scientific data would make it increasingly difficult for fisheries managers to effectively monitor the status of stocks, develop meaningful fishery regulations, and rebuild overfished stocks, particularly in the CCRA. Federal and state resource management agencies would be affected to various extents. Although resource management agencies have other available data sources to support resource management decisions, the No Research Alternative is expected to result in increased uncertainty and changes in some management scenarios. If the SWFSC discontinued collecting information on fish stocks, management authorities would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect ecological properties of the environment would become less effective. The indirect effects of these potential management implications would likely vary among research areas and the different fish stocks assessed by the SWFSC. There are too many unknown variables to estimate what the indirect effects of this loss of information would mean to any particular fish stock. Given the potential for resource management agencies to compensate for this loss of scientific information to some extent and the tendency to avoid accelerated, major changes in management strategies, the potential magnitude of effects on fish stocks would likely vary from minor to moderate and be limited in geographic scope. Through these indirect effects on future management decisions, the overall impact on fish stocks would be adverse and moderate for the CCRA and minor adverse for the ETPRA and ARA.

4.5.4 Effects on Marine Mammals

Under the No Research Alternative, the SWFSC would no longer conduct or fund fisheries and ecosystem research associated with directed marine mammal research fieldwork in marine waters of the CCRA, ETPRA, or ARA. Directed research on marine mammals may continue under MMPA section 10 directed research permits but the associated use of acoustic equipment and fishing gear (various nets and hook-and-line gear) to sample prey fields and other oceanographic conditions would not be conducted under the No Research Alternative. This would eliminate the potential for direct effects on marine mammals through capture and entanglement in research gear, potential Level B harassment due to acoustic disturbance, and impacts to prey fields due to fisheries and ecosystem research in all three research areas and for all species of marine mammals.

Oceanographic and fisheries data collected by the SWFSC during directed marine mammal research cruises is important for monitoring the ecological status of the environment important to marine mammals. While there would be no direct effects on marine mammals due to adverse interactions with research gear, the loss of ecological information important to marine mammals would indirectly affect resource management decisions concerning the conservation of marine mammals. Given the fact that the SWFSC is not the only source of information available to federal and state resource managers, and the potential for resource managers to compensate for this loss of information, The No Research Alternative is expected to have an adverse and minor indirect effect on marine mammals for all of the SWFSC research areas. There are too many unknown variables to estimate what the indirect effects of this loss of information would mean to any particular species.

4.5.5 Effects on Birds

Under the No Research Alternative, the SWFSC would no longer conduct or fund fisheries and ecosystem research involving fieldwork in marine waters of the CCRA, ETPRA, or ARA. This would eliminate the potential for direct effects on birds through disturbance, entanglement in gear, changes to prey fields, and contamination of the marine environment in all three research areas and for all species of birds. However, many of the SWFSC projects that would be eliminated under this alternative include observations made from the deck of the vessels (transects while vessels are underway) which provide scientific data on the abundance and distribution of seabirds in these three areas. While bird observations may still be made during directed mammal cruises (as described above), especially in the ETPRA, other fisheries research cruises have served as "platforms of opportunity" for seabird observations and this data would be lost under the No Research Alternative.

Oceanographic and fisheries data collected by the SWFSC is also important for monitoring the ecological status of the environment important to seabirds. While there would be no direct effects on seabirds, the loss of observational and ecological information important to seabirds would adversely affect resource management decisions concerning the conservation of seabirds. Although NMFS does not have regulatory jurisdiction over birds, the scientific contribution from the SWFSC observational research on seabirds is used, at least partially, to support fishery management decisions, USFWS conservation efforts, and international treaties such as CCAMLR. If the SWFSC discontinued collecting observational information on seabirds on some cruises, the ability of state and federal agencies as well as international treaty organizations to make informed decisions about the marine environment would be adversely affected, especially as time went on and uncertainty about the status of various populations of birds increased. Resource management authorities would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect ecological properties of the environment would become less effective. Given the fact that the SWFSC is not the only source of information available to federal and state resource managers, and the potential for resource managers to compensate for this loss of information, The No Research Alternative is expected to have an adverse and minor indirect effect on seabirds for all of the SWFSC research areas. There are too many unknown variables to estimate what the indirect effects of this loss of information would mean to any particular species.

4.5.6 Effects on Sea Turtles

Under the No Research Alternative, the SWFSC would no longer conduct or fund fisheries and ecosystem research involving fieldwork in marine waters of the CCRA and ETPRA. This would eliminate the potential for direct impacts to sea turtles through disturbance, entanglement in gear, or contamination associated with SWFSC research activities. The No Research Alternative would result in elimination of the direct adverse impacts to all species of sea turtles in the CCRA and ETPRA described in Section 4.2.6 for the Status Quo Alternative.

However, several of the SWFSC projects that would be eliminated under this alternative include observations made from the deck of the vessels which provide scientific data on the distribution of sea turtles in the CCRA and ETPRA Research Areas. While sea turtle observations may still be made during directed mammal cruises (as described above), especially in the ETPRA, other fisheries research cruises have served as "platforms of opportunity" for sea turtle observations and this data would be lost under the No Research Alternative.

Oceanographic and fisheries data collected by the SWFSC is also important for monitoring the ecological status of the environment important to sea turtles. These data support the management and conservation of sea turtle populations and the habitats and ecosystems that sustain them. Many of the plans, polices and decisions that are based upon SWFSC data are used to support the conservation and ongoing management of sea turtle populations, both inside and outside the U.S. EEZ. FMPs that are developed based, at least partially, on scientific advice derived from SWFSC data include management measures such as time area closures and gear type restrictions for commercial fisheries specifically intended to reduce adverse interactions with sea turtles. These management measures strategically limit impacts to sea turtles, and are partially dependent on periodic input of SWFSC data. Without these data, management authorities would lack some of the information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect sea turtles would become obsolete. The loss of scientific information important to understanding sea turtle ecology under The No Research Alternative would affect federal and state resource management agencies to various degrees. Without the input of SWFSC data relevant to sea turtle ecology, management authorities would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect ecological properties of the environment would become less effective. Since the SWFSC is not the sole provider of scientific information on sea turtles or their habitats, resource management agencies would be forced to adequately compensate for this loss of information through changes in management scenarios. There are too many unknown variables to estimate what the indirect effects of this loss of information and associated management implications would mean to any particular sea turtle species. Under the No Research Alternative, the loss of information currently provided by SWFSC research activities is expected to have adverse and minor indirect effects on sea turtles in the CCRA and ETPRA.

4.5.7 Effects on Invertebrates

The No Research Alternative would result in no direct impacts to invertebrates. However, increased adverse effects could result indirectly from a loss of information necessary for informed decision making and conservation of invertebrates and their habitats. Currently, SWFSC collects data which are used to manage and conserve marine resources, including invertebrates such as market squid in the CCRA and krill in the ARA, their habitats, and the ecosystems that sustain invertebrate populations in the CCRA, ETPRA, and ARA. Under The No Research Alternative, discontinuation of SWFSC research activity would affect federal, state, and international resource management agencies to various degrees. Without the input of SWFSC data, management authorities would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect ecological properties of the environment would become less effective. Resource management agencies would have to adequately compensate for this loss of information through changes in management scenarios based on greater uncertainty. Given the fact that the SWFSC is not the only source of information available to federal and state resource managers, and the potential for resource managers to compensate for this loss of information, the overall indirect effects of The No Research Alternative on invertebrate populations is expected to be adverse and moderate for the CCRA and minor adverse for the ETPRA and ARA.

4.5.8 Effects on the Social and Economic Environment

Under The No Research Alternative, the SWFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered in the scope of this Final PEA in all three research areas, and it is also assumed that associated funding to other agencies and entities would cease. This would likely reduce the $50 million in annual funding to the SWFSC that support fisheries research, including a direct loss of (currently) $22 million annually in direct expenditures to local economies in fees, taxes, equipment, fuel, and employment. Land-based research activity could continue, including the assessments of the effects of conservation and management measures on participants in fisheries, and on fishing communities.

NMFS manages finfish, invertebrate (squid), and shellfish harvest under the provisions of several major statutes (See Chapter 6), including the MSA, the Tuna Conventions Act, the MMPA, the ESA, the International Dolphin Conservation Program Act, and the AMLR Convention Act. Accomplishing the requirements of these statutes requires specific research and the close interaction of numerous research entities. Lack of field surveys could detract from the reliability of estimates that provide future stock assessments and annual setting of catch limits, thereby creating increased economic uncertainty in the fishing industry and in fishing communities. It would also disturb the partnership and collaboration with other agencies, entities, and countries that collect, analyze, and share complementary data.

4.5.8.1 California Current

The direct and indirect effects of The No Research Alternative would be minor to moderate for the CCRA without the support of SWFSC field data. Of the three research areas covered by the SWFSC, the CCRA would be most affected because of the large expenditures in at-sea field work that occur there, affecting the primary and secondary local economies. The SWFSC also has much larger interactions with ports and fishing communities in the CCRA than in the ETPRA or ARA. In addition, under the MSA, the SWFS has a responsibility to contribute reliable data to fisheries management that indirectly provides economic support to fishing communities, which would be reduced under The No Research Alternative. While the relationship of field data to the productivity of fisheries cannot be readily quantified, it is probable that the effectiveness of fisheries management would be reduced by NMFS reliance on using data from other sources. The overall direct and indirect effect would be adverse and moderate.

4.5.8.2 Eastern Tropical Pacific Research Area

The SWFSC has few at-sea data collection efforts in the ETPRA and the voyages have limited interaction with ports in Mexico and South America. The data gathered supports research about global interactions of major marine ecosystems, which could indirectly affect fisheries management, stocks, and fishing communities in the U.S. The lack of field work would also probably affect cooperative research with other countries and treaty commitments (see Chapter 6). Because of the existing relatively low level of field work and expenditures in the ETPRA, the overall direct and indirect effects of The No Research Alternative would be adverse and minor.

4.5.8.3 Antarctica

The Antarctic field program is larger than that of the ETPRA in expenditures and voyages, but affects far fewer communities than that of the CCRA. The data gathered supports research about global interactions of major marine ecosystems, which could indirectly affect fisheries management, stocks, and fishing communities in the U.S. The lack of field work would also probably affect cooperative research with other countries and treaty commitments (see Chapter 6). The overall direct and indirect effects of The No Research Alternative would be adverse and minor.

CUMULATIVE EFFECTS CHAPTER 5

5.1 INTRODUCTION AND ANALYSIS METHODOLOGY

The Council on Environmental Quality (CEQ) defines cumulative impact as:

> *"The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 Code of Federal Regulations [CFR] 1508.7).*

Cumulative effects are assessed by aggregating the potential direct and indirect effects of the proposed action with the impacts of past, present, and reasonably foreseeable future actions in the vicinity of the project. The ultimate goal of identifying potential cumulative effects is to provide for informed decisions that consider the total effects (direct, indirect, and cumulative) of the project alternatives. As suggested by the CEQ handbook *Considering Cumulative Effects Under the National Environmental Policy Act* (1997), the following basic types of cumulative effects are considered:

- Additive – the sum total impact resulting from more than one action,
- Countervailing – adverse impacts that are offset by beneficial impacts, and
- Synergistic – when the total impact is greater than the sum of the effects taken independently.

Cumulative effects may result from the incremental accumulation of similar effects or the synergistic interaction of different effects. Repeated actions may cause effects to build up over time, or different actions may produce effects that interact to produce cumulative impacts greater than (or less than) the sum of the effects of the individual actions.

As directed by CEQ's National Environmental Policy Act (NEPA) regulations (40 CFR 1502.16), this chapter discusses direct and indirect impacts on specific physical, biological, and social resources in combination with varying levels of effects, ranging from minor to major. While the effects of individual actions may be only minor, substantial cumulative effects may result from multiple actions occurring in the same geographic area. The implementing regulations of NEPA require analysis of cumulative effects in order to alert decision makers of the full consequences of all actions affecting a resource component and assess the relative contribution of the proposed action and alternatives.

Chapter 3 of this Programmatic Environmental Assessment (PEA) provides baseline information on the physical, biological, and social components of the environment that may be affected by Southwest Fisheries Science Center (SWFSC) research activities, including summaries of historic activities within the three SWFSC Research Areas (California Current Research Area [CCRA], Eastern Tropical Pacific Research Area [ETPRA], and Antarctic Research Area [ARA]). Chapter 4 provides an analysis of the direct and indirect effects on these resources of the four alternatives considered in this Final PEA. Because the first three alternatives involve the continuation of SWFSC research activities (referred to collectively as the research alternatives) and contribute similar effects to the cumulative effects on most resources, they are generally considered together in the following cumulative effects analysis. The contribution of the No Research Alternative to cumulative effects is quite different and is considered separately for each resource.

5.1.1 Analysis Methodology

The cumulative effects analysis methodology is similar to the effect assessment methodology for direct and indirect effects in Section 4.1. It consists of the following steps:

1. **Define the geographic area and timeframe**. These may vary between resource components.
2. **Identify external actions**[14], including:
    a. Past actions that have already occurred and resulted in lasting effects (see Chapter 3),
    b. Present actions occurring within the same timeframe as the proposed action and alternatives (see Chapter 3), and
    c. Reasonably foreseeable future actions (RFFAs), which are planned and likely to occur (see Table 5.1-1).
3. **Evaluate the direct and indirect effects of the alternatives along with the adverse and beneficial effects of external actions and rate the cumulative effect using the effects criteria table** (Table 4.1-1).
4. **Assess the relative contribution of the alternatives to the cumulative effects**.

5.1.2 Geographic Area and Timeframe

This cumulative effects analysis considers external actions that influence the geographic areas where SWFSC surveys occur; these areas include the CCRA, ETPRA, and ARA, as described in Section 3.1 and illustrated in Figure 1.1-2. Some actions that originate outside of the SWFSC Research Areas, such as discharge of pollutants, or actions that influence populations of Highly Migratory Species (HMS), could potentially contribute to cumulative effects within the geographic areas of interest; such actions are considered in the analysis of cumulative effects. Other actions considered in the analysis of cumulative effects may be geographically widespread, such as those that could potentially result in climate change or ocean acidification.

The periods of time that must be considered to understand the baseline conditions vary between resource components. The availability of existing information for different resources also varies. All analyses project at least five years into the future from the date this Final PEA is finalized.

5.1.3 Reasonably Foreseeable Future Actions

Table 5.1-1 summarizes the RFFAs external to SWFSC fisheries research that are likely to occur in the next five years, the areas where those actions are likely to occur, and the resources they are likely to affect. This information has been collected from a wide variety of sources, including recent NEPA documents, federal and state fishery agency websites and documents, the United States (U.S.) Navy website and documents, and a variety of documents concerning industrial developments. Wildlife management documents, such as take reduction plans, and conservation measures for sea turtles and marine mammals were also consulted to identify the potential for RFFAs to impact particular species and habitats.

Deciding whether to include actions that have already occurred, are ongoing, or are reasonably foreseeable in the cumulative impacts analysis depends on the resource being analyzed. Past, ongoing, and future actions must have some known or expected influence on the same resources that would be affected by the alternatives to be included in the cumulative impacts analysis. CEQ refers to this as the cause-and-effect method of connecting human activities and resources or ecosystems. The magnitude and extent of the effect of an action on a resource or ecosystem depends on whether the cumulative impacts exceed the capacity of the resource/ecosystem to sustain itself and remain productive over the long-term.

[14] External actions are other human activities and natural occurrences that have resulted or will result in effects to the resource components that comprise the affected environment.

CEQ guidelines state that "it is not practical to analyze cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful." In general, actions can be excluded from the analysis of cumulative impacts if:

- The action is outside the geographic boundaries or time frame established for the cumulative impacts analysis.
- The action will not affect resources that are the subject of the cumulative impacts analysis.
- The action is not planned or is not reasonably foreseeable (e.g., it is not yet formally proposed, planned, permitted, authorized, or funded).

Table 5.1-1 Reasonably Foreseeable Future Actions related to SWFSC Research Areas.

Blank cells indicate no effects on that resource.

Action	SWFSC Research Area			Effect on Physical Environment	Effect on Special Resource Areas	Effect on Water Quality	Effect on Fish	Effect on Marine Mammals	Effect on Seabirds	Effect on Sea Turtles	Effect on Invertebrates	Effect on Social and Economic Environment
	California Current	Eastern Tropical Pacific	Antarctic									
Other (Non-SWFSC) Scientific Research	X	X	X	Presence of additional vessel traffic Sea floor disturbance Generation of Marine debris	Habitat disturbance Contamination (Spills, Discharges)	Short-term turbidity increase Increased contaminant concentrations	Habitat disturbance Removal of individuals and biomass Behavioral disruptions	Behavioral displacement Loss/injury from ship strikes Noise responses	Loss from avian by-catch Potential for ship collisions (lighting attraction)	Loss/injury from ship strikes	Loss or displacement due to habitat disturbance Removal of individuals and biomass	Increased understanding of environment leading to better resource management
Federal and State Managed Fisheries	X	X		Presence of additional vessel traffic Sea floor disturbance Generation of marine debris	Habitat disturbance Contamination (Spills, Discharges) Generation of marine debris	Short-term turbidity increase Increased contaminant concentrations	Removal of managed targeted fisheries species By-catch removal of non-target species Habitat disturbance Behavioral disruption Loss from capture by derelict gear	Loss/injury from ship strikes Loss/injury from entanglement Noise responses Altered or reduced prey resources Behavioral displacement	Loss from avian by-catch Potential for ship collisions (lighting attraction) Alteration or reduction of prey resources	Loss/injury from ship strikes Loss/injury from turtle by-catch Loss/injury from entanglement with fishing gear	Direct loss or displacement due to bottom trawling Indirect loss or displacement due to habitat disturbance	Provision of jobs and economic opportunity Provision of food and industrial raw materials Cost of operations and gear requirements Need for catch limits for resource management Need for time/area closures for resource management
Other Fishing Operations (Charter, Private, or managed by treaty)	X	X	X	Presence of additional vessel traffic Sea floor disturbance Generation of marine debris	Habitat disturbance Contamination (Spills, Discharges) Generation of marine debris	Short-term turbidity increase Increased contaminant concentrations	Removal of managed targeted fisheries species By-catch removal of non-target species Habitat disturbance Behavioral disruption Loss from capture by derelict gear	Loss/injury from ship strikes Loss/injury from entanglement Noise responses Altered or reduced prey resources Behavioral displacement	Loss from avian by-catch Potential for ship collisions (lighting attraction) Alteration or reduction of prey resources	Loss/injury from ship strikes Loss/injury from turtle by-catch Loss/injury from entanglement with fishing gear	Direct loss or displacement due to bottom trawling Indirect loss or displacement due to habitat disturbance	Provision of jobs and economic opportunity Provision of recreational opportunities Provision of food
Military Operations (SOCAL Range Complex, etc.)	X	X	X	Contamination of water and sediment Generation of marine debris, including munitions	Contamination Generation of marine debris, including munitions	Increased contaminant concentrations	Noise effects (stress, altered behavior, auditory damage) Mortality near detonation Loss/injury from contamination Contamination of fish for human consumption	Loss/injury from ship strikes Noise effects (stress, altered behavior, auditory damage) Behavioral disturbance Displacement Injury/loss due to ingestion or entanglement in marine debris Mortality near detonation	Loss/injury due to entanglement in marine debris Potential for loss from ship collisions (lighting attraction) Behavioral disturbance Mortality near detonation	Noise effects (stress, altered behavior, auditory damage) Loss/injury from ship strikes Loss/injury from ingestion/entanglemen t in marine debris Mortality near detonation	Injury/loss due to contamination Mortality near detonation	Temporary and localized disruption of fishing due to operations Maintaining National Defense

Action	SWFSC Research Area			Effect on Physical Environment	Effect on Special Resource Areas	Effect on Water Quality	Effect on Fish	Effect on Marine Mammals	Effect on Seabirds	Effect on Sea Turtles	Effect on Invertebrates	Effect on Social and Economic Environment
	California Current	Eastern Tropical Pacific	Antarctic									
									Displacement			
Liquid Natural Gas (LNG) Terminals (Sempra Energy Terminal, Ensenada Mexico; Jordan Cove Project, Coos Bay, OR	X	X		Increased turbidity (construction phase) Sea floor disturbance Presence of additional vessel traffic Provision of new underwater structures	Contamination Increased turbidity Sea floor disturbance	Increased turbidity (construction phase) Localized changes in water temperature	Loss/injury from contamination Construction related habitat disturbance Provision of new structured habitat Contamination of fish for human consumption	Loss/injury from ship strikes Noise effects (construction, vessel) Behavioral disturbance Loss/injury from contamination Loss/injury due to ingestion/entanglement in marine debris Loss/injury due to entanglement in buoy chains Alteration or reduction of prey resources	Loss/injury from contamination Loss from structure or ship collision (lighting attraction) Loss/injury due to ingestion/entanglement in marine debris Alteration or reduction of prey resources	Loss/injury from ship strikes Noise effects (construction, vessel) Behavioral disturbance Loss/injury from contamination Loss/injury due to ingestion/entanglement in marine debris Alteration or reduction of prey resources	Habitat disturbance Increased risk from invasive species due to long-distance shipping activity Loss/injury from contamination Creation of new hard substrate habitats on structures	Fishing exclusion zones may displace fisheries Provision of new jobs Increased capacity for inexpensive fuel transport and handling
Oil Extraction	X	X		Increased turbidity (construction phase) Sea floor disturbance	Contamination Increased turbidity Sea floor disturbance	Increased contaminant concentrations Increased turbidity	Loss/injury from contamination Habitat disturbance Contamination of fish for human consumption	Loss/injury from ship strikes Noise effects (construction, vessels) Behavioral disturbance Loss/injury from contamination Alteration or reduction of prey resources	Loss/injury from contamination Loss from structure or ship collision (lighting attraction) Alteration or reduction of prey resources	Loss/injury from ship strikes Noise effects (construction, vessel) Behavioral disturbance Loss/injury from contamination Loss/injury due to ingestion/entanglement in marine debris Alteration or reduction of prey resources	Habitat disturbance Loss/injury from contamination	Fishing exclusion zones may displace fisheries Provision of new jobs
Vessel Traffic (Shipping)	X	X	X	Contamination of water and sediment	Increased risk from invasive species due to long-distance shipping activity Contamination	Increased contaminant concentrations Increased turbidity	Loss due to competition or predation from invasive species Loss/injury from contamination Noise effects (stress, altered behavior)	Loss/injury from ship strikes Displacement Noise effects (stress, altered behavior) Behavioral disturbance Loss/injury due to ingestion/entanglement in marine debris	Loss/injury from contamination Noise effects (stress, altered behavior) Loss/injury due to ingestion/entanglement in marine debris Ship collision (lighting attraction)	Loss/injury from contamination Noise effects (stress, altered behavior) Loss/injury due to ingestion/entanglement in marine debris	Loss due to competition or predation from invasive species Loss/injury from contamination	Provision of jobs and economic opportunity
Vessel Traffic (Other)	X	X	X	Contamination of water and sediment	Increased risk from invasive species due to long-distance shipping activity Contamination	Increased contaminant concentrations Increased turbidity	Loss due to competition or predation from invasive species Loss/injury from contamination Noise effects (stress, altered	Loss/injury from ship strikes Displacement Noise effects (stress, altered behavior) Behavioral disturbance Loss/injury due to ingestion/entanglement in	Loss/injury from contamination Noise effects (stress, altered behavior) Loss/injury due to ingestion/entanglement in marine	Loss/injury from contamination Noise effects (stress, altered behavior) Loss/injury due to ingestion/entanglement in marine debris	Loss due to competition or predation from invasive species Loss/injury from contamination	

