Agenda Item E.4.a
Attachment 1
March 2015

# Comprehensive Ecosystem-Based Amendment 1: Protecting Unfished and Unmanaged Forage Fish Species

## of the U.S. Portion of the California Current Ecosystem

**DRAFT Environmental Assessment for**

**Amendment 15 to the Coastal Pelagic Species Fishery Management Plan**
**Amendment 25 to the Pacific Coast Groundfish Fishery Management Plan**
**Amendment 3 to the Highly Migratory Species Fishery Management Plan**
**and Amendment 19 to the Pacific Coast Salmon Fishery Management Plan**

**Prepared by the Ecosystem Workgroup of the**

**Pacific Fishery Management Council**
**7700 NE Ambassador Place, Suite 101**
**Portland, OR 97220**
**(503) 820-2280**
**(866) 806-7204**
**www.pcouncil.org**
**February 2015**

## List of Acronyms and Abbreviations

| | |
|---|---|
| BOEM | Bureau of Energy Management |
| C | Celcius |
| CalCOFI | California Cooperative Oceanic Fisheries Investigations |
| CCE | California Current Ecosystem, or California Current Large Marine Ecosystem |
| CDFG | California Department of Fish and Game (documents prior to January 1, 2013) |
| CDFW | California Department of Fish and Wildlife (present agency name) |
| CEQ | Council on Environmental Quality (of the White House) |
| CFR | Code of Federal Regulations |
| COP | Council Operating Procedure |
| Council | Pacific Fishery Management Council |
| CPS | Coastal Pelagic Species |
| EC | Ecosystem component (species) |
| EEZ | Exclusive Economic Zone |
| EFH | Essential Fish Habitat |
| EFP | Exempted Fishing Permit |
| ENSP | El Niño Southern Oscillation |
| EO | Executive Order |
| ESA | Endangered Species Act |
| FEP | Fishery Ecosystem Plan |
| FERC | Federal Energy Regulatory Commission |
| FMP | Fishery Management Plan |
| FMU | Fishery management unit |
| FONSI | Finding of No Significant Impact |
| HMS | Highly Migratory Species |
| MBTA | Migratory Bird Treaty Act |
| MMPA | Marine Mammal Protection Act |
| MSA | Magnuson-Stevens Fishery Conservation and Management Act |
| NEPA | National Environmental Policy Act |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanic and Atmospheric Administration |
| NWTRC | Northwest Training Range Complex (of the U.S. Navy) |
| ODFW | Oregon Department of Fish and Wildlife |
| OFL | Overfishing limit |
| OY | Optimum yield |
| PDO | Pacific Decadal Oscillation |
| PFMC | Pacific Fishery Management Council |
| RIR | Regulatory Impact Review |
| SAFE | Stock Assessment and Fishery Evaluation Report |
| SST | Sea surface temperature |
| STRI | Smithsonian Tropical Research Institute |
| U & A | Usual and Accustomed (Fishing Areas) |
| U.S. | United States of America |
| USCG | United States Coast Guard |
| WCGOP | West Coast Groundfish Observer Program |
| WDFW | Washington Department of Fish and Wildlife |

Document cover image – Blue Marble: Next Generation, Reto Stöckli, NASA Earth Observatory

# Contents

1.0 Introduction ........ 1
1.1 How this document is organized ........ 1
1.2 Purpose and Need ........ 2
1.3 Schedule and Process for Developing CEBA 1 ........ 2
2.0 Description of Alternatives ........ 5
2.1 Alternatives ........ 5
2.1.1 Alternative 1 (No Action Alternative) – Federal List of Authorized Fisheries and Gear .. 6
2.1.2 Alternative 2 (Preferred) – Bring Species into FMPs and Prevent Future Fisheries from Developing Without Scientific Information on Harvest Sustainability and Potential Ecological Effects, *Incidental Retention Allowed* ........ 6
2.1.3 Alternative 3 – Bring Species into FMPs and Prevent Future Fisheries from Developing Without Scientific Information on Harvest Sustainability and Potential Ecological Effects, *Incidental Retention Prohibited* ........ 7
2.2 Alternatives Considered But Rejected from Further Analysis ........ 7
2.2.1 Bring All Shared EC Species into the CPS FMP as FMU species ........ 8
2.2.2 Convert the FEP to an EFMP ........ 8
3.0 Description of the Affected Environment ........ 9
3.1 Physical Environment ........ 9
3.1.1 Major Oceanographic Features ........ 9
3.1.2 Vegetation and Structure-Forming Invertebrates ........ 10
3.1.3 Aspects of Climate Change Expected to Affect Living Marine Resources ........ 12
3.2 Biological Environment ........ 13
3.2.1 Shared EC Species ........ 13
3.2.2 Council-Managed (FMP) Predators of Shared EC Species ........ 25
3.2.3 Protected Species Predators of Shared EC Species ........ 31
3.3 Socio-Economic Environment ........ 44
3.3.1 Directed Fisheries for Shared EC Species ........ 46
3.3.2 EEZ Fisheries Taking Shared EC Species Indirectly ........ 54
3.3.3 Non-Fishing Human Activities Affecting Shared EC Species ........ 59
4.0 Impacts on the Affected Environment ........ 61
4.1 Impacts of the Alternatives on the Physical Environment ........ 61
4.2 Impacts of the Alternatives on the Biological Environment ........ 62
4.2.1 Shared EC Species ........ 62
4.2.2 Council-Managed (FMP) Predators of Shared EC Species ........ 62
4.2.3 Protected Species Predators of Shared EC Species ........ 63
4.3 Impacts of the Alternatives on the Socio-Economic Environment ........ 65

4.3.1 Directed Fisheries for Shared EC Species ... 65
4.3.2 EEZ Fisheries Taking Shared EC Species Indirectly ... 71
4.3.3 Non-Fishing Human Activities Affecting Shared EC Species ... 71
4.4 Cumulative Effects Analysis ... 72
4.4.1 Consideration of the Affected Resources ... 73
4.4.2 Geographic Boundaries ... 73
4.4.3 Temporal Boundaries ... 74
4.4.4 Actions Other than the Proposed Action ... 74
4.4.5 Magnitude and and Direction of Impacts of Actions Other than the Proposed Action ... 77
4.4.6 Cumulative Effects of Preferred Action on all of the Affected Resources ... 83
4.5 Summary of Reasons for Adoption of the Final Preferred Alternative ... 84
5.0 Consistency with FMPs and Applicable Laws ... 85
5.1 Magnuson-Stevens Fishery Conservation and Management Act (MSA) – National Standards, EFH, and Council FMPs ... 85
5.1.1 National Standards ... 85
5.1.2 Essential Fish Habitat ... 87
5.1.3 Fishery Management Plans ... 87
5.2 Endangered Species Act ... 89
5.3 Marine Mammal Protection Act ... 90
5.4 Migratory Bird Treaty Act and E.O. 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds ... 90
5.5 Coastal Zone Management Act ... 91
5.6 Administrative Procedure Act ... 91
5.7 Paperwork Reduction Act ... 92
5.8 Information Quality Act ... 92
5.9 Impacts of the Action Relative to Federalism: E.O. 13132 ... 92
5.10 Consultation and Coordination with Indian Tribal Governments: E.O. 13175 ... 93
5.11 Environmental Justice: E.O. 12898 ... 93
5.12 Regulatory Flexibility Analysis ... 93
6.0 Consistency with the National Environmental Policy Act ... 95
6.1 National Environmental Policy Act ... 95
6.2 Related NEPA Documents ... 95
6.3 Finding of No Significant Impact (FONSI) ... 95
6.4 List of Persons and Agencies Consulted ... 96
7.0 Draft FMP Amendment Language and Draft Council Operating Procedure 24 ... 97
7.1 CPS FMP – Amendment 15 Revisions to the FMP ... 97
7.2 Groundfish FMP – Amendment 25 Revisions to the FMP ... 101

7.3 HMS FMP – Amendment 3 Revisions to the FMP .......... 104
7.4 Salmon FMP – Amendment 19 Revisions to the FMP .......... 106
7.5 *Proposed* Council Operating Procedure 24 – Protocol for Consideration of Exempted Fishing Permits for Shared Ecosystem Component Species .......... 109
8.0 Sources .......... 112
Appendix .......... 139

# 1.0 Introduction

The Pacific Fishery Management Council (Council) adopted a Fishery Ecosystem Plan (FEP) and FEP appendix in April 2013 (PFMC 2013). From its *Purpose and Need Statement*, the FEP is intended in part to provide "management policies that coordinate Council management across its Fishery Management Plans (FMPs) and the California Current Ecosystem (CCE)." For FMP policies, the FEP is needed to "identify and prioritize research needs and provide recommendations to address gaps in ecosystem knowledge and FMP policies, particularly with respect to the cumulative effects of fisheries management on marine ecosystems and fishing communities." The FEP's appendix provides a series of example ecosystem-based fishery management initiatives exploring how the Council could address issues that affect two or more Council FMPs or coordinate major Council policies across the FMPs to fulfill identified FEP needs. Concurrent with the adoption of its FEP, the Council also began planning this Ecosystem Initiative 1, which is intended to implement the Council's policy on protection for forage fish species that are unfished and unmanaged in Federal waters off the U.S. West Coast.

At its April 2014 meeting, the Council chose a preliminary preferred alternative for this action, Alternative 2, which would result in all four of the Council's FMPs being amended to bring unfished and unmanaged forage fish species into the FMPs as ecosystem component (EC) species. This multi-FMP amendment will be known as Comprehensive Ecosystem-Based Amendment 1 (CEBA 1) and will include these FMP amendments: Amendment 15 to the Coastal Pelagic Species (CPS) FMP, Amendment 25 to the Pacific Coast Groundfish FMP, Amendment 3 to the Highly Migratory Species (HMS) FMP, and Amendment 19 to the Pacific Coast Salmon FMP.

The following species and species groups are under Council consideration to become EC species shared between all four of the Council's FMPs:

- Round herring (*Etrumeus teres*) and thread herring (*Opisthonema libertate* and *O. medirastre*)
- Mesopelagic fishes of the families *Myctophidae, Bathylagidae, Paralepididae,* and *Gonostomatidae*
- Pacific sand lance (*Ammodytes hexapterus*)
- Pacific saury (*Cololabis saira*)
- Silversides (family *Atherinopsidae*)
- Smelts of the family *Osmeridae*
- Pelagic squids (families: *Cranchiidae*, *Gonatidae*, *Histioteuthidae*, *Octopoteuthidae*, *Ommastrephidae* except Humboldt squid (*Dosidicus gigas*), *Onychoteuthidae, and Thysanoteuthidae*)

Throughout this document, this group of species is collectively referred to as the "Shared EC Species."

## 1.1 How this document is organized

This document includes elements of a National Environmental Policy Act (NEPA) analysis and responses to the Council's April 2013, September 2013, April 2014, and September 2014 directions on the action. This document will evolve along with Council discussion on the action, meaning that sections may be added, removed, or amended over time. Chapter 1 of this document describes the document's organization, provides the action's Purpose and Need statement, and outlines a schedule and process for action. Chapter 2 discusses the no action alternative, the action alternatives and the alternatives eliminated from further consideration. Chapter 3 describes the current physical, biological, and socio-economic environments relevant to the action. Chapter 4 discusses the potential effects of the alternatives. Chapter 5 addresses the action's consistency with FMPs and applicable laws. Chapter 6 addresses the action's consistency with

NEPA. Chapter 7 provides draft FMP amendatory language and a draft Council Operating Procedure (COP) for review and consideration by the Council, its advisory bodies, and the public. Sources cited throughout the document are listed in Chapter 8. The appendix provides the Council's policy on the development of new fisheries for unfished species from Section A.1.1 of the FEP Appendix.

## 1.2 Purpose and Need

At its April 2014 meeting, the Council adopted the following Statement of Purpose and Need for this action:

*The purpose of this action is to prohibit new directed commercial fishing in Federal waters on unmanaged, unfished forage fish species until the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem. This action is needed to proactively protect unmanaged, unfished forage fish of the U.S. West Coast Exclusive Economic Zone (EEZ) in recognition of the importance of these forage fish to the species managed under the Council's FMPs and to the larger CCE. This action is not intended to supersede tribal or state fishery management for these species, and coordination would still occur through the existing Council process.*

## 1.3 Schedule and Process for Developing CEBA 1

CEBA 1 will bring new species into the Council's four FMPs, requiring FMP amendments for each of the FMPs. Each of the Council's FMPs requires that the Council follow public notice and comment processes to develop and consider amendments to the FMPs. The Council has adopted a process for CEBA 1 intended to meet all four of the FMPs' requirements for Council processes to develop, consider, and adopt FMP amendments.

*1st Council meeting (September 2013)*: review a draft process and schedule for FMP amendment(s) to add new species to applicable FMP(s) and provide guidance to the Ecosystem Workgroup on future reports to the Council.

*2nd Council meeting (April 2014)*: review list of potential species to be added to FMP(s), review ecological, biological, economic and other data on the role of species as forage and potential for the development of fisheries on those species in the CCE, adopt preliminary preferred and other alternatives for review and comment, adopt process and schedule for potential draft FMP amendment(s).

*3rd Council meeting (September 2014)*: review CEBA 1 analysis document and recommend any changes or additional analysis; confirm preliminary preferred alternative; review draft FMP amendatory language, revise as needed, and, after the meeting, send analysis document and FMP amendatory language out for public review.

*4th Council meeting (March 2015)*: Review and either adopt final FMP amendatory language, or revise and send language out for an additional round of review and comment by advisory bodies and the public. If an additional round of review and comment is needed, a 5th Council meeting will be added before finalizing Council recommendations to the National Marine Fisheries Service (NMFS).

*1st* ***Federal Register*** *Notice*: NMFS publishes a Notice of Availability for the amendments to the four FMP.

*2nd **Federal Register** Notice*: NMFS publishes Council recommendations as proposed rule.

*3rd **Federal Register** Notice*: NMFS publishes a final rule if it partially or fully approves the Council's recommendations to amend the FMPs and publish Federal regulations.

As stated in Section 1.0, CEBA 1 includes the following FMP amendments: Amendment 15 to the CPS FMP, Amendment 25 to the Groundfish FMP, Amendment 3 to the HMS FMP, and Amendment 19 to the Salmon FMP. CEBA 1 would amend the Council's FMPs as follows, and as detailed in Chapter 7, *Draft FMP Amendatory Language*:

***CPS FMP***

Amendment 15 to the CPS FMP, detailed in Section 7.1 of this document, would amend these sections of the FMP:

- 1.1 *History of the Fishery Management Plan* updated to briefly describe Amendment 15
- 1.2 *Stocks in the Fishery Management Plan* amended to add Shared EC Species
- 1.4 *Ecosystem Component Species* amended to add prohibition language for Shared EC Species
- 2.2.8 *Exempted Fishing* updated to reference potential exempted fishing permits (EFPs) for Shared EC Species
- 5.1.7 *Incidental Catch Allowance for Shared EC Species*, new section to describe potential incidental allowances for Shared EC Species

***Groundfish FMP***

Amendment 25 to the Groundfish FMP, detailed in Section 7.2 of this document, would amend these sections of the FMP:

- 1.1 *History of the FMP* updated to briefly describe Amendment 25
- 1.2 *How This Document is Organized* amended at the description of Chapter 3 of the FMP to add mention of EC species, in addition to the fishery management unit (FMU) species already mentioned
- 2.2 *Operational Definition of Terms* amended to revise the definition of "Ecosystem Component Species" to include EC species that are shared between to all four FMPs
- 3.1 *Species Managed by this Fishery Management Plan* amended to include Shared EC Species
- 4.4.4 *Ecosystem Component Stocks Without OFL Values* amended to add a paragraph on Shared EC Species
- 6.5.2.1 *Endangered Species Act Species* amended to add a sentence on eulachon
- Chapter 8 *Experimental Fisheries* amended to reference potential EFPs for Shared EC Species

***Highly Migratory Species (HMS) FMP:***

Amendment 3 to the HMS FMP, detailed in Section 7.3 of this document, would amend these sections of the FMP:

- 1.1 *Purpose of This Document* updated to briefly describe Amendment 3
- 3.3 *Species Included in the FMP as Ecosystem Component Species* amended to include Shared EC Species
- 6.1.11 *Exempted Fishing Permits* amended to reference potential EFPs for Shared EC Species

***Salmon FMP***

Amendment 19 to the Salmon FMP, detailed in Section 7.4 of this document, would amend these sections of the FMP:

- *Introduction, Table 1, and Section 1* updated to briefly describe Amendment 19
- 1.1 *Stock Classification and Table 1-4* amended to include Shared EC Species in the FMP
- 1.4 *Ecosystem Component Species* amended to add prohibition language for Shared EC Species
- 6.6.6 *Experimental Fishing* updated to reference potential EFPs for Shared EC Species

# 2.0 Description of Alternatives

Between April 2013 and March 2015, the Council considered a variety of processes and options for action alternatives that would meet its Statement of Purpose and Need (Section 1.2). At the April 2014 meeting, the Council adopted a range of alternatives for analysis, rejected some previously considered alternatives from further consideration (Section 2.2), and adopted a preliminary preferred alternative, Alternative 2. At that meeting, the Council also asked the Ecosystem Workgroup to report back in September 2014 with options for defining minimal catch levels for the group of lower trophic level species subject to this action (referred to herein as "Shared EC Species") and for providing for incidental catch levels of these species. The Council added Alternative 3 (see Section 2.1.3) to this analysis in September 2014 to explore different approaches to retaining or discarding incidentally-caught Shared EC Species. At its March 2015 meeting, the Council adopted Alternative XX as its final preferred alternative.

## 2.1 Alternatives

In developing these alternatives, the Council reviewed, among other items: Amendment 12 to the CPS FMP to prohibit the harvest of krill within the U.S. West Coast EEZ; the South Atlantic Fishery Management Council's Comprehensive Ecosystem-Based Amendment analysis and regulatory processes; and the North Pacific Fishery Management Council's regulation of forage fish species in its Arctic FMP and in its Groundfish FMPs for the Bering Sea and Aleutian Islands and for the Gulf of Alaska. Alternative 1 is the No Action alternative, which is to protect Shared EC Species through the Council's September 2013 recommendations to narrow the range of gear types and fisheries allowed for use within the U.S. West Coast EEZ without prior Council consultation. Alternative 2 (Preferred) is to use a comprehensive FMP amendment process to bring certain forage fish into the FMPs as EC species to prohibit new directed commercial fishing in Federal waters on unmanaged, unfished forage fish species until and unless the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem. Like Alternative 2, Alternative 3 would also use a comprehensive FMP amendment process to bring the same forage fish species into the FMPs as Shared EC Species to prohibit new directed commercial fishing on those species in Federal waters. However, under Alternative 3, fisheries participants would be prohibited from retaining or landing these species when they are taken in the EEZ.

Under Alternative 2 or 3, the species listed in Section 1.0 and described in Section 3.2.1 would be added to all of the FMPs as Shared EC Species. Federal regulations at 50 CFR 600.310(d)(5) provide details on classifying species as EC species, saying that those species should:

(A) Be a non-target species or non-target stock;
(B) Not be determined to be subject to overfishing, approaching overfished, or overfished;
(C) Not likely to become subject to overfishing or overfished, according to the best available information, in the absence of conservation and management measures; and
(D) Not generally be retained for sale or personal use.

Shared EC Species meet these qualifications for all fisheries in Federal waters. Some Shared EC Species, particularly the osmerid smelts, are subject to small commercial and recreational fisheries within state waters, primarily within the surf zone. One of the Shared EC Species, eulachon, an osmerid smelt, listed as threatened under the Endangered Species Act (ESA). As with any Council action that could affect ESA-listed species, this and future Council actions need to be consistent with the eulachon recovery plan (NMFS 2013a).

### 2.1.1 Alternative 1 (No Action Alternative) – Federal List of Authorized Fisheries and Gear

Under the No Action alternative, Alternative 1, fishing within the EEZ for species that are not managed under a Council FMP or a state management program is governed by the Federal list of authorized fisheries and gear at 50 CFR 600.725(v). The list of authorized fisheries and gear specifies those fisheries and gears that are authorized to operate within an EEZ, but does not prohibit new fisheries from emerging. Rather, it requires that persons wanting to develop new fisheries notify the Council, so that the Council has an opportunity to comment on, develop a regulatory plan for, or recommend that NMFS prohibit the proposed fishery as it deems appropriate.

A person wanting to begin a new fishery that is not listed in 50 CFR 600.725 must first notify the relevant fishery management council or its Director. If the council or its Director receives a complete notification, then "a signed return receipt for the notice serves as adequate evidence of the date that the notification was received by the appropriate Council . . . and establishes the beginning of the 90-day notification period, unless required information in the notification is incomplete" (50 CFR 600.747(c)(2)(i)). More information on what constitutes a complete notification under Federal regulations is available at 50 CFR 600.747(c)(2).

At its September 2013 meeting, the Council finalized its recommendations to update the portion of that list that applies to the EEZ off the U.S. West Coast. These recommendations explicitly remove Pacific saury, a Shared EC Species, from the list of species that could be fished without prior notification to the Council. The Council's recommendations also explicitly removed all commercial net gear from those gears that are generally available for use in new fisheries that could develop within the U.S. West Coast EEZ without prior notification of the Council. Its rationale for requiring advance Council consultation on new uses of net gear (e.g. trawl, seine, gillnet, trammel net) was that those are the gear types that are used to fish for the Shared EC Species and their analogs in other parts of the world. NMFS published a final rule implementing the Council's recommendations on December 23, 2014 (79 FR 76914).

Under Alternative 1, anyone wanting to begin a new fishery for one of the Shared EC Species could follow the process described in Federal regulations at 50 CFR §§ 600.725 and 600.747 to initiate that fishery. In other words, the no action alternative would give new fisheries the opportunity to begin after the passage of the 90-day notification period. The Council could recommend new regulations, including complete prohibition, for the new fishery at any time during or after the 90-day notification period.

### 2.1.2 Alternative 2 (Preferred) – Bring Species into FMPs and Prevent Future Fisheries from Developing Without Scientific Information on Harvest Sustainability and Potential Ecological Effects, *Incidental Retention Allowed*

Under this alternative, the Council will use a comprehensive FMP amendment process to bring Shared EC Species into the FMPs as EC species and to prohibit new directed commercial fishing in Federal waters on them until the Council has had adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem. No new directed fishing could begin for these species without a Council process to develop an EFP. Shared EC Species could continue to be taken incidentally and landed or discarded without violating Federal regulations, unless regulated or restricted for other purposes, such as with bycatch minimization regulations for eulachon recovery. No long-term directed EEZ fisheries would be possible for these species without some future FMP amendment to specify the targeted species as an FMU species and to meet Magnuson-Stevens Fishery Conservation and Management Act (MSA) requirements for FMU species, which include: developing harvest specifications, identifying essential fish habitat (EFH) for the species, and providing gear specifications for the fishery.

Under Alternative 2, all of the Shared EC Species would be identified in all four FMPs as EC species, to recognize that, as a group, these species serve as prey for many CCE predators, including FMP species. Shared EC Species would be identified in the FMPs as EC species under 50 CFR 600.310(d)(5)(iii) to address "other ecosystem issues," because these species are the broadly used prey of marine mammal, seabird, and fish species in the U.S. West Coast EEZ. Shared EC Species are among the known prey of FMU species of all four of the Council's FMPs; therefore, Shared EC Species support predator species' growth and development and may also be identified as EC species under 50 CFR 600.310(d)(5)(iii) "for ecosystem considerations related to specification of optimum yield for the associated fishery."

### 2.1.3 Alternative 3 – Bring Species into FMPs and Prevent Future Fisheries from Developing Without Scientific Information on Harvest Sustainability and Potential Ecological Effects, *Incidental Retention Prohibited*

Under this alternative, the Council would also use a comprehensive FMP amendment process to bring Shared EC Species into the FMPs as EC species and prohibit new directed commercial fishing in Federal waters on these species until the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem. No new directed fishing could begin for these species without a Council process to develop an EFP. Shared EC Species could continue to be taken incidentally **but must be discarded at sea**, unless regulated or restricted for other purposes, such as with bycatch minimization regulations for eulachon recovery. No long-term directed EEZ fisheries would be possible for these species without some future FMP amendment to: specify the targeted species as an FMU species, develop harvest specifications and identify EFH for that species, and provide gear specifications for the species.

Under Alternative 3, all of the Shared EC Species would be identified in all four FMPs as EC species, to recognize that, as a group, these species serve as prey for many CCE predators, including FMP species. Shared EC Species will be identified in the FMPs as EC species under 50 CFR 600.310(d)(5)(iii) to address "other ecosystem issues," because these species are the broadly used prey of marine mammal, seabird, and fish species in the U.S. West Coast EEZ. Shared EC Species are among the known prey of FMU species of all four of the Council's FMPs; therefore, Shared EC Species support predator species' growth and development and may also be identified as EC species under 50 CFR 600.310(d)(5)(iii) "for ecosystem considerations related to specification of optimum yield for the associated fishery."