Action	SWFSC Research Area			Effect on Physical Environment	Effect on Special Resource Areas	Effect on Water Quality	Effect on Fish	Effect on Marine Mammals	Effect on Seabirds	Effect on Sea Turtles	Effect on Invertebrates	Effect on Social and Economic Environment
	California Current	Eastern Tropical Pacific	Antarctic									
							behavior)	marine debris	debris Ship collision (lighting attraction)			
Ocean Disposal and Discharges	X	X	X	Sea floor disturbance Sedimentation	Contamination Disturbance of benthic habitats Sea floor disturbance Sedimentation	Increased turbidity Toxic contamination Eutrophication	Bioaccumulation of contaminants Loss/injury from contamination Habitat disturbance	Bioaccumulation of contaminants Loss/injury from contamination Loss/injury from ship strike Alteration or reduction of prey resources Habitat disturbance	Bioaccumulation of contaminants Loss/injury from contamination Alteration or reduction of prey resources Habitat disturbance	Bioaccumulation of contaminants Loss/injury from contamination Alteration or reduction of prey resources Habitat disturbance	Bioaccumulation of contaminants Loss/injury from contamination Habitat disturbance	Potential indirect impact on subsistence resources
Dredging	X	X		Sea floor disturbance Increased turbidity	Sea floor disturbance Increased turbidity	Increased turbidity Contamination (Discharges)	Loss of habitat due to sea floor disturbance Displacement due to turbidity	Noise effects (stress, altered behavior) Loss/injury from ship strikes Habitat disturbance/alteration Alteration or reduction of prey resources	Noise effects (stress, altered behavior) Habitat disturbance/altera tion Alteration or reduction of prey resources	Mortality by entrainment in dredge Habitat disturbance/alteration	Direct loss or displacement due to bottom trawling Indirect loss or displacement due to habitat disturbance Loss/displacement due to turbidity	
Geophysical/ Geotechnical Activities	X	X	X	Sea floor disturbance	Sea floor disturbance	Localized turbidity	Habitat disturbance Noise effects from acoustic surveys	Noise effects from acoustic surveys Loss/injury from ship strikes Behavioral disturbance	Potential for loss due to ship collisions (lighting attraction) Behavioral disturbance	Loss/injury from ship strikes Behavioral disturbance	Habitat disturbance Localized benthos disturbance	
Sea Turtle Conservation Measures	X	X								Decreased serious injury and mortality		Cost to fisheries, gear modifications
Marine Mammal Conservation Measures	X	X	X					Decreased serious injury and mortality				Cost to fisheries Displacement of personnel from fishing and other marine activities Need for time/area closures
Climate Change	X	X	X	Sea level rise, saltwater infusion in estuaries and coastal habitats Increased erosion and siltation	Sea level rise, saltwater infusion in estuaries and coastal habitats Increased	Water chemistry changes	Unknown ecosystem level changes, variable effects on different species	Unknown ecosystem level changes, variable effects on different species	Unknown ecosystem level changes, variable effects on different species	Unknown ecosystem level changes, variable effects on different species	Unknown ecosystem level changes, variable effects on different species	Rising water levels in coastal areas Potential changes in fisheries due to ecosystem changes New regulations on

Action	SWFSC Research Area			Effect on Physical Environment	Effect on Special Resource Areas	Effect on Water Quality	Effect on Fish	Effect on Marine Mammals	Effect on Seabirds	Effect on Sea Turtles	Effect on Invertebrates	Effect on Social and Economic Environment
	California Current	Eastern Tropical Pacific	Antarctic									
				Increased water temperatures More extreme storm events	erosion and siltation Increased water temperatures More extreme storm events							greenhouse gas emissions Incentives for higher vessel fuel efficiency
Ocean Acidification	X	X	X	Increased pCO^2 Decreased pH	Decreased calcification among food web organisms Change in primary production	Increased pCO^2 Decreased pH	Potential adverse effects on prey, availability of nutritional minerals Potential direct adverse effects on growth, reproduction, development	Potential adverse effects on prey, availability of nutritional minerals	Potential adverse effects on prey, availability of nutritional minerals	Potential adverse effects on prey, availability of nutritional minerals	Decreased calcification, shell hardening impaired Potential adverse effects on prey, availability of nutritional minerals	Potential effects on fisheries, especially for invertebrate species

List of documents for SWFSC RFFA table:

* AMLR (Draft Programmatic EIS) on Codified Regulations at 50 CFR Part 300 Subparts A and G; June 2005
  Implementing Conservation and Management Measures Adopted by the Commission for the Conservation of Antarctic Marine Living Resources
* Pacific Offshore Cetacean Take Reduction Plan Regulations (50 CFR Part 229) Jan 1999
* Steller Sea Lion and Northern Fur Seal Research Final PEIS Chapter 4 May 2007
* Sempra Energy Mexico LNG terminal Construction Update.pdf (2009)
* http://www.energy.ca.gov/lng/documents/4_WEST_COAST_PROJECTS_PROPOSALS_STATUS_UPDATE.PDF
*Over-Sea-ice seismic reflection surveys in Antarctica (2005)
*Southern California Navy Range Complex EIS- Chapter 4 - http://www.socalrangecomplexeis.com/

5.2 CUMULATIVE EFFECTS ON THE PHYSICAL ENVIRONMENT

Activities external to SWFSC fisheries research that could potentially affect the physical environment in the CCRA, ETPRA, and ARA may include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, oil extraction, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and include:

- Sea floor disturbance
- Increased turbidity and re-suspension of sediments
- Presence of new underwater structures
- Effects of climate change such as increased water temperatures and sea level rise

5.2.1 California Current Research Area

External Factors in the CCRA

The physical environment of the CCRA has been affected by human activity since the colonization of the Americas. Until recent times, however, the magnitude of effects on the physical environment was limited. With the advent of offshore development and exploitation of resources from the ocean environment, cumulative impacts on the physical environment have increased substantially. Within the SWFSC CCRA, the physical environment continues to experience the effects of both natural and anthropogenic factors including climate change, ocean acidification, seafloor disturbance from commercial fisheries, substrate disturbance from geophysical/ geotechnical activities, contamination from spills and discharges, presence of vessel traffic, and marine debris. Sources of impacts to the physical environment from RFFAs are identified in Table 5.1-1.

Past activities that disturbed the seafloor were generally limited to commercial fishing activities, U.S. naval testing activities, the laying of underwater cables for communications systems, and offshore oil and gas exploration and development. These activities presently continue to influence benthic habitat in the CCRA. While the effects of these activities on benthic habitat could be acute, they are spatially limited to less than 10% of the CCRA. Additional activities that may disturb the seafloor include channel dredging, construction of offshore structures, and discharges to the ocean from land-based developments and agriculture. These activities may cause introduction or re-suspension of sediments into the water column, changes in benthic contours, and loss of benthic habitat. Offshore developments may have long-term effects on the physical environment over relatively small areas resulting from the presence of new underwater structures. Scientific research conducted by agencies other than the National Marine Fisheries Service (NMFS) may also result in localized adverse impacts to the seafloor in the CCRA. These impact-producing factors are likely to persist in the future at levels similar to those currently affecting the sea floor in the CCRA.

Climate change may affect the marine environment in a variety of ways, including changes in sea level, changes in water temperatures, extreme weather events, and alteration of ocean currents. These changes and others are expected to continue over the reasonably foreseeable future and could aggregate with the effects of industrial activity to impact the physical environment. In addition to changes in air and water temperatures, changes in the acidity of the world's oceans are expected to continue and accelerate over the reasonably foreseeable future (United States Geological Survey [USGS] 2011). Ocean acidification may have substantial impacts on the physical environment, and must be considered in combination with actions that may lead to cumulative impacts. Ocean acidification can harm organisms that build shells of calcium carbonate, including corals, mollusks and crustaceans, which add to the physical structure of the ocean floor in some sections of the CCRA. Although the root causes of climate change and the potential magnitude and timing of its effects are poorly understood, there is general acknowledgement that the potential impacts resulting from climate change could be substantial.

Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on the physical environment in the CCRA are discussed in section 4.2.1. Direct and indirect effects to benthic habitat (seafloor disturbance) and removal of organisms that produce structure would be minimal in the CCRA because the SWFSC does not use bottom-contact trawl equipment in the CCRA and only has one small bottom longline survey (sablefish) and one anchored longline survey (thresher shark) in the CCRA. Likewise, SWFSC research activities are not expected to result in increased turbidity, re-suspension of sediments, or the presence of new underwater structures in the CCRA. Although CO_2 emissions from SWFSC research vessels would contribute to atmospheric CO_2 levels, the contribution would be minor compared to other natural and anthropogenic CO_2 sources. When aggregated with the impacts of past, present, and reasonably foreseeable future actions in the vicinity of the project, SWFSC research activities would make a minor additive contribution to cumulative adverse effects on the physical environment in the CCRA under each of the research alternatives.

Contribution of the No Research Alternative

The No Research Alternative would eliminate the risk of direct adverse impacts to physical resources within the CCRA resulting from SWFSC research activities. However, many of the SWFSC projects that would be eliminated under this alternative generate a great deal of information that, when combined with research conducted by other branches of NOAA and other agencies and institutions not included in this Final PEA, is used to monitor the effects of climate change, ocean acidification, and other changes in the physical environment. This information may also be used by resource managers to limit fishing related impacts to physical habitat such as disturbance of benthic habitat and removal of organisms that produce seafloor structure in the CCRA. Without the input of SWFSC data, management authorities would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect ecological properties of the environment would become less effective. Although resource management agencies have other available data sources to support resource management decisions, the No Research Alternative is expected to result in increased uncertainty and changes in some management scenarios. Through these indirect effects on future management decisions, the contribution of this alternative to adverse cumulative impacts on physical resources would be minor to moderate.

5.2.2 Eastern Tropical Pacific Research Area

External Factors in the ETPRA

The physical environment of the ETPRA is affected by similar past, present, and reasonably foreseeable future factors as described for the CCRA.

Contribution of the Research Alternatives

Direct and indirect effects to benthic habitat (seafloor disturbance) and removal of organisms that produce structure would not occur in the ETPRA because SWFSC does not use bottom-contact trawl equipment in the ETPRA. Likewise, SWFSC research activities are not expected to result in increased turbidity, re-suspension of sediments, or the presence of new underwater structures in the ETPRA. Although CO_2 emissions from SWFSC research vessels would contribute to atmospheric CO_2 levels, the contribution would be minor compared to other natural and anthropogenic CO_2 sources. SWFSC research activities in the ETPRA would make insubstantial contributions to the impacts of climate change such as increased water temperatures and sea level. When aggregated with the impacts of past, present, and reasonably foreseeable future actions in the vicinity of the project, SWFSC research activities would make a minimal additive contribution to cumulative adverse effects on the physical environment in the ETPRA under each of the research alternatives. Considering the magnitude of effects resulting from past, present, and reasonably foreseeable future actions external to SWFSC fisheries research activities, the contribution of SWFSC research activities to cumulative impacts on the physical environment would be minor under all the research alternatives.

Contribution of the No Research Alternative

The No Research Alternative would eliminate the risk of direct adverse impacts to physical resources within the ETPRA resulting from SWFSC fisheries and ecosystem research activities. However, as described for the CCRA, many of the SWFSC projects that would be eliminated under this alternative generate a great deal of information is important to resource managers to monitor environmental changes and design effective conservation measures for various resources. Without the input of SWFSC data, management authorities would lack important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect ecological properties of the environment would become less effective. Although resource management agencies have other available data sources to support resource management decisions, the No Research Alternative would result in increased uncertainty and changes in some management scenarios. Through these indirect effects on future management decisions, the contribution of this alternative to adverse cumulative impacts on physical resources would be minor to moderate.

5.2.3 Antarctic Research Area

External Factors in the ARA

Anthropogenic impacts to the physical environment of the ARA have occurred more recently and at lower levels compared to those affecting the CCRA and ETPRA. Anthropogenic impact-producing factors were largely absent from the Antarctic Peninsula until after World War II. Most exploration of the ARA has occurred during the past 70 years and vast areas of the physical environment within the ARA are still poorly characterized. Past actions influencing the physical environment in this area include military operations and scientific research. The impacts of these activities on the physical environment within the ARA are poorly characterized. However, based on information gathered during SWFSC research activities, the benthic environment of the ARA appears to have been relatively unaffected by past actions compared to the other research areas. Commercial fishing operations may have historically removed structure-producing organisms and affected the benthic environment within the ARA but commercial harvests are presently prohibited throughout the ARA by the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR). Apart from SWFSC activities, very little scientific research occurs in the ARA, and that research is not expected to result in substantial effects on the physical environment.

Climate change may affect the marine environment in a variety of ways, including changes in sea level, changes in water temperatures, extreme weather events, and alteration of ocean currents. Antarctica is among the fastest warming regions, and as a result, the physical environment of the ARA is expected to experience rapid changes (Barnes and Conlan 2007). In the next century, temperature stress and the potential invasion of non-indigenous species may result in substantial impacts to both physical and biological resources in the Antarctic (Barnes and Conlan 2007). Distributions of sea ice are expected to change as a result of increasing temperatures. In addition to changes in air and water temperatures, changes in the acidity of the world's oceans are expected to continue and accelerate over the reasonably foreseeable future (USGS 2011). Ocean acidification may have substantial impacts on the physical environment, and must be considered in combination with actions that may lead to cumulative impacts. Ocean acidification can harm organisms that build shells of calcium carbonate, including corals, mollusks and crustaceans, which add to the physical structure of the ocean floor in some sections of the ARA. Although the root causes of climate change and the potential magnitude and timing of its effects are poorly understood, there is general acknowledgement that these factors could produce substantial impacts to the physical environment within the ARA.

Contribution of the Research Alternatives

When aggregated with the impacts of past, present, and reasonably foreseeable future actions in the vicinity of the project, SWFSC research activities would make a minor additive contribution to cumulative adverse effects on the physical environment in the ARA under each of the research alternatives. Under each of the research alternatives, the SWFSC would occasionally use a hard-bottom trawl in order to collect information about demersal fish and benthic invertebrates within the ARA (Jones et al. 2009; Lockhart et al. 2009). Bottom contact fishing gear can break or disrupt corals, thereby reducing structural complexity, which may reduce species diversity of the corals and other animals that utilize the habitat (Freiwald et al. 2004). Effects of SWFSC research activities on organisms that produce structure would be independent of seasonal considerations since the organisms are not mobile and take long periods to recover. However, standard operating procedures involving acoustic reconnaissance to verify bottom conditions suitable for trawling, avoidance of coral areas, the small areal extent of surveys using bottom trawl gear, and the periodic nature of the surveys would minimize the magnitude of effects on the physical environment. Although CO_2 emissions from SWFSC research vessels would contribute to atmospheric CO_2 levels, the contribution would be minor compared to other natural and anthropogenic CO_2 sources. The primary factors affecting the physical environment in the ARA include natural oceanographic and atmospheric cycles and effects related to climate change. The contribution of the SWFSC research activities to these effects would be minor under all the research alternatives.

Contribution of the No Research Alternative

The No Research Alternative would eliminate the risk of direct adverse impacts to physical resources within the ARA resulting from SWFSC research activities. However, as described for the CCRA, many of the SWFSC projects that would be eliminated under this alternative generate a great deal of information is important to resource managers to monitor environmental changes and design effective conservation measures for various resources. Without the input of SWFSC data, fisheries management authorities and international treaty signatories would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect ecological properties of the environment would become less effective. Although resource management agencies have other available data sources to support resource management decisions, the No Research Alternative is expected to result in increased uncertainty and changes in some management scenarios. Through these indirect effects on future management decisions, the contribution of this alternative to adverse cumulative impacts on physical resources would be minor to moderate.

5.3 CUMULATIVE EFFECTS ON SPECIAL RESOURCE AREAS

Activities external to SWFSC fisheries research that could potentially affect special resource areas in the CCRA, ETPRA, and ARA may include commercial and recreational fisheries, commercial shipping, ocean disposal and discharges, dredging, coastal development, oil extraction, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and may include:

- Contamination resulting from spills or discharges
- Habitat disturbances
- Increased risk of invasive species introductions resulting from long-distance shipping activity

- Effects of climate change such as increased water temperatures and sea level rise
- Effects of ocean acidification such as decreased calcification among food web organisms and
- Changes in primary production

5.3.1 California Current Research Area

External Factors in the CCRA

As described in Section 3.1.2, special resource areas within the CCRA include Essential Fish Habitat (EFH), Habitat Areas of Particular Concern (HAPC), Closed Areas, and Marine Protected Areas (MPAs), including National Marine Sanctuaries (NMS). The cumulative effects of activities that disturb the physical environment in special resource areas are similar to those discussed for the physical environment in Section 5.2. Cumulative impacts to biological resources within special resource areas are discussed in Sections 5.4 through 5.8. The effects of proposed offshore projects in the CCRA related to oil extraction, dredging, military operations, and geophysical exploration, would be considered as part of the Federal permitting process. Contributions to cumulative effects from such activities would be limited by permit conditions and mitigation measures required by permitting agencies. Impacts resulting from commercial fishing operations would affect EFH and HAPC areas, but would not directly affect closed areas or some marine reserves that are closed to commercial fishing. In some cases, closed areas have been designated to allow the recovery of areas that were heavily affected by commercial fisheries in the past. In addition to the SWFSC, the Northwest Fisheries Science Center (NWFSC) also conducts fisheries research in the CCRA. In instances where the research activities of multiple science centers overlap in space and time, impacts resulting from those activities would accumulate in an additive or synergistic fashion. The cumulative effect from all external sources of disturbance to special resource areas is expected to be minor to moderate.

Contribution of the Research Alternatives

When aggregated with the impacts of past, present, and reasonably foreseeable future actions in the vicinity of the project, SWFSC research activities would make a minor additive contribution to cumulative adverse impacts to special resource areas in the CCRA under each of the research alternatives. Because the SWFSC does not employ bottom-contact research gear within the CCRA, which is the only SWFSC research area where federally designated EFH exists, there would be no direct impacts to EFH benthic habitat. Impacts to pelagic habitats within special resource areas resulting from SWFSC research activities using a combination of surface and mid-water trawl gear, as well as various plankton nets, water sampling devices and acoustic survey equipment would generally not extend beyond the duration of the survey period, and the magnitude and geographic extent of such impacts would be minor. Although the magnitude of future effects of climate change and ocean acidification on special resource areas is uncertain, the contribution of SWFSC research activities to the effects of climate change and ocean acidification would be minor. Likewise, SWFSC research activities are not expected to contribute to the risk of invasive species introductions or contamination from spills or discharges. Considering the magnitude of effects resulting from past, present, and reasonably foreseeable future actions external to SWFSC fisheries research activities, the contribution of SWFSC research activities to cumulative impacts on special resource areas would be minor under all research alternatives.

Contribution of the No Research Alternative

The No Research Alternative would result in elimination of any direct impacts to special resource areas that could potentially occur under each of the research alternatives. However, the SWFSC research activities proposed under the research alternatives would generate information important to resource managers to monitor environmental changes and design effective conservation measures for the special resource areas. This type of information is especially important for management of special resource areas designated to protect and conserve natural resources that are susceptible to natural fluctuations and anthropogenic impacts. Without the input of SWFSC data, management authorities would lose important information needed to effectively manage and conserve special resource areas. Although resource management agencies have other available data sources to support resource management decisions, the No Research Alternative is expected to result in increased uncertainty and changes in some management scenarios. Through these indirect effects on future management decisions, the contribution of this alternative to adverse cumulative impacts on special resource areas, including National Marine Sanctuaries would be minor to moderate.

5.3.2 Eastern Tropical Pacific Research Area

External Factors in the ETPRA

Special resource areas in the ETPRA are affected by the same past, present, and reasonably foreseeable future factors as described for the CCRA (Table 5.1-1). Because the ETPRA does not include EFH, HAPC, or National Marine Reserves, cumulative impacts to these areas would not occur in the ETPRA. The cumulative impacts resulting from all external sources of disturbance to special resource areas are expected to be minor to moderate.

Contribution of the Research Alternatives

Under each of the research alternatives, the SWFSC would not employ bottom-contact research gear within the ETPRA and would remove small numbers of fish and invertebrates from ecosystems. Effects resulting from past, present, and reasonably foreseeable future actions external to SWFSC fisheries research activities, described in Table 5.1-1, would dominate the cumulative effects to special resource areas in the ETPRA. When aggregated with the impacts of past, present, and reasonably foreseeable future actions, SWFSC research activities would make a minor additive contribution to cumulative adverse effects on the special resource areas in the ETPRA under each of the research alternatives.

Contribution of the No Research Alternative

The No Research Alternative would result in elimination of all direct impacts to special resource areas that could potentially occur under any of the research alternatives. However, as described for the CCRA, data from SWFSC research activities is important to inform science-based decisions related to the management of special resource areas and meet obligations under international treaties. The loss of information currently provided by SWFSC research activities would have minor to moderate adverse contributions to cumulative impacts on special resource areas in the ETPRA under the No Research Alternative.

5.3.3 Antarctic Research Area

External Factors in the ARA

Cumulative impacts to special fishery related areas within the ARA are subsets of the cumulative impacts to specific physical, biological, and socioeconomic resources that are addressed in the resource specific sections of this Final PEA. Past, present, and reasonably foreseeable future factors likely to impact physical resources within Antarctic special resource areas are discussed in Section 5.2. Special resource areas within the ARA include closed areas established by CCAMLR conservation measures (CCAMLR 2010). Taking of all finfish, other than for scientific research purposes, is prohibited in CCAMLR statistical subareas 48.1 and 48.2, which overlap with the SWFSC ARA (Figure 3.1-5). The closed areas established by CCAMLR theoretically eliminate any present or reasonably foreseeable future impacts from commercial fisheries to finfish resources within the ARA. In addition, very little scientific research is conducted in the ARA by entities other than SWFSC. Past, present, and reasonably foreseeable future impacts to special resource areas within the ARA resulting from commercial fishing, scientific research, military operations, and vessel traffic are expected to be minor. The future effects of climate change on Antarctic special resource areas are difficult to quantify, but some sources suggest that these factors could produce substantial impacts to special resource areas within the ARA (Barnes and Conlan 2007).

Contribution of the Research Alternatives

When aggregated with the impacts of past, present, and reasonably foreseeable future actions, SWFSC research activities would make a minor additive contribution to cumulative adverse effects on the special resource areas in the ARA under each of the research alternatives. Periodic bottom trawl sampling and removals of fish and invertebrates (krill) would make minor contributions to cumulative impacts on ARA special resource areas under each of the research alternatives. Although the magnitude of future effects of climate change and ocean acidification on special resource areas is uncertain, the contribution of SWFSC research activities to the effects of climate change and ocean acidification would be minor. Likewise, SWFSC research activities are not expected to contribute to the risk of invasive species introductions or contamination from spills or discharges. The primary factors affecting the physical and biological environments in ARA special resource areas would be related to climate change and ocean acidification, as well as natural oceanographic and atmospheric cycles. The contribution of the SWFSC research activities to these effects would be minor under all the research alternatives.

Contribution of the No Research Alternative

The No Research Alternative would eliminate any direct adverse impacts to special resource areas within the ARA resulting from SWFSC research activities. However, the loss of scientific information currently provided by SWFSC survey activities would make it difficult for CCAMLR managers to assess the efficacy of special resource areas in fulfilling the ecosystem functions for which they were designated. If the SWFSC discontinued research in the ARA, management authorities would lack the information needed to establish management measures in a meaningful fashion, and over time the conservation measures currently in place to protect ecological properties of the environment would become obsolete. In addition, the No Research Alternative would preclude fulfillment of U.S. commitments to CCAMLR and obligations under the Antarctic Treaty. The loss of scientific information currently provided by SWFSC research activities would have minor to moderate adverse contributions to cumulative impacts under the No Research Alternative for the ARA.

5.4 CUMULATIVE EFFECTS ON FISH

Activities external to SWFSC fisheries research that could potentially affect fish species in the CCRA, ETPRA, and ARA may include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, oil extraction, other scientific research, military operations, climate change, and ocean acidification. These activities and potential effects are summarized in Table 5.1-1 and include:

- Injury or mortality due to directed catch or bycatch in commercial and recreational fisheries
- Habitat disturbances
- Changes in distribution and food availability due to climate change or habitat degradation

5.4.1 California Current Research Area

5.4.1.1 Endangered Species Act (ESA)-listed Species

External Factors in the CCRA

Several ESA-listed fish species occur in the CCRA (see Section 3.3.1.1), yet few are caught incidental to SWFSC fisheries research. Species periodically caught include canary rockfish, Pacific eulachon, steelhead trout, and all four species of ESA-listed salmon Only canary rockfish and Chinook and coho salmon will be discussed here, as the other ESA-listed species are rarely caught.

The past, present, and reasonably foreseeable future activities that have or are likely to have the greatest effect on endangered fish in the CCRA external to SWFSC fisheries research are intentional and incidental mortalities in commercial and recreational fisheries. Habitat alterations, especially for anadromous species, and periodic short-term and longer term climate changes may also affect population viability and stock sizes. In addition, research conducted by other NMFS fisheries sciences centers, such as the Northwest Fisheries Science Center (NWFSC), occurs in some of the same areas affected by SWFSC research, and is therefore considered in the set of external factors that contribute to cumulative effects in the CCRA.

The main factors responsible for the decline of canary rockfish are overfishing in the commercial and recreational fisheries, habitat degradation, water quality problems, contaminants, and inadequacy of existing regulatory mechanisms (75 Federal Register [FR] 22276,). The spawning biomass of canary rockfish began to rapidly decline during the late 1970s, reached a minimum in the mid-1990s, and was declared overfished in 1999. Management actions (trip/bag limits, spatial closures, and gear restrictions) reduced the rate of removal and overfishing has not occurred since before 1999. Canary rockfish are harvested by commercial trawl and non-trawl fisheries, as bycatch in the Pacific whiting (hake) fishery, in recreational fisheries, and during research. Total catches in 2008-2010 ranged from 38 mt to 82 mt (Wallace and Cope 2011).

Threats and impacts to threatened and endangered Pacific salmonids include logging, agriculture, mining activities, urbanization, stream channelization, dams, wetland loss, water withdrawals, hydropower, and unscreened diversions (77 FR 19552). In addition, ocean-atmosphere climatic shifts over decadal time scales (e.g., the Pacific Decadal Oscillation) may lead to decreased ocean productivity that exacerbates degraded freshwater habitat conditions important to salmon (http://www.nmfs.noaa.gov/pr/species/fish/salmon.htm). There is evidence of strong correlations between oceanic productivity "regimes" and salmon population abundance (Good et al. 2005 and citations therein).

Commercial and recreational fisheries are closed for coho salmon in California, but the Central California Coast coho salmon ESU may still be incidentally captured in fisheries for other species. The impacts of incidental bycatch are not well known (77 FR 19552). Commercial and recreational fisheries for Chinook and coho salmon in the Pacific Fisheries Management Council area of jurisdiction along the U.S. West Coast (ocean fisheries between the U.S./Canada border and the U.S./Mexico border from 3 to 200 nm offshore) are responsible for the greatest direct removal of salmon in the area. In 2011, commercial harvests of Chinook salmon were 160,304 fish or 933,947 kilograms (kg) dressed weight; recreational harvests were 83,380 fish. Fewer coho salmon were harvested, with a commercial harvest of 17,130 fish (44,000 kg) and 58,737 fish in the recreational fishery. Commercial harvests include Treaty Indian fisheries (Pacific Fisheries Management Council [PFMC] 2012).

The activities external to SWFSC fisheries research affecting ESA-listed fish will likely continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

The three research alternatives considered in this Final PEA include similar scopes of SWFSC research in the CCRA. The primary differences lie in the number and types of associated mitigation measures for protected species. The SWFSC does some directed research on ESA-listed Pacific salmon and only a few listed species have been caught incidental to the California Cooperative Oceanic Fisheries Investigation (CalCOFI), Coastal Pelagic Species (CPS), Juvenile Salmon, and Juvenile Rockfish surveys. Chinook and coho salmon catch incidental to offshore surveys average 705 kg and 132 kg, respectively, each year. This level of mortality is sufficiently small that effects on stocks would be considered minor, particularly from non-listed stocks.

As noted in Section 4.2.3, an average of 156 kg (0.156 mt) of canary rockfish is currently removed annually during SWFSC research. This level of mortality accounts for a very small fraction (0.002%) of the spawning biomass and is considered minor. It is also a small fraction of the total commercial catch of canary rockfish, accounting for 0.41% of the total catch in 2009 and 0.19% of the 2010 commercial catch. In addition, it is unclear what proportion of this catch, if any, belong to the Puget Sound/Georgia Basin threatened DPS.

When considered in conjunction with commercial and recreational fisheries, and aggregated with other past, present, and reasonably foreseeable future activities affecting ESA-listed fish in the CCRA, the contribution of SWFSC fisheries research activities to cumulative effects would be minor.

Contribution of the No Research Alternative

Under the No Research Alternative, SWFSC would no longer conduct or fund fieldwork for fisheries and ecosystem research in the CCRA, so would not directly contribute to cumulative effects on threatened and endangered fish species in this region. In the absence of research surveys, important scientific information would not be collected about the status of fish stocks used for fisheries and conservation management, including trends in abundance, recruitment rates, and the amount of fish being harvested relative to overfishing metrics. This loss of scientific data would make it much more difficult for fisheries managers to effectively monitor the status of stocks, develop fishery regulations, and rebuild overfished stocks such as canary rockfish. SWFSC research also provides information on ecosystem characteristics important for monitoring potential effects from climate change and increases in ocean acidification, which could impact the population and distribution of many marine and anadromous species. Under The No Research Alternative, the loss of scientific data would make it increasingly difficult for fisheries managers to effectively monitor the status of stocks, develop meaningful fishery regulations, and rebuild overfished stocks such as canary rockfish. Although resource management agencies have other available data sources to support resource management decisions, the No Research Alternative is expected to result in increased uncertainty and changes in some management scenarios. Through these indirect effects on future management decisions, the contribution of this alternative to adverse cumulative impacts on fish stocks would be moderate. The indirect contribution of the No Research Alternative to cumulative effects on any one species is difficult to ascertain due to numerous unknown variables, but would likely impact long-term monitoring and management capabilities for ESA-listed species.

5.4.1.2 Target Species

External Factors in the CCRA

The numerous target species in the CCRA are managed through the PFMC and several fisheries management plans (FMPs) (Table 3.3.1). Target species taken by SWFSC during research surveys in quantities greater than 100 kg per year (Table 4.2-5) are included in the effects analysis. HMS are discussed in the following section; Pacific coast groundfish and coastal pelagic species are also included here.

By definition, target species are those managed for recreational and commercial fisheries. These fisheries are the primary past, present, and reasonably foreseeable future activities that have or are likely to have the greatest effect on these species in the CCRA external to SWFSC fisheries research. In addition, research conducted by other NMFS fisheries sciences centers, such as the Northwest Fisheries Science Center (NWFSC), occurs in some of the same areas affected by SWFSC research, and is therefore considered in the set of external factors that contribute to cumulative effects in the CCRA. Natural population fluctuations, and periodic short-term and longer term climate changes also affect population viability and stock sizes.

The Pacific whiting (hake) fishery is the largest fishery along the West Coast from northern California to British Columbia, with total landings (U.S. and Canada combined) of 217,000 mt in 2010. The 2011 spawning biomass was estimated to be 2 million mt. Since 2001, total catches have been below coast-wide Allowable Biological Catches (ABCs) (Stewart and Forrest 2011).

Among the species included in the CPS FMP are Pacific sardines, Pacific mackerel, Northern anchovy, and Jack mackerel. The first two are actively managed; the latter two are monitored species (PFMC 2011a). West Coast landings of Pacific sardine, Pacific mackerel, Jack mackerel, and anchovy in 2010 were 66,817 mt, 2,104 mt, 314 mt, and 1,284 mt, respectively. The estimated recreational harvest of Pacific mackerel in 2010 was 233.41 mt (PFMC 2011a).

Pacific sardines supported the largest fishery in the western hemisphere during the 1930s and 1940s, after which the population and fishery declined until reaching extremely low levels in the 1970s. With increasing abundance during the 1980s, a directed purse-seine fishery was reestablished. Pacific sardine landings are now made in the Pacific Northwest and in Baja California, México (Hill et al. 2011).

Pacific mackerel supported one of California’s major fisheries during the 1930s and 1940s before experiencing a long-term decline. In the early 1970s, the State of California implemented a ‘moratorium’ on the directed fishery. Following a period of recovery, the moratorium was lifted and, through the 1990s, the fishery ranked third in volume for finfish landed in California (PFMC 2011a). The estimated total biomass in 2011 was 211,126 mt (Crone et al. 2011).

California landings of northern anchovy increased in the 1960s, but declined after reaching peak levels in 1975. From 2000 to 2010, northern anchovy landings averaged 322 mt for Washington, 71 mt for Oregon, and 9,028 mt for California (PFMC 2011a).

Jack mackerel has not been significantly targeted on the West Coast. Landings of jack mackerel in the California pelagic wetfish fishery through the 1990s averaged under 1,900 mt over 1990-2000, with a maximum of 5,878 mt in 1992 (PFMC 2011a).

The activities external to SWFSC fisheries research affecting target species will likely continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures and management schemes. The potential effects of climate variability are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

The average catch of target species during SWFSC research surveys (Table 4.2-5) is orders of magnitude smaller than commercial and recreational harvest levels. For example, the SWFSC average annual catch of Pacific mackerel (7,534 kg) is 0.36% of 2010 commercial landings. Average annual research catch of Pacific whiting (1,045 kg) is the equivalent of 0.0005% of the 2010 commercial landings. In addition, the SWFSC research catch represents much less than 0.1% of the ABC or other fisheries metric for the target species (Table 4.2-5). For all target species in the CCRA, mortality from SWFSC research surveys is considered minor on the population level.

When considered in conjunction with commercial and recreational fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting target species in the CCRA, the contribution of SWFSC fisheries research activities to cumulative effects would be minor under all the research alternatives.

Contribution of the No Research Alternative

Under the No Research Alternative, SWFSC would no longer conduct or fund fieldwork for fisheries and ecosystem research in the CCRA, so would not directly contribute to cumulative effects on target species in this region. In the absence of research surveys, important scientific information would not be collected about the status of fish stocks used for fisheries and conservation management, including trends in abundance, recruitment rates, and the amount of fish being harvested relative to overfishing metrics. This loss of data would make it much more difficult for fisheries managers to effectively monitor the status of stocks, develop fishery regulations, and rebuild overfished stocks. Ceasing or interrupting long-term data series on oceanography, abundance and distribution of various species, and diet studies (e.g., 60 years of CalCOFI research) would have long-term effects on the ability of scientists to monitor and model effects of ecosystem changes. The loss of information and increasing uncertainty about the status of fish stocks and their habitats would have serious implications for fisheries management. Through these indirect effects on future management decisions, the contribution of this alternative to adverse cumulative impacts on fish stocks would be moderate. The indirect contribution of the No Research Alternative to cumulative effects on any one species is difficult to ascertain, but would likely impact long-term monitoring and management capabilities for numerous economically and ecologically important species.

5.4.1.3 Highly Migratory and Prohibited Species

External Factors in the CCRA

HMS are designated due to their wide geographic distribution and their significant, but variable migrations across ocean basins. This makes them more available for harvest by multiple fisheries and more challenging to manage (PFMC 2011). HMS in the Pacific Region that are actively managed under the HMS FMP include various tunas, sharks, billfish/swordfish, and dorado, also known as dolphinfish or mahi-mahi (PFMC 2011b).

There is no single, pan-Pacific institution that manages all HMS throughout their ranges. Within the U.S., HMS fishery management in the Pacific is the responsibility of the Western Pacific Regional Fishery Management Council, North Pacific Fishery Management Council (NPFMC), PFMC, and the adjacent states (PFMC 2011b).

HMS along the U.S. West Coast are harvested commercially and recreationally. Commercial gears include surface hook and line, pelagic drift gillnet, pelagic longline, purse seine and harpoon. Sport fisheries target albacore, mixed tunas and dorado, billfish, and sharks (PFMC 2011b). The albacore fishery is the largest HMS fishery in the CCRA and is comprised of vessels that predominately troll for albacore using jigs, and to a lesser extent live bait. Surface hook-and-line gear accounts for most West Coast albacore landings (PFMC 2011b). The 2010 commercial landings in California, Oregon, and Washington combined were 11,822.6 mt (PFMC 2011c). Drift gillnet vessels operating off California, Oregon and Washington, and longline vessels targeting swordfish, beyond the West Coast Exclusive Economic Zone (EEZ) also harvest albacore. The recreational fishery for albacore harvests up to 1,500 mt in some years (PFMC 2011b).

California commercial landings of other HMS that are also targeted by SWFSC research include 67.9 mt of thresher sharks in the large mesh drift gillnet fishery and 17.2 mt of mako sharks and 1.4 mt of thresher sharks in set gillnets (PFMC 2011c).

The activities external to SWFSC fisheries research affecting HMS fish will likely continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures and management schemes. The potential effects of climate variability are unpredictable, but are also likely to impact these species and to continue into the foreseeable future.

Contribution of the Research Alternatives

The HMS caught by SWFSC research in the CCRA includes blue sharks, common thresher shark, North Pacific albacore tuna, and shortfin mako. The level of catch by SWFSC is relatively small compared to known harvests in commercial and recreational fisheries and, in the case of North Pacific albacore tuna, a fraction (0.0003%) of the ABC (Table 4.2-5). The effects of SWFSC research on these HMS are considered minor.

When considered in conjunction with commercial and recreational fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting HMS fish in the CCRA, the contribution of SWFSC fisheries research to cumulative effects would be minor.

Contribution of the No Research Alternative

Under the No Research Alternative, the SWFSC would not directly contribute to cumulative effects on HMS in the CCRA. In the absence of research surveys, important scientific information would not be collected, such as stock abundance and recruitment, making it more difficult for fisheries managers to effectively monitor status of stocks, develop fishery regulations, and rebuild overfished stocks. SWFSC research on HMS supports U.S. commitments to international management of HMS in the Pacific Ocean, including stock assessment and management advice to NMFS and U.S. officials and commissioners to the Inter-American Tropical Tuna Commission (IATTC) and other international committees. The loss of this scientific information would compromise the U.S. support of such international treaties and agreements.

SWFSC research also provides information on ecosystem characteristics important for monitoring potential effects from climate change and increases in ocean acidification, which could impact the population and distribution of many marine species. The indirect effects of the No Research Alternative could, therefore, result in adverse effects to fish stocks through a lack of information essential for informed decision making and conservation of fish, their prey, and their habitats. The indirect contribution of the No Research Alternative to cumulative effects for any particular species is difficult to ascertain, however the No Research Alternative would likely impact long-term monitoring and management capabilities for many economically and ecologically important species. When considered in conjunction with commercial and recreational fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting marine fish in the CCRA, the contribution of the No Research Alternative to cumulative effects on fish would be minor to moderate.

5.4.2 Eastern Tropical Pacific Research Area

External factors in the ETPRA

Fisheries in the Eastern Tropical Pacific (ETP) range from small-scale artisanal to large-scale industrial operations. Targeted species include herring, sardines, anchovies, mackerel, various tuna species, and squid (FAO 2005). The tuna purse seine fishery is one of the largest and most closely monitored, largely due to present and historical marine mammal by-catch. Yellowfin tuna, followed by skipjack and big-eye tuna, are the primary target species of the tuna fishery. The IATTC is an international convention with U.S. membership that provides the framework for conservation and management of tuna resources in the ETP. The implementing statute for the IATTC Convention is the Tuna Conventions Act of 1950 (PFMC 2011c).

The U.S. tuna purse seine fleet operating in the ETP decreased from 155 large (>362.8 mt) vessels in 1976 to about five such vessels per year from 2001 through 2003. About ten or fewer small purse seine vessels (< 100 mt) mostly target coastal pelagic species (Pacific mackerel and sardine) but occasionally catch tuna in the ETP (National Oceanic and Atmospheric Administration [NOAA] 2004). The international fleet comprises the majority of fishing the effort and carrying capacity in the ETP tuna fishery. From 1997 through 2001, an average of 132 international tuna purse seine vessels greater than 400 mt carrying capacity and an average of 71 vessels smaller than 400 mt carrying capacity fished in the ETP annually. In addition, the smaller vessels fish for tuna year-round off the coasts of Central and South America (NOAA 2004, and citations therein).

Commercial catches of yellowfin, skipjack, and big eye tuna in the Eastern Pacific Ocean in 2010 were 256,126 mt, 150,661mt, and 81,391mt, respectively. Most were caught by purse seine. Nearly half of the 2010 yellowfin purse seine catch (104,969 mt) was from Mexican flagged boats (IATTC 2011).

Commercial fisheries are the primary activity impacting fish species in the ETPRA and will likely continue into the foreseeable future. The level of impact will depend on the application and efficacy of current and proposed mitigation measures and management schemes. Potential effects of climate variability are possible and are unpredictable, but are also likely to impact these species and to continue into the foreseeable future.

Contribution of the Research Alternatives

The current SWFSC research activities in the ETPRA that are common to all three research alternatives are not oriented toward stock assessments of any target species and remove only very small quantities of fish, primarily larval and juvenile size classes caught in plankton nets. The overall catch of fish is only about 1 kg per year, which is considered minor for all species in the ETP.

The proposed longline survey in the ETPRA would be used by the SWFSC to monitor the abundance and distribution of HMS in the ETPRA. Given the small amount of effort (60 sets) over a very large area, the resulting fish mortality would likely be very small relative to any of the fish populations and the effects would be minor. When compared with the commercial tuna fisheries whose annual catch levels are in the hundreds of thousands of kg, and aggregated with other past, present, and reasonably foreseeable future activities, the contribution of the SWFSC proposed longline catch to cumulative effects would be considered minor.

Contribution of the No Research Alternative

Under the No Research Alternative, the SWFSC would not directly contribute to cumulative effects on other fish in this region. Indirectly, however, the loss of information obtained through this research could have adverse impacts on management decisions and analysis of long-terms trends affecting tuna fisheries in the ETP and their associated environmental impacts, especially bycatch of dolphins. The indirect contribution of the No Research Alternative to cumulative effects on any one species is difficult to ascertain, but would likely impact long-term monitoring and management capabilities for many economically and ecologically important species. When considered in conjunction with commercial and recreational fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting marine fish in the ETPRA, the contribution of the No Research Alternative to cumulative effects on fish would be minor to moderate.

5.4.3 Antarctic Research Area

External Factors in the ARA

The primary activities external to SWFSC research in the ARA likely to impact fish in the region are commercial fisheries and, most likely, climate change.

The Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) was signed in 1980, with the primary purpose of protecting and conserving living marine resources in the waters surrounding Antarctica, including krill, icefish and other finfish, mollusks, crustacea, and all other species of living organisms (NMFS 2006). CCAMLR sets catch limits for both established (assessed) fisheries and new and exploratory fisheries. These catch limits are for total catch by all countries in the convention area; there are no individual country allocations (NMFS 2006). CCAMLR currently regulates commercial fishing for Antarctic krill (*Euphausia superba*), Patagonian/Antarctic toothfish (*Dissostichus* spp.), icefish (*Champsocephalus gunnari*), and other species such as lantern fish (*Electrona carlsbergi*), squid (*Martialia hyadesi*), and crabs (*Paralomis* spp.) (http://www.ccamlr.org/pu/e/sc/fish-monit/hs-intro.htm, accessed May 7 2012).

Of these managed species, only mackerel icefish (*Champsocephalus gunnari*), was among the species taken in appreciable amounts (>100 kg) in the most recent SWFSC bottom trawl surveys. The CCAMLR Working Group recently recommended that the catch limit for *C. gunnari* should be set at 3,072 mt in 2011/12 and 2,933 mt in 2012/13 (CCAMLR 2011).

Several stocks of Antarctic finfish in the Southern Scotia Arc region were decimated in the 1970s and 1980s due to unmanaged commercial harvest. As a result, CCAMLR imposed a moratorium on all finfish fishing in 1990 in order to protect the remaining fish stocks (NOAA 2011b).

According to Turner et al. (2009), accelerated global warming and increased UV-B levels resulting from the ozone hole that develops in spring are the most important anthropogenic changes currently affecting the Antarctic. They note that the Antarctic marine ecosystem has been affected by climate change over the last fifty years, especially on the western side of the Antarctic Peninsula, with warming ocean temperatures and declining sea ice. A projected continued decline in sea ice could affect production of marine algae, with cascading effects through higher trophic levels, fish included. Increased ocean acidification is another potential side effect of environmental change (Turner et al. 2009).

The activities external to SWFSC fisheries research affecting fish in the ARA will likely continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures and management schemes. The potential effects of climate variability are unpredictable, but are also likely to have continued impacts into the foreseeable future.

<u>Contribution of the Research Alternatives</u>

SWFSC surveys in the ARA primarily focus on Antarctic krill, which are discussed in Section 4.2.7. Every two to three years, the SWFSC also conducts bottom trawl surveys in the South Orkney Islands area to monitor the recovery of several finfish that were overfished in the 1970s and 1980s. During the last research survey, conducted during the 2008-2009 season, only seven species were caught in totals greater than 100 kg (Table 4.2-6). Of these, only mackerel icefish is among the species for which CCAMLR recommended catch limits (see above). The level of periodic catch by SWFSC is minor (0.02% of the recommendation). The overall contribution of SWFSC research to cumulative effects on fish species in the ARA would be considered minor under all research alternatives.

<u>Contribution of the No Research Alternative</u>

Under the No Research Alternative, the SWFSC would not directly contribute to cumulative effects on fish in the ARA. Indirectly, however, the loss of information obtained through this research could impact management decisions affecting fish species in the Antarctic. SWFSC research includes estimating stock status and characterizing population dynamics for commercially important finfish, as well as other demersal Antarctic finfishes. SWFSC research is regularly presented to the scientific advisory bodies to the CCAMLR. In addition, SWFSC is the primary source of scientific advice to the U.S. Commissioner and delegation to CCAMLR. The loss of this information would have adverse effects on the management of fish in the ARA and would compromise the U.S. compliance with international treaty obligations. The indirect contribution of the No Research Alternative to cumulative effects on any one species is difficult to ascertain, but would likely impact long-term monitoring and management capabilities for many economically and ecologically important species. When considered in conjunction with commercial fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting marine fish in the ARA, the contribution of the No Research Alternative to cumulative effects on fish would be minor to moderate.

5.5 CUMULATIVE EFFECTS ON MARINE MAMMALS

5.5.1 California Current Research Area

Activities external to SWFSC fisheries research that may potentially affect marine mammals in the CCRA include commercial and recreational fisheries, vessel traffic, ocean discharges, dredging, geophysical activities and oil extraction, other scientific research, military operations, conservation measures, and climate change. These activities and potential effects are summarized in Table 5.1.1 and include:

- Disturbance/behavioral changes or physical effects from anthropogenic noise (e.g., marine vessels of all types, military readiness operations, navigational equipment, construction)
- Injury or mortality due to vessel collisions, entanglement in fishing gear, and contamination of the marine environment
- Changes in food availability due to prey removal, ecosystem change, or habitat degradation

5.5.1.1 ESA-listed Species

External Factors in the CCRA

The endangered marine mammal species in the CCRA include the Southern Resident killer whale (SRKW) Distinct Population Segment (DPS), sperm whales, humpback, blue, fin, and sei whales. Threatened species include Guadalupe fur seals and the southern subspecies of sea otters. The Eastern DPS of Steller sea lions was delisted from its former threatened status in November 2013. Commercial whaling was the single greatest historical source of mortality for the endangered whale species (except killer whales), as was commercial sealing for Guadalupe fur seals during the 19th century (Carretta et al. 2011 and citations therein, Perry et al. 1999). Commercial harvests of sperm whales ended worldwide in 1986 (NMFS 2010). Humpback whales and blue whales were protected in 1966 (NMFS 1998, Perry et al. 1999). The International Whaling Commission (IWC) banned hunting of fin whales throughout the North Pacific in 1976 (Perry et al. 1999). Hunting of sei whales in the eastern North Pacific ended after 1971 and after 1975 in the western North Pacific (Perry et al. 1999).

Live capture of killer whales in Washington and British Columbia for use in aquaria was a major historical source of population decline for SRKWs between 1962 and 1977. Seventy percent (47 or 48 animals) of the whales retained or killed were Southern Residents (NMFS 2008, and citations therein).

Commercial harvests of sea otters for their pelts during the 18th and 19th centuries nearly extirpated the species throughout its range. Southern sea otter populations gradually expanded along the central California coast after being protected under the International Fur Seal Treaty in 1911 (Carretta et al. 2011, and citations therein).

More recent past, present, and reasonably foreseeable future conservation concerns and threats to recovery are outlined in the respective recovery plans for the ESA-listed species for which plans exist. Those for blue whales (NMFS 1998), humpback whales (NMFS 1991), sperm whales (NMFS 2010c), fin whales (NMFS 2010a), sei whales (NMFS 2011), SRKWs (NMFS 2008a), and southern sea otters (U.S. Fish and Wildlife Service [USFWS] 2003) were finalized or recently updated. Noted conservation concerns and threats include vessel collisions, entanglement in fishing gear, anthropogenic noise, vessel/human disturbance, pollutants and pathogens, disease, habitat degradation, competition with fisheries for prey, and climate change.

Vessel collisions are considered threats for several endangered large whales, particularly blue, humpback, and fin whales. The contribution of ship strikes to the annual average anthropogenic sources of mortality is noted in Section 3.2.2 under the respective species descriptions. The Pacific coast of the U.S. includes numerous shipping lanes, active ports and vessel traffic. The major container ports are Seattle, Tacoma, Portland, Oakland, Long Beach and Los Angeles. The Santa Barbara Channel, through which most Long Beach and Los Angeles-bound vessels transit, contains some of the highest densities of commercial maritime traffic in the world. An average of 6,500 large (over 300 gross tons) vessels annually pass through the Channel, most at speeds greater than 14 knots (kts) (Channel Islands National Marine Sanctuary [CINMS] 2006 cited in Abramson et al. 2009). In addition, there are several large Naval bases (e.g., Naval Base San Diego, the largest on the West Coast and home to the Pacific Fleet) and U.S. Coast Guard (USCG) Stations in Washington and California.

Fin whales had the highest incidence of confirmed ship strike mortality (five whales), followed by blue whales (two) and humpback whales (one) along the Washington coast between 1980 and 2006. Three of the fin whales and one of the blue whales were discovered draped over the bows of container ships. Possible additional ship strike mortalities include two fin whales, one sperm whale, and one sei whale (Douglas et al. 2008).