## 2.2 Alternatives Considered But Rejected from Further Analysis

At its September 2013 meeting, the Council established the list of species it wanted to consider under this action. The Council explicitly decided to not include American shad (*Alosa sapidissima*) in this action, despite its role as forage within the CCE. American shad is an introduced species, and the Council determined that it did not need to extend protections to non-native forage species. The Council also considered, but rejected, the possibility of including Pacific tomcod (*Microgadus proximus*) and small croakers (*Sciaenidae*) in this action. Both tomcod and croakers are native to the CCE; however, they are also predominantly or exclusively nearshore species that are not thought to range into the EEZ, which is the Council's geographic area of authority.

At its April 2014 meeting, the Council confirmed the range of alternatives for this action and rejected the alternatives in this section from further consideration. At that meeting, the Council considered three different pathways for developing Alternative 2, above, each of which would have brought different species into the FMPs using different criteria. The Council rejected a pathway that would have brought particular species into the FMPs where FMP fisheries might take those species incidentally, or where those species could be taken by fishing gear similar to gear authorized for use under the FMPs. Not all of the Shared EC Species are taken as bycatch in FMP fisheries; therefore, the Council determined that the connections between Shared EC Species and FMP gear and fisheries were not strong enough to support that pathway. The Council also rejected a pathway that would have brought particular species only into the FMPs that managed predator species that prey upon those species. Each of the Shared EC Species or species groups are preyed upon by predator species harvested in Council-managed fisheries, and most Shared EC Species are prey for predators managed under more than one FMP. The Council determined that bringing all of the Shared EC Species into all of the FMPs to acknowledge their broad trophic role as the prey of Council-managed fish species and other predators (Alternatives 2 and 3) would have the benefit of explicitly acknowledging connections between FMP species and Shared EC Species, while also accounting for other predators within the CCE ecosystem. The Council did not choose to develop either of the rejected pathways as a stand-alone alternatives because all three of the pathways, including the adopted pathway for Alternatives 2 and 3, would have had the same effects on the environment and thus did not differ from each other in any measurable way (PFMC 2014a).

### 2.2.1 Bring All Shared EC Species into the CPS FMP as FMU species

Krill (*Euphausiacea*) is an FMU species in the CPS FMP. In Council discussions prior to the development of the FEP, the Council had considered bringing other forage species into the CPS FMP as FMU species, but rejected this alternative because not all of the Shared EC Species could be connected to the CPS FMP as either prey of CPS FMP species or as bycatch taken in CPS fisheries. The lack of connection between some Shared EC Species and the CPS FMP also caused the Council to reject the idea of including all of the Shared EC Species as EC species only within the CPS FMP. In other words, the Shared EC Species are not all components of the CPS fishery; therefore, they cannot be EC species of just that FMP. By including all of the Shared EC Species in all of the FMPs, the FMPs collectively acknowledge the connections among Shared EC Species, FMP species, and the larger ecosystem.

### 2.2.2 Convert the FEP to an EFMP

One alternative for accomplishing the Council's Purpose of and Need for Action would be to convert the FEP to an Ecosystem FMP, and to amend the CPS FMP to move krill from that FMP into the Ecosystem FMP. In an Ecosystem FMP, krill could serve as the sole FMU species, and the species subject to this action could be EC species. Similar to the North Pacific Fishery Management Council's Arctic FMP, an Ecosystem FMP could prohibit all commercial harvest of these species until and unless sufficient information is available to manage sustainable harvest for those species. The Shared EC Species would be identified as EC under 50 CFR 600.310(d)(5)(iii) to address "other ecosystem issues," because these species are broadly used prey of marine mammal, seabird, and fish species of the U.S. West Coast EEZ. For any fishery to develop on any of these species, the targeted species would need to be moved to one of the Council's species group FMPs, where that species would be identified as an FMU species, with harvest specifications, EFH, gear specifications and other management measures.

During the development of its FEP, the Council considered the possibility of creating an Ecosystem FMP with regulatory authority, but rejected that option because doing so would have added an unnecessary administrative and regulatory layer to the Council's management processes. This "considered but rejected" alternative is discussed here to illustrate how forage fish management measures used in another fishery management council might have been adapted for the U.S. West Coast.

# 3.0 Description of the Affected Environment

## 3.1 Physical Environment

This action addresses species and fisheries of the U.S. portion of the CCE, 3-200 nm off the coasts of Washington, Oregon, and California. The physical environment is described in the following sections of the FEP, which are incorporated here by reference: Section 3.1.1, General Description and Oceanographic Features of the CCE; Section 3.1.2, Major Bio-Geographic Sub-Regions of the CCE; Section 3.3.1, Geological Environment; Section 3.3.2, Water Column and Chemical Regimes; Section 3.3.3, CCE Vegetation and Structure-Forming Invertebrates; Section 3.3.4, Human Effects on Council-Managed Species' Habitat; Section 4.3, Direct and Indirect Effects of Fishing on Biophysical Habitat, and; Section 4.5, Aspects of Climate Change Expected to Affect Living Marine Resources within the CCE (PFMC 2013).

The CCE is comprised of a major eastern boundary current, the California Current, which is dominated by strong coastal upwelling, and is characterized by fluctuations in physical conditions and productivity over multiple time scales (Parrish et al. 1981, Mann and Lazier 1996). Food webs in these types of ecosystems tend to be structured around coastal pelagic species, such as Shared EC species, that exhibit boom-bust cycles over decadal time scales (Bakun 1996, Checkley and Barth 2009, Fréon et al. 2009). By contrast, the top trophic levels of such ecosystems are often dominated by highly migratory species such as salmon, tuna, billfish and marine mammals, whose dynamics may be partially or wholly driven by processes in entirely different ecosystems, even different hemispheres. This Section 3.1 focuses on those aspects of the physical environment that are most likely to have some effect on Shared EC Species: major oceanographic features (3.1.1), vegetation and structure-forming invertebrates (3.1.2), and aspects of climate change likely to affect living marine resources (3.1.3).

### 3.1.1 Major Oceanographic Features

The CCE essentially begins where the west wind drift (or the North Pacific Current) reaches the North American continent. The North Pacific Current typically encounters land along the northern end of Vancouver Island, although this location varies latitudinally from year to year. This current then splits into the southward-flowing California Current heading south (shown in Figure 3.1) and the northward-flowing Alaska Current. The "current" in the California Current is a massive southward flow of water ranging from 50 to 500 kilometers offshore (Mann and Lazier, 1996). Beneath this surface current, flows what is known as the California Undercurrent in the summer, which then surfaces and is known as the Davidson current in winter. This current moves water poleward from the south in a deep yet more narrow band of water typically close to and offshore of the continental shelf break (Hickey 1998, Checkley and Barth 2009). The southward-flowing California Current is typically considered distinct from the wind-driven coastal upwelling jets that develop over the continental shelf during the spring and summer, which tend to be driven by localized forcing and to vary on smaller spatial and temporal scales than offshore processes (Hickey, 1998). Jets result from intensive wind-driven coastal upwelling, and lead to higher nutrient input and productivity; they in turn are influenced by the coastal topography (capes, canyons and offshore banks), particularly the large capes such as Cape Blanco, Cape Mendocino and Point Conception. The flow from the coastal upwelling jets can be diverted offshore, creating eddies, fronts and other mesoscale changes in physical and biological conditions, and even often linking up to the offshore California Current (Hickey, 1998).

Superimposed on the effects of these shifting water masses that drive much of the interannual variability of the CCE, are substantive changes in productivity that often take place at slower rates, during multi-year and decadal periods of altering ocean condition and productivity regimes. The El Niño/Southern Oscillation

(ENSO) is the dominant mode of interannual variability in the equatorial Pacific, with impacts throughout the rest of the Pacific basin (including the California Current) and the globe (Mann and Lazier 1996). During the negative (El Niño) phase of the ENSO cycle, jet stream winds are typically diverted northward, often resulting in increased exposure of the West Coast of the U.S. to subtropical weather systems (Cayan and Peterson 1989). Concurrently in the coastal ocean, the effects of these events include reduced upwelling winds, a deepening of the thermocline, intrusion of offshore (subtropical) waters, dramatic declines in primary and secondary production, poor recruitment, growth and survival of many resident species (particularly salmon and groundfish), and northward extensions in the range of many tropical species.

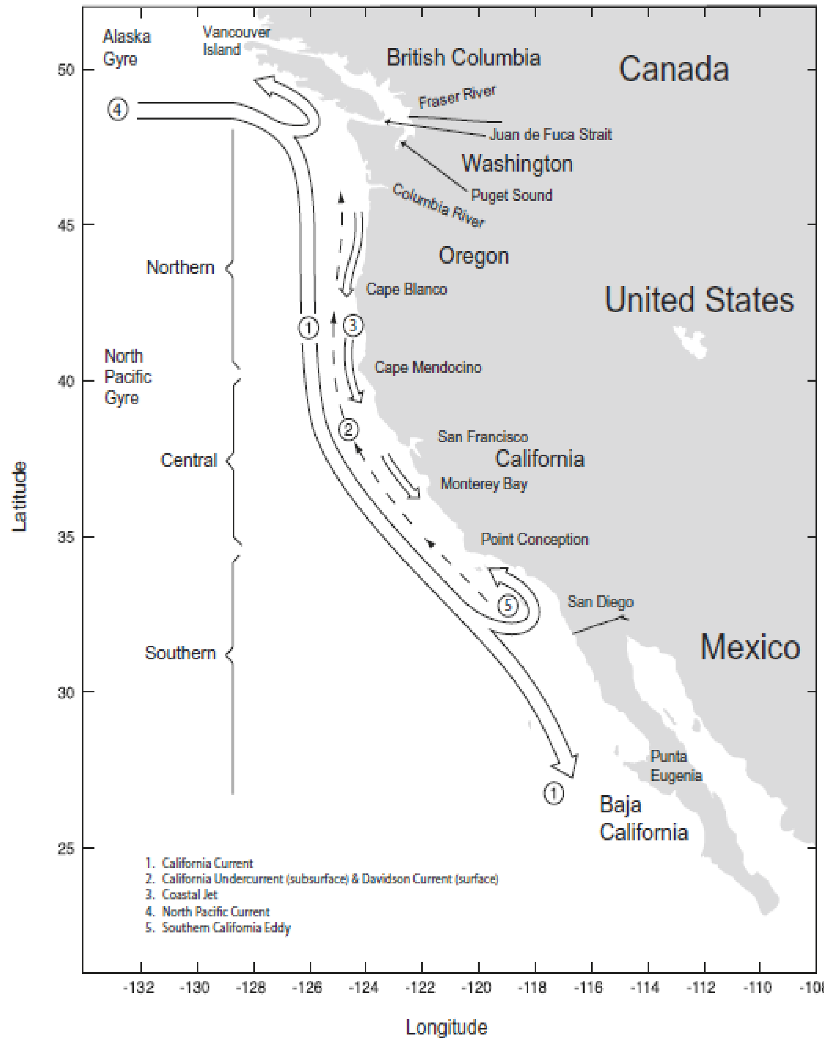



**Figure 3.1: Dominant current systems off the U.S. West Coast**

While the ENSO cycle is generally a high-frequency event (taking on the order of three to seven years to complete a cycle), lower frequency variability has been associated with what is now commonly referred to as the Pacific (inter) Decadal Oscillation, or PDO (Mantua et al. 1997). The PDO is the leading principal component of North Pacific sea surface temperatures (above 20° N. lat.), and superficially resembles ENSO over a decadal time scale. During positive regimes, coastal sea surface temperatures in both the Gulf of Alaska and the California Current tend to be higher, while those in the North Pacific Gyre tend to be lower; the converse is true in negative regimes. The effects of the PDO have been associated with low frequency variability in over 100 physical and biological time series throughout the Northeast Pacific, including time series of recruitment and abundance for commercially important coastal pelagics, groundfish and invertebrates (Mantua and Hare 2002).

### 3.1.2 Vegetation and Structure-Forming Invertebrates

Vegetation forms two major classes of large-scale habitats: large macro-algal attached benthic beds, and microalgal blooms. Seagrass beds are an important macro-algal habitat within the CCE, and U.S. West species include eelgrass species (*Zostera* spp.), widgeongrass (*Ruppia maritima*), and surfgrass (*Phyllospadix* spp.). These grasses are vascular plants, not seaweeds, forming dense beds of leafy shoots year-round in the lower intertidal and subtidal areas. Eelgrass is found on soft-bottom substrates in intertidal and shallow subtidal areas of estuaries and occasionally in other nearshore areas, such as the Channel Islands and Santa Barbara littoral. Surfgrass is found on hard-bottom substrates along higher energy coasts. Studies have shown seagrass beds to be among the areas of highest primary productivity in the world (Herke and Rogers 1993; Hoss and Thayer 1993).

Along the Pacific coast, there are two major canopy-forming species of kelp, the giant kelp (*Macrocystis pyrifera*), and the bull kelp (*Nereocystis leutkeana*). These species can form the kelp forests that provide habitat for a diverse mix of species including fishes, invertebrates, marine mammals and sea birds. Kelp forests provide cover or nursery grounds for many adult, young of the year, or juvenile nearshore and shelf rocky reef fishes and invertebrates such as abalone (*Haliotidae* spp.), sea urchins, spiny lobsters, and crabs. Sea otters (*Enhydra lutris*) are also found associated with kelp forests. Kelp plays an important role in the diet of some reef fishes and many invertebrates (e.g., urchins and abalone). In addition, when plants are ripped up after storms, the resulting kelp detritus functions as beach enrichment or contributes nutrients to the benthic environment when drifting plants sink.

The major phytoplankton classes within the CCE include diatoms, dinoflagellates, small (often termed "pico"-) eukaryotes, and cyanobacteria. Diatoms are mainly responsible for large productive blooms in the nearshore upwelling regions and often form the basis of the productive food webs in those areas. Dinoflagellates also bloom in upwelling and other regions, and may provide an important food source for microzooplankton. Dinoflagellates have a dual role, since certain dinoflagellates may form harmful algal blooms (HABs, although a few species of diatoms may also form HABs as well). Pico-eukaryotes and cyanobacteria are the smallest "phytoplankton" and form only a minor portion of phytoplankton biomass, although their productivity rates may be high in offshore regions. Thus, these pico-phytoplankton form an important link in offshore food webs, and may also fuel the growth of the smallest microzooplankton within nearshore regions as well (Sherr et al. 2005).

Seasonally, diatoms tend to bloom nearshore in the later winter or early spring, in a progression from south to north. The timing of this bloom tends to follow a change in upwelling strength, from the predominant downwelling condition during the fall and spring, to a net cumulative upwelling in the late winter to early spring (Lynn et al. 2003). This change from downwelling to upwelling and the resulting phytoplankton blooms are termed the spring transition (Holt and Mantua, 2009). Year to year variability may occur in this timing, due to large scale changes in wind patterns across the Pacific basin. Occasionally, there are brief periods of mixing or upwelling that occur prior to the main spring transition, which may also result in localized phytoplankton blooms of short duration that may disappear before the main spring transition time. Blooms of dinoflagellates and other phytoplankton types tend to occur largely after the main spring transition. In particular, dinoflagellates often bloom in the fall period, upon the cessation of upwelling, as the waters stratify.

A host of invertebrate species of varying sizes and trophic levels inhabit the CCE. The delineation of benthic structure forming invertebrates, in particular corals and sponges, is under more thorough discussion within the Groundfish EFH Review Committee for updates to Groundfish EFH designation (EFHRC 2012). Whitmire and Clarke (2007) listed 101 species of corals identified in the U.S. West Coast EEZ, within which four species were classified as having adequate individual or colony size and morphological complexity to be considered of high structural importance: *Lophelia pertusa, Antipathes dedrochristos, Paragorgia arborea*, and *Primnoa pacifica*. Several additional classes and individual species of coral were identified as being of medium structural importance: *Dendrophyllia oldroydae, Bathypathes* sp., *Isidella* sp., *Keratoisis* sp. Corals of the West Coast EEZ are distributed over a variety of bottom habitats, with higher concentrations on hard-bottom (not sand) and medium-to-high relief rocky habitat. With their morphologically complex forms, corals can enhance the relief and complexity of physical habitat (Whitmire and Clarke 2007), although scientific literature remains divided on whether West Coast deep sea corals serve to aggregate fish (Etnoyer and Morgan 2005, Auster 2005, Tissot et al. 2006).

### 3.1.3 Aspects of Climate Change Expected to Affect Living Marine Resources

Climate change is expected to lead to substantial changes in physical characteristics and dynamics within the marine environment, with complex and interacting impacts to marine populations, fisheries and other ecosystem services (Scavia et al. 2002, Harley et al. 2006, Doney et al. 2012). Three major aspects of future climate change that will have direct effects on the CCE are: ocean temperature, pH (acidity versus alkalinity) of ocean surface waters, and deep-water oxygen. Globally by 2050, ocean temperatures on average are expected to rise at least 1°C (by the most conservative estimates, IPCC 2007), while at the same time, ocean pH in the upper 500m has steadily been decreasing (becoming more acidic, aka "ocean acidification") at a rate of approximately -0.0017 pH per year (Byrne et al. 2010). On a more regional basis within the CCE, deep-water oxygen levels have shown a steady and relatively rapid decrease since the mid 1980's (Bograd et al. 2008, McClatchie et al. 2010). These three factors are linked: ocean temperature affects ocean pH, ocean temperature and deep water oxygen levels both can be controlled by large scale circulation patterns, and primary production can affect both oxygen and pH (Gilly et al. 2013). All three factors show long-term trends and decadal-scale variance similar to changes in the PDO (Mantua et al. 1997) and North Pacific Gyre Oscillation (DiLorenzo et al. 2008) climate signals. In addition to these three large-scale aspects of climate change, some more immediate and localized aspects of climate change observed in coastal marine ecosystem include: intensification of upwelling (Bakun, 1990, Schwing and Mendelssohn, 1997), changes in phenology (Bograd et al. 2009), and changes in the frequency and intensity of existing interannual and interdecadal climate patterns (Yeh et al. 2009, NMFS 2012, and references therein). Substantial changes in weather and precipitation patterns will also affect snowpack, streamflow, river temperatures and other aspects of freshwater habitat, with tremendous real and potential consequences to the future productivity and sustainability of anadromous resources such as salmon (Mantua and Francis 2004, Crozier et al. 2008). As described by Bakun (1990) global warming has led to an intensification of alongshore wind stress, which in turn has led to an intensification of coastal upwelling, as has been documented both around the globe, and specifically within the CCE (Schwing and Mendelssohn, 1997). Within the CCE, this long-term intensification is most notable during April to July, and is of greater magnitude than the typical seasonal variability. Such an increase in upwelling should lead to cooler surface waters and higher productivity; however, the long-term trend of increasing sea surface temperature (SST) has masked this effect, leading to overall net higher water temperatures (Schwing and Mendelssohn, 1997).

These changes in upwelling and major climate patterns result in changes to the phenology of physical and biological events within the CCE. Recent trends over the past 5 years indicate an earlier timing to the start of upwelling in the south, and a later start to upwelling in the north (NMFS 2012), with an earlier start of upwelling likely leading to higher integrated productivity. In any case, changes in the timing of upwelling may result in match-mismatch between predators and their prey, if those timings are somewhat uncoupled (e.g. salmon entering the ocean may have a different timing set by terrestrial forcing, as opposed to the timing of upwelling initiation). Changes in the timing of upwelling will also likely have impacts all the way up the food chain to the top level predators and consumers, since it is the timing and strength of upwelling that primarily controls primary productivity of the CCE, and thereby overall productivity. However, the exact nature of how upwelling phenology may change is not clear, as it is affected by many factors, such as wind patterns, sea surface temperature (SST), mixing, stratification, circulation etc., and may vary by region. These physical factors, SST, mixing, wind etc., are in turn controlled by interrelated large-scale patterns – which are undergoing both long-term changes, and changes in their strength and variability as described above – therefore further complicating prediction of ecosystem response. An important secondary effect of changes in upwelling strength and phenology are potential changes in upper ocean pH. Upwelled water may act to further decrease the surface ocean pH, which means that changes in upwelling phenology are also likely to change seasonal and long-term patterns of ocean pH.

## 3.2 Biological Environment

The larger biological environment of the CCE, including the roles and major species groups of lower trophic level CCE species, is described within the FEP in the following sections: Section 3.2, Biological Components and Relationships of the CCE; Section 3.3.3, CCE Vegetation and Structure-Forming Invertebrates; Section 4.1, Changes in Fish Abundance within the Ecosystem; Section 4.2, Changes in the Abundance of NonFish Organisms within the Ecosystem, and; Section 4.3, Direct and Indirect Effects of Fishing on Biophysical Habitat (PFMC 2013).

This section addresses Shared EC Species (3.2.1), Council-managed species that prey upon Shared EC Species (3.2.2), and species managed under the ESA, Marine Mammal Protection Act (MMPA) and Migratory Bird Treaty Act (MBTA) that prey upon Shared EC Species (3.2.3). In Section 3.2.1, this EA discusses what is known of the life history of Shared EC Species and their roles as prey in the CCE. Sections 3.2.2 and 3.2.3 describe what is known of the predator-prey relationships between Shared EC Species and many of the higher-order predators of the CCE.

### 3.2.1 Shared EC Species

The FEP categorizes CCE species by broad trophic level. Shared EC Species are generally categorized within the FEP's "low trophic level" category, discussed in section 3.2.1.3 of the FEP. This section of the EA provides some life history characteristics of the species the Council has identified as the subjects of this action:

- Round herring (*Etrumeus teres*) and thread herring (*Opisthonema libertate* and *O. medirastre*)
- Mesopelagic fishes of the families *Myctophidae, Bathylagidae, Paralepididae,* and *Gonostomatidae*
- Pacific sand lance (*Ammodytes hexapterus*)
- Pacific saury (*Cololabis saira*)
- Silversides (family *Atherinopsidae*)
- Smelts of the family *Osmeridae*
- Pelagic squids (families: *Cranchiidae, Gonatidae, Histioteuthidae, Octopoteuthidae, Ommastrephidae* except Humboldt squid, *Onychoteuthidae, and Thysanoteuthidae*)

#### *3.2.1.1 Round (Etrumeus teres) and Thread Herrings (Opisthonema spp.)*

Round and thread herrings are members of the widely distributed and often abundant group of fishes in the suborder *Clupeoidei*. This taxonomic group includes herrings, sardines, anchovies, sprats, shads and others. Clupeoid fishes are targets of commercial and subsistence fisheries worldwide and catches are substantial. Half of the worldwide catch of fishes comes from just sixty species of various groups, half of which are clupeoids (Whitehead 1985).

Round herring is a circumglobal, marine, pelagic species. In the Eastern Pacific Ocean, they are found from Southern California, throughout the Gulf of California, to Peru and in the Galapagos and Hawaiian islands (Whitehead 1985; STRI 2013). Within the U.S. EEZ, round herring have been taken off the U.S. West Coast from approximately Monterey Bay to the southern boundary with Mexico.

Round herring is a pelagic, schooling fish found mostly in nearshore waters. They range to depths as great as 200 meters, but are found mostly from about 12 meters depth to the surf zone. Round herring fall into the general category of lower trophic level fishes. The adults are planktivores, feeding on euphausiids and copepods and they, in turn, are fed upon by birds and higher tropic level fishes (e.g. see Wilson 1985;

Abitía-Cárdenas et al. 1997; and Shimose et al. 2013). Round herring are summer-to-fall spawners and their eggs and larvae are a common part of ichthyoplankton communities off southern California in summer and fall (Green-Ruiz and Acal-Sánchez 1987; Watson and Sandknop 1996; and Oozeki et al. 2007).

Thread herrings (*Opisthonema* spp.) are schooling, pelagic fishes from tropical and subtropical coastal waters of the western Atlantic and eastern Pacific oceans. Deepbody thread herring (*O. libertate*) and middling thread herring (*O. medirastre*) are occasional visitors to southern areas of the U.S. EEZ, from approximately Port Hueneme, CA to the southern boundary (Coto et al. 2010a; b). They are opportunistic planktivores with a wide spectrum of prey ranging from diatoms to euphausiids, copepods, ostracods and polychaetes (López-Martinez et al. 1999). They are preyed upon by marine mammals, birds and predatory fishes (Abitía-Cárdenas et al. 1997). Thread herring spawn in the spring-to-fall period and their eggs and larvae are part of ichthyoplankton communities (Watson and Sandknop 1996).

#### *3.2.1.2 Mesopelagic Fishes of the families Myctophidae, Gonostomatidae Paralepididae, and Bathylagidae*

Mesopelagic fish are a very large, yet lightly exploited, marine resource with wide distribution in the world oceans. Worldwide mesopelagic fish biomass has long been estimated at one billion tons (Tsarin 1997), but recent data indicate that the true biomass may be closer to 10 billion tons (Kaartvedt et al. 2012; Irigoien 2014). For comparison, worldwide harvest of all marine capture fisheries was 82.4 million tons in 2011 (FAO 2013). Within the California Current region (770,000 km2) alone, there is an estimated mesopelagic fish biomass of 18.5 million metric tons or 24.0 g/m2. This compares to less than 2 million tons for the combined stock of sardines and anchovies, the dominant epipelagic planktivores in the region (Davidson et al. 2013). Based on the abundance of larvae sampled annually from 1955 through 1960 in the CCE (Ahlstrom 1969), deep-sea pelagic fishes are predominantly of three kinds, myctophids (41.1%), gonostomatids (40.6%) and bathylagids (18.3%). However, bathylagids appear to be only a small portion of samples from studies of adult mesopelagic fishes in the CCE.