An average of three large whales per year was found dead along the California coast between 2000 and 2011with injuries caused by ship strike (Kennedy 2012). Between September and November 2007, five blue whale deaths in the Southern California Bight near the Northern Channel Islands were attributed to ship strikes. NMFS designated these deaths an Unusual Mortality Event (UME), which the MMPA defines as "a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response" (CINMS 2008). In 2010, two blue whales, one humpback, and two fin whales were found dead in and around Monterey Bay, Gulf of the Farallones, and Cordell Bank NMS and one blue whale was found dead on San Miguel Island within CINMS (Kennedy 2012).

In response to the UME in 2007, NOAA developed numerous mitigation and monitoring measures to address ship strikes, especially in the Santa Barbara Channel. This includes a seasonal Whale Advisory Zone. When five or more blue, humpback, and/or fin whales are sighted in the Whale Advisory Zone during monitoring of shipping lanes, NOAA coordinates with USCG and National Weather Service to broadcast a notice to mariners advising ships over 300 gross tons to watch for large whales and to maintain speeds of 10 kts or less (http://channelislands.noaa.gov/focus/management.html). Based on Automatic Identification System station data on ships transiting within and outside the Santa Barbara Channel during 2007-2009, CINMS staff found that most ships have not slowed to 10 kts (Kennedy 2012).

The USCG completed a Port Access Route Study in 2011 for San Francisco Bay. A formal proposal was submitted to the IMO to extend the northern (17 nm), western (3 nm), and southern (8.5 nm) shipping lanes and to narrow the northern and western lanes to three nautical miles wide each. The northern and western shipping lanes were also shifted slightly (33 CFR 167). These changes will keep vessels on a more predictable path and avoid the Area of Special Biological Significance at Point Reyes and an important feeding area for whales at Cordell Bank National Marine Sanctuary (NOAA 2012).

Disturbance by vessels is a possible contributing factor in the recent decline in the population of SRKWs (NMFS 2008a). In order to protect killer whales from interference and noise associated with vessels, in 2011, NMFS established regulations prohibiting vessels from approaching killer whales within 200 yards (182.9 meters [m]) and from parking in the path of whales when vessels are in inland waters of Washington State (76 FR 20870). This should help reduce the number and severity of vessel incidents and promote population growth and recovery (NMFS 2010b).

Entanglement in fishing gear is another concern for several ESA-listed species. Overall, the level of take for ESA-listed marine mammals in the CCRA is relatively low. There are no fisheries mortalities or serious injuries documented for blue, fin, or sei whales, and the mean annual take of sperm whales by unknown fisheries was ≥0.2. The mean annual take of humpback whales (≥3.2) in pot or trap fisheries and unknown fisheries exceeds 10 percent of the potential biological removal (PBR), so is not approaching a zero mortality and serious injury (M&SI) rate (Carretta et al. 2011). Drift and set gillnet fisheries may cause incidental mortality of Guadalupe fur seals, but there are no reports of mortality or injuries in the U.S. and information is not available for Mexico. Steller sea lions have been taken in the Pacific whiting trawl fishery (0.8 mean annual take, 2000-2004), but there were no fishery-related strandings between 2004 and 2008 (Allen and Angliss 2011). Information on takes of southern sea otters in commercial fisheries is limited, although drift and set gillnet fisheries, purse seine fisheries, pot fisheries, and hook and line fisheries have the potential to kill or injure southern sea otters (Carretta et al. 2011).

The Pacific Offshore Cetacean Take Reduction Plan (POCTRP) was finalized in 1997 to reduce the level of M&SI of several marine mammal stocks, including sperm and humpback whales, in the California/Oregon drift gillnet fishery for thresher shark and swordfish (62 FR 51805). Data from 2008-2009 indicated that the POCTRP achieved the MMPA short term goal of reducing serious injuries and mortalities of all strategic stocks to below PBR and the long term goal of reducing serious injuries and mortalities of all marine mammals (except long-beaked common dolphins) to insignificant levels (POCTRT 2009).

The potential effects of commercial fisheries on prey availability are not clear. Direct competition with fisheries for prey is unlikely for blue, fin, and sei whales whose diet consists of 80-100% large zooplankton, primarily krill (Barlow et al. 2008). Humpbacks consume roughly 50% large zooplankton, along with small pelagic and miscellaneous fish. Sperm whales consume about 60% large squid, and a mix of various fish, small squid, and benthic invertebrates. Krill is not commercially harvested, nor are most of the other prey items (Barlow et al. 2008).

Recovery plans for SRKWs identified reduced prey availability as a risk to the population. Chinook salmon is overwhelmingly the most frequently consumed prey, of which 80-90% is from the Fraser River (Hanson et al 2010). The SRKW population may consume 12–23% of available Fraser River Chinook in the region from May–September, which might exceed takes from all fisheries in the region combined. As both species have at-risk conservation status and transboundary (Canada–U.S.) ranges, there could be competition between conservation objectives for killer whales and Chinook salmon (Williams et al. 2011).

The potential for competition for prey exists for the eastern DPS of Steller sea lions. Steller sea lions are known to consume several commercially important species including Pacific whiting, salmonids, Pacific herring, and squid. Although the fishery for Pacific whiting is one of the largest off the West Coast, there are no indications of resource competition along the Oregon and Washington outer coasts. In addition, the coastal Pacific whiting fishery is essentially closed south of 42°N latitude eliminating direct fishery impacts on Steller sea lions in central California, and minimizing potential resource competition during the summer months when the Steller sea lion population is concentrated on rookeries in southern Oregon and northern California (Baraff and Loughlin 2000, NMFS 2008b).

Climate change impacts on ESA-listed species are possible through changes in habitat and food availability. Migration, feeding, and breeding locations influenced by ocean currents and water temperature could be impacted, which could, ultimately, affect productivity of ESA-listed species (NMFS 2010, NMFS 2011). In addition, research conducted by other NMFS fisheries sciences centers, such as the Northwest Fisheries Science Center (NWFSC), occurs in some of the same areas affected by SWFSC research, and is therefore considered in the set of external factors that contribute to cumulative effects in the CCRA.

With the exception of the historical sources of population decline, all of the aforementioned effects are likely to continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

No collisions with ESA-listed species have been reported from any fisheries research activities conducted or funded by the SWFSC in CCRA, as described in Section 4.2.4. Given the relatively slow speeds of research vessels, mitigation measures, and the small number of research cruises, the likelihood of fisheries research vessels causing serious injury or mortality to ESA-listed species due to ship strikes is considered possible but the potential risk is minor.

The potential effects from use of active acoustic devices for research activities would have rare or infrequent and temporary behavioral avoidance effects on ESA-listed marine mammals throughout the CCRA. Relative to the volume of other ship traffic and anthropogenic sources of acoustic disturbance, the contribution of noise from SWFSC research would be minor.

There have been no adverse interactions or takes of ESA-listed marine mammals during SWFSC fisheries research in the CCRA and takes of ESA-listed species are not anticipated. Based on historical takes of an analogous species, California sea lions, the SWFSC Letter of Authorization (LOA) application (Appendix C) estimated that Steller sea lions from the recently delisted Eastern DPS could be taken in the future by trawl gear (average of two animals per year or ten over the five-year LOA period, including one take per five-year period attributed to “undetermined pinniped species”) and longline gear (average of 0.4 animals per year or two over the five-year LOA period, including one take per five-year period attributed to “undetermined pinniped species”). Given the existing and proposed additional mitigation measures, and the lack of historical takes of this species, it is unlikely that the requested level of take would be realized. A total average of 2.4 lethal takes of Steller sea lions per year due to SWFSC research, if they occurred, combined with other sources of anthropogenic mortality (average of 40.8 animals per year from the stock, Allen and Angliss 2011), would still be well below 10 percent of PBR for the stock (238 animals). The contribution of SWFSC research activities to the cumulative impacts on the population would be minor adverse.

Although there is some overlap in prey of ESA-listed marine mammals in the CCRA and the species collected during SWFSC research surveys, the total amount sampled is minimal compared to overall biomass and commercial fisheries removals. In addition, the size classes of fish targeted in SWFSC research are generally smaller than that preyed upon. The contribution of research catches to the cumulative effects on marine mammals through competition for prey is therefore considered minor for all species in the CCRA.

The cumulative effects from all past and present factors on ESA-listed species have, by definition, major impacts on the populations of these species. However, when considered in conjunction with other past, present, and reasonably foreseeable future activities affecting ESA-listed marine mammals in the CCRA, the contribution of the three research alternatives to cumulative effects on ESA-listed marine mammals would be minor and adverse through incidental take. However, fisheries and ecosystem research conducted by the SWFSC also provides valuable information for the conservation and management of ESA-listed species and this contribution to cumulative effects would be beneficial for these species.

Contribution of the No Research Alternative

Under the No Research Alternative, NMFS would not promulgate rulemaking or issue LOAs for SWFSC fisheries research. SWFSC would no longer conduct or fund fisheries or ecosystem survey activities in the CCRA and would not directly contribute to cumulative effects on threatened and endangered species in this region. Indirectly, however, the loss of information obtained from SWFSC ecosystem research on marine mammal feeding ecology, oceanographic components of their habitat, status of prey stocks, and fisheries interactions could adversely impact management decisions regarding the recovery of these ESA-listed species and analysis of long-term trends affecting the marine ecosystem. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but would likely impact long-term monitoring and management capabilities for many ESA-listed marine mammals in the CCRA. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting ESA-listed marine mammals in the CCRA, the contribution of the No Research Alternative to cumulative effects on ESA-listed marine mammals would be minor to moderate.

5.5.1.2 Other Cetaceans

External Factors in the CCRA

The cetacean species included in this section are not listed as threatened or endangered. These species are all subject to similar types of effects from external activities as described above for ESA-listed species. Interactions with commercial fisheries are likely to have the greatest effect on most of these species and are generally well-documented.

Fisheries in which these species have been subject to mortality or serious injury between 2004 and 2008 include set gillnet fisheries (harbor porpoise), Washington/Oregon/California domestic groundfish trawl (Dall's porpoise), Puget Sound salmon drift gillnet (Dall's porpoise), California/Oregon thresher shark/swordfish drift gillnet fishery (Pacific white-sided dolphins, Risso's dolphins, short- and long-beaked common dolphins, and nothern right whale dolphin), West Coast limited entry bottom trawl fishery (Pacific white-sided dolphins), California squid purse seine (short-beaked common dolphins), California small mesh drift gillnet fishery for white seabass, yellowtail, barracuda, and tuna (long-beaked common dolphins), and unknown fisheries (Carretta et al. 2011). The reported number of takes is less than 10 percent of the respective PBR levels for each of these species, so population-level effects from commercial fishery takes are minor. There were no reported takes of striped dolphins, short-finned pilot whales, pygmy or dwarf sperm whales during that time period.

Mitigation measures effectively reduced Level A takes for harbor porpoise in central California coastal gillnet fisheries and for several species in the California/Oregon thresher shark/swordfish drift gillnet fishery. A 2002 ban on gillnets inshore of the 60 fathom (110 m) isobath from Point Arguello to Point Reyes was thought to reduce potential harbor porpoise mortality to near zero for the Morro Bay, Monterey Bay, and San Francisco-Russian River stocks (Carretta et al. 2011). Low levels of take of harbor porpoise in unknown and marine set gillnet fisheries occur north of the closure area from northern California to the Washington coast (Carretta et al. 2011). Implementation of the POCTRP in 1997 (62 FR 51805) resulted in considerable decreases in overall cetacean entanglement rates in the drift gillnet fishery. Data from 2008-2009, indicated that the POCTRP achieved the MMPA short term goal of reducing serious injuries and mortalities of all strategic stocks to below PBR and the long term goal of reducing serious injuries and mortalities of all marine mammals (except long-beaked common dolphins) to insignificant levels (POCTRT 2009).

Prey consumed by the odontocetes considered here includes some commercially valuable species, such as herring and anchovies that are preyed upon by harbor porpoise, plus an array of non-commercially important mesopelagic fish, small pelagic fish, squid, and miscellaneous fish (Barlow et al. 2008). It is unlikely that commercial fisheries affect the availability of prey for non ESA-listed cetaceans.

Climate change impacts are difficult to predict, but will likely affect non ESA-listed cetaceans through changes in habitat and food availability.

The activities external to SWFSC fisheries research affecting cetaceans are likely to continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

There have been no documented cases of cetaceans being disturbed or changing their behavior in response to SWFSC research vessels other than bow-riding by dolphins and Dall's porpoise, which is a common behavior not considered detrimental. However, potential disturbance from acoustic sources could take place under the surface of the water and be undetectable by observers on the deck of a research vessel. Based on an analysis of sound source characteristics of acoustic equipment used in research and hearing capacities of marine mammals, the potential effects from use of active acoustic devices for research activities would likely be rare or infrequent and cause temporary avoidance reactions in cetaceans throughout the CCRA, which is considered to have an overall minor impact.

Two species of cetaceans, Pacific white-sided dolphins and northern right whale dolphins, have been caught or entangled in SWFSC research trawl gear in the past. The SWFSC LOA application (Appendix C) includes estimates of the number of other cetaceans that may have adverse interactions with research gear based on similarities to these two species and historical takes in analogous commercial fisheries (Table 4.2-10). These species include two porpoise species, seven species of dolphins, short-finned pilot whale, and pygmy and dwarf sperm whales. As described in the ESA-listed species section above, the SWFSC does not think this many cetaceans would actually be taken in the next five years but has chosen to use a conservative estimation procedure to ensure accounting for the maximum amount of potential take.

For all but one cetacean species (bottlenose dolphins), the estimated average annual take from SWFSC research is less than 10 percent of PBR (Table 4.2-10) and is considered minor in magnitude. For bottlenose dolphins (two small stocks), estimated takes in the LOA application are greater than 10 percent and less than 50 percent of PBR and are considered moderate in magnitude. When the contribution of estimated incidental take from SWFSC research is added to other sources of anthropogenic mortality (primarily incidental take in commercial fisheries and ship strikes, Carretta et al. 2011), total anthropogenic mortality and serious injury for most species remains much less than 10 percent of PBR and the cumulative magnitude of effect is considered minor.

For Risso's dolphin (PBR = 39), the contribution of estimated future research take (2.6 animals per year, including one take per five-year period attributed to "undetermined delphinid species"), when added to other mortality and serious injury (1.6 animals per year, Carretta et al. 2011), causes the cumulative mortality and serious injury (4.2 animals per year) to exceed 10 percent of PBR (3.9 animals per year). This cumulative impact, if it occurred, would be considered moderate in magnitude. However, as described in the direct and indirect effects analysis in section 4.2.4, in addition to the magnitude of effects, NEPA analyses must also consider other elements such as the frequency or duration of effects and their likelihood of occurrence. For Risso's dolphin, the estimated takes and contribution of research to historic takes are based on one incident in 2008 when 11 Pacific white-sided dolphins were caught in one trawl set. Although Risso's dolphins have never been caught in SWFSC research gear in the past, there is the possibility for multiple animals to be caught at one time. However, given the implementation of several new mitigation measures since 2008, including MMEDs in Nordic 264 trawl nets, the SWFSC considers future takes of this species at the estimated rate to be unlikely and to occur only rarely. The overall contribution of SWFSC research to the cumulative effects of adverse gear interactions with this species is therefore considered minor.

For Pacific white-sided dolphins and northern right whale dolphins, the average annual mortality and serious injury data from all anthropogenic sources reported in Table 4.2-10 includes historic incidental takes of these species in SWFSC and Northwest Fisheries Science Center fisheries research (Carretta et al. 2011). For Pacific white-sided dolphins (PBR = 193), the contribution of estimated future research take (average 7.2 animals per year, including one take per five-year period attributed to "undetermined delphinid species"), when added to non-research mortality and serious injury (10.5 animals per year), brings the cumulative mortality and serious injury (17.7 animals per year) close to 10 percent of PBR (19.3 animals per year). This cumulative impact, if it occurred, would be considered minor in magnitude.

For northern right whale dolphins (PBR = 48), the contribution of estimated future research take (average 2.2 animals per year, including one take per five-year period attributed to "undetermined delphinid species"), when added to non-research mortality and serious injury (3.6 animals per year), causes the cumulative mortality and serious injury (5.8 animals per year) to exceed 10 percent of PBR (4.8 animals per year) but be less than 50 percent of PBR (24 animals per year). This cumulative impact, if it occurred, would be considered moderate in magnitude. As described for Risso's dolphins above, NEPA analyses must also consider the frequency or duration of effects and their likelihood of occurrence. For northern right whale dolphins, the estimated takes and contribution of research to historic takes are based on one incident in 2008 when six northern right whale dolphins were caught in one trawl set. Given the implementation of several new mitigation measures since that time, including MMEDs in Nordic 264 trawl nets, the SWFSC considers future takes of this species at the estimated rate to be unlikely and to occur only rarely. The overall contribution of SWFSC research to the cumulative effects of adverse gear interactions with this species is therefore considered minor.

For bottlenose dolphins (PBR = 5.5 for the offshore stock and 2.4 for the coastal stock), anthropogenic sources of mortality and serious injury is low (0.2 animals per year for each of the two stocks) and does not include any past incidental takes from NMFS research (Carretta et al. 2011). In the LOA application the estimated takes for these two stocks are divided by gear type and includes takes assigned to both stocks for "undetermined delphinid species" for trawl gear. The total estimated average take in trawl gear is 1.8 animals per year in trawl gear for the offshore stock and 0.8 animals per year for the coastal stock. In addition, the LOA application includes an estimated take of one bottlenose nose dolphin in a five-year period in longline gear from the offshore stock only (average of 0.2 animals per year). When added to historic takes from other sources, the total estimated take in both trawl and longline gear for both stocks is greater than 10 percent of PBR but less than 50 percent of PBR for each stock. This cumulative impact, if it occurred, would be considered moderate in magnitude for both stocks. Given the lack of historical takes of this species in research gear and the implementation of new mitigation measures since 2008, the SWFSC considers future takes of this species at the estimated rate to be unlikely and to occur only rarely. As described above for Risso's dolphins and northern right whale dolphins, the overall contribution of SWFSC research to the cumulative effects of adverse gear interactions with this species is therefore considered minor adverse.

Although there is some overlap in prey of non ESA-listed cetaceans in the CCRA and the species collected during SWFSC research surveys (e.g., sardines, anchovy, and mackerel), the total amount sampled is minimal compared to overall biomass and commercial fisheries removals. The contribution of research catches to the effects on marine mammals through competition for prey is therefore considered minor adverse for cetaceans in the CCRA.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non-ESA-listed cetaceans in the CCRA, the contribution of the three research alternatives to cumulative effects on cetaceans would be primarily through adverse gear interactions and would be minor and adverse. This conclusion depends largely on the efficacy of mitigation measures implemented by the SWFSC, future levels of take in commercial fisheries, and the actual annual take during the course of research operations. Fisheries and ecosystem research conducted by the SWFSC also provides valuable information for the conservation and management of marine mammals and this contribution to cumulative effects would be beneficial for cetaceans in the CCRA.

Contribution of the No Research Alternative

Under the No Research Alternative, NMFS would not promulgate rulemaking or issue LOAs for SWFSC fisheries research. SWFSC would not directly contribute to cumulative effects on non-ESA-listed cetaceans in the CCRA. Indirectly, however, the loss of information obtained from SWFSC ecosystem research on marine mammal feeding ecology, oceanographic components of their habitat, status of prey stocks, and fisheries interactions could adversely affect management decisions and analysis of long-term trends affecting the marine ecosystem. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but would likely impact long-term monitoring and management capabilities for all cetaceans in the CCRA. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non-ESA-listed cetaceans in the CCRA, the contribution of the No Research Alternative to cumulative effects on non-ESA-listed cetaceans would be minor to moderate and adverse.

5.5.1.3 Other Pinnipeds

External Factors in the CCRA

Four species of non-ESA-listed pinnipeds commonly occur in the CCRA, including California sea lions, northern fur seals, harbor seal (several stocks), and northern elephant seals. These species are all subject to similar types of effects from external activities as described above for other species. Interactions with commercial fisheries likely have the greatest effect on most of these species and are also generally well-documented.

Fisheries in which California sea lions have been subject to mortality or serious injury in the CCRA include California/Oregon thresher shark/swordfish large mesh drift gillnet fishery, California angel shark/halibut and other species large mesh (>3.5 inches) set gillnet fishery, CA small-mesh drift gillnet fishery for white seabass, yellowtail, barracuda, and tuna; CA anchovy, mackerel, and tuna purse seine fishery; Washington/Oregon/California domestic groundfish trawl fishery; Washington/Oregon/California domestic groundfish bottom trawl fishery; Washington/Oregon salmon net pen fishery; and unknown entangling net fisheries. The minimum total annual take (2000-2004) was ≥159 animals, but well below ten percent of the PBR of 8,511 (Carretta et al. 2011).

Of the several stocks of harbor seals in the CCRA, the California stock experiences the highest level of incidental take (an average of 388 per year, 1999-2003), primarily in the California angel shark/halibut and other species large mesh (>3.5 in) set gillnet fishery. Low levels of takes were reported in the Washington/Oregon/California groundfish trawl and unknown net and hook fisheries. This level of annual mortality is greater than ten percent of the calculated PBR (1,896), so cannot be considered insignificant and approaching zero M&SI rate and could, therefore, have a minor effect at the population level. There is currently no PBR estimate for the Oregon/Washington coastal stock, but levels of annual mortality are low (≥1.8, 2004-2008) in the Northern Washington marine set gillnet fishery and the Washington/Oregon/California groundfish trawl (Carretta et al. 2011).

Northern elephant seals are taken in small numbers (> 8.8 mean annual take, 2000-2004), primarily in the California/Oregon thresher shark/swordfish large mesh drift gillnet fishery. Some mortality reported in U.S. fisheries may be of seals from the breeding population in Mexico and some of the U.S. breeding population may be taken in drift gillnet fisheries along the Pacific coast of Baja California, Mexico (Carretta et al. 2011). The reported level of incidental take is well below ten percent of PBR (4,382), so considered minor in magnitude.

While it is possible for northern fur seals from the Eastern Pacific stock to be taken during the winter/spring along the continental U.S. West Coast, for the purposes of the stock assessment reports, NMFS considers any northern fur seals taken by commercial fisheries off California, Oregon and Washington to be from the San Miguel Island stock. Between 2004 and 2008, there were no reported deaths in any observed fishery along the West Coast of the continental U.S., for an estimated mean mortality rate of zero for this stock (Carretta et al. 2011).

Pinnipeds in the CCRA have a diverse diet that includes Pacific whiting, market squid, northern anchovy, Pacific herring, and Pacific sardine. All support commercially valuable fisheries which could potentially affect prey availability (Baraff and Loughlin 2000). Pacific whiting is widely available as prey, commonly consumed, and is one of the most commercially valuable and abundant groundfish resources of the California Current. There are, however, no indications of resource competition along the Oregon and Washington outer coasts and, since the fishery is essentially closed south of 42°N latitude, impacts on pinnipeds in southern and central California are unlikely. Pinniped predation on herring and the commercial fishery coincide during the fall–winter spawning season, but there do not appear to be any conflicts over prey availability (Baraff and Loughlin 2000).

Climate change impacts are difficult to predict, but may affect non ESA-listed pinnipeds through changes in habitat and food availability.

The activities external to SWFSC fisheries research affecting pinnipeds are likely to continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

Fisheries research activities conducted by SWFSC in the CCRA are most likely to impact pinnipeds through periodic interactions with survey gear. Potential effects of active acoustic devices used in research activities would be considered minor throughout the CCRA during all seasons.

California sea lions and northern fur seals have been incidentally caught or entangled in trawl and longline gear during past SWFSC fisheries research surveys (Tables 4.2-7 and 4.2-8). The SWFSC LOA application (Appendix C) includes calculations of potential takes of these and other pinnipeds that may interact with research gear based on similarities to these two species and historical takes in analogous commercial fisheries (Table 4.2-10). As described in the ESA-listed species section above, the SWFSC does not think this many pinnipeds would actually be taken in the next five years but has chosen to use a conservative estimation procedure to ensure accounting for the maximum amount of potential take.

For California sea lions (PBR = 9,200), the total estimated take of 5.4 animals per year in SWFSC research surveys (average of 4.2 in trawl gear and 1.2 in longline gear, including takes assigned for "undetermined pinniped species" for both trawl and longline gear), even when added to annual takes in commercial fisheries (average of 431 per year, Carretta et al. 2011), would be much less than 10 percent of PBR (920 animals) and would be considered minor in magnitude. These incidental takes of California sea lions in commercial and scientific fishing gear occur on a regular basis and a wide geographic area but the overall impact to the population of California sea lions is considered minor. The contribution of SWFSC fisheries research takes to this cumulative effect, if they occur, would be considered minor adverse.