Most mesopelagic fish are small, generally only growing to a few centimeters in length, and thus are considered to be part of the micronekton, which also includes larger-sized crustaceans, such as euphausiids, shrimps, mysids, and small squids, most of which dwell in the mesopelagic zone and undertake diel vertical migration. A notable portion of the fish biomass in the CCE is concentrated in micronektonic fishes, most of which are in the families *Myctophidae*, *Gonostomatidae*, *Bathylagidae*, and juvenile pelagic nekton (Suntsov and Brodeur 2008).

During daylight hours, mesopelagic fish are mostly found in the mesopelagic zone (between 200 m and 1,000 m deep) along the continental slopes and further out into the deep ocean. Many mesopelagic species are diel vertical migrators. They move upward into the epipelagic zone at night to feed and migrate back to the mesopelagic zone at dawn to avoid predation. Although occurring from Arctic to Antarctic seas, they are most abundant in tropical and subtropical seas (FAO 1997). Scattered evidence suggest that some micronektonic mesopelagic fishes may undertake spawning and feeding migrations of up to 1,000 km (Brodeur and Yamamura 2005). California Cooperative Oceanic Fisheries Investigations (CalCOFI) larval surveys in the southern portion of the CCE consistently found that myctophids (lanternfish), gonostomatids (lightfishes) and bathylagids (deep-sea smelts) made up 90% of the larvae of deep-sea pelagic fishes (Ahlstrom 1969). In this southern part of the CCE, the dominant myctophid is *Triphoturus mexicanus*. CalCOFI larval fish sampling from in the transitional zone off Newport, OR and Crescent City, CA found densities (number/1000 m3) of 131.46 for *Myctophidae*, 1.58 for *Bathylagidae*, 0.07 for *Paralepididae* and 0.00 for *Gonostomatidae* (Auth 2009). In the subtropical eastern Pacific region, *Myctophidae*, *Gonostomatidae* and *Phosichthydae* comprise most of the total mesopelagic fish (Brodeur and Yamamura 2005). Mesopelagic larvae sampled off California and Baja California annually from 1955 to 1960 were 39.4% Myctophids (mainly *Triphoturus mexicanus*, *Stenobrachius leucopsarus* and *Diogenichthys* *laternatus*), 37.9% Gonostomatids (*Vinciguerria lucetia*, *Cyclothone* spp., and *Ichthyococcus* spp.), 17.6% Bathylagids (*Leuroglossus stilbius*, *Bathylagus ochotensis*, and *B. wesethi*) and 5.2% other, which included very few Paralepidids (Ahlstrom 1969). The genus *Vinciguerria* is now in the family Phosichthyidae.

*Myctophidae*

Myctophids are often the dominant component of micronektonic communities in the North Pacific, with very high abundances and biomass (Beamish et al. 1999; Brodeur and Yamamura 2005). Myctophids represent an important trophic link between phytophagous zooplankton such as copepods and euphausiids and higher trophic level organisms such as salmon, tuna, seabirds, and marine mammals (Brodeur and Yamamura 2005). They dominate the fish biomass in oceanic waters of the Northeast Pacific (Pearcy 1977; Gjøsæter and Kawaguchi 1980; and Beamish et al. 1999), and their transport onto continental shelves represents an important flux of energy into these systems, as represented in food web models of the CCE (Brodeur et al. 1999; Field et al. 2006).

Worldwide, myctophids comprise at least 50% of all fish larvae taken in open-water plankton tows (Moser and Ahlstrom 1974), and as adults, they comprise some 65% of all mesopelagic fishes (Stiassny 1997). Myctophids are the key members of mesopelagic fish communities and their total resource in the world oceans is estimated at 600 million tons. While distribution is worldwide, production appears to be highest in tropical and sub-tropical areas (FAO 1997). Myctophids account for about 75% of total global catch of small mesopelagic fishes (Vipin et al. 2011). Myctophids typically have a maximum size of 7-8 cm (standard length), with individuals in this size range weighing 2-6 g. A unique characteristic of the myctophids is the presence of non-bacterial bioluminescent organs that give myctophids their common name, lanternfish. Three lanternfish species (*Tarletonbeania crenularis*, *S. leucopsarus*, and *Diaphus theta*) form the bulk of micronekton fishes found in the northern California Current. These three species account for two thirds of all fishes collected in Isaac-Kidd midwater trawl tows in the upper 200 m off Oregon, USA (Pearcy 1977; Suntsov and Brodeur 2008.)

The great majority of myctophid species undergo extensive vertical diurnal migrations and while average peak abundance during the day ranges between 300-1200 m, nighttime peaks are more usually between 10-100 m (at or around the surface mixing zone). Migratory disposition may depend on factors such as recency of last feeding, general condition, and reproductive state (Nafpaktitis et al. 1977). Diel vertical migration of micronekton contributes substantially to the rapid vertical transport of organic material from epipelagic to mesopelagic zones, referred to as the biological pump. Through this biological pump, carbon fixed as living organic matter plus anthropogenic substances such as insecticides, butyltin and PCBs are transported to deep-sea ecosystems. Myctophids have been suggested as particularly good monitors of deep-sea pollution because they encounter a variety of water masses (of different origin) during their substantial diel vertical migrations (Brodeur and Yamamura 2005). In the Northeast Pacific Ocean, vertically migrating mesopelagic fish play an important role in the global carbon cycle and account for 15% to 17% of the carbon exported from the epipelagic zone down into the mesopelagic zone (Davidson et al. 2013).

Owing to their large mouths, relatively scarce and serrated gill rakers, well-developed stomach, and short intestine, myctophids consume predominantly actively moving prey (copepods, euphausiids, etc.). Among the micronekton, myctophids are believed to be the most important consumers of crustacean zooplankters, and act as competitors for prey with small pelagic fishes (such as sardine, anchovy, and saury) and the juveniles of various larger-sized oceanic fishes, such as tuna and salmon (Tyler and Pearcy 1975). Suntsov and Brodeur (2008) found that myctophids of the northern California Current primarily prey upon euphausiids, followed by hyperiid amphipods, planktonic tunicates and copepods.

In the sub-Arctic and transitional regions of the Northeast Pacific Ocean, fishes of the families *Myctophidae* and *Microstomatidae* are the most abundant by numbers and biomass, accounting for 80% to 90% of total micronektonic fish catch (Brodeur and Yamamura 2005). Off the U.S. West Coast, myctophids are known as prey for marine mammals, birds, and fish (Gjøsæter and Kawaguchi 1980; Brodeur 1990; and Brodeur and Yamamura 2005). Groundfish consume mesopelagic prey, including myctophids (Pereyra et al. 1969). In the slope region of the Bering Sea, species from the families *Bathylagidae* and *Myctophidae*, along with pollock (*Theragra chalcogramma*), were important forage fish for groundfish predators (Lang and Livingston 1986). In the Kamchatka and North Kuril Islands area, Pacific halibut (*Hippoglossus stenolepis)*, Greenland turbot (*Reinchardtius hippoglossoides)* and Kamchatka flounder (*Atherestes evermanni)* all fed on myctophids (Orlov 2007). *S. leucopsarus* were recovered from stomachs of trawl-caught sockeye (*Oncorhynchus nerka)*, pink (*O. gorbuscha)* and chum (*O. keta)* salmon and Dolly Varden trout (*Salvelinus malma)* in the Bering Sea (Nagasawa and Nishimura 1997). Among marine mammal species, Dall's porpoise (*Phocoenoides dalli*) have been particularly documented to include myctophids in their diets and consume a large portion of the myctophic biomass (Ohizumi et al. 2003).

There are few examples of commercial fisheries targeting mesopelagic fishes. A Soviet fishery for the myctophids *D. coeruleus* and *Gymnoscopelus nicholski* (species considered edible) in the Southwest Indian Ocean and Southern Atlantic began in 1977, and catches by the former Soviet Union reached 51,680 t in 1992, after which the fishery ceased (Kock 2000). Despite this, the Commission for Conservation of Antarctic Marine Living Resources still permits a total allowable catch for this fishery of 200,000 t in its convention area. An industrial purse seine fishery for the myctophid *Lampanyctodes hectoris* in South African waters closed in the mid-1980s due to processing difficulties caused by the high oil content of the fish (FAO 1997). In the late 1970s and early 1980s, researchers investigated the feasibility of developing a commercial fishery for mesopelagic fishes in the northern Arabian Sea. These studies indicated that such a fishery might be commercially feasible, especially for *Benthosema pterotum* in the Gulf of Oman region (FAO 1997). After decades of studies and planning, with recommendations based on extensive research as to the best fishing seasons, areas and depths, trial catch rates were too low (<30 tons daily per boat) to support a commercially viable fishery (Valinassab et al. 2007).

*Gonostomatidae (20 genera)*

Fishes of this family have elongated bodies with adults ranging from 2 to 30 cm. They have a number of green or red light-producing photophores aligned along the underside of their head and bodies. Their common name, bristlemouths, comes from their equally sized bristle-like teeth. The genus Cyclothone, with 12 species, is thought to be the most abundant vertebrate genus in the world (Paxton and Eschmeyer 1998). Worldwide, fishes of the families *Myctophidae* and *Gonostomatidae* account for 60% to 90% of the total micronekton catch in both weight and number (Gjøsæter and Kawaguchi 1980).

Most of the gonostomatid genus *Cyclothone* and some of the *Gonostoma* genus do not make vertical migrations, remaining in deep water. Non-migrants do not form dense (easily harvested) schools and have high wax contents. Fish with high wax contents are not considered suitable for human consumption (Brodeur and Yamamura 2005). For these reasons, the *Gonostomatidae* are considered to have little commercial fishery potential (Gjøsæter and Kawaguchi 1980).

*Paralepididae (five genera)*

Paralepidids are small to medium-sized (6 to 56 cm), very elongate and slender aulopiform fishes. The body cross-section is oval or compressed. The eye is medium to large, the snout very long and pointed with terminal mouth, but lower jaw projects as a fleshy process. They have alternately fixed and depressible fang-like teeth on the lower jaw and roof of mouth. The caudal fin is deeply forked. Their appearance is similar to that of barracuda, and for this reason their common name is barracudina. Barracudinas are found from polar to tropical regions worldwide, but are most common in the tropics. They can be found from the surface to about 800 m. Some species have separate sexes; others are synchronous hermaphrodites. They feed on small fishes. No fisheries exists, however, Paralepidids exist in large quantities in the waters off Nova Scotia and have been considered as a replacement for sperm whale (*Phseter macrocephalus*) oil due to their high body lipid content (Ackman et al. 1972).

A 2005 diet study (Allain 2005) of four tuna species from the west and central Pacific found mesopelagic fish to be an important part of the diet of three of the species. The diet of big eye tuna was 36% mesopelagic fish of which *Paralepididae* were 22.3%. The bathypelagic Paralepidid, *Magnesudes indica* was 10% of the diet. Yellow fin tuna diet was 5% mesopelagic fish including 3% *Paralepididae*. Albacore diet was 47% mesopelagics, 25% of which were Paralepidids. Only skipjack tuna, which appears to be a diurnal, epipelagic feeder, did not have mesopelagic fish in its diet.

*Bathylagidae (two genera)*

Bathylagidae (deep-sea smelts, black smelts; subclass *Actinopterygii*, order *Salmoniformes*) is a family of small (15 cm) open-ocean fish with large eyes, a small mouth, and varying body shape, that probably undertake vertical migrations between different ocean depths. There are about 35 species (Allaby 1999). As stated above in the section on *Gonostomatidae*, Ahlstrom (1969) found that 37.5% of the mesopelagic fish larvae in CalCOFI surveys were bathylagids. Bathylagid larvae exhibited a threefold range in relative abundance between years sampled, with greatest abundance when waters were cooler (Ahlstrom 1969).

#### ***3.2.1.3 Pacific sand lance (Ammodytes hexapterus)***

Pacific sand lance are an abundant nearshore species ranging from coastal California, northward to Alaska's Beaufort Sea, and westward to the Sea of Okhotsk and the water's off Japan's Hokkaido Island (Kitaguchi 1979; Craig 1984; Hashimoto 1984; Field 1988; and Robards and Piatt 1999). *Ammodytes* species worldwide, commonly known as sand lances or sand eels, are similar to each other in their life histories and trophic roles. Pacific sand lance are strongly associated with sand and gravel bottom habitat shoreward of the 50-100 m depth range (Macy et al. 1978; Field 1988; and Ostrand et al. 2005). Off British Columbia, Pacific sand lance prefer shallow depth habitat (<80 m) featuring coarse sand particles of 0.25-2.0 mm diameter grains and waters with relatively higher current speeds (Robinson et al. 2013). Sand lances, *A. hexapterus* included, are known for a habit of alternating between burying themselves individually in sandy or pebbled substrate and forming pelagic swimming schools (Richards 1965; Meyer et al. 1979; and Ostrand et al. 2005). Sand lance bury themselves both on a nightly basis during their active periods in spring through fall, and for prolonged periods during winter hibernation (Robards and Piatt 1999; Robards et al. 1999a).

Sand lance recruitment success appears to be temperature-related, such that when sea surface temperatures rise or fall beyond their preferred range, recruitment declines (Bertram et al. 2001; Arnott and Ruxton 2002; and Robards et al. 2002). Off the U.S. West Coast, the southern and warmer portion of the species' range, low sand lance recruitment in El Niño years has been shown to have notable negative effects on seabird nestling survival (Bertram et al. 2001; Hedd et al. 2006). In areas where sand lance fisheries occur, sand lance recruitment success appears to be inversely related to fisheries harvest levels (Furness 2002; Frederiksen et al. 2004; and Greenstreet et al. 2006). Interestingly, seabird predation has similar effects on sand lance recruitment in areas where sand lance fisheries do not occur (Bertram and Kaiser 1993; Hedd et al. 2006).

Pacific sand lance are not targeted in U.S. or Canadian Pacific coast fisheries. As a result, sand lance data are not collected with the geographic and temporal regularity needed to estimate coastwide abundance for coastal North American populations. Existing studies tend to not discuss the species as a coastwide stock, but instead focus on populations in particular bays and estuaries, such as Puget Sound (West 1997; Quinn 1999; and Penttila 2007), and the bays and islands of British Columbia (Bertram and Kaiser 1993; Hedd et al. 2006; and Haynes et al. 2007) and Alaska (Robards et al. 1999b; Bertram et al. 2001; and Ostrand et al.

2005). Because sand lance lack swim bladders, their populations are not good subjects for acoustical surveys, unlike several other lower trophic level species or larvae with pelagic schooling habits (Thomas et al. 2002).

Pacific sand lance prey upon plankton throughout their lives, focusing on larger-sized zooplankton, particularly copepods, as adults (Field 1988; Allen 2008; and Hipfner and Galbraith 2013). *A. hexapterus* grow to greater sizes in the northern portions of their range, reaching 270 mm (10.6 in) in the Bering Sea, but about 200 mm (7.9 in) off California (Robards et al. 1999a). Reaching maturity between their first and second years of life, none of the six *Ammondytes* species worldwide are long-lived. Pacific sand lance have been aged to 7 years, although individuals over age-3 are rarely found (Field 1988; Robards and Piatt 1999).

Off the U.S. West Coast, Pacific sand lance are known prey of marine mammals, seabirds, and fish (Hobson 1986; Litzow et al. 2000; Willson et al. 1999; and Daly et al. 2013). Of particular relevance to the Council, Pacific sand lance have been shown to figure strongly in the diet and survival of juvenile salmon (*Oncorhyncus* spp.) in the northern California Current (Beacham 1986; Daly et al. 2013). Among seabird species, rhinoceros auklet (*Cerorhinca monocerata*), tufted puffin (*Fratercula cirrhata*), and pigeon guillemot (*Cepphus columba)* are known for their heavy sand lance predation (Vermeer 1980; Bertram and Kaiser 1993; Davoren and Burger 1999; Litzow et al. 2000; and Bertram et al. 2001).

#### *3.2.1.4 Pacific saury (Cololabis saira)*

Pacific saury are a scomberesocid fish common throughout the epipelagic waters of the northern Pacific Ocean (Hubbs and Wisner 1980). They feed primarily on zooplankton, copepods, euphausiids and other small crustaceans, and reach a length of 12-13 inches. Major predators include yellowfin (*Thunnus albacares*), bluefin (*Thunnus orientalis*), and albacore tuna (*Thunnus alalunga*), fur seals, sei whales (*Balaenoptera borealis)*, birds and squid (Pinkas et al. 1971; Pearcy 1972; Kato 1992; and Gould et al. 1997b).

Pacific saury are distributed primarily between 20-25° N. lat. and the Gulf of Alaska. There are three distinct stock groups within this broad geographic area: the western Pacific (the largest), the central Pacific, and the eastern Pacific. Evidence suggests that the western and central stocks mix, while the eastern Pacific population does not (Kato 1992). Within the water column, they are found from the surface down to approximately 230 m. Saury distribution is strongly influenced by sea surface temperatures (Tseng et al. 2013), with a preference for waters between 15-18° C. As a result, Pacific saury make extensive migrations from the subtropical spawning regions to subarctic regions as temperatures change seasonally. This link between distribution and sea surface temperatures may also make Pacific saury susceptible to interannual and interdecadal environmental change (Tseng et al. 2013). For this reason, Pacific saury may be a useful indicator of changing oceanographic conditions (Brodeur et al. 2005).

There has been debate regarding the lifespan of Pacific saury, but more recent research suggests it is 2 years with maturity reached after 1 year (Huang et al. 2007). Pacific saury spawn throughout the year in 2-4 month intervals with defined peak spawning periods (Love 2011). Females produce 500-2000 eggs per batch depending on size (Kato 1992). Within the eastern Pacific population, peak spawning first occurs in January off southern California. Saury spawning occurs off the coast of San Francisco in the spring, and then the population migrates northward, with saury eventually spawning off the Washington coast in August through October. Recruitment success is determined by oceanographic conditions and therefore abundance and size composition exhibit large variations from year to year (Huang et al. 2007). Current population estimates for the eastern Pacific stock are unavailable, but past estimates put the entire eastern Pacific stock at 450,000 tons (Kato 1992).

The western Pacific saury stock is the largest and is fished heavily by Japan for food and fish meal. Additionally, it is a preferred baitfish in the longline fishery for tuna. The average annual catch in Japan is 258,000 mt (Huang et al. 2007). No eastern Pacific saury fishery currently exists in U.S. waters. In the 1960s, the western Pacific saury stock reached record lows, which led to research by the Japanese into a potential U.S. waters fishery. However, with catches not considered high enough for economical fishing and the rebound of the Western Pacific population, fishing efforts off the coast of the U.S. were abandoned in the 1970s (Kato 1992).

#### *3.2.1.5 Silversides (family Atherinopsidae)*

There are three species of silversides off the U.S. West Coast: jacksmelt *(Atherinopsis californiensis)*, topsmelt *(Atherinops affinis)*, and grunion *(Leuresthes tenuis)*. "Smelt" is included in the common names of two of these species; however, silversides are not true smelts of the family *Osmeridae*. Osmerid smelts are described in Section 3.2.1.6. In 2010, the Council designated jacksmelt as an ecosystem component species of the CPS FMP to ensure monitoring of their landings in the fishery.

*Jacksmelt (Atherinopsis californiensis)*

Jacksmelt occur throughout the year in nearshore waters from the tip of Baja California, Mexico, to Yaquina Bay, Oregon. They are schooling fish, often found near kelp and other structures, as well as in most bays and estuaries south of Coos Bay, Oregon. Jacksmelt are rarely seen offshore and are most often found at depths ranging from 5-50 feet. They are a relatively fast growing species and can reach approximately five inches in their first year and up to eight inches in their second, with a maximum size of about 17 inches (Clark, 1929; Miller and Lea 1972). Jacksmelt are known to spawn several times during their October to April spawning season, and to lay their eggs on nearshore algae and eelgrass.

Jacksmelt is an important member of the coastal and estuarine marine community in California (Allen and DeMartini 1983), as both a consumer and as a prey species, however they are a relatively poorly studied species. Jacksmelt, like most atherinids, are omnivorous, feeding on algae, crustaceans, and detritus, with their diet varying based on their habitat (Horn 2006). In turn, they are eaten by a variety of nearshore and kelp forest piscivorous fishes such as yellowtail (*Seriola Dorsalis)*, kelp bass (*Paralabrax clathratus*), California halibut (*Paralichthys californicus*) and sharks among others. Jacksmelt are also eaten by some piscivorous birds such as brown pelicans (*Pelecanus occidentalis*), gulls, least terns (*Sterna antillarum*) and common murres (*Uria aalge*) and is likely eaten by other surface feeding birds as well as some marine mammals (Baxter 1960; Feder et al. 1974). Although jacksmelt are likely preyed upon by a variety of predators, little is known about their relative importance as a prey component of the nearshore environment.

As a commercial species along the U.S. West Coast, jacksmelt is of minor importance, showing up intermittently as incidental catch in some fisheries in California. Most commercial catch of jacksmelt over the years has been incidental to roundhaul/encircling net fisheries; however, some minor directed catch of jacksmelt, typically by gillnets in harbors and bays, has occurred historically with the fish marketed in fresh fish markets. Jacksmelt commercial landings have varied over the last 70 years with landings reaching a high in 1945 of approximately 1,000 mt (likely a result of the high sardine catches at the time). Since the mid-1990s, annual landings have varied between a high of approximately 18 mt to a low of less than a ton (CDFG 2001; CDFW 2013). From 2000 through 2009, average incidental catch in the coastal purse seine fisheries was 5.79 mt, with most of the catch being landed in the Los Angeles area as incidental catch to the CPS fisheries (PFMC 2011a). In California, jacksmelt are also commonly caught from piers and along the shoreline (Love 2011) and make up a notable portion of recreational landings in the state.

*Topsmelt (Atherinops affinis)*

Similar to jacksmelt, topsmelt range from the Gulf of California, Baja California, Mexico, to the southern end of Vancouver Island, British Columbia; however, it is not common north of Tillamook Bay, Oregon (Emmett et al. 1991). They are usually found near the ocean's surface and are common inhabitants of the nearshore coastal environment, typically found around kelp beds and along sandy beaches. Topsmelt are also often the most abundant pelagic fishes in many estuaries along the Pacific coast (Horn and Allen 1985) and like jacksmelt, are uncommon offshore. Most juvenile and adult topsmelt make seasonal movements between bay and estuarine environments and coastal kelp beds, being typically found in or close to bays in the spring and summer when they move to shallow water to spawn and coastal areas in the fall and winter (Wang 1986). During their first year of growth, topsmelt grow from 2.5 to 4 inches, adding another 2 inches during their second year, at which time most are sexually mature. They are thought to live up to 8 years old, with the largest measured topsmelt reaching approximately 15 inches (Miller and Lea, 1972).

Topsmelt are omnivorous, with their prey and feeding habits varying depending on the habitat they are using. When occupying nearshore kelp and beach habitat, they typically feed on zooplankton near the surface, while primarily being herbivorous and feeding along the bottom when in shallow estuarine habitats (Quast 1968; Horn et al. 2006). Topsmelt are the prey of a variety of nearshore piscivorous fish, birds and marine mammals, including kelp and sand bass (*Paralabrax spp.*), California halibut, leopard sharks (*Triakis semifasciata*), cormorants (*Phalacrocorax* spp.), terns and sea lions (Feder et al. 1974, Kao 2000).

As it relates to fishery exploitation, topsmelt are far less common as incidental catch compared to jacksmelt in commercial fisheries, possibly due to their smaller size and lower affinity for schooling. However, like jacksmelt, topsmelt make up a notable portion of the recreational pier and shore catch throughout California (CDFG 2001; CDFW 2013).

*Grunion (Leuresthes tenuis)*

The primary range for California grunion is from the middle of Baja California northward to Point Conception, California. They are non-migratory and are most often found in shallow water (15-40 ft) close to the shoreline. Little is known about the overall population status of the species, but it is not an abundant stock and the population is likely concentrated in southern California (Fritzsche et al. 1985).

California grunion grow rapidly in their first year of life reaching 5 inches long by age one. At this point, they are capable of spawning and typically live only two more years. The most studied and well known aspect of the life history of California grunion is their unusual and unique spawning behavior. During spawning, they strand themselves on sandy beaches. Grunion are the only California fish known to exhibit this behavior. Spawning occurs from early March through September during very specific lunar and tidal time periods. During the 3 or 4 nights following the full moon and only in the few hours immediately after high tide, grunion use waves to swim as high up onto the beach as possible and dig themselves into the sand to spawn. After spawning, they use the next wave to return to the ocean (Martin et al. 2011). The fertilized eggs remain in the sand and incubate until the next high tide series, when they hatch. Females can produce up to 3,000 eggs every two weeks and spawn four to eight times a year (Byrne and Avise 2009).