For northern fur seals, northern elephant seals, and harbor seals, estimated takes in SWFSC research trawl gear, when added to all other sources of anthropogenic mortality, is much less than 10 percent of PBR for each species and would be considered minor in magnitude. Incidental takes of these species from other sources occur rarely (northern fur seals) or periodically (harbor seals and elephant seals) and are distributed over a large geographic area. The contribution of SWFSC fisheries research takes to cumulative effects on these species, if they occur, would be considered minor adverse.

Although there is some overlap in prey of non ESA-listed pinnipeds in the CCRA and the species collected during SWFSC research surveys (e.g., sardines, anchovy, and mackerel), the total amount sampled is minimal compared to overall biomass and commercial fisheries removals. The contribution of research catches to the effects on marine mammals through competition for prey is therefore considered minor adverse for cetaceans in the CCRA.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non-ESA-listed pinnipeds in the CCRA, the contribution of the three research alternatives to cumulative effects on these species through disturbance, direct takes, and prey removal would be minor and adverse. However, research conducted by the SWFSC provides valuable information for the conservation and management of marine mammals and this contribution to cumulative effects would be beneficial for pinnipeds in the CCRA.

Contribution of the No Research Alternative

Under the No Research Alternative, NMFS would not promulgate rulemaking or issue LOAs for SWFSC fisheries research. SWFSC would not directly contribute to cumulative effects on non-ESA-listed pinnipeds in the CCRA. Indirectly, however, the loss of information obtained through SWFSC fisheries and ecosystem research on pinniped feeding ecology, oceanographic components of their habitat, status of prey stocks, and fisheries interactions could affect management decisions and analysis of long-term trends affecting the marine ecosystem. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species but would likely impact long-term monitoring and management capabilities for all pinniped species in the CCRA. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting pinnipeds in the CCRA, the contribution of the No Research Alternative to cumulative effects on these species would be minor to moderate and adverse.

5.5.1.4 Sea otters

External Factors in the CCRA

Sea otters along the Washington coast were extirpated by an intensive harvest for their pelts beginning in the 18^{th} century. Sea otters were absent from the state from 1911 until 1969, when 59 sea otters were reintroduced to the Washington coast from Amchitka Island, Alaska (Lance et al. 2004).

More recent past, present, and reasonably foreseeable future conservation concerns and threats include oil spills, contaminants, disease, marine biotoxins, entanglement and entrapment, habitat loss, and low genetic diversity (Lance et al. 2004). The relatively small population size and range of northern sea otters in Washington may leave them particularly vulnerable to habitat destruction or loss and, currently, oil spills and disease are of primary concern (Lance et al. 2004).

Fisheries interactions also occur. In Washington, a small number of sea otters are taken in tribal gill net fisheries along the northern coast. Non-treaty gill nets are prohibited throughout the current sea otter range on the outer coast of Washington, but tribal gill nets are used along the northern coast and into the Strait of Juan de Fuca. Incidental takes of sea otters in salmon gill net fisheries conducted by Makah tribal fishermen are considered rare, but do occur. There have been no sea otter deaths attributed to pot gear in Washington (Lance et al. 2004).

Sea otters in Washington State primarily consume sea urchins, clams, crabs, and mussels. Localized fisheries management issues are possible given that several shellfish species are also important to commercial, recreational, and tribal fisheries in Washington (Lance et al. 2004).

The activities external to SWFSC fisheries research that affect northern sea otters are likely to continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures.

Contribution of the Research Alternatives

Sea otters inhabit nearshore waters that are either not covered by SWFSC research activities (e.g., Puget Sound) or are much closer to shore than research vessels typically travel or sample. There have been no interactions with past SWFSC research activities and the risk of future disturbance, injury, or competition for prey under any of the research alternatives is considered minor. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting sea otters in the CCRA, the contribution of the three research alternatives to cumulative effects on this species through disturbance, direct takes, and prey removal would be minor adverse.

Contribution of the No Research Alternative

Under the No Research Alternative, SWFSC would not directly contribute to cumulative effects on sea otters in the CCRA. Indirectly, however, the loss of information obtained through SWFSC fisheries and ecosystem research on the oceanographic components of sea otter marine habitat and status of prey stocks could have adverse impacts on management decisions concerning sea otters. The indirect contribution of the No Research Alternative to cumulative effects on sea otters is difficult to ascertain but, when considered in conjunction with other past, present, and reasonably foreseeable future activities affecting sea otters in the CCRA, the contribution of the No Research Alternative to cumulative effects on this species would be minor adverse.

5.5.2 Eastern Tropical Pacific Research Area

Activities external to SWFSC research that may potentially affect marine mammals in the ETPRA include commercial fisheries, vessel traffic, ocean discharges, Liquid Natural Gas terminals, oil extraction and geophysical activities, dredging, other scientific research, military operations, conservation measures, and climate change. These activities and potential effects are summarized in Table 5.1.1 and include:

- Disturbance/behavioral changes or physical effects from anthropogenic noise
- Injury or mortality due to vessel collisions, entanglement in fishing gear, and contamination of the marine environment
- Changes in food availability due to prey removal, ecosystem change, or habitat degradation

5.5.2.1 ESA-listed Species

External Factors in the ETPRA

The endangered marine mammals that occur in the ETPRA include blue, fin, sei, humpback, and sperm whales (Table 3.2-4). The only threatened species and ESA-listed pinniped in the ETPRA is the Guadalupe fur seal. Commercial whaling was the single greatest historical source of mortality for these whale species, as was commercial sealing for Guadalupe fur seals during the 19th century (Carretta et al. 2011 and citations therein). Commercial harvests of sperm whales ended worldwide in 1986 (NMFS 2010). Humpback whales and blue whales were protected in the North Pacific in 1966 and Southern Hemisphere stocks of humpback whales were protected in 1963 (Leaper and Miller 2011, NMFS 1998, Perry et al. 1999). The IWC banned hunting of fin whales throughout the North Pacific in 1976 (Perry et al. 1999). Hunting of sei whales in the eastern North Pacific ended after 1971 (Perry et al. 1999).

The ETPRA is an expansive region encompassing approximately seven million square miles (NOAA 2004) and the coastlines of Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Ecuador, Peru, and the French Territory Clipperton Island. The region is, therefore, subject to an array of governmental policies and regulations; vessel traffic (national and international); coastal and offshore, large and small-scale, national and international fisheries; possible military activities; and coastal development.

The actual level of vessel traffic throughout the region would be difficult to quantify and the incidence of marine mammal-vessel interactions is largely unknown. There are several major ports and transit routes throughout this region, including the Panama Canal. The total number of transits through the canal exceeded 14,000 per year in 2009, 2010, and 2011. Included were bulk carriers, cargo ships, fishing vessels, LNG carriers, tankers, passenger ships, military, barges, dredges, and others (Canal de Panamá website http://www.pancanal.com/eng/op/transit-stats/index.html, accessed 19 April 2012). The only documented incident was of an unknown large whale that was hit, and presumably injured, by the research vessel Surveyor west of Callao, Peru in 1992 (Jensen and Silber 2004, Laist et al. 2001).

Fisheries in the ETPRA range from small-scale artisanal to large-scale industrial operations. Targeted species include herring, sardines, anchovies, mackerel, various tuna species, and squid (FAO 2005). The tuna purse seine fishery is one of the largest and most closely monitored due to present and historical marine mammal by-catch. The tuna-dolphin fishery interaction is detailed below under "Other Cetaceans." The U.S. tuna purse seine fleet operating in the ETPRA decreased from 155 large (>362.8 mt) vessels in 1976 to about five such vessels per year from 2001 through 2003. No more than 10 small purse seine vessels (< 100 mt) mostly fish for coastal pelagic species (Pacific mackerel and sardine) but occasionally harvest tuna in the ETPRA (NOAA 2004). The international fleet comprises the majority of fishing effort and carrying capacity in the ETPRA tuna fishery. From 1997 through 2001, an average of 132 international tuna purse seine vessels greater than 400 mt carrying capacity and an average of 71 vessels smaller than 400 mt carrying capacity fished in the ETPRA annually. The smaller vessels fish for tuna year-round off the coasts of Central and South America (NOAA 2004, and citations therein). There are no documented mortalities of ESA-listed species in this fishery.

Climate change impacts on ESA-listed species are possible, particularly for the long-distance migrants that spend at least part of the year in high-latitude waters that are considered more susceptible to the effects of climate change. Climate and oceanographic change could potentially affect habitat and food availability. Migration, feeding, and breeding locations influenced by ocean currents and water temperature could be impacted. Such changes could, ultimately, affect productivity of ESA-listed species (NMFS 2010, NMFS 2011). There is currently no evidence of environmental change in terms of decadal-scale climate shifts in the ETPRA since 1977. However, the time period over which data are available is too short to make meaningful inferences about decadal variability or long-term climate change (Fiedler 2002).

The activities external to SWFSC fisheries research affecting ESA-listed marine mammals in the ETPRA are likely to continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

Behavioral disturbance of small numbers of ESA-listed marine mammals from use of active acoustic equipment during SWFSC research cruises is possible, but considered minor in magnitude throughout the ETPRA, temporary in duration, and would likely have minor effects on all ESA-listed marine mammals throughout the ETPRA. Given the large number of other commercial fishing and shipping vessels that also use acoustic gear for navigation and fish finding, the contribution of SWFSC research to cumulative effects of acoustic disturbance would be minor.

There have been no collisions with ESA-listed marine mammals during any fisheries research activities conducted by SWFSC in the ETPRA and none are anticipated in the future.

The SWFSC research activities in the ETPRA have no history of taking marine mammals because they have not deployed fishing gear in the past. With the addition of a small longline survey under Alternatives 2 and 3, there is a risk of entanglement in the future. However, the SWFSC LOA application does not include any estimated takes of ESA-listed marine mammals based on the small sampling effort, rarity of the species and implementation of mitigation measures. The risk of adverse interactions between ESA-listed marine mammals is considered very small and is not expected to occur in the next five years.

The potential for prey removal or competition for resources by SWFSC sampling in the ETPRA is unlikely. The amount of plankton and fish removed is minor in magnitude, temporary, and highly localized. The highly migratory fish species that will be sampled in the proposed longline surveys are not consumed by most of the ESA-listed species, expect, perhaps, sperm whales. Given the much larger harvests of potential prey by commercial fisheries in the ETPRA, the contribution of SWFSC research to cumulative removal of prey is minor.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting ESA-listed marine mammals in the ETPRA, the contribution of the three research alternatives to cumulative effects on these species through disturbance, direct takes, and prey removal would be minor and adverse. However, research conducted by the SWFSC provides valuable information for the conservation and management of marine mammals and this contribution to cumulative effects would be beneficial for ESA-listed species in the ETPRA.

<u>Contribution of the No Research Alternative</u>

Under the No Research Alternative, NMFS would not promulgate rulemaking or issue LOAs for SWFSC fisheries research. SWFSC would continue to conduct marine mammal research in the ETPRA under MMPA section 10 directed research permits. However, it would no longer use acoustic equipment or deploy various nets and hook-and-line gear to sample marine mammal prey fields or other oceanographic parameters. This would eliminate the risk of direct impacts due to entanglement, capture, or hooking on research gear and Level B harassment from acoustic disturbance and would therefore not directly contribute to these types of adverse cumulative effects on threatened and endangered species in this region. Indirectly, however, the loss of information obtained through this research on marine mammal feeding ecology, oceanographic components of their habitat, status of prey stocks, and fisheries interactions could have adverse impacts on management decisions and analysis of long-terms trends affecting the marine ecosystem. Given the fact that the SWFSC is not the only source of this type of ecological and oceanographic data, the potential impact of this information loss for management purposes could be compensated by other research programs, at least in part. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but would likely impact long-term monitoring and management capabilities for many ESA-listed marine mammals in the ETPRA. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting ESA-listed marine mammals in the ETPRA, the contribution of the No Research Alternative to cumulative effects on ESA-listed marine mammals would be minor adverse.

5.5.2.2 Other Cetaceans

<u>External Factors in the ETPRA</u>

In addition to the ESA-listed species, there are two other species of baleen whales (Bryde's and Common minke whales) and at least 23 other odontocetes in the ETPRA (Table 3.2-4). Although subject to many of the same potential impacts noted above for ESA-listed species, interactions with the tuna purse-seine fishery has had the greatest impact on several populations of dolphins in the ETP. The offshore stocks of spotted dolphins and spinner dolphins (eastern and whitebelly) are the most frequently associated with tuna and historically set upon by purse seiners starting in the 1950s. The northeastern offshore spotted dolphin population declined roughly 80% and the spinner dolphin populations by roughly 50% as a result (Gerrodette and Forcada 2005, Perrin 2009a, 2009b). Other species taken in lesser numbers include common dolphins, striped, rough-toothed, bottlenose, and Fraser's dolphins (NOAA 2004).

A series of combined management actions, including passage of the MMPA in 1972, subsequent amendments, regulations, and mitigation measures were developed to address the serious bycatch problem. In addition to the MMPA in the U.S., are several international agreements, which are particularly important as the U.S. fleet diminished and the foreign fleet increased. The IATTC, an international fisheries management organization concerned with the long-term conservation and sustainable use of tunas, billfish, and other components of the ecosystem (e.g., dolphins, turtles, non-target finfish, and sharks) that may be affected by fishing operations in the Eastern Pacific Ocean, was established in 1949. It currently includes 21 nations and fishing entities, including the U.S. The AIDCP is closely aligned with the IATTC. The AIDCP is a legally-binding multilateral agreement established in 1999. States which have ratified or acceded to the Agreement include Belize, Costa Rica, Ecuador, El Salvador, European Union, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, U.S., Vanuatu, and Venezuela; Bolivia and Colombia are provisionally applying the Agreement. The first objective of the program is to reduce incidental dolphin mortalities in the purse-seine fishery in the eastern Pacific Ocean to levels approaching zero. AIDCP includes a Dolphin Safe Tuna Certification supported by a multilateral tracking and verification system administered by member governments (Colombia, Costa Rica, Ecuador, El Salvador, the European Union, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, the U.S., Vanuatu and Venezuela) and the treaty organization (IATTC International Dolphin Conservation Program (IDCP) website: http://www.iattc.org/IDCPENG.htm, Accessed April 19 2012).

As a result of these agreements and actions, dolphin bycatch and mortality has decreased substantially. During 2010, 93% of all sets on tuna associated with dolphins were done without mortality or serious injury to the dolphins. The total mortality of dolphins in the fishery decreased from 98,882 in 1987 to 1,170 in 2010 (IATTC IDCP website: http://www.iattc.org/IDCPENG.htm, Accessed April 19, 2012).

Climate and oceanographic change could potentially affect habitat and food availability of non-ESA-listed cetaceans in the ETPRA. Migration, feeding, and breeding locations influenced by ocean currents and water temperature could be impacted, as a result. Population effects of the El Niño Southern Oscillation (ENSO) on ETPRA dolphins have not been detected, but potential responses may include moderate changes on seasonal and ENSO time scales (Fiedler 2002). There is currently no evidence of environmental change in terms of decadal-scale climate shifts in the ETPRA since 1977. However, the time period over which data are available is too short to make meaningful inferences about decadal variability or long-term climate change (Fiedler 2002).

The activities external to SWFSC fisheries research affecting cetaceans in the ETPRA are likely to continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

Some temporary behavioral disturbance of small numbers of cetaceans from active acoustic gear is possible, as described in 4.2.4, but would likely have minor effects on cetaceans throughout the ETP. Given the large number of other vessels in the ETPRA, primarily commercial fishing and bulk carriers that use active acoustic gear, the contribution of the research alternatives to cumulative effects of acoustic disturbance would be minor adverse.

There have been no collisions with marine mammals during any fisheries research activities conducted by SWFSC in the ETPRA and, given the relatively slow speeds of research vessels and bridge observers during transits, none are anticipated in the future.

The SWFSC research activities in the ETPRA have no history of taking marine mammals under the Status Quo Alternative but there is a possibility of taking cetaceans in longline gear under the Preferred and Modified Research Alternatives. In the absence of historical takes during past research surveys, the LOA application (Appendix C) used data from commercial longline fisheries to estimate which species may be vulnerable to takes in future SWFSC research using similar gear (Table 4.3-2). This includes potential takes of one each of nine cetacean species per five year period: Risso's dolphin, short-beaked common dolphin, long-beaked common dolphin, striped dolphin, Pantropical spotted dolphin, bottlenose dolphin, false killer whale, short-finned pilot whale, and dwarf sperm whale. Given the relatively large populations of these species in the ETPRA, a take of one animal over a five-year period, if it occurred, would be considered minor in magnitude at the population level for each of these species. Given the small amount of projected sampling effort and the mitigation measures that would be implemented, the SWFSC considers the risk of these potential takes to be very small; takes of any of these species would be rare and unlikely to actually occur in the next five years.

The potential for prey removal or competition for resources by SWFSC sampling in the ETPRA is unlikely. The amount of plankton and juvenile fish removed is minimal. The highly migratory fish species that would be sampled in the proposed longline surveys may also be prey of some of the larger odontocetes, but considering the small scientific sampling effort and the extensive commercial fisheries in the area, the contribution of the research alternatives to impacts on prey availability would be minor.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non-ESA-listed cetaceans in the ETPRA, the contribution of the three research alternatives to cumulative effects on these species through disturbance, direct takes, and prey removal would be minor and adverse. However, research conducted by the SWFSC provides valuable information for the conservation and management of these species and this contribution to cumulative effects would be beneficial for non-ESA-listed cetaceans in the ETPRA.

Contribution of the No Research Alternative

Under the No Research Alternative, NMFS would not promulgate rulemaking or issue LOAs for SWFSC fisheries research. The SWFSC would continue to conduct marine mammal research in the ETPRA under MMPA section 10 directed research permits. However, it would no longer use acoustic equipment or deploy various nets and hook-and-line gear to sample marine mammal prey fields or other oceanographic parameters. This would eliminate the risk of direct impacts due to entanglement, capture, or hooking on research gear and Level B harassment from acoustic disturbance and would therefore not directly contribute to these types of adverse cumulative effects on other cetaceans in the ETPRA. Indirectly, however, the loss of information obtained through this research on marine mammal feeding ecology, oceanographic components of their habitat, status of prey stocks, and fisheries interactions could impact international management decisions and analysis of long-term trends affecting cetaceans in the ETPRA. SWFSC is responsible for monitoring and conducting research on dolphins incidentally caught in the ETPRA tuna purse-seine fishery. Some elements, but not all, of this research are covered under this Final PEA (status of prey fields, plankton studies, and oceanographic conditions supporting marine mammal habitat assessments) and would therefore be lost under the No Research Alternative. However, research on the tuna purse-seine fishery is permitted under section 10 of the MMPA and supports the U.S. delegation to the AIDCP. SWFSC is the only entity that provides dolphin monitoring and research results to the AIDCP parties, which forms the basis for management measures taken by the Parties, including setting annual dolphin mortality limits and establishing independent observer program requirements. In the absence of some of the ecological data provided by SWFSC fisheries and ecological research covered under this Final PEA, the AIDCP parties would have less information to inform their decisions on the efficacy of current management measures or whether new measures are needed, and the U.S. delegation may be unable to meet some of its obligations to the other AIDCP parties and the Secretariat (SWFSC 2010). Given the fact that the SWFSC is not the only source of this type of ecological and oceanographic data, the potential impact of this information loss for management purposes could be compensated by other research programs, at least in part.

The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual marine mammal species, but would likely impact long-term monitoring and management capabilities for cetaceans in the ETPRA. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non-ESA-listed cetaceans in the ETPRA, the contribution of the No Research Alternative to cumulative effects on these species would be minor adverse.

5.5.2.3 Other Pinnipeds

External Factors in the ETPRA

In addition to the ESA-listed Guadalupe fur seal, there are three other species of pinnipeds in the ETPRA (Table 3.2.4), including California sea lion, Northern elephant seal, and South American sea lion. Distribution in the ETPRA is limited and pinnipeds are infrequently seen during surveys of the area. Sightings of California sea lions and Northern elephant seals are usually limited to the northern end of the survey area along the coast of Baja California, Mexico, while South American sea lions are usually observed along the Peruvian coast (Jackson et al. 2004, Kinzey et al. 1999). In these respective areas, potential impacts include vessel and fishery interactions, discharges and pollution, coastal development, anthropogenic noise, and climate change, as described above for other species. Although pinnipeds have been sighted in the ETPRA, they are not known to interact regularly with tuna purse seines (NOAA 2004).

The activities external to SWFSC fisheries research that may affect pinnipeds in the ETPRA will likely continue into the foreseeable future (see Table 5.1-1). The level of impact depends on numerous factors, including the efficacy of current and proposed mitigation measures that affect pinnipeds. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

The infrequency with which pinnipeds are observed during SWFSC research likely minimizes impacts of the research activities on pinnipeds in the ETPRA. Temporary behavioral disturbance from active acoustics could affect small numbers of pinnipeds and would likely have minor effects on pinnipeds encountered in the ETPRA. Given the large number of other vessels in the ETPRA, primarily commercial fishing and bulk carriers that use active acoustic gear, the contribution of the research alternatives to cumulative effects of acoustic disturbance would be minor.

There have been no collisions with marine mammals during any fisheries research activities conducted by SWFSC in the ETPRA and, given the relatively slow speeds of research vessels and bridge observers during transits, no collisions with pinnipeds are anticipated in the future. The potential for prey removal or competition for resources with pinnipeds as a result of SWFSC sampling in the ETPRA is unlikely. The amount of plankton and juvenile fish removed is minimal. Smaller size classes of highly migratory fish species that would be sampled in the proposed longline surveys might occasionally be consumed by pinnipeds, but given the extensive commercial fisheries in the area, the contribution of the research alternatives to impacts on prey availability would be minor.

The SWFSC research activities in the ETPRA have no history of taking marine mammals under the Status Quo Alternative but there is a possibility of taking pinnipeds in longline gear under the Preferred and Modified Research Alternatives. In the absence of historic takes during past research surveys, the LOA application (Appendix C) used data from commercial longline fisheries to estimate which species may be vulnerable to takes in future SWFSC research using similar gear (Table 4.3-2). Estimated potential takes include one take per year (for a total of five over a five-year period) for California sea lions and South American sea lions. Considering the small number of longline sets that are being proposed in the area and the mitigation measures included, the SWFSC considers the risk of these potential takes to be very small; takes of these pinniped species would be rare and unlikely to actually occur in the next five years. The estimated loss of one animal per year from these species, if it occurred, would be much less than 10 percent of PBR for both species and would be considered minor in magnitude.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non-ESA-listed pinnipeds in the ETPRA, the contribution of the three research alternatives to cumulative effects on these species through disturbance, direct takes, and prey removal would be minor and adverse. However, research conducted by the SWFSC provides valuable ecological information that may be used for the conservation and management of these species and this contribution to cumulative effects would be beneficial.

Contribution of the No Research Alternative

Under the No Research Alternative, NMFS would not promulgate rulemaking or issue LOAs for SWFSC fisheries research. As described above, the SWFSC would continue to conduct directed marine mammal research in the ETPRA but would not conduct related ecological studies under the No Research Alternative. This would eliminate the risk of direct impacts due to entanglement, capture, or hooking on research gear and Level B harassment from acoustic disturbance and would therefore not directly contribute to these types of adverse cumulative effects on pinnipeds in the ETPRA. Indirectly, however, the loss of information obtained through this research on the ecology, oceanography, and fisheries of the ETPRA could impact long-term monitoring and management decisions and analysis of long-terms trends affecting the ETPRA ecosystem. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting pinnipeds in the ETPRA, the contribution of the No Research Alternative to cumulative effects on pinnipeds would be minor adverse.

5.5.3 Antarctic Research Area

Activities external to SWFSC research that may potentially affect marine mammals in the ARA include commercial fisheries, vessel traffic, ocean discharges, geophysical activities, other scientific research, military operations, conservation measures, and climate change. These activities and potential effects are summarized in Table 5.1.1 and include:

- Disturbance/behavioral changes or physical effects from anthropogenic noise
- Injury or mortality due to vessel collisions, entanglement in fishing gear, and contamination of the marine environment
- Changes in food availability due to prey removal, ecosystem change, or habitat degradation

International conservation and management entities and treaties for Southern Ocean resources were created to address actual or foreseeable adverse impacts to the region. The following are of particular relevance to marine mammals. The International Convention for the Regulation of Whaling was signed in 1946 and established the IWC for the purposes of managing whale resources (IWC website: http://www.iwcoffice.org/commission/iwcmain.htm, accessed April 17 2012). The Antarctic Treaty was signed in 1959 to ensure that Antarctica shall be forever used exclusively for peaceful purposes and that scientific investigation and cooperation continue (ATS website: http://www.ats.aq/e/ats.htm, accessed April 17 2012). The Convention for the Conservation of Antarctic Seals was signed in 1972 for the protection, scientific study, and rational use of Antarctic seals (Leaper and Miller 2011). The CCAMLR was signed in 1980 in response to concerns that an increased krill fishery could seriously affect populations of krill and the marine predators that depend on krill for food. The aim of the CCAMLR is to conserve marine life of the Southern Ocean, without excluding harvesting done in a rational manner (CCAMLR website: http://www.ccamlr.org/pu/e/gen-intro.htm, accessed April 17, 2012).