California grunion are infrequently caught incidentally by the CPS fishery and have historically had no commercial fisheries. However, they do support a very limited but important recreational fishery in southern California (CDFG 2001). During a limited time of the year, the fish may be taken by hand when they are on the beach. Although not an abundant prey item, a variety of nearshore fish, bird and marine mammal predators are known to feed on grunion, primarily when they aggregate before and during spawning (Martin et al. 2011).

### *3.2.1.6 Osmerid Smelts*

Osmerid smelts found in U.S. West Coast estuarine and marine waters include: whitebait smelt (*Allosmerus elongatus*), capelin (*Mallotus villosus*), surf smelt (*Hypomesus pretiosus*), night smelt (*Spirinchus starksi*) and eulachon (*Thaleichthys pacificus*). Eulachon is listed as threatened under the ESA and is managed under that law; however, management measures for eulachon focus on the nearshore and freshwater portions of its range. Eulachon occur within Federal waters, but are not subject to directed fisheries there. This action to prevent the future development of fisheries for eulachon and other forage fish species in Federal waters is consistent with eulachon recovery planning under the ESA (NMFS 2013a). Therefore, eulachon is retained on the list of osmerid smelts considered Shared EC Species for this action. Delta smelt (*H. transpacificus*) and longfin smelt (*S. thaleichthys*) are both osmerids, but are not eligible as Shared EC Species because they are freshwater and estuarine species not found offshore of 3 nm (CDFG 2009; USFWS 2013). Delta smelt is listed as endangered under the ESA and longfin smelt is listed as threatened in California under the California Endangered Species Act.

Although various smelt species have been part of the diets of Native Americans for centuries (see Gustafson et al. 2010 for eulachon in human cultural history) and are still taken in small nearshore fisheries coastwide, they are not subject to offshore commercial fisheries off North America. As a result, there is little information on the marine life stages of these species and data taken on smelt found in marine waters often does not distinguish between the different species of smelt. Therefore, this section discusses osmerid smelts as a species group, with some references to particular species, but will not discuss each smelt species individually.

Like salmonids, osmerid smelts of the northeastern Pacific Ocean are anadromous and smelt populations tend to be more strongly aggregated as they approach or arrive in their estuarine and freshwater ranges (Martin and Swiderski 2001; Rosenfeld and Baxter 2007; Vandeperre and Methven 2007; Arimitsu et al. 2008; and Therriault et al. 2009). Osmerid smelt species have similar life histories, varying from each other in the northern and southern extents of their ranges, and varying from each other in how far upriver they travel to spawn. Whitebait smelt, surf smelt, night smelt, longfin smelt, and eulachon are all broadly distributed along the U.S. West Coast, with surf smelt having the most southerly distribution (Hubbs 1925; Eschmeyer et al. 1983; Ilves and Taylor 2008; Gustafson et al. 2010; and Love 2011). Capelin is a circumpolar species, with the southern end of its distribution occurring off northern Washington and in the Strait of Juan de Fuca (Brown 2002; Rose 2005; and Dodson et al. 2007).

Osmerid smelts are short-lived, several with 2-3 year lifespans, and most living no longer than 8-9 years. Like other anadromous species, some smelt species, such as eulachon, breed once before dying (Macy et al. 1978; Christiansen et al. 2008; and Gustafson et al. 2010). Most Pacific *Osmeridae* with marine life stages, as opposed to those that are almost exclusively freshwater species, spawn in estuarine waters and immediately seaward of the tideline. Of the *Osmeridae* found in the northeast Pacific, eulachon travels the farthest upstream to spawn (Mecklenburg et al. 2002). Smelt eggs adhere to sand particles and both smelt eggs and the spawning adults are heavily preyed upon during the spawning through egg maturation periods.

Osmerid smelts are planktivorous and several studies have shown that adult-stage smelts rely heavily upon crustacean zooplankton like krill (Miller and Brodeur 2007; Wilson 2009; Miller et al. 2010; and Love 2011). Off the U.S. West Coast, osmerid smelts are known prey of marine mammals, seabirds, and fish (Antonelis and Perez 1984; Hunt et al. 1999; London et al. 2002; Roby et al. 2003; Emmett and Krutzikowsky 2008; Roth et al. 2008; Lance and Jeffries 2009; and Strong 2010,). Of particular relevance to the Council, osmerid smelts are parts of the diets of Chinook salmon (*Oncorhynchus tshawytscha*, Hunt et al. 1999), Pacific whiting (*Merluccius productus)*, rockfish, and jack mackerel (*Trachurus symmetricus*, Emmett and Krutzikowsky 2008). Smelts are taken as bycatch in the pink shrimp (*Pandalus jordani*) fishery (Hannah and Jones 2007) and in the groundfish fisheries (Al-Humaidhi et al. 2012).

#### *3.2.1.7 Pelagic Squids other than Humboldt Squid*

Pelagic squid in the Shared EC Species category include all species from the families: *Cranchiidae, Gonatidae, Histioteuthidae, Octopoteuthidae, Ommastrephidae* except Humboldt squid (*Dosidicus gigas*), *Onychoteuthidae, and Thysanoteuthidae*.

*Cranchiid squids*

Cranchiid squids are known as "glass squids" for their transparent or translucent mantles. Cranchiid squids are broadly distributed throughout the world ocean, except for within the Arctic Ocean (FAO 2010). A common life history characteristic of cranchiids is that many species tend to occupy sunlit pelagic waters as juveniles, but descend to greater ocean depths as they grow larger and older (Voss 1980). This cranchiid habit of descending to great depths with age has confused squid taxonomists in their attempts to distinguish different cranchiid species and habitats (Voss 1980). There are no directed fisheries for cranchiid squids, possibly because their ammonia-filled, gelantinous mantles make them unappealing for human consumption (FAO 2010). Their North Pacific predators include groundfish consuming them at their demersal adult life stages, and sharks, tunas, and a wide variety of marine mammals and seabirds (Antonelis et al. 1987; Hills and Fiscus 1988; Gould et al. 1997a; Tsuchiya et al. 1998; Buckley et al. 1999; Drazen et al. 2001; Walker et al. 2002; Ohizumi et al. 2003; Pitman et al. 2004; and Kubodera et al. 2007). Clarke (1996) considers *Cranchiidae*, along with *Ommastrephidae*, and *Histioteuthidae* (described below) to be the most important cephalopod families in the diets of whales.

*Gonatid squids*

Many high seas squid species are distinguishable from each other only by subtle differences in the shapes of their mantles or configurations of their tentacles, some of which are only visible under magnification. Gonatid squids are known as "armhook squids" for having small hooks, rather than suckers, on some parts of some of their tentacles (FAO 2010). Gonatid squid are temperate and polar species that inhabit near-surface waters as juveniles, but descend to mesopelagic depths as they grow to adulthood. Of the squid families of the northeast Pacific Ocean, *Gonatidae* are the most abundant (Nesis 1997). Although *Gonatidae* are often found as prey within the stomachs of higher order predators, the delicacy of the bodies of most gonatid species makes collecting organisms difficult, complicating potential ecology and life history studies for these species (Jorgensen 2007). Except for one of the more dermersal of the *Gonatidae*, *Berryteuthis magister*, gonatid squids are not the subject of target fisheries, but they can be taken incidentally in temporal and near-polar fisheries (Jorgensen 2007). *Berryteuthis magister* has been directly targeted in commercial fisheries off Russia and Japan since the 1960s, but is primarily taken as bycatch in demersal fisheries off northern North America (Nesis 1997). Although life history information for *Gonatidae* is minimal, they are thought to live for approximately 2 years, and to spawn throughout the year, with some periods of concentrated spawning (FAO 2010). Gonatid squid prey heavily upon euphausiids and other crustacean zooplankton as juveniles, then descend in the water column as adults, where they feed broadly on other squids, fishes, and crustaceans. Their North Pacific predators include groundfish, Chinook salmon, sharks, albacore, and a wide variety of marine mammals and seabirds (Antonelis et al. 1987; Hills and Fiscus 1988; Pearcy et al. 1988; Nesis 1997; Buckley et al. 1999; Drazen et al. 2001; Walker et al. 2002; Pitman et al. 2004; Watanabe et al. 2004b; and Kubodera et al. 2007).

*Histioteuthid squids*

Histioteuthid squids have several distinct physical characteristics that make them relatively easy to distinguish from squids of other families. One of their common names, "cock-eyed squids" refers to the size differences between their two eyes, with the left eyes of histioteuthids being noticeably larger than their right eyes. Their more complimentary common name, "jewel squids" references the photophores, light-emitting spots that cover their mantles and arms (FAO 2010). In addition to these distinctive characteristics, histioteuthid squids have webbed connective tissue between their arms, giving them a moderate umbrella look. Histioteuthid squid are deep water species (Watanabe et al. 2006), making them less appealing as fisheries targets. There are no large-scale commercial fisheries for histioteuthids, although the United Nations' Food and Agriculture Organization (FAO) considers future bycatch of these species a possibility, should deep-water trawling (greater than 1500 m) become more commonplace (FAO 2010). Marine waters off the U.S. West Coast are closed to trawling offshore of the 700 fathom (1280 m) depth contour (50 CFR 660.76), making future histioteuthid bycatch unlikely in West Coast fisheries. Histioteuthids prey upon fish and crustaceans (Voss et al. 1998) and are preyed upon by groundfish, sharks, tunas, and a wide variety of marine mammals and seabirds (Antonelis et al. 1987; Hills and Fiscus 1988; Clarke 1996; Gould et al. 1997a; Tsuchiya et al. 1998; Voss et al. 1998; Drazen et al. 2001; Walker et al. 2002; Ohizumi et al. 2003; Pitman et al. 2004; and Kubodera et al. 2007).

*Octopoteuthid squids*

Octopoteuthid squids, known as "octopus squids" for their eight arms, inhabit mesopelagic and deeper waters of the world's tropical oceans. Their preference for deeper waters makes them challenging research subjects and infrequently encountered in fisheries; their gelatinous bodies also make them unappealing for human consumption (FAO 2010). Several octopoteuthid species are thought to have wide-ranging habitats throughout the world ocean, although there is an octopoteuthid species with a range thought to be limited to the deep waters of the CCE, *Octopoteuthis deletron* (FAO 2010). Like other deep ocean, high seas squids, octopoteuthids are a frequent prey of toothed whales (Clarke 1996), and *Octopoteuthis deletron* serves that role within the CCE (Fiscus et al. 1989), as well as being preyed upon by northern elephant seals and other pinnipeds (Condit and LeBoeuf 1984). Little is known about the life history and reproductive behavior of octopoteuthids, although their complex bioluminescing habits have been recently studied by researchers collecting data via remotely-operated underwater vehicles, or ROVs (Bush et al. 2009; Hoving et al. 2012; and Zylinski and Johnsen 2014). Their known Pacific predators include groundfish, sharks, tunas, and a wide variety of marine mammals and seabirds (Condit and LeBoeuf 1984; Hills and Fiscus 1988; Fiscus et al. 1989; Clarke 1996; Gould et al. 1997a; Tsuchiya et al. 1998; Drazen et al. 2001; Walker et al. 2002; Ohizumi et al. 2003; Pitman et al. 2004; and Kubodera et al. 2007).

*Ommastrephid squids*

Ommastrephids are known as "flying squids" for their habit of escaping predators by hurling themselves above the ocean's surface and skimming over the water for several meters at a time. According to the FAO, ommastrephids are "the most abundant, widely distributed and ecologically active family of cephalopods" (FAO 2010 at p. 269). The muscularity required for their flying habits make many ommastrephid species appealing for human consumption and they are important commercial fishery targets throughout the world (FAO 2010). As elsewhere in the world, ommastrephids are broadly distributed throughout the North Pacific Ocean. Like all squid species, ommastrephid species are short-lived, usually only living for one year. Humboldt squid and neon flying squid (*Ommastrephes bartramii*) dominate commercial catches of North Pacific ommastrephids (FAO 2010). Neon flying squid were the subject of large high seas driftnet fisheries in the 1970s and 1980s, and have been studied by various scientists of North Pacific nations (Yatsu et al. 1997; Bower and Ichii 2005; and FAO 2010). Ommastrephids, particularly the larger-bodied species like neon flying squid and Humboldt squid, must be voracious predators in order mature quickly and to attain their large sizes. Their high growth rates mean that their survival, abundance and distribution are all strongly dependent upon prey availability (FAO 2010). Bower and Ichii (2005) demonstrated that neon flying squid abundance is also strongly linked to water temperature and salinity, which may themselves be indicators of prey availability. Due to their rapidly changing body size, the prey favored by the larger-bodied ommastrephids varies considerably throughout their brief lives, ranging from the zooplankton and myctophids they favor as juveniles to the larger fish they consume as adults (Yatsu et al. 1997; Walker et al. 2002; Chen and Chiu 2003; Watanabe et al. 2004a; Bower and Ichii 2005; Xinjun et al. 2008; and FAO 2010). Similarly, ommastrephids are prey for many different species of fish, mammals, and birds.

*Onychoteuthid squids*

Like gonatids, the common name for squids of the family *Onychoteuthidae*, "clubhook" refers to apparatuses at the ends of their tentacles, which include suckers, hooks, and club-shaped tentacle ends. Onychoteuthids tend to inhabit open ocean areas of the temperate and tropical oceans, eschewing northern and southern polar waters. The two clubhook squid species that appear in the U.S. West Coast EEZ as both prey and predators, *Onykia robusta*, and *Onychoteuthis borealijaponicus*, have the one-year life spans of many squid species. Like neon flying squid and Humboldt squid, these Onychoteuthid squids are voracious, rapidly-growing predators that die after spawning. As juveniles, they are prey to a wide range species and adults, they prey on some of those same species (FAO 2010). Onychoteuthids are considered muscular and fast-swimming, as opposed to some of the more gelatinous squid families like Octopoteuthids. Although experimental fisheries have been tried for *Onykia robusta*, the robust clubhook squid, its flesh is too ammonia-filled to be made palatable for human consumption (FAO 2010). Boreal clubhook squid, *Onychoteuthis borealijaponicus*, is caught in small numbers off the northern U.S. West Coast, and in larger numbers around northern Japan. The boreal clubhook squid appears to be less abundant in the northeastern Pacific than in the northwestern Pacific (Orlov 2007), making it less likely to support U.S. or Canadian fisheries. Scientific data and analyses for these species is somewhat slim; while their ranges within the North Pacific are generally known, clarity on their taxonomic classification is relatively new (Tsuchiya and Okutani 1991) and limited individual samples of these species makes describing their life histories challenging (Orlov 2007).

*Thysanoteuthid squids*

There is only one living Thysanoteuthid squid species, *Thysanoteuthis rhombus*, commonly known as "Diamond" or "rhomboid" squid for its broad diamond-shaped mantles. Diamond squid is widely distributed in a large belt of temperate and tropical waters throughout the world ocean. This species exclusively uses tropical waters for spawning and is one of the few squid species with egg masses known to float at the ocean's surface (Nigmatullin et al. 1995, Miyahara et al. 2006). Off the U.S. West Coast, diamond squid is not common in the cooler waters off Oregon and Washington. Although capable of migrations to 650-800 meters in depth, diamond squid often drift fairly passively in upper ocean layers. Like other squid species, they feed on myctophids, small fishes and small squids (Bower and Miyahara 2005). Their varied vertical distribution makes them prey for a range of predators, from highly migratory tunas feeding near the surface, to sperm whales feeding at lower depths (FAO 2010). Like the other squid discussed in this section, diamond squid are highly fecund and have a one-year life cycle. Diamond squid tend not to aggregate in large numbers in much of their world habitat, making them more difficult to target in commercial fisheries. However, they do aggregate somewhat within the coastal waters of Japan, and are caught in relatively large numbers there (Miyahara et al. 2005; FAO 2010).

### 3.2.2 Council-Managed (FMP) Predators of Shared EC Species

As stated in Section 1.2, *Purpose and Need*, "The purpose of this action is to prohibit new directed commercial fishing in Federal waters on unmanaged, unfished forage fish species . . ." This action focuses on the role of Shared EC Species as forage, or prey, for other species within the U.S. portion of the CCE. Therefore, the affected biological environment includes predators of Shared EC Species. While there is a variety of species interactions other than the predator/prey relationship (e.g. competition, parasitism, etc.), this section 3.2.2 focuses on the predator/prey relationships, if known, between FMP species and Shared EC Species. This section is not a complete discussion of all the predator/prey interactions for all the FMP species; it is simply a targeted look at connections between FMP species and Shared EC Species. All FMP species prey upon wide ranges of prey species, often including other FMP species and sometimes including at least some Shared EC Species. We may have little or no diet data for many CCE species, which limits our understanding of the full web of predator-prey relationships between species. This section does not provide detailed life history information on Council-managed species. Each FMP contains information on its managed species, as do the stock assessments and many NEPA analyses completed for actions taken under the authority of the FMPs.

#### *3.2.2.1 CPS FMP species*

*Shared EC Species that are prey of at least one CPS FMP species:*

- *Mesopelagic fishes*
- *Pacific sand lance*
- *Pacific saury*
- *Osmerid smelts*
- *Pelagic squids*

The CPS FMP includes five species and one species group within its FMU: Pacific sardine (*Sardinops sagax*), Pacific or "chub" mackerel (*Scomber japonicas*), northern anchovy (*Engraulis mordax*), market squid (*Loligo opalescens*), jack mackerel, and krill or euphausiids. General descriptions of the life histories of CPS FMP species may be found in Appendix A of Amendment 8 to the CPS FMP (PFMC 1998). Most CPS FMP species fit within the low trophic level group described in Section 3.2.1.3 of the FEP (PFMC 2013).

Most of the CPS FMP finfish species are similarly sized to Shared EC finfish species, have the same prey as Shared EC Species, and are consumed by the same predators as Shared EC Species. Adult Pacific mackerel are known to prey upon copepods and other crustacean zooplankton, and on unspecified fish (Collette and Nauen 1983). Jack mackerel, however, is a voracious mid-trophic predator that preys upon several Shared EC Species. While euphausiids are jack mackerel's dominant prey, Brodeur et al. (1987) found fishes (including northern anchovy) in several jack mackerel stomachs. Grinols and Gill (1968) found Pacific saury and myctophids in jack mackerel diets of fish sampled off Oregon. Emmett and Krutzikowsky (2008) analyzed the stomach contents of night-feeding jack mackerel collected over a seven year period and found their prey to include a wide variety of crustaceans, molluscs, and fishes, including osmerids, myctophids, and sand lance. Brodeur et al. (2014) characterized jack mackerel, along with Pacific whiting, spiny dogfish, and albacore as one the CCE predators with the greatest predation influence on the abundance of forage fish populations (including some Shared EC Species) in the CCE. Therefore, the CPS FMP species jack mackerel may be considered a predator of the following Shared EC Species or species groups: mesopelagic fishes, Pacific sand lance, Pacific saury, osmerid smelts, and, possibly, pelagic squids.

#### *3.2.2.2 Groundfish FMP species*

> *Shared EC Species that are prey of at least one Groundfish FMP species:*
>
> - *Mesopelagic fishes*
> - *Pacific sand lance*
> - *Pacific saury*
> - *Silversides*
> - *Osmerid smelts*
> - *Pelagic squids*

There are over 90 species in the Groundfish FMP's FMU, including: 60+ rockfish species, 12 flatfish species, 6 roundfish species, 6 sharks and rays, plus spotted ratfish (*Hydrolagus colliei*), finescale codling (*Antimora microlepis*), and Pacific grenadier (*Coryphaenoides acrolepis)*. General descriptions of the life histories of Groundfish FMP species may be found in Appendix B, Part 2, to the Groundfish FMP (PFMC 2005b). Many groundfish species occupy the mid-trophic levels that may prey upon Shared EC Species and, as a group, are described with other mid to high trophic level fishes and invertebrates in Section 3.2.1.3 of the FEP (PFMC 2013). Species of the Groundfish FMP tend to occupy those parts of the water column close to or at the ocean floor; therefore, their prey from the Shared EC Species group tend to be those species that are also found at or near the ocean floor. Groundfish FMP species diet data varies widely from species to species, with some species being particularly well-studied and others not studied at all. This Section 3.2.2.2 separates Groundfish FMP species roughly by type, addressing whether Shared EC Species are eaten by some members of the groups: roundfish, rockfish, flatfish, and minor Groundfish FMP species (sharks, skates, ratfish, morids, and grenadiers). More detailed diet descriptions for some groundfish species are available in Chapter 6 of Groundfish Essential Fish Habitat Synthesis: A Report to the Pacific Fishery Management Council (NMFS 2013b; and Appendix at NMFS 2013c). Groundfish species for which we could not find diet analyses are not discussed herein.

*Roundfish*

Laidig et al. (1997) examined the contents of 1,868 sablefish (*Anoplopoma fimbria*) stomachs, found sablefish to be strongly piscivorous, and found their prey to include Shared EC Species from the mesopelagic fish and pelagic squid groups. Brodeur et al. (2014) confirmed sablefish predation on myctophids, based on stomachs collected in 2005 and 2008. Buckley et al. (1999) analyzed the diets of Pacific whiting (1,334 stomachs) and sablefish (731 stomachs), among other groundfish species. Both species eat a wide variety of prey, and their prey includes the Shared EC Species myctophids, gonostomatids, Pacific saury, osmerid smelts, and gonatid squids (Buckley et al. 1999). Brodeur et al. (1987) also included sablefish and Pacific whiting in a larger study of the diets of finfish species and found sablefish and whiting stomach contents to include the Shared EC Species or species groups of myctophids, Pacific sand lance, Pacific saury, and osmerid smelts. Emmett and Krutzikowsky (2008) examined Pacific whiting stomach contents from samples taken off Oregon, and found whiting diet to include osmerid smelt and Pacific sand lance. Brodeur et al. (2014) characterize Pacific whiting as one of the most important predators in the EEZ for the effects their predation has on forage fish, including osmerids, population abundance. Tinus (2012) found a wide variety of fishes, including Pacific sand lance, and invertebrates in the stomachs of lingcod (*Ophiodon elongatus*) taken off Oregon. Beaudreau and Essington (2009) also found sand lance in the stomachs of lingcod taken off the San Juan Islands of Washington State, as well as other Shared EC Species groups, mesopelagic fishes and osmerids. Therefore, Groundfish FMP roundfish species may be considered predators of the following Shared EC Species or species groups: mesopelagic fishes, Pacific sand lance, Pacific saury, osmerid smelts, and pelagic squids.

*Rockfish*

Brodeur and Pearcy (1984) examined the contents of 480 stomachs of a mix of five shelf rockfish species: yellowtail rockfish (*Sebastes flavidus*), canary rockfish (*S. pinniger*), Pacific ocean perch (*S. alutus*), splitnose rockfish (*S. diploproa*), and darkblotched rockfish (*S. crameri*). This study found that these shelf rockfish, taken off the coast of Oregon, fed predominantly on euphausiids, but also that their prey included myctophids, osmerid smelts, Pacific sand lance, and gonatid squids (Brodeur and Pearcy 1984). Brodeur et al. (1987) examined over 1,600 stomach of 20 finfish species taken off Oregon, including black rockfish (*S. melanops*) and yellowtail rockfish. Both black and yellowtail rockfish diets in the Brodeur et al. (1987) study had eaten a wide variety of smaller-sized crustaceans, but also included Pacific sand lance and osmerid smelts. A more recent study of black rockfish taken off Oregon also showed osmerid smelts in black rockfish stomachs (Gladics et al. 2014). Adams (1987) examined the contents of 381 widow rockfish stomachs and found that, although widow rockfish feed heavily on salps (*Thaliacea* spp.), their Shared EC Species prey include myctophids. Buckley et al. (1999) collected stomach samples from commercially important groundfish species taken off the U.S. West Coast, including shortspine and longspine thornyhead, and found the two thornyhead species diets to include bathylagids, myctophids, Pacific saury, and gonatid squid. Therefore, Groundfish FMP rockfish species may be considered predators of the following Shared EC Species or species groups: mesopelagic fishes, Pacific sand lance, Pacific saury, osmerid smelts, and pelagic squids.

*Flatfish*

Dover sole (*Microstomus pacificus*), one of the most common West Coast flatfish species, predominantly preys upon benthic worms and smaller benthic crustaceans (Pearcy and Hancock 1978, Gabriel and Pearcy 1981, Buckley et al. 1999), rather than on the finfish and squid of the Shared EC Species groups. Pearcy and Hancock (1978) confirmed this trend for other, smaller flatfish species, finding that rex sole (*Glyptocephalus zachirus*) has a diet similar to Dover sole, feeding on polychaetes and amphipods, while Pacific sanddab (*Citharichthys sordidus*) and slender sole (*Lyopsetta exilis*, not an FMP species) tend to prey on pelagic crustaceans. Ketchen and Forrester (1966) found that petrale sole (*Eopsetta jordani*) preyed upon Pacific sand lance in addition to its primary prey of euphausiids and Pacific herring (*Clupea pallasii*). Buckley et al. (1999) also looked at the stomach contents of arrowtooth flounder (*Atheresthes stomias*), a larger-bodied flatfish, and found that arrowtooth prey largely upon a wide variety of crustaceans and other invertebrates, but that their vertebrate prey includes osmerid smelts and mesopelagic fishes. Yang and Nelson (2000) studied the diets of a variety of groundfish taken off Alaska, and found that arrowtooth flounder taken off Alaska also prey primarily upon crustaceans, with some osmerids, Pacific sand lance, and myctophids in their diets. Therefore, Groundfish FMP flatfish species may be considered predators of the following Shared EC Species or species groups: mesopelagic fishes, Pacific sand lance, and osmerid smelts.

*Minor Groundfish FMP species (sharks, skates, ratfish, finescale codling, and Pacific grenadier)*

Jones and Geen (1977) studied the stomach contents of spiny dogfish (*Squalus acanthias*) taken off British Columbia and found both eulachon and Pacific sand lance in dogfish stomachs. Brodeur et al. (1987) found gonatid squid beaks in the stomachs of soupfin sharks (*Galeorhinus zyopterus*) and Brodeur et al (2014) found osmerid smelts in the stomachs of spiny dogfish. Although CCE dogfish is not as abundant as Pacific whiting, Brodeur et al (2014) characterized spiny dogfish as one of the EEZ predators that most strongly influences forage fish biomass. Grinols and Gill (1968) observed blue sharks (*Prionace glauca*, an HMS FMP species), and soupfin sharks feeding on Pacific saury and myctophids off the coast of Oregon. Robinson et al. (2007) collected longnose skates (*Raja rhina*) off the coast of California and identified gonatid squids, histioteuthid squids, and myctophids within the wide variety of prey species in their stomachs. Leopard sharks sampled from California's Elkhorn Slough had eaten a variety of invertebrates as well as several fish species, including Pacific topsmelt (Kao 2000). Diets for big skate (*R. binoculata*) taken off the U.S. West Coast have not been identified to the species or family level; however, Ebert et al. (2008) found Pacific sand lance within the varied diet of big skates sampled from the Gulf of Alaska. There are few food habits studies on ratfish, although those studies that do address ratfish diet characterize ratfish as preying primarily upon smaller invertebrates like shrimp, molluscs, and echinoderms (Johnson and Horton 1972; Quinn et al. 1980), and thus are less likely to prey upon Shared EC Species. There is little available information on the diets of CCE finescale codling. Like its Atlantic analog, blue antimora (*Antimora rostrata*), finescale codling occupies bathypelagic waters and tends to regurgitate upon being raised to the surface, making stomach content sampling difficult (Sedberry and Musick 1978); therefore, finescale codling diets were not considered in this EA. A Drazen et al. (2001) study on the diets of Pacific grenadier and giant grenadier (*Albatrossia pectoralis*, not an FMP species) identified Shared EC pelagic squids (cranchiidae, gonatidae, histioteuthidae, octopoteuthidae) among the Pacific grenadier stomach contents. Buckley et al. (1999) also identified gonatid and cranchiid squid as Pacific grenadier prey, as well as myctophids. Therefore, minor Groundfish FMP species (sharks, skates, ratfish, finescale codling, and Pacific grenadier) may be considered predators of the following Shared EC Species or species groups: mesopelagic fishes, Pacific sand lance, Pacific saury, silversides, osmerid smelts, and pelagic squid.

#### *3.2.2.3 HMS FMP species*

The FMU for the HMS FMP includes: North Pacific albacore, yellowfin tuna, bigeye tuna (*Thunnus obesus*), skipjack tuna (*Katsuwonus pelamis*), northern bluefin tuna, common thresher shark (*Alopias vulpinus*), shortfin mako or bonito shark (*Isurus oxyrinchus*), blue shark, striped marlin (*Tetrapturus audax*), swordfish (*Xiphias gladius*), and dorado or dolphinfish (*Coryphaena hippurus*). General descriptions of the life histories of HMS FMP species may be found in Appendix F to the HMS FMP (PFMC 2003). HMS FMP species are among the highest order cold-blooded predators of the CCE and, as a group, are described with other mid to high trophic level fishes and invertebrates in Section 3.2.1.3 of the FEP (PFMC 2013). Species of the HMS FMP tend to occupy waters farther offshore than many other Council-managed species; therefore, their prey from the Shared EC Species group tend to be those species that are also found farther offshore.

*Shared EC Species that are prey of at least one HMS FMP species:*

- *Round and thread herring*
- *Mesopelagic fishes*
- *Pacific saury*
- *Silversides*
- *Pelagic squids*

As their name implies, the HMS FMP species that spend some part of their life cycle within the U.S. West Coast EEZ also migrate to and throughout the larger Pacific Ocean. Diet studies for the HMS FMP species that migrate between the U.S. EEZ, the EEZs of other nations, and the high seas are developed by scientists from the member nations of the multi-national HMS management entities of the Pacific Ocean, described in the FEP at Section 3.5.4.4 (PFMC 2013). While the HMS FMP species' diet studies discussion below includes studies from individual fish taken in waters off Washington, Oregon, and California, it also includes scientific work on fish taken from the high seas, or from waters off other northern and eastern Pacific nations. This Section 3.2.2.3 separates HMS FMP species roughly by type, addressing whether Shared EC Species are eaten by tuna species (albacore, yellowfin, bigeye, skipjack, and bluefin), shark species (common thresher, shortfin mako, and blue) or by billfish species (striped marlin and swordfish), or dorado.

*Albacore, Yellowfin tuna, Bigeye tuna, Skipjack tuna, and Bluefin tuna*

As discussed above in Section 3.2.1.2, yellowfin tuna, bigeye tuna, and albacore are all predators of mesopelagic fishes (Tyler and Pearcy 1975; Moteki et al. 2001; Allain 2005; and Brodeur and Yamamura 2005). Pacific saury has also been documented as the prey of albacore, yellowfin, and bluefin tuna (Pinkas et al. 1971; Pearcy 1972; and Kato 1992). Glaser (2009) found albacore prey to include myctophids, Pacific saury, and gonatid, octopoteuthid, and onychoteuthid squids. Pinkas et al. (1971) found a wide array of prey species in the diets of albacore, bluefin tuna, and bonito, including jacksmelt in the diet of bluefin tuna, and onychoteuthid squid in the diet of albacore. Tsuchiya et al. (1998) found a variety of pelagic squid species in the stomachs of albacore, bigeye tuna, and swordfish taken in the tropical East Pacific. Brodeur et al. (2014) characterized albacore as one of the CCE's most voracious predators of forage fish, with albacore populations strongly influencing forage fish population abundance. Shimose et al. (2013) found round herring in the stomachs of bluefin tuna. Therefore, HMS FMP tuna species may be considered predators of the following Shared EC Species or species groups: round and thread herring, mesopelagic fishes, Pacific saury, silversides, and pelagic squids.

*Common thresher shark, shortfin mako shark, blue shark*

Preti et al. (2012) compared the CCE diets of the three FMP shark species and found that mako sharks feed heavily on jumbo squid and Pacific saury, the most important prey for blue sharks are jumbo and gonatid squids, and thresher sharks prey heavily on CPS FMP species like anchovy and sardine. This same study found that the diets of these three shark species included the following Shared EC Species or species groups: paralepipdidae, Pacific saury, topsmelt, and gonatid, histioteuthid, octopoteuthid, and onychoteuthid squids (Preti et al. 2012). In a 2001 common thresher shark diet study, Preti et al. found a variety of FMP-managed species (e.g. anchovy, Pacific whiting, Pacific mackerel, and sardine) in thresher shark stomachs, as well as California grunion and gonatid squids (Preti et al. 2001). Kubodera et al. (2007) examined stomachs of blue and salmon sharks (*Lamna ditropis*), and found that blue shark (an FMP species) preyed upon a wide variety of cephalopods, including cranchiid, gonatid, histioteuthid, octopoteuthid, and onychoteuthid squids, as well as several different myctophid species. Markaida and Sosa-Nishizaki (2010) reviewed both blue shark diet literature and the stomach contents of almost 900 blue sharks taken in Pacific waters off Mexico, and found the following Shared EC Species or species groups in Agenda Item I.1.a, Attachment 1blue shark stomachs: cranchiid, gonatid, histioteuthid, octopoteuthid, ommastrephid, and onychoteuthid squids, and Pacific saury. Therefore, HMS FMP shark species may be considered predators of the following Shared EC Species or species groups: mesopelagic fishes, Pacific saury, silversides, and pelagic squids.

*Striped marlin, swordfish, dorado*

Abitía-Cárdenas et al. (1997) studied the stomach contents of striped marlin and, among other prey species, found ommastrephid squids, round herring, and thread herring. In a follow-up 2002 study, Abitía-Cárdenas et al. evaluated more recently collected striped marlin stomach contents and again found ommastrephid squid and round herring within a broad suite of marlin prey species (Abitía-Cárdenas et al. 2002). Moteki et al. (2001) found mesopelagic fishes from the families gonostomatidae, paralepididae, and myctophidae in the stomachs of swordfish taken in the eastern tropical Pacific Ocean. Markaida and Hochberg (2005) examined swordfish stomach contents from fish taken in Pacific waters off Baja California, attempting to identify the squid prey of swordfish at the species level. That study found that swordfish prey heavily on cephalopods, including gonatid, histioteuthid, octopoteuthid, ommastrephid, onychoteuthid, and thysanoteuthid squids (Markaida and Hochberg 2005). Similarly, Watanabe et al. (2009) found swordfish of the western North Pacific to have a strongly squid-dominant diet, also identifying members from all of the Shared EC pelagic squid families among swordfish stomach contents. Olson and Galván-Magaña (2002) evaluated the stomach contents of 545 dorado (a.k.a. "dolphinfish") and found that dorado prey heavily on both flying fish and on the Shared EC pelagic squid species, and to a lesser degree, prey upon myctophids. Moteki et al. (2001) had similar findings for dorado stomach contents, although derived from a much smaller sample size. Therefore, HMS species striped marlin, swordfish, and dorado may be considered predators of the following Shared EC Species or species groups: round and thread herring, mesopelagic fishes and pelagic squids.

### *3.2.2.4 Salmon FMP species*

> *Shared EC Species that are prey of at least one Salmon FMP species:*
>
> - *Mesopelagic fishes*
> - *Pacific sand lance*
> - *Pacific saury*
> - *Silversides*
> - *Osmerid smelts*
> - *Pelagic squids*

Salmon are anadromous fish native to the rivers and oceans of the northern hemisphere. Seven salmon species are native to the Pacific Ocean and five of those species spawn in the rivers of the western U.S.: Chinook, chum, coho (*O. kistuch*), pink, and sockeye. Steelhead, an anadromous form of rainbow trout (*Oncorhynchus mykiss*), occupies similar habitats and a similar ecological niche to the Pacific salmon species.

The Salmon FMP manages U.S. West Coast fisheries for Chinook, coho, and pink salmon. This Section 3.2.2.4 discusses salmon species broadly and looks at whether Shared EC Species are eaten by Chinook, coho, and pink salmon. Section 3.2.3.1, *ESA-listed species other than mammals and birds*, additionally addresses whether Shared EC Species are eaten by sockeye salmon, chum salmon, or steelhead. While some U.S. West Coast populations of Chinook and coho salmon are listed under the ESA, there is insufficient information about the marine diets of particular salmon stocks to warrant discussing those stocks separately from this section's larger discussion of known diets of FMP-managed salmon species. This EA focuses on the marine (not freshwater) diets of predator species because the geographic scope of the action is the U.S. West Coast EEZ, which does not include the freshwater habitat of salmon and other predators. General descriptions of the life histories of Chinook, coho, and pink salmon may be found in Appendix A of Amendment 14 to the Salmon FMP (PFMC 2000). Salmon occupy mid- and higher trophic levels that may prey upon Shared EC Species and, as a group are described with other mid to high trophic level fishes and invertebrates in Section 3.2.1.3 of the FEP (PFMC 2013).

*Chinook salmon*

Groot et al. (1995) reviewed Chinook stomach contents and identified Chinook salmon marine prey as including fish (particularly Pacific herring and sand lance), euphausiids and other crustacean zooplankton, squid, and amphipods. Dufault et al. (2009) identified Chinook diet within the CCE as including: megazoobenthos (crabs), cephalopods, viperfish (*Chauliodus macouni*), small deepwater rockfish, small planktivores (anchovy, sardine, Pacific herring), and large zooplankton (euphausiids, chaetognaths, pelagic shrimps, pelagic polychaetes, pasiphaeids). Osmerid smelts, which also include anadromous species, have been found in Chinook stomachs (Hunt et al. 1999), as have myctophids (Brodeur et al. 1987), and gonatid squids (Pearcy et al. 1988). Hunt et al. (1999) found, among other prey, sand lance, Pacific saury, and jacksmelt within stomachs of Chinook salmon. Therefore, Chinook salmon may be considered predators of the following Shared EC Species or species groups: mesopelagic fishes, Pacific sand lance, Pacific saury, silversides, osmerid smelts, and pelagic squids.

*Coho salmon*

Coho salmon are nearly as piscivorous as Chinook salmon and have some diet similarities to Chinook. Groot et al. (1995) reviewed coho stomach contents and found the following marine prey: amphipods, euphausiids, and fish (including, among others, osmerids and Pacific sand lance). While crustacean zooplankton dominate coho stomach content in several studies, coho diets also include osmerids, myctophids, paralepidids, cephalopods (particularly gonatid squid) and sand lance (Pearcy et al. 1988; Schabetsberger et al. 2003; Aydin et al. 2005; Pool et al. 2008; and Daly et al. 2009). Therefore, coho salmon may be considered predators of the following Shared EC Species or species groups: mesopelagic fishes, Pacific sand lance, osmerid smelts, and pelagic squids.

*Pink salmon*

The U.S. West Coast EEZ is at the southern end of the range of pink salmon within the eastern North Pacific, so there tends to be less diet data available for West Coast pink salmon than for other salmon species. Pink salmon are more planktivorous and less piscivorous than Chinook and coho. According to Groot et al. (1995), pink salmon diets are dominated by hyperiid amphipods, although the Shared EC Species they consume include myctophids and squids. North Pacific studies confirm the presence of gonatid squid in the diets of pink salmon (Kaeriyama et al. 2004; Aydin et al. 2005). There is some evidence that adult pink salmon of the western North Pacific also prey upon sand lance and capelin (Brodeur 1990). Therefore, pink salmon may be considered predators of the following Shared EC Species or species groups: mesopelagic fishes, Pacific sand lance, osmerid smelts, and pelagic squids.

### 3.2.3 Protected Species Predators of Shared EC Species

As discussed in Section 3.2.1, a wide variety of predators prey upon Shared EC Species, including many species protected and managed under the ESA, MMPA, and MBTA. The FEP's Table 3.5.5 details the species of the U.S. portion of the CCE that are listed as threatened or endangered under the ESA. All marine mammals of the CCE are protected under the MMPA and listed in the FEP at Table 3.5.6. A wide variety of bird species are protected under the MBTA, including the seabirds of the CCE. Similar to Section 3.2.2, this section focuses on the predator/prey relationships, if known, between protected species and Shared EC Species. This section is not a complete discussion of all of the predator/prey interactions of all protected species; it is simply a targeted look at connections between the protected species of the U.S. West Coast EEZ and Shared EC Species. All protected species prey upon wide ranges of prey species, often including at least some Shared EC Species, as noted in this section. We may have little or no diet data for many CCE species, which limits our understanding of the full web of predator-prey relationships between species. In this section, protected species are divided into three groups: ESA-listed species other than marine mammals and birds, marine mammals protected under the ESA and MMPA, and birds protected under the ESA and MBTA.

#### *3.2.3.1 ESA-listed species other than mammals and birds*

The ESA-listed species that occur within the U.S. West Coast EEZ include marine mammals, seabirds, sea turtles, two species of abalone, green sturgeon (*Acipenser medirostris),* eulachon, and several populations of wild salmonids. ESA-listed mammals that may prey upon Shared EC Species are discussed in Section 3.2.3.2. ESA-listed seabirds that may prey upon Shared EC Species are discussed in Section 3.2.3.3. The Puget Sound populations of three species of rockfish (bocaccio [*Sebastes paucispinis*], canary, and yelloweye [*S. ruberrimus]*) are listed and protected under the ESA, but Puget Sound is not within the geographic area for this action, the U.S. West Coast EEZ. Similarly, black abalone (*Haliotis sorenseni*) and white abalone (*H. crachereodii*) are large nearshore sea snails and are not found within the EEZ.

*Shared EC Species that are prey of ESA-listed salmon and steelhead, including species also managed under MSA:*

- *Mesopelagic fishes*
- *Pacific sand lance*
- *Pacific saury*
- *Silversides*
- *Osmerid smelts*
- *Pelagic squids*

The following ESA-listed sea turtle species may occur in the U.S. West Coast EEZ: leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), olive ridley (*Lepidochelys olvivacea*), and green (*Chelonia mydas*). Sea turtles are either herbivores or, like leatherbacks, forage primarily on jellyfish (*Scyphozoa* spp., Benson et al. 2011). ESA-listed sea turtle species will not be further discussed in this EA because there is not sufficient information to link them to Shared EC Species.

The ESA-listed finfish populations that may occur within the U.S. West Coast EEZ include: green sturgeon originating from the Sacramento River basin and from coastal rivers south of the Eel River; eulachon originating from the British Columbia's Skeena River, southward to and including the Mad River in northern California; and various ESUs of Chinook salmon, chum salmon, coho salmon, sockeye salmon, and steelhead trout. Eulachon is a Shared EC Species within the osmerid smelt group (see Section 3.2.1.6) and will not be discussed further in this predator-focused section. Green sturgeon is a benthic anadromous fish that primarily eats benthic invertebrates (Dumbauld et al. 2008; Huff et al. 2011), which are not subject to this action. Therefore, salmonids are the only ESA-listed predators, other than marine mammals and birds, within the affected environment for this action.

Each species of salmon has multiple genetically-distinct populations, usually identified by the population's river basin of origin and time of year the population enters fresh water to begin its spawning migration. Salmon populations listed as threatened or endangered under the ESA are often delineated by their evolutionarily significant unit (ESU), meaning a population that is substantially reproductively isolated from other conspecific populations and that represents an important component of the evolutionary legacy of the species (Waples 1991). For example, one of the threatened populations of Chinook salmon listed under the ESA is the Sacramento River winter run, which means that the majority of that run enter the Sacramento River basin as adults during winter months. West Coast salmon and steelhead ESUs listed as threatened or endangered under the ESA are shown in Table 3.2.1.

**Table 3.2.1: ESA-listed salmonids that may occur in U.S. West Coast EEZ**

| **Species** | | **Status** |
|---|---|---|
| Chinook salmon (*Oncorhynchus tshawytscha*) | Sacramento River winter ESU | Endangered |
| | Central Valley Spring ESU | Threatened |
| | California Coastal ESU | Threatened |
| | Snake River Fall ESU | Threatened |
| | Snake River Spring/Summer ESU | Threatened |
| | Lower Columbia River ESU | Threatened |
| | Upper Willamette River ESU | Threatened |
| | Upper Columbia River Spring ESU | Endangered |
| | Puget Sound ESU | Threatened |
| Chum salmon (*Oncorhynchus keta*) | Hood Canal Summer Run ESU | Threatened |
| | Columbia River ESU | Threatened |
| Coho salmon (*Oncorhynchus kistuch*) | Central California Coastal ESU | Endangered |
| | S. Oregon/N. CA Coastal ESU | Threatened |
| | Oregon Coast ESU | Threatened |
| | Lower Columbia River ESU | Threatened |
| Sockeye salmon (*Oncorhynchus nerka*) | Snake River ESU | Endangered |
| | Ozette Lake ESU | Threatened |
| Steelhead (*Oncorhynchus mykiss*) | Southern California DPS | Endangered |
| | South-Central California DPS | Threatened |
| | Central California Coast DPS | Threatened |
| | California Central Valley DPS | Threatened |
| | Northern California DPS | Threatened |
| | Upper Columbia River DPS | Threatened |
| | Snake River Basin DPS | Threatened |
| | Lower Columbia River DPS | Threatened |
| | Upper Willamette River DPS | Threatened |
| | Middle Columbia River DPS | Threatened |
| | Puget Sound | Threatened |

This section 3.2.3.1 focuses on predator prey interactions between Shared EC Species and ESA-listed predators. NMFS updates detailed life history information on ESA-listed salmon and steelhead in ESA status review documents at least once every five years. The 2011 status reviews of ESA-listed salmon and steelhead provide life history information on each of the ESUs listed in Table 3.2.1. Five-year status reports on ESA-listed salmon and steelhead, except for Oregon Coast coho, and the supporting documents for those reports are available on the NMFS West Coast Region website: http://www.westcoast.fisheries.noaa.gov/publications/status_reviews/salmon_steelhead/2011_status_reviews_of_listed_salmon_steelhead.html. Life history and ESA status review information for Oregon Coast coho is available on a separate NMFS West Coast Region website: http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/salmon_and_steelhead_listings/coho/oregon_coast_coho.html.

Chinook, coho, and pink salmon are FMP species and the roles of Shared EC Species in their diets are discussed in Section 3.2.2.4. U.S. West Coast ESA-listed salmonid populations include some runs of Chinook and coho salmon, but no runs of pink salmon. As discussed above, there is not sufficient diet information on the particular ESA-listed ESUs of these species to warrant an additional discussion of these species in this section. This section additionally discusses chum and sockeye salmon and steelhead as predators and whether they are known to prey upon Shared EC Species.

*Chum salmon*

Washington State and the Columbia River are at the southern end of the range of chum salmon within the eastern North Pacific, so there tends to be less diet data available on West Coast chum salmon than on other salmon species. Chum salmon diets are so similar to those of pink salmon that the aggressive foraging behavior of pink salmon may allow them to outcompete chum salmon for more calorie-rich prey during years when pink salmon are relatively more abundant (Ruggerone and Nielsen 2004). Like pink salmon, chum salmon are considered primarily planktivores. Chum salmon are known for consuming gelatinous zooplankton in greater quantities than other salmon species (Kaeriyama et al. 2004). Groot et al. (1995) found the marine diet of chum salmon to include euphausiids, amphipods, pteropods, calanoids, and fish (unspecified). Brodeur (1990) found some evidence of myctophids, sand lance, and squid in chum salmon diets and Davis et al. (2000) confirmed the presence of squids in chum stomachs. While few finfish species or species groups have been positively identified among chum salmon stomach contents, Nagasawa et al. (1997) confirmed the presence of myctophids in chum diets. Therefore, chum salmon may be considered predators of the following Shared EC Species or species groups: mesopelagic fishes, Pacific sand lance and pelagic squids.

*Sockeye salmon*

Sockeye are known as generalist feeders, less piscivorous than Chinook or coho, yet not as planktivorous as pink and chum salmon. Groot et al. (1995) found that euphausiids play a strong role in sockeye diets, as do other crustacean zooplankton like amphipods, while the Shared EC Species in their diets include myctophids and pelagic squids. Several studies have confirmed the presence of squids in sockeye stomach contents (Pearcy et al. 1988; Davis et al. 2000; Kaeriyama et al. 2004; Kitagawa et al. 2005; and Nagasawa et al. 1997) identified myctophids among sockeye finfish prey. Brodeur (1990) additionally found evidence of sand lance in some sockeye diets. Therefore, sockeye salmon may be considered predators of the following Shared EC Species or species groups: mesopelagic fishes, Pacific sand lance and pelagic squids.

*Steelhead*

Steelhead feed at higher trophic levels than several other salmonids, with many fish, squid, and amphipods in their diets (LeBrasseur 1966, Brodeur 1990). Light (1985) conducted an extensive review of North

Pacific steelhead stomach contents, finding steelhead diet to strongly feature fish, squid, polychaetes, and crustaceans, and miscellaneous zooplankton. While Atka mackerel (*Pleurogrammus monopterygius*) was the most important fish species Light (1985) found in steelhead stomachs, myctophids were also among the fish in steelhead diets, as were gonatid squids. Therefore, steelhead may be considered predators of the following Shared EC Species or species groups: mesopelagic fishes and pelagic squids.

Taking into account the feeding habits of Chinook and coho salmon discussed in Section 3.2.2.4 and the feeding habits of chum and sockeye salmon and steelhead discussed in this section, ESA-listed salmonids of the U.S. West Coast may be considered predators of the following Shared EC Species or species groups: mesopelagic fishes, Pacific sand lance, Pacific saury, silversides, osmerid smelts, and pelagic squids.

### *3.2.3.2 Marine mammals, including species listed under the ESA*

*Shared EC Species that are prey of at least one CCE marine mammal species:*

- *Mesopelagic fishes*
- *Pacific sand lance*
- *Pacific saury*
- *Silversides*
- *Osmerid smelts*
- *Pelagic squids*

The MMPA protects all marine mammals within U.S. waters, regardless of whether a species or population is listed as threatened or endangered under the ESA. MMPA conservation measures focus primarily on preventing or prohibiting the directed take of marine mammals and minimizing incidental take of marine mammals. Under the MMPA, "take" means to "harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal" (16 U.S.C. §1362). This action does not address the take of marine mammals in fisheries or elsewhere; however, many Shared EC Species are prey of CCE marine mammals. This section examines the predator-prey interactions, if known, between Shared EC Species and marine mammals. Marine mammals occupy higher trophic levels that may prey upon Shared EC Species and, as a group, are described with other high trophic level non-fish species in Section 3.2.1.1 of the FEP (PFMC 2013).