5.5.3.1 ESA-listed Species

External Factors in the ARA

The endangered marine mammal species in the ARA include sperm, humpback, blue, fin, sei, and southern right whales. Commercial whaling was the single greatest historical source of mortality for each of these species, resulting in substantial population declines through overexploitation (Perry et al. 1999).

The southern right whale was protected in 1935 (Leaper and Miller 2011). In the Southern Hemisphere, humpback whales were protected in 1963, blue whales in 1967 (Leaper and Miller 2011), fin whales in 1976, and sei whales in 1977 (Perry et al. 1999). Commercial harvests of sperm whales ended worldwide in 1986 (NMFS 2010). Over the last two decades, previous illegal whaling and under-reporting of catches by the Soviet whaling fleet have come to light. The actual takes for many stocks grossly exceeded reported harvests. For example, between 1946 and 1986, the reported catch of humpbacks in the Antarctic was 2,710, while the actual catch was 48,721. Similarly, four southern right whales were reported, yet 3,368 were actually taken (Ivashchenko et al. 2011).

After the global ban on commercial whaling, the government of Japan began operating a scientific permit whaling program beginning with the 1987/1988 season. Antarctic minke whales (eastern Indian Ocean and western South Pacific stocks) are the primary target with sample sizes proposed for full-scale research beginning in 2008/2009 of 850 whales per year; however, takes of 50 humpbacks (D and E stocks) and 50 fin whales (Indian Ocean and western South Pacific stocks) were also proposed (Leaper and Miller 2011). The most recently reported takes under these permits were 507 minkes and 1 fin whale in 2009/2010 and 171 minkes and 2 fin whales in 2010/2011; no humpbacks have yet been taken (http://www.iwcoffice.org/conservation/table_permit.htm, accessed April 17, 2012). The harvest areas (and stocks) do not overlap with the SWFSC research area.

A recent review by Leaper and Miller (2011) summarizes the threats likely to impact baleen whales in the Antarctic. The final recovery plans for sperm whales (NMFS 2010c), fin whales (NMFS 2010a) and sei whales (NMFS 2011) also include sections on Southern Hemisphere stocks and potential threats to those populations. The following derives largely from these documents and from the Final Programmatic Environmental Impact Statement (EIS) on Codified Regulations at 50 CFR Part 300 Subparts A and G Implementing Conservation and Management Measures Adopted by the CCAMLR (NMFS 2006).

In addition to scientific whaling, other noted threats include pollutants, particularly in coastal areas near to base stations and tourist destinations; noise from shipping, research, and tour ships; ship strikes; fisheries interactions; competition for resources; and climate change (Leaper and Miller 2011, NMFS 2010). To date, ship traffic in the area is still relatively low and there have been only three reported ship strikes of humpback whales in the western Antarctic Peninsula region (Jensen and Silber 2004, Leaper and Miller 2011). Fisheries interaction, including potential removal of prey resources, and climate change are likely to have the greatest impacts on marine mammals in this region.

The toothfish fishery, which primarily uses longline gear, and the krill fishery, which uses trawl gear, are the fisheries most likely to interact with marine mammals in Antarctic waters. Entanglement of marine mammals with longline gear is considered rare in CCAMLR Convention waters. Killer whales and sperm whales have been known to take toothfish off longline hooks, but there were no marine mammal entanglements during longline testing trials by the U.S. vessels (NMFS 2006). No cases of marine mammal mortalities in CCAMLR fisheries were reported in 2010 (CCAMLR 2010).

There have been no reports of whales directly interacting with the krill trawl fishery in any CCAMLR Area (NMFS 2006). However, since most baleen whales in the Antarctic feed predominately on krill, the greatest potential indirect effect of the fishery would likely be competition for food. A survey of krill and cetaceans in Area 48, which includes the ARA, by CCAMLR and the IWC in 2000 estimated that cetaceans in Area 48 consume approximately 5% (about 2.5 million mt) of the krill standing stock (Reilly et al., 2004 cited in NMFS 2006). Although some area-specific competition is possible, available information on cetacean abundance estimates, consumption rates, and the krill standing stock suggest that the krill fishery is unlikely to negatively impact cetaceans (NMFS 2006).

According to Turner et al. (2009), accelerated global warming and increased UV-B levels resulting from the ozone hole that develops in spring are the most important anthropogenic changes currently affecting the Antarctic. They note that the Antarctic marine ecosystem has been affected by climate change over the last fifty years, especially on the western side of the Antarctic Peninsula, with warming ocean temperatures and declining sea ice. A long-term decline in krill abundance was linked to the loss of winter sea ice (under which krill over-winter) and global warming (Atkinson et al. 2004). Large reductions in krill stocks could substantially impact Antarctic marine mammals that depend on krill as a primary prey.

Responses of baleen whale populations to climate change may be difficult to interpret and distinguish from lingering effects of over-exploitation, and, since whales are long-lived, effects may not be detected for some time (Turner et al. 2009). In the long term, climate change could affect the recovery rate of species that are in the early stages of recovery from whaling. Climate change impacts on baleen whales will most likely occur through changes in sea ice dynamics that alter habitat characteristics and changes in prey abundance and distribution (Turner et al. 2009 and citations therein). Prey availability could affect whale population dynamics. Leaper et al. (2006) suggest that breeding success of southern right whales off South Georgia is driven by underlying relationships with the availability of krill, which fluctuates relative to sea surface temperature anomalies. Climate change may similarly affect sperm whales through changes in habitat and food availability and, possibly, reproductive rates (NMFS 2010).

The activities external to SWFSC fisheries research affecting ESA-listed marine mammals in the ARA will likely continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

Temporary behavioral disturbance from active acoustic gear used by SWFSC research vessels could affect small numbers of ESA-listed marine mammals throughout the ARA. Given the relatively small area covered and small number of research days at sea, the contribution of the research alternatives to cumulative effects of acoustic disturbance would be minor.

There have been no historic takes, serious injuries, or mortalities of ESA-listed species during SWFSC research in the ARA due to ship strikes or entanglement in gear. Given the relatively slow speeds of research vessels, the presence of bridge observers during transits and other mitigation measures, and the small sampling effort, no takes of these species are expected in the future under any of the research alternatives.

SWFSC Antarctic Marine Living Resources (AMLR) surveys in the Antarctic monitor krill and remove a small amount of post-larval and adult krill during sampling with small-mesh midwater trawl nets (IKMT) in order to estimate krill biomass around the South Shetland Islands and South Orkney Islands. The amount of krill and other zooplankton collected during research is a minor fraction of overall biomass and would not affect the abundance or availability of prey to any marine mammals, so the impact of the removal is minor.

The SWFSC also conducts periodic (every two to three years) bottom trawl surveys in the South Orkney Islands area to monitor the recovery of several finfish that were overfished in the 1970s and 1980s. Although the importance of these fish species as marine mammal prey is unknown, the relative infrequency with which the surveys occur and the relatively small amount of fish removed over a large area make it unlikely that the surveys affect prey distribution or availability for marine mammals.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting ESA-listed whales in the ARA, the contribution of the three research alternatives to cumulative effects on these species through disturbance and prey removal would be minor and adverse. However, research conducted by the SWFSC provides valuable information for the conservation and management of marine mammals in the ARA and this contribution to cumulative effects would be beneficial

Contribution of the No Research Alternative

Under the No Research Alternative, NMFS would not promulgate rulemaking or issue LOAs for SWFSC fisheries research. The SWFSC would not directly contribute to cumulative effects on ESA-listed species in the ARA. Indirectly, however, the loss of information obtained through this research could impact management decisions and analysis of long-terms trends affecting ESA-listed species in the Antarctic. For example, SWFSC fisheries and ecosystem research surveys collect observational data on whale distribution, abundance, and behavior in the Scotia Sea. In conjunction with data collected on the abundance and distribution of krill and other species, this data has provided valuable ecological information for the conservation of many species and results of SWFSC research are regularly presented to the scientific advisory bodies to the CCAMLR. In addition, SWFSC is the primary source of scientific advice to the U.S. Commissioner and delegation to CCAMLR. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but would likely impact long-term monitoring and management capabilities for many ESA-listed marine mammals in the ARA. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting ESA-listed marine mammals in the ARA, the contribution of the No Research Alternative to cumulative effects on ESA-listed marine mammals would be minor adverse.

5.5.3.2 Other Cetaceans

External Factors in the ARA

In addition to the ESA-listed whales, minke whales and at least 16 other odontocetes occur in the ARA. Please refer to Section 3.2.2 and Appendix C for species lists and descriptions.

Antarctic minke whales of the eastern Indian Ocean and western South Pacific stocks are the primary target of Japanese scientific whaling operations. As noted above, recent takes numbered 507 and 171 minke whales during the 2009/2010 and 2010/2011 seasons, respectively (http://www.iwcoffice.org/conservation/table_permit.htm, accessed April 17 2012). Neither the harvest areas nor stocks, however, overlap with the SWFSC research area.

Similar to the ESA-listed species, other potential threats include pollutants, particularly in coastal areas near to base stations and tourist destinations; noise from shipping, research, and tour ships; ship strikes; fisheries interactions; competition for resources; and climate change (Leaper and Miller 2011). Fisheries interactions, including potential removal of prey resources, and climate change are likely to have the greatest impacts on Antarctic cetaceans.

There have been no recent reports of marine mammal mortalities in CCAMLR fisheries, but competition for prey resources apparently occurs. Killer whales (and sperm whales) depredate toothfish off longline hooks, which is more of a detriment to the fishers than to the whales. Fishers often move to other locations to avoid sperm and killer whales in order to increase catch rates (NMFS 2006).

As with the ESA-listed baleen whales, minke whales in the Antarctic feed predominately on krill, so the greatest potential indirect effect of the krill fishery would likely be competition for food. The two species of minke whales (Dwarf and Antarctic) in the Southern Ocean consume approximately two-thirds of the estimated total krill consumed by baleen whales in the Southern Ocean (NMFS 2006). As noted above, some area-specific competition is possible, yet available information on cetacean abundance estimates, consumption rates, and the krill standing stock suggest that the krill fishery is unlikely to negatively impact cetaceans (NMFS 2006).

Climate change effects described above for ESA-listed species would be similar for other cetaceans in the ARA. The most likely effects could be changes in habitat and food availability and, possibly, reproductive rates.

The activities external to SWFSC fisheries research affecting cetaceans in the ARA will likely continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

The contribution of SWFSC research to cumulative effects on other cetaceans would be the same as described above for ESA-listed marine mammals.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting cetaceans in the ARA, the contribution of the three research alternatives to cumulative effects on these species through disturbance and prey removal would be minor and adverse. However, research conducted by the SWFSC provides valuable information for the conservation and management of marine mammals and this contribution to cumulative effects would be beneficial for cetaceans in the ARA.

Contribution of the No Research Alternative

Under the No Research Alternative, NMFS would not promulgate rulemaking or issue LOAs for SWFSC fisheries research. The SWFSC would not directly contribute to cumulative effects on non-ESA-listed cetaceans in the ARA. Indirectly, however, the loss of information obtained through this research could impact management decisions and analysis of long-terms trends affecting cetaceans in the Antarctic. For example, SWFSC research surveys collect observational data on cetacean distribution, abundance, and behavior in the Scotia Sea. In conjunction with data collected on the abundance and distribution of krill and other species, this data has provided valuable ecological information for the conservation of many species and results of SWFSC research are regularly presented to the scientific advisory bodies to the CCAMLR. In addition, SWFSC is the primary source of scientific advice to the U.S. Commissioner and delegation to CCAMLR. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but would likely impact long-term monitoring and management capabilities for many cetaceans in the ARA. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting cetaceans in the ARA, the contribution of the No Research Alternative to cumulative effects on cetaceans would be minor adverse.

5.5.3.3 Other Pinnipeds

External Factors in the ARA

The nine species of pinnipeds in the ARA are listed in Section 3.2.2 and described in Appendix C. None are ESA-listed.

Large-scale hunting during the exploratory and commercial sealing periods of the 18th and 19th centuries severely depleted populations of many southern fur seal species, including the Antarctic fur seal, and larger seals, such as elephant seals (Boyd 2009, Forcada and Stanland 2009).

More recent and reasonably foreseeable potential threats to Antarctic pinniped species are similar to those outlined above for ESA-listed and other cetaceans. As with the other species, fisheries interactions and climate change are likely to have the greatest effects.

Fur seals may be both directly and indirectly impacted by the krill fishery. Since krill is a primary component of the Antarctic fur seal diet, competition with the krill fishery is possible. Depletion of krill stocks or entanglement in trawls are potential threats to fur seal populations (NMFS 2006). In 2002/2003, at least 114 Antarctic fur seals were caught in krill fishing operations in Area 48; 53 died and 61 were released alive. In the 2003/2004, 142 fur seals were observed killed and 12 released alive aboard the F/V Top Ocean, a U.S. flagged vessel. United Kingdom scientific observers aboard six of the nine vessels fishing in Subarea 48.3 (the area including South Georgia and the South Sandwich Islands) reported a minimum take of 292 fur seals (NMFS 2006). The take of Antarctic fur seals in the 2003/2004 fishing season was very small compared to an estimated population of 4,500,000 – 6,200,000 fur seals from a 1999/2000 census of South Georgia (the area of take) (NMFS 2006).

The incidental take of Antarctic fur seals in krill fishing trawls was attributed to the lack of effective mitigation measures (escape panels in the nets) and inexperienced crews new to the fishery. Experienced vessels, using effective mitigation measures, caught no seals (NMFS 2006).

The southern elephant seal is the only Antarctic pinniped species known to have toothfish in its diet. Interpreting trophic links between toothfish and elephant seals is complicated by the long distances traveled by elephant seals and the amount of time between visits ashore for breeding and molting (NMFS 2006 and citations therein).

The other Antarctic pinnipeds are ice-associated. Since fishery operations are confined to ice-free environments, direct interactions are unlikely.

The primary impacts of climate change are likely to be the same as described for ESA-listed species, including changes in abundance, quality, or stability of food resources caused by food web modifications related to changes in the physical environment (Turner et al. 2009). Loss of a stable food supply and shortage of food, rather than other habitat constraints, are more likely to affect long-term fitness. Antarctic fur seals are exposed to increasing ecosystem fluctuation caused by extreme climatic events manifest near one of the regions' most rapidly warming areas, the Antarctic Peninsula (Turner et al. 2009).

The activities external to SWFSC fisheries research affecting pinnipeds in the ARA will likely continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

The contribution of SWFSC research to cumulative effects on pinnipeds would be the same as described above for ESA-listed marine mammals and other cetaceans.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting pinnipeds in the ARA, the contribution of the three research alternatives to cumulative effects on these species through disturbance and prey removal would be minor and adverse. However, research conducted by the SWFSC provides valuable information for the conservation and management of marine mammals and this contribution to cumulative effects would be beneficial for pinnipeds in the ARA.

Contribution of the No Research Alternative

Under the No Research Alternative, NMFS would not promulgate rulemaking or issue LOAs for SWFSC fisheries research. The SWFSC would not directly contribute to cumulative effects on pinnipeds in the ARA. Indirectly, however, the loss of information obtained through this research could impact management decisions and analysis of long-terms trends affecting pinnipeds in the Antarctic. For example, SWFSC research surveys collect observational data on pinniped distribution, abundance, and behavior in the Scotia Sea. In conjunction with data collected on the abundance and distribution of krill and other species, this data has provided valuable ecological information for the conservation of many species and results of SWFSC research are regularly presented to the scientific advisory bodies to the CCAMLR. In addition, SWFSC is the primary source of scientific advice to the U.S. Commissioner and delegation to CCAMLR. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but would likely impact long-term monitoring and management capabilities for many pinnipeds in the ARA. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting pinnipeds in the ARA, the contribution of the No Research Alternative to cumulative effects on pinnipeds would be minor adverse.

5.6 CUMULATIVE EFFECTS ON BIRDS

Activities external to SWFSC fisheries research that could potentially affect birds in the CCRA, ETPRA, and ARA may include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, oil extraction, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and may include:

- Mortality from avian by-catch
- Potential for ship collisions
- Alteration or reduction of prey resources
- Loss or injury due to ingestion of or entanglement in marine debris
- Behavioral disturbance

5.6.1 California Current Research Area

External Factors in the CCRA

Seabirds in the CCRA are being affected by the cumulative effects of past and present manmade and natural factors.

Manmade factors include: mortality in longline and gill-net fisheries, ingestion of plastic debris, human use and development of nesting habitat, oil spills, attraction to and disorientation by artificial lights leading to exhausted birds landing in dangerous situations and colliding with power lines and other structures, habitat destruction, predation by non-native terrestrial mammals, nesting habitat loss and degradation from guano mining and invasive species, pollution, competition with fisheries for prey species, underwater explosions from industrial and military operations, entanglement in debris, ingestion of marine debris, vessel collisions, and hunting. Some seabird species travel long distances over the ocean and have many potentially adverse interactions with humans and their activities, such as commercial and recreational fisheries, and oil spills from transport vessels and offshore oil wells. Human activities on land can also affect them at sea or at inland nest sites, such as oil and gas exploration, coastal development and transportation, dock construction, marine pollution, and dredging, as well as agricultural and urban runoff contamination and land clearing for resource development.

Natural factors include: threats to their nesting habitat on volcanic islands, predation on adults, eggs, and young by birds and mammals, and habitat loss due to encroachment of vegetation. Natural factors such as changes in ocean currents, prey availability, and severe weather can drive population fluctuations for many species (Ainley and Hyrenbach 2007).

The factors that have affected seabirds in the CCRA in the past are likely to do so in the future. Reasonably foreseeable future actions include continuation and possible expansion of fisheries activities, military operations, oil and gas exploration and production, marine vessel traffic, ocean disposal and discharge, climate change, and ocean acidification.

The cumulative effects on seabirds in the CCRA resulting from external anthropogenic factors (past actions, present actions, and RFFAs) are considered major (for some ESA-listed species) to minor (other species).

Contribution of the Research Alternatives

No seabirds have ever been caught incidentally in SWFSC fisheries surveys and changes in availability of seabird prey resulting from SWFSC research surveys are expected to be localized and insubstantial. The contribution of SWFSC research activities to seabird collisions with vessels and loss or injury of seabirds from interactions with marine debris are expected to be minor. Discharge of contaminants from vessels used during research surveys is possible, but unlikely, and if it occurs, would be isolated in both time and location and likely small in volume. When aggregated with the impacts of past, present, and reasonably foreseeable future actions, SWFSC research activities would make a minor additive contribution to cumulative adverse effects on birds in the CCRA due to slight increases in the potential for injury or mortality, changes in food availability due to discards and removal of prey, and alterations to seabird habitat under each of the research alternatives. However, research conducted by the SWFSC provides valuable information for the conservation and management of seabirds and this contribution to cumulative effects would be beneficial.

Contribution of the No Research Alternative

The lack of research under this alternative would eliminate any direct effects on seabirds in the CCRA. It is important to note that some of the SWFSC projects that would be eliminated under this alternative include bird observers when space is available and generate a great deal of information on the abundance, distribution, and feeding behaviors of seabirds in the CCRA. The loss of this information could indirectly affect resource management decisions concerning the conservation of seabirds. Resource management authorities would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect ecological properties of the environment would become less effective. There are too many unknown variables to estimate the level of impact this lack of information would have on any particular species of seabirds but the contribution of this alternative to cumulative impacts on seabirds would likely be minor.

5.6.2 Eastern Tropical Pacific Research Area

External Factors in the ETPRA

Seabirds in the ETPRA are being affected by the same types of manmade and natural factors described above in the CCRA section, and are likely to be affected by the same types of RFFAs. When aggregated with the impacts of past, present, and reasonably foreseeable future actions, SWFSC research activities would make a minor additive contribution to cumulative adverse effects on birds in the ETPRA under each of the research alternatives. Overall cumulative effects to seabirds in the ETPRA resulting from external anthropogenic factors (past actions, present actions, and RFFAs) would be considered major for some ESA-listed species to minor for other species.

Contribution of the Research Alternatives

No seabirds have ever been caught incidentally in SWFSC fisheries surveys in the ETPRA and, although the future longline survey in the ETPRA may increase that risk, the future risk is still considered very low. Changes in the availability of seabird prey resulting from SWFSC research surveys are expected to be localized and insubstantial. When aggregated with the impacts of past, present, and reasonably foreseeable future actions, SWFSC research activities would make a minor additive contribution to cumulative adverse effects on birds in the ETPRA due to slight increases in the potential for injury or mortality and changes in food availability due to discards and removal of prey under each of the research alternatives. However, research conducted by the SWFSC provides valuable information for the conservation and management of seabirds in the ETPRA and this contribution to cumulative effects would be beneficial.

Contribution of the No Research Alternative

For the same reasons as described under the CCRA section, the indirect contribution of the No Research Alternative to cumulative impacts on seabirds would be minor and adverse through the loss of information used for the management and conservation of seabirds.

5.6.3 Antarctic Research Area

External Factors in the ARA

Seabirds in the ARA are being affected by the same types of manmade and natural factors described above in the CCRA section, and are likely to be affected by the same RFFAs. The cumulative effects on seabirds in the ETPRA resulting from external anthropogenic factors (past actions, present actions, and RFFAs) are considered major (for some albatross and penguin species) to minor (other species).

Contribution of the Research Alternatives

No seabirds have ever been caught incidentally in SWFSC fisheries surveys in the ARA and are not likely to be caught in the future. The contribution of SWFSC research activities to seabird collisions with vessels and loss or injury of seabirds from interactions with marine debris are expected to be minor. Discharge of contaminants from vessels used during research surveys is possible, but unlikely, and if it occurs, would be isolated in both time and location and likely small in volume. When aggregated with the impacts of past, present, and reasonably foreseeable future actions, SWFSC research activities would make a minor additive contribution to cumulative adverse effects on birds in the ARA due to slight increases in the potential for injury or mortality and changes in food availability due to discards and removal of prey under each of the research alternatives. However, research conducted by the SWFSC provides valuable information for the conservation and management of seabirds in the ARA, especially for penguins and albatross, and this contribution to cumulative effects would be beneficial.

Contribution of the No Research Alternative

For the same reasons as described under the CCRA section, the indirect contribution of the No Research Alternative to cumulative impacts on seabirds would be minor and adverse through the loss of information used for the management and conservation of seabirds, especially for penguins and albatross.

5.7 CUMULATIVE EFFECTS ON SEA TURTLES

Activities external to SWFSC fisheries research that could potentially affect sea turtles in the CCRA, ETPRA, and ARA may include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, oil extraction, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and may include:

- Loss or injury of turtles resulting from ship strikes
- Loss or injury resulting from turtle bycatch or entanglement in fishing gear
- Alteration or reduction of prey resources
- Loss or injury due to ingestion of or entanglement in marine debris
- Behavioral disturbance

5.7.1 California Current and Eastern Tropical Pacific Research Areas

External factors in the CCRA and ETPRA

Sea turtles are susceptible to impacts resulting from natural and anthropogenic factors, both on land and in the water (Table 5.1-1). Effects on land involve habitat degradation, injury, and mortality through numerous mechanisms: beach erosion, beach armoring and nourishment, artificial lighting, increases in human presence, beach cleaning, recreational beach equipment, beach driving, coastal construction, fishing piers, disturbance of dunes and beach vegetation, and poaching. Increases in human presence near nesting beaches have led to the introduction of exotic fire ants, dogs, raccoons, and armadillos, all of which may feed on turtle eggs. Adverse impacts to sea turtles also involve habitat degradation, injury, and mortality through numerous mechanisms: oil and gas exploration, coastal development and transportation, dock construction, marine pollution, dredging, underwater explosions, offshore artificial lighting, entanglement in debris, ingestion of marine debris, fishery interactions, boat collisions, and poaching.

Threats to sea turtles in the CCRA and ETPRA include incidental capture, injury, and mortality during commercial fishing operations. This conservation issue has been the subject of numerous conservation engineering studies. The implementation of turtle excluder devices and time/area restrictions in commercial trawl fisheries has reduced the level of captures and mortality in trawl fisheries. Use of circle hooks instead of ‘J’ hooks and finfish bait instead of squid bait in commercial pelagic longline fisheries has also reduced sea turtle mortalities (Watson et al. 2005). However, capture and entanglement in several types of fishing gear continues to be a conservation concern, especially since all sea turtle species are listed as threatened or endangered under the ESA (NMFS and USFWS 1992 and 2008c).

Multiple past and present actions have affected sea turtles in the CCRA and ETPRA, and many of these impact producing factors are likely to continue for the foreseeable future. All species of sea turtles that occur in the SWFSC research areas are threatened or endangered, and have therefore been subject to major population-level cumulative effects.