The U.S. West Coast EEZ supports a large and diverse marine mammal community that plays an important role in the ecosystem as top-level predators. Because most marine mammals make annual migrations between feeding and breeding sites, the specific species and the number of marine mammals found in the U.S. West Coast EEZ will vary both seasonally and inter-annually. However, some models estimate that cetaceans may consume around 2 million tons of prey (primarily krill, but also small fishes and squids and other prey) annually in the in U.S. West Coast EEZ (Barlow et al. 2008). Although some marine mammals prefer specific types of prey, most are opportunistic feeders. As discussed in section 3.2.1 and in this section, most of the Shared EC Species are preyed upon to some degree by at least one species of marine mammal.

Table 3.2.2 lists the marine mammal species that may occur within the U.S. West Coast EEZ and indicates whether any populations of these species are listed as threatened or endangered under the ESA. In addition to the marine mammals listed in Table 3.2.2, southern sea otters (*Enhydra lutris nereis*) occur within state waters off California. The southern sea otter population off the U.S. West Coast is listed as threatened under the ESA. Sea otters will not be considered further in this document because their West Coast population does not tend to use EEZ waters, and because they primarily prey upon benthic invertebrates like urchins (USFWS 2014). Except for some of the deeper offshore squid species included in the "pelagic squid" Shared EC category, benthic invertebrates are not addressed by this action.

NMFS is responsible for administering the MMPA for cetaceans, seals, and sea lions, while the USFWS administers the MMPA for polar bears, walruses, manatees, and sea otters [16 U.S.C. §1362]. Similar to ESA-listed finfish species, NMFS maintains marine mammal life history information on regularly-updated webpages. Detailed life history information for cetaceans (odontocetes and mysticetes) may be found on

NMFS's Protected Resources Cetacean page: http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/. Detailed life history information for seals and sea lions may be found on NMFS's Protected Resources Pinnipeds page: http://www.nmfs.noaa.gov/pr/species/mammals/pinnipeds/. Carretta et al. (2013) provides U.S. Pacific marine mammal stock assessment summaries in a NOAA Technical Memorandum.

| **Table 3.2.2: Marine mammal species that may occur in U.S. West Coast EEZ** | | |
|---|---|---|
| **Species** | **Stocks** | **ESA-listed?** |
| **Odontocetes** | | |
| Harbor porpoise (*Phocoena phocoena*) | Various | |
| Dall's porpoise (*Phocoenoides dalli*) | CA/OR/WA stock | |
| Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) | North Pacific stock; CA/OR/WA stock | |
| Risso's dolphin (*Grampus griseus*) | CA/OR/WA stock | |
| Bottlenose dolphin (*Tursiops truncatus*) | California coastal stock | |
| Bottlenose dolphin (*Tursiops truncatus*) | CA/OR/WA offshore stock | |
| Short-beaked common dolphin (*Delphinus delphis)* | CA/OR/WA stock | |
| Long-beaked common dolphin (*Delphinus capensis)* | California stock | |
| Northern right whale dolphin (*Lissodelphis borealis*) | CA/OR/WA stock | |
| Striped dolphin (*Stenella coeruleoalba*) | CA/OR/WA stock | |
| Short-finned pilot whale (*Globicephala macrorhynchus*) | CA/OR/WA stock | |
| Sperm whale (*Physeter macrocephalus*) | CA/OR/WA stock | Endangered |
| Dwarf sperm whale (*Kogia sima*) | CA/OR/WA stock | |
| Pygmy sperm whale (*Kogia breviceps*) | CA/OR/WA stock | |
| Killer whale (*Orcinus orca*) | Eastern North Pacific southern resident stock | Endangered |
| Killer whale (*Orcinus orca*) | Eastern North Pacific offshore stock | |
| Killer whale (*Orcinus orca*) | west coast transient stock | |
| Mesoplodont beaked whales (*Mesoplodon* spp.) - (Hubbs' beaked whales, Gingko -toothed whale, Stejneger's beaked whale, Blainville's beaked whale, Pygmy beaked whale or Lesser beaked whale, Perrin's beaked whale) | CA/OR/WA stocks | |
| Cuvier's beaked whale (*Ziphius cavirostris*) | CA/OR/WA stock | |
| Baird's beaked whale (*Berardius bairdii*) | CA/OR/WA stock | |
| **Mysticetes** | | |
| Blue whale (*Balaenoptera musculus)* | Eastern North Pacific stock | Endangered |
| Fin whale (*Balaenoptera physalus)* | CA/OR/WA stock | Endangered |
| Humpback whale (*Megaptera novaeangliae*) | CA/OR/WA stock | Endangered |
| North Pacific right whale (*Eubalaena japonica*) | Eastern North Pacific stock | Endangered |
| Sei whale (*Balaenoptera borealis)* | Eastern North Pacific stock | Endangered |
| Minke whale (*Balaenoptera acutorostrata*) | CA/OR/WA stock | |
| Gray whale (*Eschrichtius robustus*) | Eastern North Pacific stock | |
| | Western North Pacific | Endangered |
| **Pinnipeds** | | |
| California sea lion (*Zalophus californianus californianus*) | U.S. stock | |
| Harbor seal (*Phoca vitulina richardsi*) | CA stock and OR & WA coastal stock | |
| Northern elephant seal (*Mirounga angustirostris*) | CA Breeding Stock | |
| Guadalupe fur seal (*Arctocephalus townsendi*) | | Threatened |
| Northern fur seal (*Callorhinus ursinus*) | San Miguel Island stock | |
| | Eastern North Pacific | |
| Steller sea lion (*Eumetopias jubatus*) | Eastern Pacific stock (U.S.) | |

This section separates U.S. West Coast EEZ marine mammals into three species groups to discuss whether any members of those groups are known to prey upon Shared EC Species: odontocetes (toothed cetaceans, including sperm whales, orcas, beaked whales, and dolphins); mysticetes (baleen whales); and pinnipeds (seals and sea lions).

*Odontocetes*

Odontocetes of the U.S. West Coast EEZ include a variety of dolphins, porpoises, beaked whales, sperm whales, and killer whales (*Orcinus orca*, see Table 3.2.2). The most important Shared EC Species to toothed whale diets are likely the pelagic squids, followed by the mesopelagic fishes. Approximately 80 percent of all odontocete species worldwide regularly consume squids, with squids being a main food item in 28 different species (Clarke 1996). U.S. West Coast EEZ odontocete predators of various squid species include the sperm and beaked whales, as well various dolphins and porpoises (Kawakami 1980; Fiscus et al. 1989; Nesis 1997; and Walker et al. 2002). Mesopelagic fishes also often appear in marine mammal diet studies and are commonly consumed by the smaller odontocetes, such as dolphins and porpoises (Fitch and Brownell 1968).

Ohizumi et al. (2003) examined the stomach contents of 386 Dall's porpoises, finding their diets to include a wide array of pelagic squid species, mesopelagic fish species, and Pacific saury. The Dall's porpoises in that study had been taken incidentally in salmon gillnet fisheries across the North Pacific Ocean and the authors estimated that Dall's porpoise are the primary myctophid consumers in the North Pacific (Ohizumi et al. 2003). Walker et al. (1998) examined the stomach contents of beached Dall's porpoises and harbor porpoises (*Phocoena phocoena*) from the beaches of Washington and British Columbia, finding their diets to include eulachon, Pacific sand lance, and gonatid and onychoteuthid squids. In a study of the ecology and feeding behavior of bottlenose dolphins (*Tursiops truncatus*) in the Southern California Bight, Hanson and DeFran (1993) found the diet of this highly-piscivorous species to include jacksmelt and topsmelt (atherinopsids). Fitch and Brownell (1968) found that, in addition to mesopelagic fishes and anchovies, Pacific saury were among the stomach contents of short-beaked common dolphins (*Delphinus delphis)* off Southern California. Walker et al. (1986) examined the stomach contents of Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) that had stranded on the beaches of Southern California and the west coast of Baja California and found their diets to include, among other organisms, mesopelagic fishes and pelagic squid. Morton (2000), studying Pacific white-sided dolphins off British Columbia, observed them feeding on schools of capelin and eulachon as well as Pacific herring (not a Shared EC Species). Stroud et al. (1981) found the diets of Pacific white-sided dolphins and Dall's porpoises taken off California and Washington to include, among other organisms, Pacific saury, osmerid smelts, mesopelagic fishes, and pelagic squid. Killer whale diets vary by population type, whether "residents" of nearshore waters that largely feed on fish, or "transients" passing through nearshore waters that feed primarily on mammals and birds. For the most part, piscivorous killer whales eschew Shared EC Species for larger and higher trophic order fish species; however, beached killer whale stomach contents have been documented to include pelagic squid (Ford et al. 1998). Fiscus et al. (1989) documented a wide variety of cephalopods in the stomachs of sperm whales, including cranchiidae, gonatidae, histioteuthidae, octopoteuthidae, ommastrephidae, and onychoteuthidae. Flinn et al. (2002) examined the preserved stomachs of sperm whales taken from commercial whaling stations of British Columbia in the 1960s, finding a strong presence of pelagic squid in sperm whale stomachs. Therefore, odontocetes may be considered predators of the following Shared EC Species or species groups: mesopelagic fishes, Pacific sand lance, Pacific saury, silversides, osmerid smelts and pelagic squid.

*Mysticetes*

There are 7 species of baleen whales (Suborder Mysticeti) that can be found off of the U.S. West Coast EEZ. Mysticetes or baleen whales primarily feed on euphausiids and copepods and other zooplankton and do not notably rely on the Shared EC Species. Blue whales (*Balaenoptera musculus)*, for example, prey almost exclusively on euphausiids, even showing preferences for particular euphausiid species. Off the U.S. West Coast, euphausiids are sufficiently abundant that blue whales do not need to seek out other prey (Fiedler et al. 1998, Reeves et al. 1998). Gray whales (*Eschrichtius robustus*) also tend to prey primarily on crustacean zooplankton, including mysids and crab larvae (Dunham and Duffus 2002, Newell and Cowles 2006, Moore et al. 2007). The North Pacific right whale (*Eubalaena japonica*) is extremely rare, making diet studies, fecal sampling, and stomach sampling from beached whales also rare. However, based on the diets of other right whale species worldwide and on observations of North Pacific right whales during feeding, they are also thought to prey almost exclusively on euphausiids and other crustacean zooplankton (NMFS 2013d). The existing U.S. West Coast EEZ prohibition on euphausiid (krill) harvest already preserves the prey base for mysticetes, particularly those that feed more exclusively on euphausiids.

Although mysticetes strongly prefer euphausiid prey, some mysticetes will also regularly feed on small schooling fishes such as herrings and anchovies. Specifically, fin (*Balaenoptera physalus*), minke (*Balaenoptera acutorostrata*), sei (*Balaenoptera borealis)* and humpback whales (*Megaptera novaeangliae*) will all commonly or opportunistically feed on fishes (Gaskin 1982; Kasamatsu and Tanaka 1991; and Witteveen et al. 2008). Of the Shared EC Species fishes, sei whales are known to consume saury (Kato 1992), and humpback whales feed on Pacific sand lance, myctophids and certain osmerid smelts, such as capelin, while feeding in waters off of Alaska (Frost and Lowry 1981; Neilson and Gabriele 2008; Witteveen et al. 2008). Flinn et al. (2002) examined the preserved stomachs of fin and sei whales taken from commercial whaling stations of British Columbia in the 1960s, and found that both species primarily preyed upon euphausiids and copepods, although their other prey species included Pacific saury and myctophids, (Shared EC Species), as well as rockfish and ragfish (*Icosteus aenigmaticus*), among the otherwise unspeciated fish and squid stomach contents. Witteveen et al. (2008) tracked humpback whales on foraging dives off Alaska and found them preying upon schools of capelin, eulachon, and pollock (not a Shared EC species). Minke whales feed primarily on euphausiids, but will feed opportunistically on schooling fish. Although we could not find minke whale diet studies for the eastern North Pacific, western North Pacific populations have been noted for preying upon Pacific herring and anchovy and, among other species, Pacific saury and sand lance (Tamura and Fujise 2002; Song and Zhang 2014). Therefore, mysticetes may be considered predators of the following Shared EC Species or species groups: mesopelagic fishes, Pacific saury, osmerid smelts, and Pacific sand lance.

*Pinnipeds*

Pinniped species of the U.S. West Coast EEZ include: California sea lion (*Zalophus californianus californianus)*, harbor seal (*Phoca vitulina richardsi*), northern elephant seal (*Mirounga angustirostris*), Guadalupe fur seal (*Arctocephalus townsendi*), northern fur seal (*Callorhinus ursinus*), and Steller sea lion (*Eumetopias jubatus*). Since seals and sea lions spend some portion of their lives on land, more detailed diet information is typically available for them through scat samples than for other marine mammals (Lowry 2011). Estimates suggest that pinnipeds in the U.S. West Coast EEZ may consume as much as a million tons of fish and squid prey annually (Hunt et al. 2000). California sea lions are known to prey on Shared EC Species within every group except for the herrings (Lowry 2011; Feder et al. 1974; and Weise and Harvey 2008). Harbor seals, typically feeding nearshore, are known predators of both sand lance and osmerids (Brown and Mate 1983; London et al. 2002; Orr et al. 2004; and Lance and Jefferies 2009). Antonelis et al. (1987) sampled the stomach contents of 59 live elephant seals and found their diet to include a variety of squid species, including cranchiids, gonatids, histioteuthids. Guadalupe fur seals are listed as threatened under the ESA and their population is small enough that diet data collection is more difficult than for other CCE pinnipeds (Lander et al. 2000); however, Hanni et al (1997) sampled the stomach contents of stranded Guadalupe fur seals and found that their diets included pelagic squid and mesopelagic fishes. Antonelis and Perez (1984) found that northern fur seals off the U.S. West Coast consumed a wide variety of species, including many CPS and Groundfish FMP species, as well as Pacific saury, onychoteuthid squid, and osmerid smelts. Stroud et al. (1981) found the diets of northern fur seal taken off California and Washington to include, among other organisms, Pacific saury, eulachon, and gonatid and onychoteuthid squid. Zeppelin and Ream (2006) analyzed Alaskan northern fur seal diets from fecal samples and found that fur seals had consumed gonatid squid and Pacific sand lance, among other prey. Many of the available Steller sea lion diet studies focus on the Alaska stock; however, Riemer et al (2011) focused on the food habits of Steller sea lions off Oregon and northern Calfornia, finding their diet to include the Shared EC Species Pacific sand lance and osmerid smelts, as well as many other FMP and non-FMP species. Therefore, pinnipeds may be considered predators of the following Shared EC Species or species groups: mesopelagic fishes, Pacific sand lance, Pacific saury, osmerid smelts and pelagic squid.

#### *3.2.3.3 Seabirds*

> *Shared EC Species that are prey of at least one CCE seabird species:*
>
> - *Thread herring*
> - *Mesopelagic fishes*
> - *Pacific sand lance*
> - *Pacific saury*
> - *Silversides*
> - *Osmerid smelts*
> - *Pelagic squids*

A variety of seabird species prey upon Shared EC Species, including the three West Coast seabirds listed under the ESA: short-tailed albatross (*Phoebastria albatrus*, USFWS 2008a) and California least tern (*Sterna antillarum browni*, UWFWS 1985), endangered; and marbled murrelet (*Brachyramphus marmoratus*), threatened (USFWS 1997). In addition its work under the ESA, the USFWS assesses U.S. migratory, nongame bird populations under the Fish and Wildlife Conservation Act for whether they are likely to become designated as threatened or endangered under the ESA, and designates those species likely to become ESA-listed without directed conservation measures as Birds of Conservation Concern (BCC, USFWS 2008b). The MBTA protects birds that migrate between the U.S. and other nations from unlicensed or unlawful directed harvest, including seabirds. This action does not address the take of seabirds in fisheries or elsewhere; however, many Shared EC Species are prey of CCE seabirds. This section examines the predator-prey interactions, if known, between Shared EC Species and seabirds. Seabirds occupy the higher trophic levels that may prey upon Shared EC Species and, as a group are described with other high trophic level non-fish species in Section 3.2.1.1 of the FEP (PFMC 2013). This section discusses only those seabird species or species groups that are known to spend at least some portion of their lives within the U.S. West Coast EEZ. Shorebirds that primarily prey upon intertidal invertebrates are not discussed herein.

The USFWS is responsible for administering the MBTA, including seabird management and colony monitoring (e.g. Naughton et al. 2007). Recovery of seabirds listed as threatened or endangered under the ESA is also a USFWS responsibility. On November 1, 2013, the USFWS updated its *List of Migratory Birds*, which is the list of species protected under the MBTA (78 FR 65844). That list includes migratory species that range throughout the world, which means that it includes many species that are not relevant to the geographic scope of this EA, the U.S. West Coast EEZ. To focus on species within the CCE, this Section 3.2.3.3 relies on the *List of Migratory Birds* and on the USFWS Regional Seabird Conservation Plan for the Pacific Region (USFWS 2005), which includes species profiles for seabirds of the California Current System and of U.S. Pacific Islands. The USFWS and NOAA documents discussed herein provide life history descriptions for seabirds that are known to occur within the U.S. West Coast EEZ for at least some part of their lives, listed in Table 3.2.3.

The USFWS Seabird Conservation Plan provides life history descriptions for all of the species listed in Table 3.2.3, except for: the five shearwater species, northern fulmar (*Fulmaris glacialis*), Bonaparte’s gull

(*Chroicocephalus Philadelphia*), glaucous gull (*Larus hyperboreus*), Heermann's gull (*L. heermanni*), mew gull (*L. canus*), black-legged kittiwake (*Rissa tridactyla*), and Craveri's murrelet (*Synthlibroramphus craveri*). The USFWS Alaska Office's Seabird Information Series provides life histories for many of the species in Table 3.2.3, including short-tailed (*Puffinus tenuirostris*) and sooty (*P. griseus*) shearwaters, northern fulmar, Bonaparte's gull, glaucous gull, mew gull, and blacklegged kittiwake (Denlinger 2006). NOAA's Cordell Bank, Gulf of the Farallones, and Monterey Bay National Marine Sanctuaries maintain an online Sanctuary Integarated Monitoring Network species database (http://sanctuarysimon.org/species/) that provides life history descriptions for species that occur within those sanctuaries, including profiles for Buller's (*P. bulleri*), and pink-footed (*P. creatopus*) shearwaters, and Heermann's gull. Craveri's murrelet and black-vented shearwater (*P. opisthomelas*) are not discussed in detail in either the USFWS publications or the Sanctuary database. Craveri's murrelet nests on islands within the Southern California Bight and until 2007, Craveri's and Xantus's (*Synthliboramphus hypoleucus*) murrelet populations of that area had not been managed or studied separately from each other because their life histories are so similar. Black-vented shearwaters are known to have similar life histories to other petrel-like species, to nest in burrows on small islands off the Pacific Coast of Baja California, primarily Natividad Island (Keitt et al. 2003), and to migrate into and feed within the U.S. EEZ off California, with documented appearances in the National Marine Sanctuaries
(http://ccma.nos.noaa.gov/ecosystems/sanctuaries/california/html/data/pdfs/bird_bvsh.pdf).

The following species are on the *List of Migratory Birds* and have been known to very occasionally range into the U.S. West Coast EEZ, but occur too infrequently or in too small numbers within the U.S. West Coast EEZ to be considered within this section: shy albatross (*Thalassarche cauta*), wandering albatross (*Diomedea exulans*), flesh-footed shearwater (*P. carneipes*), Murphy's petrel (*Pterodroma ultima*), mottled petrel (*P. inexpectata*), Cook's petrel (*P. cookii*), Stejneger's petrel (*P. longirostris*), neotropic cormorant (*Phalacrocorax brasilianus*), laughing gull (*Leucophaeus atricilla*), Thayer's gull (*Larus thayeri*) and parakeet auklet (*Aethia psittacula*). White pelican (*Pelecanus erythrorhynchos*) is also on the *List of Migratory Birds*, but it prefers inland freshwater with winter migration to the brackish waters and estuaries of California and is not considered an EEZ species off the U.S. West Coast.

CCE seabirds likely to prey upon Shared EC Species may be roughly divided by taxonomic order and family. Seabird species of the order Procelliforme include albatrosses, petrels, shearwaters, and storm-petrels. Procellliforme species tend to be highly migratory and may breed outside of the U.S. West Coast EEZ, yet migrate through and feed within the EEZ. Seabird species of the order Pelecaniformes include two families of seabird species that occur off the U.S. West Coast, *Pelecanidae* (pelicans) and *Phalacrocoracidae* (cormorants). Pelecaniformes are more nearshore species than Procelliformes and those that are residents of the U.S. West Coast EEZ may spend all or most of their lives within the EEZ. Species of the order Charadriiformes include the suborder *Lari* (gulls, terns, noddies, and skimmers) and *Alcae* (murres, auklets, guillemots, and puffins). Charadriiformes are also nearshore species, often known for their large coastal colonies at breeding sites.

| **Table 3.2.3: Seabird species that may occur in U.S. West Coast EEZ** | | |
|---|---|---|
| **Species** | **Pacific Distribution** | **ESA-listed or Bird of Conservation Concern?** |
| **Procelliformes** | | |
| Fork-tailed storm-petrel (*Oceanodroma furcata*) | North Pacific | |
| Leach's storm-petrel (*O. leucorhoa*) | Northern Hemipshere | |
| Ashy storm-petrel (*O. homochroa*) | CCE | BCC |
| Black storm-petrel (*O. melania*) | Channel Islands, CA, Baja California | |
| Black-footed albatross (*Phoebastria nigripes*) | Central Pacific, ranging into CCE | BCC |
| Laysan albatross (*P. immutabilis*) | Central Pacific, ranging into CCE | BCC |
| Short-tailed albatross (*P. albatrus*) | North Pacific | Endangered |
| Black-vented shearwater (*Puffinus opisthomelas*) | West Coast of Baja California breeder, migrates into CCE | BCC |
| Buller's shearwater (*P. bulleri*) | Southern Pacific breeder, migrates throughout Pacific Ocean | |
| Pink-footed shearwater (*P. creatopus*) | Southeastern Pacific breeder, migrates throughout Pacific Ocean | BCC |
| Short-tailed shearwater (*P. tenuirostris*) | Southern Pacific breeder, migrates throughout Pacific and Indian Oceans | |
| Sooty shearwater (*P. griseus*) | Southern Pacific breeder, migrates throughout Pacific Ocean | |
| Northern fulmar (*Fulmarus glacialis*) | Arctic circumpolar, south to central CA | |
| **Pelecaniformes** | | |
| Brown pelican (*Pelecanus occidentalis*) | Temperate and tropical Americas | |
| Double-crested cormorant (*Phalacrocorax auritus*) | Western subspecies (*P.a. albociliatus*), throughout CCE | |
| Brandt's cormorant (*P. penicillatus*) | West Coast of North America | |
| Pelagic cormorant (*P. pelagicus*) | North Pacific | BCC |
| **Charadriiformes** | | |
| Ring-billed gull (*Larus delawarensis*) | Off western N. America, CCE | |
| California gull (*Larus californicus*) | Off western N. America, CCE | |
| Western gull (*L. occidentalis*), | Off western N. America, CCE | |
| Glaucous gull (*L. hyperboreus*) | Northern Alaska to OR coast | |
| Glaucous-winged gull (*L. glaucescens*) | Northern and northeastern Pacific | |
| Heerman's gull (*L. heermanni*) | CCE south to Central America | |
| Mew gull (*L. canus*) | Northwest Alaska south to Baja California | |
| Bonaparte's gull (*Chroicocephalus Philadelphia*) | Western Alaska south to CCE | |
| Black-legged kittiwake (*Rissa tridactyla*) | Northwest Alaska to southern CA | |
| Gull-billed tern (*Sterna nilotica*) | Southern CA, northern Mexico | BCC |
| Caspian tern (*S. caspia*), | Off western N. America, CCE | BCC |
| Royal tern (*S. maxima*), | Subspecies (*S.m. maxima*), southern CA, northern Mexico | |
| Elegant tern (*S. elegans*), | Southern CA, northern Mexico | |
| Arctic tern (*S. paradisaea*), | Arctic circumpolar, south to WA coast | BCC |
| Forster's tern (*S. forsteri*), | Central and southern CA | |
| Least tern (*Sterna antillarum)* | Subspecies (*S.A. browni*), central CA to Baja California | Endangered |
| Black skimmer (*Rynchops niger*) | California south to southern South America | BCC |
| Common murre (*Uria aalge*) | Arctic circumpolar, south to central CA | |
| Pigeon guillemot (*Cepphus Columba*) | North Pacific | |

| Table 3.2.3: Seabird species that may occur in U.S. West Coast EEZ | | |
|---|---|---|
| **Species** | **Pacific Distribution** | **ESA-listed or Bird of Conservation Concern?** |
| Marbled murrelet (*Brachyramphus marmoratus*) | Northeastern North Pacific | Threatened, BCC |
| Xantus's murrelet (*Synthliboramphus hypoleucus*) | Southern CA, northern Mexico | BCC |
| Ancient murrelet (*S. antiquus)* | Northern North Pacific, south to WA coast | |
| Craveri's murrelet (*S. craveri*) | Southern CA to Baja California | |
| Cassin's auklet (*Ptychoramphus aleuticus*) | Northeastern North Pacific | BCC |
| Rhinoceros auklet (*Cerorhinca monocerata*) | Northern North Pacific, south to southern CA | |
| Tufted puffin (*Fraterculata cirrhata*) | Northern North Pacific, south to Farallon Islands | |

This section separates U.S. West Coast EEZ seabirds into three species groups to discuss whether any members of those groups are known to prey upon Shared EC Species: Procelliformes, Pelecaniformes, and Charadriiformes. As with marine mammals and fish, there are several species in each species group for which no diet data are available. Because seabirds must hunt at or near the ocean's surface, their diets tend to include more pelagic than benthic species, except when they may be hunting in shallow and nearshore waters.

*Procelliformes*

Most of the Procelliformes species that spend some part of their lives within the CCE do not nest on or near the U.S. West Coast. Species-specific diet sampling for highly migratory bird species that spend most of their lives on the high seas is simplest at their nesting sites, where scientists can collect the excess castings from parent birds regurgitating to feed their chicks. Birds observed at sea are often observed from fishing vessels, where they are usually feeding on vessel-discarded offal; therefore, fisheries-based observations of bird diet may not accurately represent what those bird species would eat if they were foraging away from fisheries activities. For example, Gould et al. (1997b) attributed the myctophids and Pacific saury in the stomachs of northern fulmars taken incidentally in high seas driftnet fisheries to independent hunting by the fulmars, yet concluded that the squid in fulmar stomach was likely scavenged from the squid driftnet fisheries' catch. Hatch (1993a) looked at populations of northern fulmar in their North Pacific colonies and found their diets to include Pacific sand lance, capelin, myctophids, Pacific saury and unidentified squid. In a study of Laysan (*Phoebastria immutabilis*) and black-footed (*Phoebastria nigripes*) albatrosses taken incidentally in high seas driftnet fisheries, Gould et al. (1997a) found the diets of those albatross species to be dominated by neon flying squid, but to also include gonostomatids, myctophids, and Pacific saury. Gould and colleagues continued their seabird diet studies for seabirds taken incidentally in high seas driftnet fisheries with a 2000 diet study on sooty and short-tailed shearwaters, finding that those shearwater species preyed upon pelagic squid, Pacific saury, and myctophids. Outside of fisheries, several studies concur that albatrosses prey heavily on pelagic squid species, both worldwide (Cherel and Klages 1997) and within the CCE (Pitman et al. 2004). Baltz and Morejohn (1977), studying the diets of seabirds found in Monterey Bay, found pelagic squids in the diets of northern fulmar, and short-tailed, sooty and pink-footed shearwaters. Therefore, Procelliformes may be considered predators of the following Shared EC Species or species groups: Pacific saury, mesopelagic fishes osmerid smelts, and pelagic squids.

*Pelecaniformes*

Several U.S. brown pelican populations, including the coastal California population, were among the many bird populations decimated by the widespread use of the pesticide DDT (dichlorodiphenyltrichloroethane) in the mid-20th century. Brown pelican populations were delisted from their ESA-protected status in 2009 (74 FR 59444, November 17, 2009). ESA-listing for these populations led to diet studies for the species and brown pelicans of California are well known to feed almost exclusively on northern anchovy (Anderson and Gress 1983; Briggs et al. 1983; and USFWS 1983), although the USFWS recovery plan for brown pelican also noted small numbers of Pacific saury and topsmelt in pelican diets (USFWS 1983).

In examining the pellets, regurgitations, and stomach samples of pelagic, Brandt's (*Phalacrocorax penicillatus*), and double-crested (*P. auritus*) cormorants, Ainley et al. (1981) found that their diets included the Shared EC Species: osmerid smelts, Pacific sand lance, silversides, thread herring and mesopelagic fishes. Sand lance has also been found in the diets of double-crested and pelagic (*P. pelagicus*) cormorants of British Columbia (Robertson 1974) and in the diets of double-crested cormorants of the Columbia River estuary (Collis et al. 2002). Talent (1984) found Pacific saury and jacksmelt in diets of Brandt's cormorants wintering in Monterey Bay. Therefore, Pelecaniformes may be considered predators of the following Shared EC Species or species groups: thread herring, Pacific sand lance, Pacific saury, mesopelagic fishes, silversides, and osmerid smelts.

*Charadriiformes*

Baltz and Morejohn (1977) studied the diets of a variety of seabirds wintering on Monterey Bay, and found that California (*Larus californicus*), glaucous-winged (*L. glaucescens*), and Western gulls (*L. occidentalis*) all prey upon boreal clubhook squid (*Onychoteuthis borealijaponicus).* Hunt and Hunt (1976) looked at the diets of Western gulls nesting on Santa Barbara Island and, in addition to a heavy reliance on anchovy, found Pacific saury in their diets. Collis et al. (2002) found Pacific sand lance and osmerid smelts in the diets of glaucous-winged gulls of the Columbia River estuary. Vermeer (1982) identified Pacific sand lance and Pacific saury in the diets of the glaucous-winged gulls of Vancouver Island. Hatch (1993b; 2013) examined black-legged kittiwake diets from regurgitated stomach samples and found Pacific sand lance, osmerids, myctophids, and unidentified squid.

Burkett (1995) collected food habits information for marbeled murrelet and found that, among other prey, they consumed Pacific sand lance and osmerids. Roth et al. (2005) reviewed the diet and prey abundance of Xantus's murrelet in Southern California and, although they did not speciate much of that murrelet's diet, they did find that Xantus murrelet prey upon Pacific saury, in addition to other species. Roth et al. (2008) studied the diets of common murre in colonies between Cape Blanco, OR and Point Conception, CA, finding that common murre are strongly piscivorous, preying upon species from the Groundfish and CPS FMPs as well as osmerid smelts. Ainley et al. (1996) looked at common murre diets in California waters and also found strong piscivory, with their diets including Shared EC Species from the osmerid smelt and silversides groups. Miller and Sydeman (2004) also found heavy common murre predation on juvenile rockfish and other species, including osmerid smelts. In a report on marbled murrelet populations and productivity in Oregon, Strong (2010) found Pacific sand lance and osmerids in both marbled murrelet and common murre diets. In addition to their notorious predation on juvenile salmon, Caspian terns (*Sterna caspia*) prey upon an array of forage fish species, including Pacific sand lance and osmerid smelts (Collis et al. 2002; Thompson et al. 2002; and Roby et al. 2003).

Wehle (1982) examined the stomach contents of tufted puffins taken off Alaska and found that, in addition to preying upon squid, tufted puffins eat Pacific sand lance and capelin, an osmerid smelt. Rhinoceros auklet chicks feed so heavily on Pacific sand lance that sand lance year class strength can be a limiting factor for annual rhinoceros auklet chick survival (Vermeer 1980; Bertram and Kaiser 1993; and Davoren and Burger 1999). Grover and Olla (1983) posited that intense rhinoceros auklet feeding on Pacific sand lance served to reveal concentrations of sand lance to other sand lance predators, such as glaucous-winged and Heermann's gulls, pelagic cormorants, and common murres. Thayer et al. (2008) studied the diets of rhinoceros auklets in colonies around the North Pacific Rim and found that diet contents varied by location, and that rhinoceros auklets off southern California feed on Pacific saury in addition to several FMP species, such as juvenile rockfish, salmon, and sablefish. Pacific sand lance also figure heavily in the diets of nesting Cassin's auklets (*Ptychoramphus aleuticus,* Bertram et al. 2001) and pigeon guillemots (Litzow et al. 2000). Adams et al. (2004) examined the euphausiid-heavy diets of Cassin's auklet chicks off Southern California and found paralepididae (mesopelagic fish) among their prey. Davoren and Burger (1999) also sampled rhinoceros auklet diets at colony sites off British Columbia and found that, in addition to Pacific sand lance, rhinoceros auklets were feeding on surf smelt (an osmerid smelt), as well as Pacific herring and Pacific salmon species (not Shared EC Species). Therefore, Charadriiformes may be considered predators of the following Shared EC Species or species groups: mesopelagic fishes, Pacific sand lance, Pacific saury, silversides, osmerid smelts and pelagic squid.

## 3.3 Socio-Economic Environment

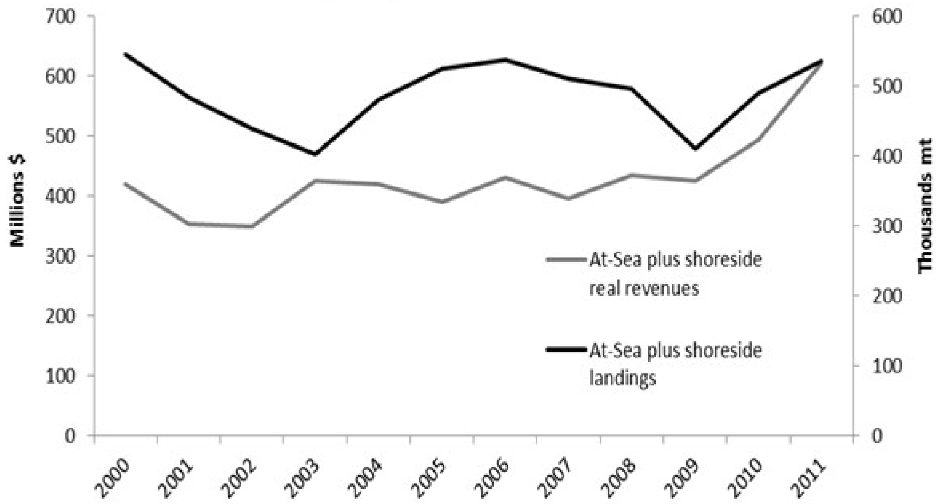
The larger socio-economic environment of the CCE, including the historical and current fisheries, fishing communities, and fisheries management processes, is described in the FEP in the following sections, which are incorporated here by reference: Section 3.1.3, Political Geographic and Large-Scale Human Demographic Features of the CCE; Section 3.4, Fisheries of the CCE; Section 3.5, Fisheries and Natural Resource Management in the CCE; Section 4.4, Changes in Fishing Community Involvement in Fisheries and Dependence Upon Fisheries Resources (PFMC 2013). This document's Section 3.3: summarizes those FEP descriptions of the socio-economic environment relevant to this action (this introduction and Section 3.3.1); describes directed fisheries for the species subject to this action, if any (Section 3.3.2); describes incidental catch, where known, of the Shared EC Species (Section 3.3.3); and summarizes the non-fishing activities, where known, that may affect Shared EC Species (Section 3.3.4). This action is explicitly intended to address non-tribal commercial fishing; therefore, Section 3.3 focuses primarily on those fisheries, rather than broadly discussing all fisheries that may occur within the U.S. West Coast EEZ. As discussed in Section 3.3.1.4, there are some small tribal harvests of osmerid smelts, but few other known tribal fisheries for Shared EC Species. Within the non-tribal sector's recreational fisheries, there are some small nearshore and surfzone recreational fisheries for Shared EC Species. However, Shared EC Species are not popular recreational fisheries targets when compared to the array of larger-bodied species available to West Coast recreational fisheries (e.g. salmon, lingcod, albacore, Pacific halibut and nearshore rockfishes).

The Council is responsible for managing fisheries that primarily occur within Federal waters, 3-200 nm offshore, and separates management for those fisheries into four fishery management plans: coastal pelagic species, groundfish species, highly migratory species, and salmon species. West Coast states have management responsibility for those ocean fisheries targeting species that primarily occur inshore of the state marine boundary of 3 nm. Off the northern Washington coast, the Makah, Quileute, Hoh and Quinault Tribes have treaty fishing rights in usual and accustomed (U&A) fishing areas that include marine waters out to 40 nm offshore. Numerous additional Puget Sound, inland Northwest, and coastal California tribes have treaty fishing rights to salmonids that range from western freshwater streams to the high seas of the Pacific Ocean. Because Pacific salmon streams reach into Idaho, the Council includes voting representatives from the State of Idaho, as well as voting representatives from the States of California, Oregon, and Washington, and a non-voting representative from the State of Alaska. The geographic scope of this action is the U.S. West Coast EEZ; therefore, the fisheries of Idaho and of treaty fishing tribes without U&A fishing areas within the EEZ will not be further discussed herein.

Major West Coast commercial fishing ports over the 2000-2011 period, by volume, include: ports in the Southern California port area, mainly San Pedro, Terminal Island, Port Hueneme and Ventura; northern Oregon ports, mainly Newport and Astoria; and southern Washington ports of Chinook and Westport. Major West Coast recreational fishing areas over the 2004-2011 period include southern California, north-central California, central Oregon, and the Washington coast off Grays Harbor, although recreational fisheries are generally more active off California than off Washington or Oregon. Human activities that compete with fishing for ocean space include: marine protected areas, non-consumptive recreation, dredging and dredge spoil disposal, military exercises, shipping, offshore energy installations, submarine telecommunications cables, mining for minerals, sand and gravel, and ocean dumping and pollution absorption.

As discussed in the FEP at Section 3.4.2, commercial landings of all species for 2000-2011 ranged from a high near 546,000 mt in 2000 to a low of about 403,000 mt in 2003, although real exvessel revenues were generally increasing throughout the period (Figure 3.2). Annual shoreside landings were dominated by CPS, mainly squid and sardine; by volume, CPS averaged 48% of total landings for the period. Groundfish followed CPS as a share of total landings, averaging 29% by volume for the period. Dungeness crab accounted for the greatest share of shoreside exvessel revenues, an average of 31% for the period; groundfish had the next highest share at 17%. Pacific whiting dominated at-sea landings from 2000 through 2011, averaging about 99% of total volume and corresponding revenues. Of total whiting landings for the period, at-sea averaged about 60% by volume and revenue. Directed commercial fisheries for Shared EC Species are discussed in Section 3.4.1 of this document, which shows that commercial landings of Shared EC Species have historically been an extraordinarily small proportion of overall U.S. West Coast commercial fisheries landings – typically 200-1,000 mt out of the 403,000-546,000 mt annual total West Coast landings.

**Figure 3.2: Total U.S. west coast landings (mt) and real exvessel revenues (2011$), 2000-2011**




Although Shared EC Species are not targeted in commercial fisheries within the CCE, those same species or similar species, are taken in the fisheries of other nations (Figure 3.3). Harvests of forage species are converted into various commodities through value added production processes (Herrick et al. 2009). Based on FAO fisheries commodities, production and trade data from 1976-2009, most of the reported lower trophic level species commodities production was in the fishmeal and fish oil category. During that period, commodities in the fishmeal and fish oil category increased to well over 50% of total annual lower trophic level species commodities production. The growing importance of these minor species in global fishery landings may reflect their increasing use as ready substitutes in the production of fishmeal and fish oils.

Demand for these species in the production of fishmeal has mainly been driven by the spectacular growth of global aquaculture, which is expected to continue into the foreseeable future (Tacon and Metian 2008; Shamshak and Anderson 2008; and Herrick et al. 2009), see Figure 3.4. The production of many aquaculture species depends on forage species fisheries to supply the raw ingredients in today's aquafeeds. In the recent boom in capture-based aquaculture, demand has increased for whole live/fresh/frozen forage species for pen fattening aquaculture operations (Zertuche-Gonzales et al. 2008). All these feed requirements pose a potential sustainability problem for the aquaculture industry, because at present, unlike fishmeal use in livestock production, there are limited opportunities to replace lower trophic level species, either in fresh or in fishmeal form, with cost effective protein substitutes. Given limited potential for increased fishmeal production from traditional lower trophic level species prices for fishmeal and fish oil will continue to rise. This makes the prospect for fisheries developing on the minor forage species all that more attractive, since higher fishmeal prices are sure to translate into higher exvessel prices for the raw ingredients.

### 3.3.1 Directed Fisheries for Shared EC Species

The Workgroup was not able to identify any directed fisheries for Shared EC Species in Federal waters off the U.S. West Coast, 3-200 nm offshore. Sections 3.3.1.1 through 3.3.1.4, below, characterize directed state and tribal fisheries for these species, if any. When taken, most of Shared EC Species or species groups have been taken in trace amounts. With the exception of some smelts, when directed landings of these species have occurred, there were often only one or two landings per year in any one state. Therefore, some landings could not be reported without violating data confidentiality requirements, which require aggregating fishing data across at least three data points – in this case, the landing of at least three different fishing vessels. Because there are notably fewer data for these species than for fisheries-targeted species, there may be substantial and unknown problems with the accuracy and precision of any catch amounts shown in this section and in Section 3.3.2, which discusses incidental take of Shared EC Species.

**Figure 3.3: Global landings of select California Current Ecosystem LTL species, 1950-2009.**

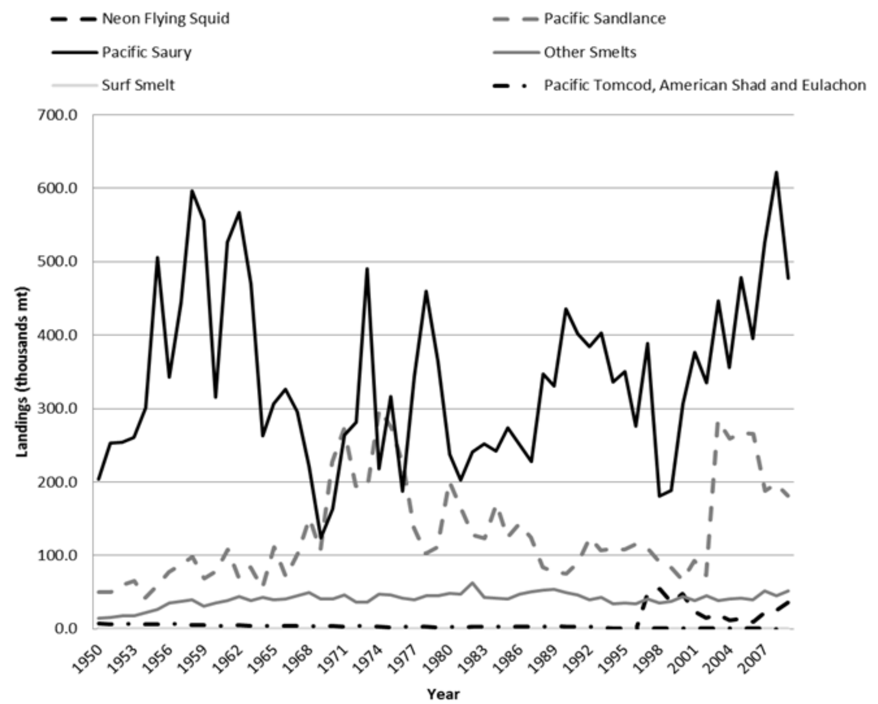
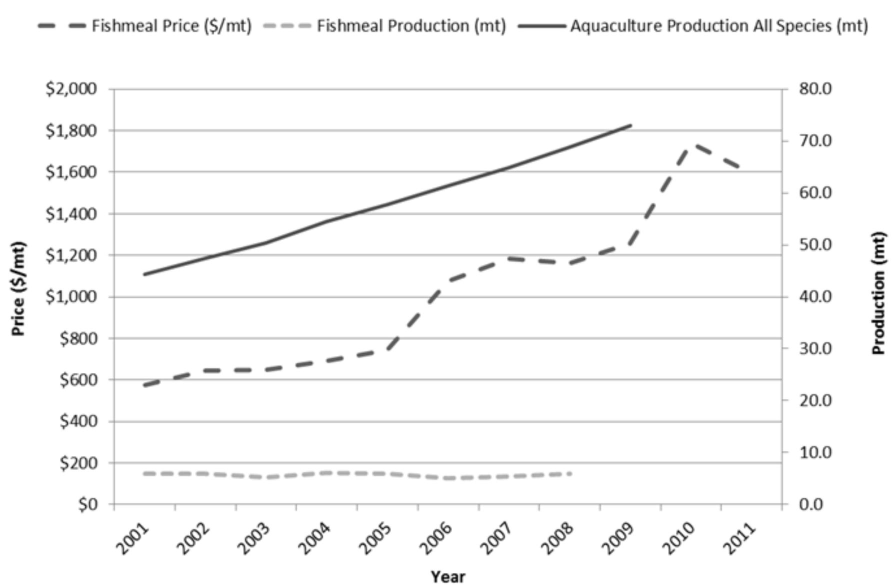
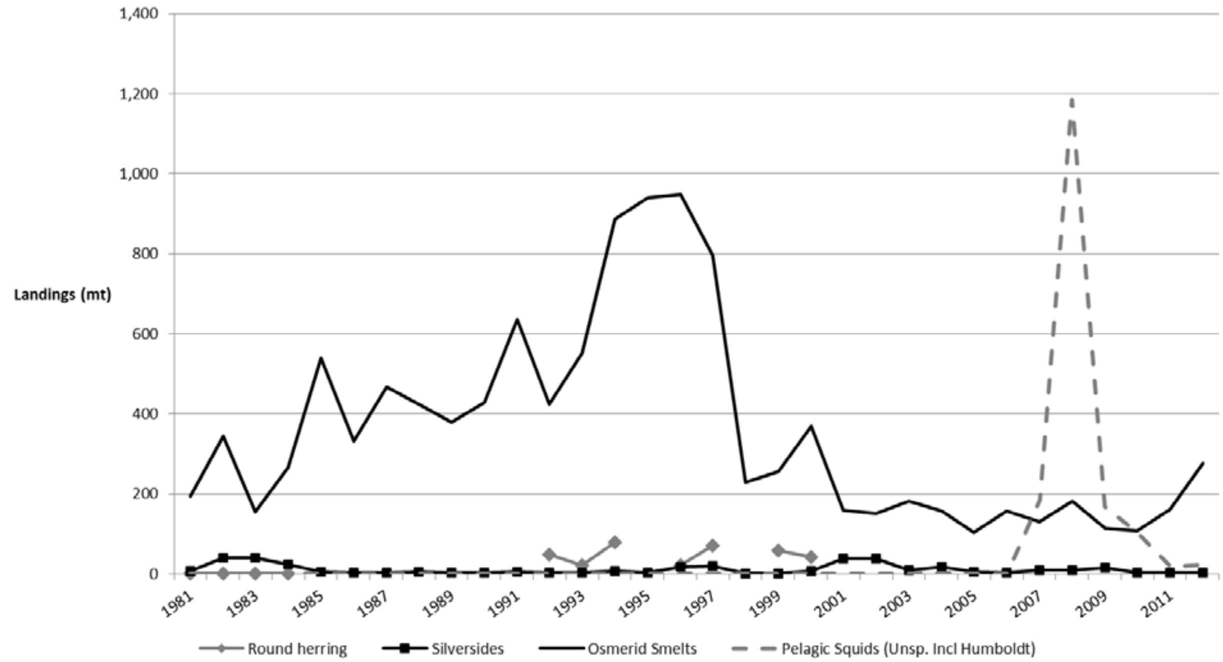



**Figure 3.4: Global aquaculture production, fishmeal production and fishmeal price, 2001-2011.**




With the exception of the true smelts (*Osmeridae*), coastwide landings of Shared EC Species have been relatively minimal or zero over the past 30+ years (Figure 3.5). The Shared EC Species or species groups that do not appear in Figure 3.5 were either not landed during the 1981-2013 period, or may have been landed under one of the very general Pacific Fisheries Information Network (PacFIN) "unspecified" or "other" categories. Directed fishing for osmerid smelts has largely occurred within state coastal waters, where those species aggregate. Landings from the Columbia River or attributed to inland waters, areas where eulachon aggregate, were not included in Figure 3.5; therefore, no eulachon landings appear in Figure 3.5. The peak in landings of pelagic squids in the past ten years is likely attributable to Humboldt squid landings, rather than to the squid species subject to this action. However, squid are not reported by species except for market squid and Humboldt squid (California only). Data confidentiality issues described above prevented displaying round herring landings in some years (refer to Section 3.3.1.3 for California landings.)