Contribution of the Research Alternatives

Fisheries research activities conducted and funded by the SWFSC have had no recorded interactions with olive ridley, green, loggerhead, or hawksbill sea turtles, and the contributions of proposed fisheries research to the cumulative effects on these species are considered minor under each of the research alternatives. In the CCRA, there has been one incident of sea turtle entanglement resulting from SWFSC research using a standard Nordic 264 trawl configured for surface fishing. In that instance, the turtle was released alive. There have been no reported interactions resulting in sea turtle mortality. Likewise, contributions of the research alternatives to ship strikes, changes in availability of prey for sea turtles, loss or injury due to ingestion of or entanglement in marine debris, and alterations to sea turtle habitat are expected to be minor. In addition, a number of SWFSC fisheries research projects have been oriented toward reducing turtle bycatch in fisheries and studying habitat needs of sea turtles and therefore contribute to conservation efforts for these species. Thus, SWFSC fisheries research activities would result in both potentially adverse and potentially beneficial contributions to cumulative impacts on sea turtles in the CCRA and ETPRA. When aggregated with the impacts of past, present, and reasonably foreseeable future actions, the overall contribution of SWFSC research activities to cumulative effects on sea turtles in the CCRA and ETPRA would be minor and potentially adverse under each of the research alternatives.

Contribution of the No Research Alternative

The No Research Alternative would eliminate any direct impacts to sea turtles that could potentially occur under the research alternatives. However, it is important to note that several of the SWFSC projects that would be eliminated under this Alternative generate data concerning the distribution of sea turtles and their habitat quality in the CCRA and ETPRA. These data are used to inform science-based decisions related to the management of sea turtles. Under the No Research Alternative, the loss of information currently provided by SWFSC research activities would have a minor to moderate contribution to adverse cumulative impacts to sea turtles in the CCRA and ETPRA through indirect effects on management decisions important to the conservation and recovery of these species.

5.8 CUMULATIVE EFFECTS ON INVERTEBRATES

Activities external to SWFSC fisheries research that could potentially affect invertebrates in the CCRA, ETPRA, and ARA may include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, oil extraction, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and may include:

- Loss or displacement due to habitat disturbance
- Removal of individuals and biomass
- Bioaccumulation of contaminants
- Disruption due to changes in water temperature resulting from climate change
- Decreased calcification due to ocean acidification

5.8.1 All SWFSC Research Areas

External factors in the CCRA, ETPRA, and ARA

Marine invertebrates continue to be susceptible to natural and anthropogenic effects including exploitation through commercial and recreational fishing, habitat degradation and disturbance, pollution, competition with invasive species, and climate change. Because marine invertebrates do not regulate their body temperature, changes in water temperature may affect the distribution of certain species as well as growth rates, reproductive ability and survival (Harley et al. 2006). In addition, ocean acidification is expected to have adverse effects on invertebrate species that form calcium carbonate shells or exoskeletons.

Degradation of invertebrate habitat can occur as a result of commercial and recreational fisheries that involve gear coming into contact with the sea floor (See Section 4.2.7.3). Other sources of habitat disruption identified in the RFFAs (Table 5.1-1) include ocean dredging, waste disposal, and offshore development projects. In addition, pollution can adversely affect the quality of water and benthic habitats upon which invertebrates depend. Effects of pollution may include decreased foraging ability and reproductive success and increased mortality (Milligan et al. 2009). However, these effects are expected to be localized to small geographic areas.

Overexploitation of undersized or immature individuals can have serious implications for the sustainability of stocks, and the overall body size of individuals in a fished population may also change with intense fishing pressure on a single size (Donaldson et al. 2010). Some commercially valuable species of invertebrates (e.g., abalone) have had population declines in the past due to overharvest.

Contribution of the Research Alternatives

SWFSC research surveys remove small numbers of invertebrates from all three research areas, primarily plankton, pelagic jellyfish and squid. Mortality resulting from SWFSC fisheries research would make minor contributions under each of the research alternatives to adverse cumulative effects on invertebrates of mortality from commercial fishing and dredging. . Because the SWFSC does not use bottom-trawl gear in the CCRA and ETPRA, SWFSC research would not contribute to benthic habitat disturbance in those areas. In the ARA, SWFSC research activities would make a minor additive contribution to adverse cumulative effects on benthic invertebrate habitat (section 4.2.7.3). The contributions of SWFSC research activities to habitat contamination, climate change, and ocean acidification are expected to be insubstantial. SWFSC fisheries research would contribute to future management decisions related to invertebrate populations in the CCRA and ARA, where commercial fisheries target market squid and krill respectively. There are no direct links between SWFSC research in the ETPRA and management of any invertebrate species in that area. When aggregated with the impacts of past, present, and reasonably foreseeable future actions, the direct contribution of SWFSC research activities to cumulative effects on invertebrates would be minor and potentially adverse under each of the research alternatives. However, research conducted by the SWFSC on invertebrates in the CCRA and ARA contributes to sustainable management of certain species and this contribution to cumulative effects would be beneficial.

Contribution of the No Research Alternative

The No Research Alternative would eliminate any direct impacts to invertebrates that could potentially occur under the research alternatives. However, increased adverse effects could result indirectly from a loss of scientific information necessary for sustainable fisheries management and conservation of invertebrates and their habitats. Data from SWFSC research activities are used to inform science-based decisions related to the management of commercially-fished invertebrates in the CCRA and ARA. Without the input of SWFSC data, management authorities would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect ecological properties of the environment would soon become obsolete. Resource management agencies would have to adequately compensate for this loss of information through changes in management scenarios based on greater uncertainty. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but would likely impact long-term monitoring and management capabilities for commercially important invertebrates in the CCRA and ARA. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting invertebrates in the CCRA and ARA, the contribution of the No Research Alternative to cumulative effects on invertebrates would be minor to moderate. Because there is no direct connection between SWFSC research and managed invertebrates in the ETPRA, there would be no contribution to cumulative effects in the ETPRA under this alternative.

5.9 CUMULATIVE EFFECTS ON THE SOCIAL AND ECONOMIC ENVIRONMENT

Activities external to SWFSC fisheries research that could potentially affect the social and economic environment in the CCRA, ETPRA, and ARA may include commercial and recreational fisheries, shipping, coastal development, oil extraction, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and may include:

- Provision of jobs and economic opportunity
- Changes in commercial fishing opportunities
- Economic costs of changes in resource availability due to climate change and ocean acidification

5.9.1 California Current Research Area

External factors in the CCRA

This section describes the contribution of SWFSC research activities to cumulative effects on the social and economic environment from past, present, and reasonably foreseeable future actions. The cumulative effects of fisheries research and management associated with the CCRA are closely related to socioeconomic conditions in Washington, Oregon, and California. Overall, California’s economy had a gross state product of about $1.9 trillion in 2010, characterized by great diversity among economic sectors

(U.S. Department of Commerce 2010). Potential future socioeconomic cumulative effects from developments in non-fishing industries, such as liquid natural gas terminals, oil extraction, shipping commerce, or climate change cannot be feasibly estimated with available data, but would be expected to dominate the economy in the future.

In regard to fishing opportunity, cumulative fishing and non-fishing industry actions would be more noticeable in coastal communities. Specific fisheries management decisions, to which the SWFSC research program contributes, could also have an effect over time. Reductions in certain stocks as a result of ocean ecosystem changes, or overfishing, which results in commercial or recreational area closures, would result in noticeable changes in the socioeconomic status of communities.

RFFAs that could contribute to cumulative effects to the social and economic environment include updates to species take reduction plans, and fishery management measures. Species take reduction plans could include measures that would lead to increased costs for fishermen through required gear modifications. These plans could also call for time and/or area closures that could affect fishing fleet locations.

Contribution of the Research Alternatives

The fundamental purpose of fisheries management is to monitor and counteract the contribution of commercial and sport fishing to the adverse cumulative effects on fish stocks from past, present, and reasonably foreseeable actions. SWFSC research is one of the most effective mechanisms to monitor the status of fish stocks and changes in the marine environment, providing substantial beneficial contributions to cumulative effects through scientific input to fishery management and other environmental decision-making processes. Continuation of this research would provide consistent data to allow evaluation of fish stock trends and the effects of actions not related to fishing.

In all research alternatives, at-sea and laboratory research, and cooperative fisheries management activities that are currently directed by SWFSC would continue. This would help promote sustainable fish populations and have substantial benefits for local economies dependent on stable fishing opportunities. Long-term sustainable catches would be promoted, increasing stability in the fishing communities and reducing boom and bust cycles related to over-exploitation of target species.

In addition, research results that identify effects not related to commercial or recreational fishing that could threaten species recoveries and sustainable yield levels would be identified in sufficient time to take corrective action before population level effects would be noticed by fishers in the form of reduced abundance and lower catches. The cumulative effect to the social and economic environment of U.S. West Coast fisheries as a result of Alternatives 1 and 2 would be beneficial and moderate in magnitude. Mitigation measures in Alternative 3 that reduce the ability of the SWFSC to sample commercial fish and invertebrate stocks in certain places and times could represent a slightly reduced benefit, as at-sea sampling operations would be reduced from the current level of comprehensiveness.

The socioeconomic effects of non-fishing industry actions are likely to dominate any cumulative effects on the socioeconomic environment of the CCRA. The research alternatives would contribute moderate (beneficial) effects to the cumulative effects because they SWFSC research provides a substantial portion of the information needed to determine if fisheries management actions are successful, and therefore balance the needs for stock recovery and sustainable catch quotas that minimize impacts to fishing communities. The at-sea surveys also provide measures to detect the result of cumulative changes contributed by non-fishing industries and climate change. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting the socioeconomic environment in the CCRA, the contribution of the research alternatives to cumulative effects on the socioeconomic environment would be moderate and beneficial in that it reduces the potential for negative cumulative effects on commercial and recreational fisheries.

Contribution of the No Research Alternative

Under the No Research Alternative, NMFS would not promulgate rulemaking or issue LOAs for SWFSC fisheries research. SWFSC would not contribute to the information base needed for sustainable fisheries management. Fisheries research activities conducted by state and private organizations are not likely to be sufficient to identify trends in target fish stocks and set sustainable fishery harvest limits without the contribution from the SWFSC. Some major commercial species would likely receive attention from state and private research efforts, so potential adverse effects would not likely be uniform across the fishing communities. Some fishers that target these major species may continue to benefit from sustainable fisheries management, but others may be affected by lack of information on their target species. Lack of consistent data input into the fisheries management process would have moderate adverse effects on the quality of the management analyses, and subsequently to the value of the management process. Elimination of at-sea operations would reduce science-based input into fisheries management decisions, which would increase the potential for negative cumulative effects on commercial fisheries.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting the socioeconomic environment in the CCRA, the No Research Alternative would contribute a moderate adverse effect to the cumulative effects on the socioeconomic environment because at-sea research efforts of the SWFSC that could detect and anticipate cumulative effects on fisheries resources, which are important for fisheries management decisions that strongly influence the socioeconomic conditions of fishing communities, would not be conducted.

5.9.2 Eastern Tropical Pacific Research Area

External Factors in the ETPRA

RFFAs associated with both fishing and non-fishing industries, and climate change, have the potential to affect international economic dynamics, in a region extending from Mexico to Peru. The SWFSC has only limited interaction with coastal communities associated with the ETPRA, and few at-sea missions there.

Contribution of the Research Alternatives

Alternative 1 retains the same level of SWFSC at-sea research, and Alternatives 2 and 3 add a new longline survey for HMS. SWFSC research in the ETP contributes to an understanding of this international ecosystem. International fishing and non-fishing activity and practices in the vast area of the ETPRA contribute to cumulative fisheries outcomes and management in many countries. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting the socioeconomic environment in the ETPRA, the research alternatives add a minor beneficial contribution to socioeconomic cumulative effects because they are not directly related to fisheries management decisions other than to monitor the effectiveness of conservation measures to protect dolphins from bycatch in the tuna fisheries.

Contribution of the No Research Alternative

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting the socioeconomic environment in the ETPRA, the No Research Alternative, with the suspension of at-sea research in the ETP, would have a minor adverse contribution to socioeconomic cumulative effects in the ETPRA because the lack of information from research could cause fisheries management decisions to become more conservative (lower fishing quotas) in order to compensate for higher uncertainty about the status of marine mammal stocks associated with the fisheries.

5.9.3 Antarctic Research Area

External Factors in the ARA

RFFAs associated with both fishing and non-fishing industries, and climate change, have the potential to affect international socioeconomic dynamics. The SWFSC has only limited interaction with coastal communities associated with Antarctica, and few at-sea missions there. The Antarctic area is distinguished by treaty agreements that establish cooperative research, although the U.S. provides the bulk of information about the Scotia Sea region of the Southern Ocean (the ARA).

Contribution of the Research Alternatives

All the research alternatives retain the same level of SWFSC at-sea research, which have limited interaction with ports in South America and Antarctic field stations. SWFSC research in the Antarctic area contributes to an understanding of the Southern Ocean ecosystem, which supports many international economic ventures. International fishing and non-fishing activity and practices in the vast area of the ARA contribute to cumulative fisheries outcomes and management in many countries. The research conducted by the SWFSC is an important component of fisheries management decisions made by CCAMLR, especially with the economically important krill fisheries. When aggregated with other past, present, and reasonably foreseeable future activities, the research alternatives would add a moderate beneficial contribution to socioeconomic cumulative effects that would be dominated by international fisheries and tourist industry elements.

Contribution of the No Research Alternative

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting the socioeconomic environment in the ARA, the No Research Alternative, which would eliminate at-sea fisheries and ecosystem research in the Antarctic region, would have moderate adverse contributions to the cumulative effects on socioeconomic conditions in the area due to the lack of scientific data in the ARA used to support fishery management and conservation decisions. The increased uncertainty about the status of krill stocks could cause reductions in harvest guidelines for the krill fisheries. Finfish fisheries that have been closed since 1990 may also remain closed due to uncertainty about the recovery of overfished species.

APPLICABLE LAWS CHAPTER 6

6.1 CALIFORNIA ENVIRONMENTAL QUALITY ACT

The California Environmental Quality Act (CEQA) requires public agencies to disclose to the public the environmental implications of proposed actions. It also requires mitigations for adverse environmental effects. Guidelines for Implementation of the CEQA (CCR Title 14, Section 15000), provides compliance procedures for agencies. In addition to addressing the National Environmental Policy Act (NEPA), this document contains an analysis of a proposed action and alternatives that is adequate for compliance with the laws and policies under the CEQA.

6.2 THE MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

In 1976, Congress passed the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801, *et seq*.). This law authorizes the United States (U.S.) to manage its fishery resources in an area extending from a state's territorial sea (generally extending from 3 miles [mi.] [4.8 kilometers (km.)] from shore out to 200 mi. [320 km.]). This area is termed the Exclusive Economic Zone (EEZ). The MSA was updated in 2006, and is known as the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act.

Two of the main purposes of the MSA are to promote domestic commercial and recreational fishing under sound conservation and management principles, and to provide for fishery management plans (FMPs). The FMPs are intended to achieve and maintain, on a continuing basis, the optimum yield from each fishery. The MSA standards require that FMPs contain certain conservation and management measures. The standards include measures necessary to prevent overfishing; rebuilding overfished stocks; ensuring conservation; facilitating long-term protection of Essential Fish Habitat (EFH); and realizing the full potential of the nation's fishery resources. Furthermore, the MSA also declares that the National Fishery Conservation and Management Program must utilize the best scientific information available; involves, and is responsive to the needs of interested and affected states and citizens; considers efficiency; and draws upon federal, state, and academic capabilities in carrying out research, administration, management, and enforcement.

Some stocks of fish been substantially reduced in number. They could be severely affected by (a) increased fishing pressure; (b) inadequacy of fishery resource conservation and management practices and controls; or, (c) direct and indirect habitat losses which have resulted in a diminished capacity to support existing fishing levels.

The resource and research surveys conducted by the SWFSC are designed to meet the requirements of the MSA by providing the best scientific information available to fishery conservation and management scientists and managers. This supports a management program that is able to respond to changing ecosystem conditions, and manages risk by developing science-based decision tools.

The U.S. Commission on Ocean Policy has identified the need for more holistic assessments of the status of marine ecosystems. The President's Ocean Action Plan has endorsed the concept of marine Ecosystem-Based Management. Sustained ecosystem monitoring programs are essential for tracking the health of marine ecosystems as part of this overall approach. The individual SWFSC surveys comprise a broader ecosystem monitoring program that meets this emerging critical need.

The EFH provisions of the MSA require the National Marine Fisheries Service (NMFS) to provide recommendations to federal and state agencies for conserving and enhancing EFH, and for any actions that may adversely impact EFH. EFH is defined as "…those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity…" Federal agencies must consult with NMFS and assess the effects of their actions on EFH. There is no separate permit or authorization process; EFH consultation is typically addressed during the NEPA process and incorporated into other permits.

On April 23, 2013, SWFSC requested concurrence from the NMFS West Coast Regional Office (WCRO) on its determination that minimal adverse effects would result to EFH as a result of proposed fisheries research conducted by SWFSC in the California Current and the Eastern Tropical Pacific Research Areas. These areas include EFH for Pacific coast groundfish, coastal pelagic species, Pacific coast salmon and highly migratory species. On April 24, 2014, the WCRO provided its concurrence with the SWFSC determination that proposed research will result in impacts to EFH that are no more than minimal and temporary in nature.

The proposed action meets the MSA's definition of scientific research activity conducted by a scientific research vessel and is therefore exempt from some requirements of the MSA. Some of the research projects do not alter the nature of commercial fishing activity, as specified by FMP regulations but merely involve scientific data collection from the catch. Other projects involve modifications to the methods or locations of the commercial fishing efforts, which then require experimental fishing permits under the MSA. Section 404 of the MSA requires the Secretary of Commerce to initiate and maintain, in cooperation with the Fishery Management Councils, a comprehensive program of fishery research to carry out and further the purposes, policy, and provisions of the MSA.

1996 amendments to the MSA require assessment, specification, and description of the effects of conservation and management measures on participants in fisheries, and on fishing communities:

> *Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.*

The Sustainable Fisheries Act of 1996 is also an amendment to the MSA. Sections 103 and 104 clarify issues surrounding highly migratory fish, and the international treaties that govern fisheries. Among the topics covered by these sections are Atlantic and Pacific fishing in international waters; fishing in the Bering Sea, shared with Russia; and congressional rules setting time limits on approval of international fishing treaties. Sections 116 to 406 of the Sustainable Fisheries Act detail the research necessary to implement the act. These sections specify the agencies responsible for research and the nature of the research to be conducted in each of several specific fishing areas, including the Pacific Ocean.

6.3 MARINE MAMMAL PROTECTION ACT

The Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. 1361 *et seq*.), as amended, prohibits the "take" [15] of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S. The primary management objective of the MMPA is to maintain the health and stability of the marine ecosystem, with a goal of obtaining an optimum sustainable population of marine mammals within the carrying capacity of the habitat. The MMPA is intended to work in concert with the provisions of the Endangered Species Act (ESA). The secretary is required to give full consideration to all factors regarding regulations applicable to the takeof marine mammals, including the conservation, development, and utilization of fishery resources, and the economic and technological feasibility of implementing the regulations.

[15] The MMPA defines take as: "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal." Harassment means any act of pursuit, torment, or annoyance which, 1) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A Harassment); or 2) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B Harassment).

Section 101(a)(5)(A-D) of the MMPA provides a mechanism for allowing, upon request, the "incidental," but not intentional, taking, of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing or directed research on marine mammals) within a specified geographic region. The NMFS Office of Protected Resources (OPR) processes applications for incidental takes of small numbers of marine mammals. Authorization for incidental takes may be granted if NMFS finds a negligible impact on the species or stock(s), and if the methods, mitigation, monitoring and reporting for takes are permissible.

The purpose of issuing incidental take authorizations is to provide an exemption to the take prohibition in the MMPA, and to ensure that the action complies with the MMPA and NMFS implementing regulations. ITAs may be issued as either: (1) regulations and associated Letters of Authorization (LOAs) under Section 101(a)(5)(A) of the MMPA; or (2) Incidental Harassment Authorizations (IHAs) under Section 101(a)(5)(D) of the MMPA. An IHA can only be issued when there is no potential for serious injury and/or mortality or where any such potential can be negated through required mitigation measures. Pursuant to Section 101(a)(5)(A) of the MMPA, NMFS, upon application from the SWFSC, plans to propose regulations to govern the unintentional taking of marine mammals, by harassment, incidental to the proposed fisheries research activities by the SWFSC in the Pacific and Southern Oceans from 2015 through 2019. The issuance of MMPA incidental take regulations and associated LOAs to the SWFSC is a federal action, thereby requiring NMFS to analyze the effects of the action on the human environment pursuant to the NEPA and NMFS NEPA procedures.

After an application is submitted, the NMFS OPR may authorize incidental takes of marine mammals through either a one-year IHA or LOAs, which is a rulemaking process that can cover activities for up to five years. The SWFSC has applied for rulemaking for the small number of incidental takes of marine mammals that could occur during their fisheries research surveys from 2015 for a period of up to five years. This Final PEA provides informational support for that LOA application and provides NEPA compliance for the authorization.

The International Dolphin Conservation Program Act (IDCPA) is a 1997 amendment to the U.S. MMPA. The Act addresses and codifies the obligations of the U.S. under the International Dolphin Conservation Program, a legally binding instrument for dolphin conservation and ecosystem management in the eastern tropical Pacific Ocean. The IDCPA directed NMFS to conduct studies to determine whether the intentional deployment on or encirclement of dolphins with purse seine nets is having a significant adverse impact on any depleted dolphin stock in the Eastern Tropical Pacific (ETP) Ocean. The observational research on marine mammal distribution and abundance conducted by the SWFSC in the ETPRA, included in this Final PEA, provides a portion of the scientific data required under the IDCPA and helps meet U.S. obligations under the Agreement.

6.4 ENDANGERED SPECIES ACT

The Endangered Species Act (ESA) of 1973 as amended (16 U.S.C. 1531, *et seq.*), provides for the conservation of endangered and threatened species of fish, wildlife, and plants. The statute is administered jointly by NMFS and the U.S. Fish and Wildlife Service (USFWS), with some exceptions - NMFS oversees marine mammal species, marine and anadromous fish species, and marine plant species; and the USFWS oversees walrus, sea otter, seabird species, and terrestrial and freshwater wildlife and plant species.

The listing of a species as threatened or endangered is based on the biological health of that species. Threatened species are those likely to become endangered in the foreseeable future (16 U.S.C. 1532[20]). Endangered species are those in danger of becoming extinct throughout all or a significant portion of their range (16 U.S.C. 1532[20]). Species can be listed as endangered without first being listed as threatened.

In addition to listing species under the ESA, the appropriate expert agency (NMFS or USFWS) must designate critical habitat of the newly listed species within a year of its listing to the "maximum extent prudent and determinable" (16 U.S.C. 1533[b] [1] [A]). The ESA defines critical habitat as those specific areas that are essential to the conservation of a listed species and that may be in need of special consideration. Federal agencies are prohibited from undertaking actions that destroy or adversely modify designated critical habitat. Some species, primarily cetaceans (whales), which were listed in 1969 under the Endangered Species Conservation Act and carried forward as endangered under the ESA, have not received critical habitat designations.

Federal agencies have an affirmative mandate to conserve listed species. An assurance of this is that federal actions, activities, or authorizations must be in compliance with the provisions of the ESA. Section 7 of the ESA provides a mechanism for consultation by the federal action agency with the appropriate expert agency. Informal consultations are conducted for federal actions that have no adverse effects on the listed species and typically result in letters of concurrence from the expert agency. In cases where a proposed action may affect listed species or critical habitat, the action agency prepares a biological assessment to determine if a proposed action would adversely affect listed species or modify critical habitat. The biological assessment contains an analysis based on biological studies of the likely effects of the action on the species or habitat. The expert agency either concurs with the assessment or provides its own analysis to continue the consultation.

If the action agency or expert agency concludes that a proposed action may have adverse effects on a listed species, including take[16] of any listed species, they must enter formal consultations under section 7 of the ESA. The expert agency must then write a Biological Opinion (BiOp) that determines whether a proposed action places the listed species in jeopardy of extinction or adversely modifies its critical habitat. If the BiOp concludes the proposed (or ongoing) action will cause jeopardy to the species or adversely modify its critical habitat, it must also include reasonable and prudent alternatives that would modify the action so it no longer poses jeopardy to the listed species. These reasonable and prudent alternatives must be incorporated into the federal action if it is to proceed. Regardless of whether the BiOp reaches a jeopardy or no jeopardy conclusion, it often contains a series of mandatory and/or recommended management measures the action agency must implement to further reduce the negative impacts to the listed species and critical habitat (50 CFR 402.24[j]). If a proposed action would likely involve the taking of any listed species, the expert agency may append an incidental take statement to the BiOp to authorize the amount of take that is expected to occur from normal promulgation of the action. The SWFSC used the Draft PEA to initiate section 7 consultation on the proposed action with the Protected Resource Offices of both NMFS (formal consultation described below) and USFWS (informal consultation) due to the SWFSC finding of "not likely to adversely affect" species under USFWS jurisdiction.

The section 7 consultation with NMFS and resulting BiOp covers three related actions taken by NMFS in relation to SWFSC research activities considered together as one proposed action. (1) On November 13, 2014, the West Coast Regional Office (WCR) received a formal ESA consultation initiation request from the SWFSC regarding the research activities described in the DPEA that may result in incidental take of species protected by the ESA and MMPA. On December 9, 2014, the WCR notified the SWFSC that the request had been reviewed and accepted as complete, and that consultation had been initiated. (2) On March 23, 2015, the WCR received an ESA consultation initiation request from the OPR regarding the proposed issuance of the MMPA LOA, as published in the Federal Register on February 13, 2015. On March 26, 2015, the WCR notified the OPR that the request had been reviewed and accepted as complete, and that consultation had been initiated. (3) In December 2014, the SWFSC submitted a draft ESA section 10 research permit application for directed capture of ESA-listed salmonids in pelagic survey trawls off the U.S. west coast to the WCR PRD Permits Office in Portland, Oregon. On April 8, 2015,

[16] The ESA defines "take" as: to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct." (16 U.S.C. 1538[a][1][B])

NMFS (WCR) published a notice of receipt for proposed ESA section 10 permit #19320 (80 FR 18820), effectively initiating consultation under the ESA on that date.

The BiOp considered the following possible impacts of the proposed action on ESA-listed species and designated critical habitats from SWFSC research activities: (1) capture or entanglement in gear used for biological or oceanographic sampling (both incidental and directed); (2) vessel collision; (3) exposure to noise from use of oceanographic equipment and vessels that may produce sound levels that can produce injury, disrupt behavior, or produce harassment; and (4) potential reductions in prey through removals from survey sampling. The BiOp concluded that the proposed action is not likely to jeopardize the continued existence of the following species expected to be incidentally or directed captured or entangled in research survey gear: leatherback sea turtle; North Pacific loggerhead sea turtle; olive ridley sea turtle; green sea turtle; Southern Pacific eulachon; Eastern Pacific scalloped hammerhead shark; Sacramento River winter Chinook; Central Valley spring Chinook; California coastal Chinook; Snake River fall Chinook; Snake River spring/summer Chinook; Lower Columbia River Chinook; Upper Willamette River Chinook; Upper Columbia River spring Chinook; Puget Sound Chinook; Hood Canal summer run Chum; Columbia River Chum; Central California coastal coho; S. Oregon/N. California coastal coho; Oregon Coast coho; and Lower Columbia River coho; Snake River sockeye; Ozette Lake sockeye; Southern California steelhead; South-Central California steelhead; Central California Coast steelhead; California Central Valley steelhead; Northern California steelhead; Upper Columbia River steelhead; Snake River Basin steelhead; Lower Columbia River steelhead; Upper Willamette River steelhead; Middle Columbia River steelhead; or Puget Sound steelhead. Critical habitat has been designated or proposed for many of these species; including most ESA-listed salmonids. However, the proposed action occurs exclusively in the coastal marine environment outside the boundaries of designated critical habitats for salmonids, Southern Pacific eulachon, and Southern Resident killer whales.

The BiOp concluded that the proposed action is not likely to adversely affect the following species through any of the potential impacts considered: blue whales; fin whales; humpback whales; sei whales; sperm whales; Southern Resident killer whales; Western North Pacific gray whales; Guadalupe fur seals; North Pacific right whales; Southern right whales; vaquita; green sturgeon (southern DPS); yelloweye rockfish (Puget Sound/Georgia Basin DPS); boccacio (Puget Sound/Georgia Basin DPS); canary rockfish (Puget Sound/Georgia Basin DPS); totoaba; white abalone; or black abalone. The BiOp also concluded that the proposed action is not likely to adversely affect any designated critical habitats for ESA-listed species, including Steller sea lions, green sturgeon, and leatherback sea turtles.

Section 4(f) of the ESA directs NMFS to develop and implement recovery plans for threatened and endangered species, unless such a plan would not promote conservation of the species. According to the statute, these plans must incorporate, at a minimum:

- a description of site-specific management actions necessary to achieve recovery of the species
- objective, measurable criteria which, when met, would result in a determination that the species be removed from the list
- estimates of the time and costs required to achieve the plan's goal

NMFS Program on Cooperative Conservation with States (section 6 of the ESA) was developed to assist states that have a cooperative agreement with NMFS in developing and implementing their conservation program for species listed in that agreement, including providing funding for management, research and monitoring that has a direct conservation benefit to the species. Conservation actions may also be carried out by federal agencies as part of their obligations under section 7(a)(1) of the ESA, or as a means to minimize activities that adversely affect a species as part of an interagency consultation. States, local agencies and private entities may conduct conservation actions as a means to minimize or mitigate "incidental take" of species as part of a Conservation Plan under section 10 of the ESA.

In order to meet these requirements and to support recovery plan development, the SWFSC conducts research aimed at determining recovery criteria and assessing threats that may potentially impede the recovery of threatened and endangered species. In addition, these activities enable NMFS, state and local agencies, and private entities to fulfill the conservation requirements outlined within the ESA.

6.5 MIGRATORY BIRD TREATY ACT

The Migratory Bird Treaty Act (MBTA) protects approximately 836 species of migratory bird species from any attempt at hunting, pursuing, wounding, killing, possessing, or transporting any migratory bird, nest, egg, or part thereof, unless permitted by regulations (i.e. for hunting and subsistence activities). Additional protection is allotted under the Bald and Golden Eagle Protection Act for the identified species. Compliance with the MBTA does not require a permit or authorization; however, the USFWS often requests that other agencies incorporate MBTA mitigation measures as stipulations in their permits. In addition, a recently signed Memorandum of Understanding (MOU) between NMFS and USFWS focuses on the means and intent to avoid and minimize, to the extent practicable, adverse impacts on migratory birds through enhanced interagency collaboration. In compliance with the MOU, the SWFSC has identified and evaluated the impacts of the proposed actions on migratory birds, which are considered minor. NMFS provided a copy of the Draft PEA to the USFWS and received no comments concerning compliance with the MBTA.

6.6 FISH AND WILDLIFE COORDINATION ACT

The Fish and Wildlife Coordination Act (FWCA) requires USFWS and NMFS to consult with other state and federal agencies in a broad range of situations to help conserve fish and wildlife populations and habitats in cases where federal actions affect natural water bodies (16 U.S.C. 661 1934). Specific provisions involve conservation or expansion of migratory bird habitats related to water body impoundments or other modifications. FWCA requires consultation among agencies and the incorporation of recommended conservation measures if feasible but does not involve a separate permit or authorization process. NMFS provided a copy of the Draft PEA to the state fish and wildlife agencies in every state affected by the SWFSC fisheries research activities considered in this document and received no comments concerning compliance with the FWCA.

6.7 NATIONAL HISTORIC PRESERVATION ACT

Section 106 of the National Historic Preservation Act (NHPA) requires review of any project funded, licensed, permitted, or assisted by the federal government for impact on significant historic properties. The agencies must allow the State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation, a federal agency, to comment on a project. On April 23, 2013, SWFSC initiated consultation with the California State Office of Historic Preservation. SWFSC received no response to its letter following a 30-day review period. As such, SWFSC concluded that the California State Office of Historic Preservation is in agreement with the proposed fisheries and ecosystem research activities.

6.8 EXECUTIVE ORDER 12989, ENVIRONMENTAL JUSTICE

Executive Order 12898 directs federal agencies to take the appropriate and necessary steps to identify and address disproportionately high and adverse effects of federal projects on the health or environment of minority and low-income populations to the greatest extent practicable and permitted by law. No such effects are identified in this Final PEA.

6.9 EXECUTIVE ORDER 12114, ENVIRONMENTAL EFFECTS ABROAD OF MAJOR FEDERAL ACTIONS

Executive Order 12114 directs federal agencies to extend their compliance with NEPA and other specified laws to major federal actions outside of the U.S., its territories, and possessions. The purpose of the order is to establish internal procedures for federal agencies to consider the significant effects of their actions on the environment outside the U.S. but it does not require redress of those effects. The Draft PEA did not identify any significant effects in areas outside of the U.S. and no public comment has been received to the contrary. The final determination of significance will be made in the FONSI decision document for this Final PEA.

6.10 EXECUTIVE ORDER 13158, MARINE PROTECTED AREAS

The purpose of this order is to strengthen and expand the Nation's system of marine protected areas (MPAs) to enhance the conservation of our Nation's natural and cultural marine heritage and the ecologically and economically sustainable use of the marine environment for future generations. The order encourages Federal agencies to use science-based criteria and protocols to identify and prioritize natural and cultural resources in the marine environment that should be protected to secure valuable ecological services and to monitor and evaluate the effectiveness of MPAs. Each Federal agency whose actions affect the natural or cultural resources that are protected by an MPA shall identify such actions. To the extent permitted by law and to the maximum extent practicable, each Federal agency, in taking such actions, shall avoid harm to the natural and cultural resources that are protected by an MPA.

6.11 INFORMATION QUALITY ACT

Pursuant to NOAA guidelines implementing Section 515 of Public Law 106-554 (the Data Quality Act), all information products released to the public must first undergo a Pre-Dissemination Review to ensure and maximize the quality, objectivity, utility, and integrity of the information (including statistical information) disseminated by or for federal agencies. The following sections address these requirements.

6.11.1 Utility

The information presented in this document is helpful to the intended users (the affected public) by presenting a clear description of the purpose and need of a proposed action, the measures proposed, and the impacts of those measures. This document is the principal means by which the information contained herein is available to the public. The information provided in this document is based on the most recent available information from the relevant data sources. The development of this document and the decisions made by NMFS to propose an action are the result of a multi-stage public process. This document is available in several formats, including printed publication and CD-ROM, upon request.

6.11.2 Integrity

Prior to dissemination, information associated with an action, independent of the specific intended distribution mechanism, is safeguarded from improper access, modification, or destruction, to a degree commensurate with the risk and magnitude of harm that could result from the loss, misuse, or unauthorized access to or modification of such information. All electronic information disseminated by NMFS adheres to the standards set out in Appendix III, "Security of Automated Information Resources," of Office of Management and Budget (OMB) Circular A-130; the Computer Security Act; and the Government Information Security Act. All confidential information (e.g., dealer purchase reports) is safeguarded pursuant to the Privacy Act; Titles 13, 15, and 22 of the U.S.C. (confidentiality of census, business, and financial information); the Confidentiality of Statistics provisions of the MSA; and NAO 216-100, Protection of Confidential Fisheries Statistics.

6.11.3 Objectivity

For purposes of the Pre-Dissemination Review, this document is considered to be a "Natural Resource Plan." Accordingly, the document adheres to the published standards of the MSA; Operational Guidelines of the FMP Process; EFH Guidelines; National Standard Guidelines; and NAO 216-6, Environmental Review Procedures for Implementing NEPA.

This document uses information of known quality from sources acceptable to the relevant scientific and technical communities. Stock status (including estimates of biomass and fishing mortality) are based on either assessments subject to peer-review through Stock Assessment Review Committees or on updates of those assessments prepared by scientists of the SWFSC. Landing information is based on information collected through the SWFSC Commercial Fisheries database. In addition to these sources, other information is presented that has been accepted and published in peer-reviewed journals or by scientific organizations.

Despite current data limitations, the measures proposed for this action were selected based upon the best scientific information available. The analyses conducted in support of the proposed action were conducted using information from the most recent complete calendar years, from 2006 through 2011. The data used in the analyses provide the best available information on the landings of the relevant species in the SWFSC region.

The supporting science and analyses, upon which the policy choices are based, have been documented. All supporting materials, information, data, and analyses within this document have been, to the maximum extent practicable, properly referenced according to commonly accepted standards for scientific literature to ensure transparency.

The review process used in preparation of this document involved staff from the SWFSC and the West Coast Regional Office. The SWFSC's technical review was conducted by senior level scientists with specialties in population dynamics, stock assessment methods, demersal resources, population biology, and the social sciences. All stock assessment data used in this document has gone through the Stock Assessment Workshop/Stock Assessment Review Committee review process. Review was conducted by those with expertise in fisheries management and policy, habitat conservation, protected species, and compliance with the applicable law.

6.12 PAPERWORK REDUCTION ACT

The purpose of the Paperwork Reduction Act is to reduce the paperwork burden on the public. The director of the OMB has the authority to manage information collection and record keeping requirements in order to reduce paperwork burdens. This authority includes the establishment of guidelines and policies, and the approval of information collection requests. The Act applies to specific public information collection requests conducted by the SWFSC for research. However, the SWFSC has determined that the research considered in this Final PEA does not make specific requests for information from the public; and, therefore, the Paperwork Reduction Act does not apply to this Final PEA.

6.13 THE MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT

The Marine Protection, Research and Sanctuaries Act (MPRSA) (16 U.S.C. 1431) prohibits all ocean dumping, except that allowed by permits, in any ocean waters under U.S. jurisdiction, by any U.S. vessel, or by any vessel sailing from a U.S. port. MPRSA authorizes the Secretary of Commerce (through NOAA) to coordinate a research and monitoring program with the EPA and the U.S. Coast Guard (USCG). The MPRSA established nine regional marine research boards for the purpose of developing comprehensive marine research plans, considering water quality and ecosystem conditions and research and monitoring priorities and objectives in each region. It also launched a national coastal water quality monitoring program that directs the EPA and NOAA together to implement a long-term program to collect and analyze scientific data on the environmental quality of coastal ecosystems, including ambient water quality, health and quality of living resources, sources of environmental degradation, and data on trends. Results of these actions are used to provide the information required to devise and execute effective programs under the Clean Water Act and Coastal Zone Management Act (CZMA).

The MPRSA authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities as national marine sanctuaries. The primary objective is to protect marine resources, such as coral reefs, sunken historical vessels or unique habitats.

Section 304(d) requires interagency consultation between the NOAA Office of National Marine Sanctuaries and federal agencies taking actions that are "likely to destroy, cause the loss of, or injure a sanctuary resource."

On April 23, 2013, SWFSC initiated the sanctuary consultation process pursuant to section 304(d) of the National Marine Sanctuaries Act. On March 16, 2015, the Office of National Marine Sanctuaries (ONMS) West Coast Region responded with comments and recommendations resulting from its review of the SWFSC DPEA. ONMS recommended that SWFSC: (1) record and report annually to ONMS the actual biomass removal for all species taken at sampling stations with West Coast National Marine Sanctuaries, including any interactions with protected species, turtles, marine mammals or birds, from survey locations in individual national marine sanctuaries and (2) provide a map for each of the five West Coast National Marine Sanctuaries indicating the location of the sampling stations within each sanctuary. On April 14, 2015, SWFSC provided its concurrence with the ONMS recommendations, and it enclosed maps showing the location of sampling stations within each West Coast National Marine Sanctuaries for the period 2005-2009. Further, SWFSC indicated it would provide ONMS with similar maps on an annual basis showing SWFSC sampling stations for the prior year.

6.14 COASTAL ZONE MANAGEMENT ACT

The principal objective of the CZMA is to encourage and assist states in developing coastal management programs, to coordinate state activities, and to safeguard regional and national interest in the coastal zone. Section 307(c) of the CZMA requires federal activity affecting the land or water uses or natural resources of a state's coastal zone to be consistent with that state's approved coastal management program, to the maximum extent practicable. NMFS has provided a copy of the Draft PEA and a consistency determination to the state coastal management agency in every state with a federally-approved coastal management program whose coastal uses or resources are affected by these fisheries research activities. Each state has sixty days in which to agree or disagree with the determination regarding consistency with that state's approved coastal management program. If a state fails to respond within sixty days, the state's agreement may be presumed.

6.15 PACIFIC INTERNATIONAL CONVENTIONS AND TREATIES

The SWFSC participates in international forums for the assessment of the status of some stocks in accordance with the relevant rules of international law. NMFS, working through the SWFSC, conducts research to support U.S. commitments to international fisheries management, including provision of stock assessment and management advice for the conventions and treaties outlined below.

The Tunas Convention Act of 1950 (16 U.S.C. 951-961; Act of September 7, 1950, as amended) addresses and codifies the obligations of the U.S. under the Inter-American Tropical Tuna Commission (IATTC) and authorizes the Secretary of Commerce to issue regulations for implementing recommendations of the Commission. The act permits limiting the size and quantity of catches and limiting or prohibiting incidental catch of regulated species.

The IATTC was established in 1949 to monitor the long-term conservation and sustainable use of tunas, billfish, dolphins, turtles, non-target finfish, sharks, and others) that may be affected either directly or indirectly by fishing operations. In 2003, the Convention's scope was broadened, and is now known as the Antigua Convention. The Antigua Convention applies to waters of the Pacific Ocean including areas off California, Oregon and Washington, and encompasses significant U.S. fisheries, such as the troll fishery targeting albacore. The IATTC is currently made up of 21 nations and fishing entities. The Secretary of Commerce has directed NMFS, via the SWFSC, to conduct research and provide scientific input into stock assessments and conservation and management recommendations for target and non-target stocks in the convention area.

The Multilateral Fisheries Treaty entered into force in 1987, and has been extended through 2013. The Treaty sets the operational terms and conditions for the U.S. tuna purse seine fleet to fish in a vast area of the Central and Western Pacific Ocean, including waters under the jurisdiction of the Pacific Island Parties. As stipulated under the Treaty, the U.S., working through NMFS, conducts research and provides scientific data necessary for stock assessments and management advice.

The Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean was established in 2004. The objective is to ensure, through effective management, the long-term conservation and sustainable use of highly migratory fish stocks. This is in accordance with the 1982 United Nations Convention on the Law of the Sea and the 1995 United Nations Fish Stocks Agreement. The Convention establishes a Commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean. NMFS, working through the SWFSC, conducts research and provides scientific data to the Commission, an obligation under the Convention.

The Western and Central Pacific Fisheries Commission (WCPFC) is an international organization organized to ensure the long-term conservation and sustainable use of highly migratory fish stocks (i.e. tunas, billfish, and marlin) in the western and central Pacific Ocean. WCPFC is made up of 25 member nations and several participating territories and cooperating nations, who have an interest in the management of high seas fisheries in the western Pacific Ocean. Through the WCPFC, the U.S. is directly engaged in the development of fisheries management measures to manage and conserve bigeye, yellowfin, and albacore tunas, and to minimize impacts on the non-associated and dependent species, such as sea turtles and seabirds. As a WCPFC Member, the U.S. has directed NMFS, via the SWFSC, to conduct research and provide scientific data for the management of high seas fisheries, a stipulation set by the Commission.

The International Scientific Committee for Tuna and Tuna-like Species (ISC) in the North Pacific Ocean was established in 1995 for the purpose of enhancing scientific research and cooperation for conservation and rational utilization of tuna and tuna-like species of the North Pacific Ocean. Through a Memorandum of Understanding, the ISC provides scientific support for the work of the Northern Committee of the WCPFC. As a Member, the U.S. supports its obligations to the Committee through scientific research conducted by NMFS and the SWFSC.

6.16 ANTARCTIC TREATY SYSTEM

The Antarctic treaty system began in 1961, and designated the area as a scientific preserve. The system refers to a collection of related acts and conventions developed since. Some of the related conventions of the Antarctic Treaty include the Antarctic Conservation Act of 1978, the Antarctic Protection Act of 1990, and the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) (1980). NMFS, through the SWFSC activities, conducts fisheries research within Antarctic waters to meet designated international obligations stipulated under the Antarctic Treaty and codified through US law and regulations.

6.17 ANTARCTIC CONSERVATION ACT

The Antarctic Conservation Act (ACA) of 1978 (Public Law [PL] 95-541), as amended by the Antarctic Science, Tourism, and Conservation Act of 1996 (PL 104-227) and the regulations issued under it, was enacted by the U.S. to implement protocol on environmental protection and meet its obligations under the Antarctic Treaty. The goal of the ACA is to conserve and protect the native mammals, birds, plants, and invertebrates of Antarctica and the ecosystem upon which they depend. The ACA applies to land and fast ice south of 60 degrees south latitude and to: U.S. citizens in Antarctica; certain persons in Antarctica who participate in U.S. government activities; U.S. corporations or other legal entities that organize expeditions into the Antarctic; and U.S. persons wherever located, or foreign persons while in the U.S., who handle certain Antarctic animals and plants.

The ACA governs the taking of fauna and flora; entry into protected areas; introduction of nonnative species; material management and waste disposal; and use of designated pollutants. Section 670.4 prohibits, unless authorized by permit, to:

(a) *take native mammal, bird or plants;*

(b) *engage in harmful interference of native mammals, birds, or plants;*

(c) *enter specially designated areas;*

(d) *possession, sale, export, and import of native mammals, birds, and plant; or*

(e) *introduction of non-indigenous animals and plants into Antarctica.*

Section 671.4 prohibits, unless authorized by permit, to:

(a) *use or release any banned substance in Antarctica;*

(b) *use or release any designated pollutant in Antarctica;*

(c) *release any waste in Antarctica.*

An ACA permit is required in addition to any permit issued under other applicable acts (*e.g*., the MMPA of 1972, ESA of 1973, MBTA, and the CCAMLR).

6.18 CONVENTION FOR THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES

The CCAMLR, part of the Antarctic Treaty System, came into force in 1982 as an international treaty between twenty five nations with the goal of preserving the stability and species diversity of the entire Antarctic marine ecosystem. The treaty was established primarily in response to concerns that increased krill catches in the Southern Ocean could lead to adverse impacts on bird, seal, and fish populations, which are highly dependent on krill for food. Apart from seals south of 60°S and whales, which are covered by the Convention for the Conservation of Antarctic Seals and the International Convention for Regulation of Whaling, CCAMLR applies to all living marine resources between the Antarctic continent in the south and the Antarctic Polar Front in the north (about 50°S).

While the treaty does not prohibit the reasonable harvest of marine resources by members, it does implement a “precautionary” approach aimed at minimizing risk associated with unsustainable harvest practices and high levels of uncertainty. To this end, CCAMLR’s Scientific Committee utilizes information, datasets, and relevant scientific techniques to develop and adopt conservation measures and catch levels for harvest species based on data and scientific advice. However, the extensive size and harsh nature of the Southern Ocean make it extremely challenging for member nations to enforce CCAMLR conservation measures.

Each member engaged in research or harvesting activities in relation to the living marine resources are allowed membership in the commission, a group of members tasked with implementing CCAMLR’s management objectives. As a member for the commission, the U.S. is obligated to provide, to the greatest extent possible “statistical, biological and other data as the Commission and Scientific Committee may require in the exercise of their functions.” In order to meet this obligation, the U.S., through NMFS and the SWFSC, conducts biological research and collects fisheries data for the Southern Ocean.

6.19 ANTARCTIC MARINE LIVING RESOURCES CONVENTION ACT

The Antarctic Marine Living Resources Convention Act (AMLRCA) of 1984 (PL 98-623) addresses and codifies the obligations of the CCAMLR. AMLRCA provides the legislative authority to establish the U.S. Antarctic Marine Living Resources (AMLR) program and authorizes the Secretary of Commerce, under 16 U.S.C. § 2441 [a] [B] to "design and conduct the program of directed scientific research supplemental to and coordinated with the United States Antarctic Program" to support the purposes of carrying out the policies and objectives of CCAMLR. In addition, AMLRCA prohibits any person under the jurisdiction of the U.S. from engaging in harvesting activities that violate CCAMLR or its associated conservation measures. The act gives the U.S. authority to enforce CCAMLR's conservation standards on its nationals and vessels on the high seas within the area south of the Antarctic Convergence.

The Secretary of Commerce has directed NMFS, via the SWFSC, to manage and operate the AMLR Program. Working through the Department of State, the AMLR Program supports U.S. participation in both the CCAMLR Commission and the Scientific Committee by collecting scientific data and monitoring commercial fisheries activities. To this end, the primary objective of the AMLR research component is to collect the information necessary to assess the effects of marine resource harvesting activities on the target, dependent, and related species and populations of the Antarctic marine ecosystem. The AMLR program has several long term field studies and marine surveys in the Southern Ocean focused on collecting the scientific data necessary to achieve this goal. In addition, the Act requires adequate monitoring of the U.S. commercial fleet in the Antarctic, with results presented to, and used by, CCAMLR for managing fisheries resources. The data and results collected and presented by the U.S. AMLR Program form a basis for which many fisheries management decisions are made by CCAMLR and are the reason for SWFSC's research activities in Antarctic waters.

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[Note: This work was primarily completed by consultants from URS Corporation in Anchorage, Alaska. In October 2014, URS was purchased by AECOM, Inc. and the final stages of the project were completed by some of the listed personnel as AECOM staff, although the service contract remained under the URS name.]

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