Figure 3.5: U.S. West Coast landings (mt) of select non-FMP forage species, 1981-2013



*3.3.1.1 Washington directed fisheries for Shared EC Species*

Table 3.3.1, below, summarizes known information about Washington-based commercial and recreational harvest of Shared EC Species.

| **Table 3.3.1: Shared EC Species in Washington fisheries** | |
|---|---|
| **Round and thread herring** | |
| | Not known to occur in Washington area waters. |
| **Mesopelagic fishes** | |
| *Myctophidae, Bathylagidae, Paralepididae,* and *Gonosomatidae* | No known landings into Washington. Trace amounts observed as bycatch in the at-sea whiting fishery. |
| **Pacific sand lance** | |
| | *Commercial*: No known commercial landings. Trace amounts observed as bycatch in the at-sea whiting fishery.<br><br>*Recreational*: Limited harvest allowed under forage fish rules. Any harvest would most likely take place in state waters. |
| **Pacific saury** | |
| | No known harvest in the state. |
| **Silversides** | |
| | No known harvest in the state. |
| **Osmerid Smelts** | |
| | Washington waters are home to several members of the smelt family including surf smelt, eulachon, longfin smelt, whitebait smelt, and night smelt. There is no commercial fishing authorized for these species in ocean waters off the Washington coast. Some recreational harvest is permitted but it likely occurs primarily, if not exclusively, within state waters. Commercial and recreational harvest occurs in Puget Sound, primarily for surf smelt. Based on PacFIN reportings for marine waters statistical areas, as much as 50% of the unidentified smelt species landed into Washington ports in any one year over 1981-1990 may have been taken from Federal waters. This figure declined to 20% over 1991-2001, but has been at 0% for 2002 through 2012. |
| **Pelagic squids** | |
| | Commercial landings of squid are not recorded to species in Washington. Large landings in 2008 were likely Humboldt squid. Based on PacFIN reportings for marine waters statistical areas, less than 2% of the unidentified squid species landed into Washington ports in any one year over 1981-1990 may have been taken from Federal waters. This figure increased to about 7% for any one year over 1991-2000, but increased to 100% in 2001-2003, slightly decreased to about 78% in 2004-2005, and then returned to 100% in 2006 through 2012. |

### *3.3.1.2 Oregon directed fisheries for Shared EC Species*

Under the general Oregon policy of marine fisheries being open unless specifically closed, commercial fishing for these species is allowed in marine waters off Oregon, with the exception of Osmerid smelts. Commercial fishing for osmerid smelts is prohibited and bycatch may not exceed 1% of the total landing by weight (Oregon Administrative Rule 635-004-0545). Commercial fishing for eulachon may occur in the Columbia River if allowed under OAR 635-042-0130. For federally managed species, Oregon Department of Fish and Wildlife (ODFW) regulations for state waters automatically conform to Federal regulations (see OAR Division 004, Commercial Fisheries Other Than Salmon and Shellfish). Any Federal regulations developed to protect these forage species in the FMPs would automatically apply to state fisheries and waters.

Current commercial fisheries do not appear to target any of these species in marine waters but may land small amounts as bycatch, with no commercial value. With the exception of eulachon from the Columbia River and unspecified squid species, which are likely Humboldt squid, the annual ex-vessel revenue from Oregon landings of all these species has been zero for the past decade. During the mid-1980s, landings of unspecified smelt species peaked at 33 mt with an ex-vessel value of $21,000. Landings of unspecified smelt species declined to less than 1 mt in most years after 1989. (ODFW commercial codes identify only whitebait smelt, surf smelt and eulachon. Other smelt and unidentified smelt are coded as smelt species).

In recent years, bycatch of these species, excluding unspecified squid species and eulachon, have been taken primarily in the whiting fishery, pink shrimp fishery, and groundfish trawl fishery. For example, recent annual landings of barracudina, a mesopelagic fish, are very small (<0.1mt) and taken as bycatch in the whiting fishery. In the pink shrimp fishery, some of these forage species are commonly taken and are discarded at sea. Myctophids are a common bycatch in shrimp trawls at depths greater than about 90 fathoms; whitebait smelt are common in trawls inside of about 65 fathoms; and Pacific sand lance are rarely encountered (R. Hannah, pers. comm., ODFW, Research biologist, January 16, 2014). Eulachon are commonly taken in shrimp trawls and can be a large component of the bycatch that remains after bycatch reduction devices have excluded the majority of incidentally-caught fishes.

For recreational fisheries, fishing for all these forage species is allowed, with the exception of eulachon. Targeting is rare, but does occasionally occur for surf smelt near or from shore. Occasionally, Pacific sand lance may be incidentally taken while fishing for herring.

Table 3.3.2, below, summarizes known information about Oregon-based commercial and recreational harvest of Shared EC Species.

| **Table 3.3.2: Shared EC Species in Oregon fisheries** | |
|---|---|
| **Round and thread herring** | |
| | Not known to occur in Oregon area waters. |
| **Mesopelagic fishes** | |
| *Myctophidae, Bathylagidae, Paralepididae,* and *Gonosomatidae* | No landings into Oregon, except trace amounts of barracudinas taken as bycatch in the at-sea whiting fishery. Myctophids are a common bycatch in shrimp trawls at depths greater than 90 fathoms and are discarded at sea. |
| **Pacific sand lance** | |
| | *Commercial:* No known commercial landings. Trace amounts observed as bycatch in the at-sea whiting fishery. No commercial code in fish ticket system.<br><br>*Recreational:* Limited harvest allowed. No known harvest since 2000. Any harvest would most likely take place in state waters, incidental to fishing for herring. |

| | |
|---|---|
| **Pacific saury** | |
| | No known harvest in the state. (commercial: one fish landed in 2012). |
| **Silversides** | |
| | *Commercial*: No known commercial landings.<br><br>*Recreational*: No reported harvest. Harvest, if any, from ocean and estuary sampling was most likely topsmelt reported as jacksmelt. |
| **Osmerid Smelts** | |
| | Oregon waters are home to several members of the smelt family including surf smelt, eulachon, longfin smelt, whitebait smelt, and night smelt.<br><br>*Commercial:* There is no commercial fishing authorized for these species in ocean waters off the Oregon coast. Smelt landings of unspecified species during the early 1980s were taken with bait shrimp pumps and bait net gear, primarily from the southern Oregon coast. Landings ranged from 10 to 33 mt during 1984-1987 and declined rapidly to low levels until prohibited. A small amount of whitebait smelt was landed in 1989. Eulachon landings are from fisheries in the Columbia River, with the exception of a trace amount of bycatch taken in the whiting fishery in 2013.<br><br>Smelt are taken as bycatch in the pink shrimp fishery and are discarded at sea. Eulachon are very commonly encountered in Oregon shrimp trawls and can be a large component of the bycatch that remains after bycatch reduction devices have excluded the majority of incidentally-caught fishes (in some years). Whitebait smelt are commonly encountered when shrimpers trawl inside of about 65 fathoms.<br><br>*Recreational*: Since 2000, trace amounts of unspecified smelts have been harvested in estuary waters. |
| **Pelagic squids** | |
| | Commercial landings of squid are not recorded to species in Oregon, with the exception of market squid. Commercial landings of all other squids were zero until 2007, when 103 mt were landed. Landings peaked in 2008 at 351 mt and have declined rapidly to 20 mt or less since 2010. These landings were likely Humboldt squid. |

#### *3.3.1.3 California directed fisheries for Shared EC Species*

Of the proposed list of forage species, there are only directed commercial fisheries for some of the osmerid smelts in California waters. There may be some directed landings of jacksmelt, although the landings of this species primarily occur incidentally to other fisheries. Bait fisheries are allowed for the smelts, but it is not clear what portion of total landings are for bait purposes. Historically, there have been limited efforts to target Pacific saury or round herring, but reported landings of these species have been minimal or nonexistent over the past 30 or 12 years, respectively. While it is difficult to determine whether these fisheries take place in state or Federal waters, it appears that for the most part, any existing directed fisheries are occurring primarily or exclusively within state waters. For federally managed fisheries for CPS, salmon and groundfish, California Department of Fish and Wildlife (CDFW) commercial regulations for state waters automatically conform to Federal regulations (see Fish and Game Code Sections 159, 182 and 189, California Code of Regulations). Any Federal regulations developed to protect these forage species in the CPS, salmon or Groundfish FMPs would automatically apply to California's state fisheries and waters only when they were being targeted, or part of a directed fishery, while fishing for CPS, salmon or groundfish.

Information on bycatch of the Shared EC Species in other fisheries is also limited. The West Coast Groundfish Observer Program (WCGOP) data indicate there have been some limited interactions among the proposed forage species and some California fisheries including: smelts and round herring with the

California halibut trawl fishery and possibly osmerid smelts in the pink shrimp fishery (although the data do not specify state of occurrence.) Table 3.3.3, below, summarizes known information about California-based commercial and recreational harvest of the Shared EC Species.

| **Table 3.3.3: Shared EC Species in California fisheries** | |
|---|---|
| **Round and thread herring** | |
| Round herring | *Commercial*: Round herring landings were reported for about ten years during the 1990s, which exceeded 170,000 pounds in 1994, but no landings have been reported since 2001. Most of the reported landings were from the Los Angeles port complex using net gear incidental to CPS species (e.g., sardine, and jack and Pacific mackerel). Regulations regarding the commercial take of herring are not specific, but generally apply to Pacific herring.<br><br>*Recreational*: While the recreational take of herring is allowed, from 1980 to 2003 the estimated catch was minimal or none. Catch from 2004 on have been trace or zero. |
| Thread herring | *Commercial*: There have been no reported landings of thread herring.<br><br>*Recreational*: While both herring species may be taken in the recreational fishery, there was no estimated catch of thread herring. |
| **Mesopelagic fishes** | |
| *Myctophidae, Bathylagidae, Paralepididae,* and *Gonosomatidae* | *Commercial*: Although there are no regulations preventing or allowing the take of mesopelagics, there have been no reported landings of these groups and there is no market category for these species.<br><br>*Recreational*: There were no catch estimates of mesopelagics from 1980 to the present. It is likely they occur too deep to be taken in the recreational fishery. |
| **Pacific sand lance** | |
| | *Commercial*: There is no market category for Pacific sand lance, and there are no landings.<br><br>*Recreational*: A fishery is allowed, but they are not targeted. Occasionally they may be taken accidentally while fishing for [Pacific] herring. |
| **Pacific saury** | |
| | *Commercial*: Pacific saury may be taken commercially, but they are not targeted. Historically, there have been several attempts to initiate saury fisheries. In 1931, 1,300 pounds were delivered in Monterey; later, Hovden cannery experimented with canning them in 1947 and produced a product "…highly satisfactory…superior to sardines in taste and appearance..." (Cox, 1949). Another fishery was initiated in the 1950s following the collapse of the sardine fishery and further attempted primarily by the Japanese in the 1960s after the decline of the western Pacific stocks; the highest landing was 3,600 tons in 1970 (Kato 1992). Since 1980, there have been trace (<100 pounds) to no reported landings. Earlier landings were likely primarily if not all from Federal waters. Anecdotal information suggests that they do not school as well as the western Pacific stock, and thus there is less incentive to initiate a fishery (S. Moore, commercial fisherman, pers. comm. September 2012.)<br><br>*Recreational*: A recreational fishery is allowed, but saury are not targeted; catch estimates were minimal or zero from 1980 through present. Anecdotal information suggests that they may be taken in the recreational fishery incidentally to HMS species (C. Valle, pers. comm., CDFW, Sr. Environmental Scientist Supervisor, April 2013). |
| **Silversides** | |

| | |
|---|---|
| Topsmelt | *Commercial*: They are allowed to be taken in the commercial fishery, although there have been zero to trace landings since 1980.<br><br>*Recreational*: Topsmelt are allowed to be taken in the recreational fishery; almost all the catch occurs in state waters.<br><br>*Marine Aquaria Trade:* They are allowed to be taken in the marine aquaria trade with the appropriate permit. |
| Grunion | *Commercial*: Grunion has a closed commercial season between April and May. There have been no or trace (≤1000 pounds) commercial landings since 1980.<br><br>*Recreational*: Grunion are targeted at night at high tides on beaches mostly in southern CA. However, due to the state's daytime and boat-based sampling priorities for its recreational fisheries, there are no reliable estimates of catch.<br><br>*Marine Aquaria*: They are allowed to be taken in the marine aquaria trade with the appropriate permit. |
| **Osmerid Smelts** | |
| | In general, there have been substantial commercial landings of "smelt" from 1980 to the present ranging from almost 500,000 pounds to over 2 million pounds in the 1990s. However, landings were primarily reported as the more general "true smelt" or as "whitebait smelt" until the mid-1980s, and there was no sampling program to validate coding to various market categories. Beginning in 1990, landings of the "true smelt" category dropped to about 5,000 pounds, then to less than 2,000 pounds in more recent years. About the same time, landings of "whitebait smelt" dropped from an annual average of almost 400,000 pounds from 1978 to 1989 to 52,675 pounds in 1990, then in 1993 dropped below 10,000 pounds. The last reported landings of whitebait smelt were in 2001. While landings of "true'; and "whitebait" smelt were declining, landings of "night" and "surf" smelt began increasing; thus, declines in landings more likely represent changes in coding rather than changes in abundance. Declines observed in landings of night and surf smelt around 1999 and 2000 are likely regulatory in nature. The majority of smelt is landed from fisheries using A-frame nets from the beach (assumed because the primary gear categories included brail+other+unk). Then, trucks are used on the beach to collect and hold the smelt and transport them to markets, which means that vehicle access to beaches constrains development of fisheries. [The update of the Redwood State Park Management Plan restricts vehicle access to some "smelt beaches" at this time.] Smelts are allowed to be taken in parts of the state for live bait. [Fish and Game Code (FGC), California Code of Regulations (CCR), Sections: 8780 - 8780.1] |
| Eulachon | *Commercial*: There have been zero to trace landings since 1980.<br><br>*Recreational*: Recreational fishing is not allowed. |
| Night smelt | *Commercial*: There have been substantial landings of "smelt" from 1980 to the present, and reported landings of night smelt averaged about 335,000 pounds annually from 1980 to 2012.<br><br>*Recreational*: Night smelt may be recreationally taken. However, due to the state's daytime and boat-based sampling priorities for its recreational fisheries, there are no reliable estimates of catch since the fishery primarily occurs at night. |
| Surf smelt | *Commercial*: Surf smelt reported annual landings have averaged about 200,000 pounds since 1980. Regulations and gear information for night smelt also apply to surf smelt.<br><br>*Recreational*: Recreational fishing for surf smelt is allowed. There is occasional targeting of surf smelt from or near shore; almost all catch occurs in state waters and |

| | |
|---|---|
| | often on the same beaches where night smelt spawn and are fished (K. Crane, pers. comm., CDFW, Environmental Scientist, October 2013. |
| Whitebait smelt | *Commercial*: Many early landings were attributed to "whitebait smelt" from 1980 to 1989, although there was no sampling to verify these landings. Whitebait smelt landings annually averaged 327,000 pounds until 1993, when the reported landings totaled 8,863 pounds. After 1993, landings dwindled and there have been no reported landings since 2001.<br><br>*Recreational*: Whitebait smelt may be taken in the recreational fishery. |
| **Pelagic squids** | |
| | *Commercial*: There were no landings for any species, nor are there any market codes, other than for Humboldt squid.<br><br>*Recreational*: There were no recorded landings, although the state's recreational sampling program does not routinely collect catch information on squids, other than Humboldt squid. |

### *3.3.1.4 Tribal directed fisheries for Shared EC Species*

There are no directed tribal fisheries for the Shared EC Species in Federal waters. There is some limited harvest of osmerid smelts at shoreline and from estuary locations. The fisheries are limited to hand seines and dipnets used from shore. These are mostly personal-use fisheries, although some commercial sales occur in years of relatively high abundance. Availability of these fish varies considerably from year to year and annual total harvests can vary from zero to approximately 40 mt. In Puget Sound, there are directed tribal fisheries for surf and longfin smelts. Again, these are primarily personal-use fisheries but some commercial sales occur when the stocks are very abundant.

| **Table 3.3.4: Shared EC Species in Treaty Tribal fisheries** | |
|---|---|
| **Round and thread herring** | |
| | Not known to occur in Washington, Treaty Area waters. |
| **Mesopelagic fishes** | |
| *Myctophidae, Bathylagidae, Paralepididae*, and *Gonosomatidae* | No directed fisheries. Trace amounts taken as bycatch in the at-sea whiting fishery. |
| **Pacific sand lance** | |
| | No directed fisheries. Trace amounts likely taken as bycatch in the at-sea whiting fishery. |
| **Pacific saury** | |
| | No directed fisheries. Bycatch unlikely. |
| **Silversides** | |
| | No directed fisheries. Bycatch unlikely. |
| **Osmerid Smelts** | No directed fisheries in Federal waters. Trace amounts taken as bycatch in the at-sea whiting fishery. Eulachon and Surf Smelt are targeted in small fisheries limited to beaches and estuarine shorelines. These are usually personal-use fisheries but include some commercial sales in years of relatively high abundance. |
| **Pelagic squids** | |
| | No directed fisheries. Trace amounts as bycatch in at-sea whiting fishery. |

### 3.3.2 EEZ Fisheries Taking Shared EC Species Indirectly

As stated in Section 1.2, Purpose and Need, "*The purpose of this action is to prohibit new directed commercial fishing in Federal waters on unmanaged, unfished forage fish species until the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem* . . ." During its April 2014 discussions on this action, the Council also indicated that it wanted to allow the currently low levels of incidental catch and retention of Shared EC Species to continue without disruption to existing fisheries or enforcement actions against vessels that may incidentally catch Shared EC Species while legitimately targeting other species in the EEZ. To that end, this Section 3.3.2 reviews available information on historic incidental catch of Shared EC Species that may have occurred within EEZ fisheries targeting other species. When Shared EC Species, or species similar to them, are taken in directed fisheries elsewhere in the world (see Section 3.3 introductory text), they are commonly harvested with small-mesh net gear. Therefore, this section 3.3.2 will briefly consider the Council's HMS and salmon fisheries, but will focus more on the potential for incidental catch in the groundfish and CPS fisheries.

For HMS and salmon fisheries, none of the species subject to this action are known to be taken as bycatch. Directed salmon fisheries in the EEZ use hook and line gear, which is not known to be effective at taking Shared EC Species. When considering designation of EC species for the HMS FMP in 2010, the HMSMT (Agenda Item G.2.b., HMSMT Report, April 2010) tabulated 2000-2008 commercial catches for many monitored species, specifically listed in the FMP at the time. Pacific saury was the only Shared EC Species on the monitored list and there were no reported landings during this period. Observer records for the drift gillnet fishery during this period also showed no observations of any of these forage species. Pacific saury was not designated an EC species and is no longer an HMS FMP species.

A review of incidental and bycatch data reported in the CPS SAFE (PFMC 2011a at Section 6) indicated incidental catch and bycatch of Shared EC Species in low or extremely low amounts in CPS fisheries. Information was based on a review of logbooks, landing receipts and observer or sampling records and found that there was no documented incidental catch or bycatch of Pacific saury, Pacific sand lance, whitebait smelt or myctophids based on logbooks, fish tickets or observer data. Smelts, except for jacksmelt, were infrequently observed in California's CPS fisheries (less than 1% frequency in landings from 2004-2008 based on bycatch observations and even less for California grunion). Smelts were not observed in Washington or Oregon CPS fisheries (PFMC 2011b). A review of the observed incidental landings of California's sardine and Pacific mackerel fisheries from 2006 – 2010 were similar: listed percent frequencies of California grunion, surf smelt, silversides, true smelts and top smelt did not exceed 0.7 in any year, and jacksmelt did not exceed 3.9 percent frequency (PFMC 2011a at Appendix A, Table 6-5). Logbook data and observed catches from the Oregon sardine fishery from 2006 – 2010 did not include any of Shared EC Species (PFMC 2011a at Appendix A, Table 6-9).

Some state and Federal monitoring programs are conducted to investigate the interactions of target fisheries with other species. The Workgroup looked at information from some of these programs for possible insights into the encounter rates of the Shared EC Species within FMP fisheries. To gauge current catch levels of Shared EC Species, the Workgroup used a dataset primarily used under the Council's Groundfish FMP and compiled by NMFS's WCGOP. The WCGOP dataset combines commercial landings data with available data taken by observers aboard commercial fishing vessels. The dataset focuses on the Groundfish FMP commercial sectors and other commercial sectors monitored because of their bycatch of Groundfish FMP stocks, such as the state pink shrimp trawl fisheries. While not covering all commercial fishing activities in the EEZ, these fishery sectors would be some of the most likely to have incidental catch of Shared EC Species. In addition, the Workgroup also reviewed information the CPS management team assembled for use during that FMP's Amendment 13 process, as well as information from the 2011 CPS Stock Assessment and Fishery Evaluation (SAFE, PFMC 2011a) document, and HMS background documents on incorporating EC species into that FMP.

Catch estimates for the species subject to this action are shown in Table 3.3.5. The mesopelagic species group includes many taxonomic groups, so those shown in Table 3.3.5 may not include all species in the dataset. Incidental catch of Shared EC Species appears to be tens of pounds and less per year, except for smelts and squid. Catch of American shad, which is not a species subject to this action, was highly variable over 2003-2012, but averaged 44 mt per year. The squid catch reported in Table 3.3.5 is not identified to the species level, but much of the catch weight is likely Humboldt Squid, which is not a Shared EC Species.

Species level allocation of the catch is an issue for most, if not all, of the species considered here. There are two basic ways that fisheries catch is accounted for in commercial fisheries, through landings records and through observer data. Fish retained and brought into port are recorded on landings receipts, also known as "fish tickets." Landings are reported to differing levels of specificity for species and taxonomy, because regulations governing the reporting of fish landings do not require many species to be identified to the species, or even higher taxonomic, level. For example, Washington State's regulations would only require mesopelagics to be reported as miscellaneous marine fish together with a wide range of other species.

Onboard fishery observers will record catch amounts, but they typically focus on the fish that are discarded at sea. Species subject to this action likely have been lower priority for sampling relative to species managed under FMPs and other higher priority species like marine mammals. Sampling coverage levels were less than 100 percent in many sectors and for much of the 2003-2012 period, which meant that the Workgroup had to expand available data to produce the estimates in Table 3.3.5: therefore, the accuracy and precision of the estimates in Table 3.3.5 reflects the fishery coverage levels and estimation methodologies for unmonitored species. In future data collection efforts, some Shared EC Species may be identifiable at the species level, which could improve catch or bycatch estimate accuracy for those species. However, these species may also occur so infrequently or in such trace amounts that requiring greater specificity in landings reporting may provide more questions than answers for future fishery monitors and managers.

**Table 3.3.5. Bycatch (metric tons) of the Initiative 1 species and species groups in the Groundfish FMP commercial sectors and other sectors monitored for their bycatch of Groundfish FMP stocks (source: Groundfish Mortality Multiyear Data Product, ver. 23-Dec-2013, WCGOP).**

| Species and Sectors | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Round Herring** | | | | | | | | | | | |
| California Halibut | -- | 0.01 | -- | -- | -- | -- | -- | -- | -- | -- | 0.01 |
| **Thread Herring** | | | | | | | | | | | |
| -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0.00 |
| **Pacific sandlance** | | | | | | | | | | | |
| Bottom trawl | -- | -- | -- | -- | -- | -- | 0.02 | -- | -- | -- | 0.02 |
| At-sea whiting trawl | -- | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- | 0.00 |
| **Pacific Saury** | | | | | | | | | | | |
| Bottom trawl | 0.01 | -- | -- | -- | 0.00 | -- | 0.02 | 0.00 | 0.00 | 0.00 | 0.03 |
| Pink Shrimp | -- | 0.00 | -- | -- | 0.00 | -- | -- | 0.00 | 0.00 | 0.01 | 0.01 |
| At-sea whiting trawl | -- | -- | -- | -- | -- | 0.00 | -- | 0.00 | 0.00 | 0.00 | 0.00 |
| Nonnearshore Fixed Gear | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0.00 | 0.00 |
| **SILVERSIDES** | | | | | | | | | | | |
| **Jack Smelt** | | | | | | | | | | | |
| Nearshore Fixed Gear | -- | -- | -- | 0.00 | 0.00 | 1.26 | 0.01 | -- | -- | -- | 1.27 |
| Bottom trawl | -- | -- | 0.00 | -- | -- | -- | -- | -- | -- | -- | 0.00 |
| California Halibut | -- | -- | -- | 0.00 | -- | -- | -- | -- | -- | -- | 0.00 |
| **Top Smelt** | | | | | | | | | | | |
| Nonnearshore Fixed Gear | -- | -- | -- | -- | -- | 0.01 | -- | -- | -- | -- | 0.01 |
| **PELAGIC SQUIDS** | | | | | | | | | | | |
| **Squid Unid. (includes Humboldt)** | | | | | | | | | | | |
| At-sea whiting trawl | 101.96 | 1,123.56 | 680.43 | 93.35 | 66.25 | 85.24 | 43.50 | 76.31 | 78.26 | 93.69 | 2,442.55 |
| Shoreside Hake | 0.16 | 0.17 | 0.06 | 0.37 | 166.19 | 880.95 | 3.09 | 98.79 | 16.26 | 22.53 | 1,188.57 |
| Bottom trawl | 52.95 | 76.97 | 46.74 | 74.25 | 53.67 | 116.69 | 113.04 | 29.22 | 6.73 | 7.80 | 578.06 |
| Tribal Shoreside | -- | -- | 0.01 | 0.16 | 5.26 | 265.76 | 100.03 | 0.00 | 0.54 | 0.25 | 372.01 |
| Pink Shrimp | 0.10 | 7.63 | 5.59 | -- | 5.47 | 5.11 | 1.21 | 14.50 | 39.44 | 79.11 | 158.16 |
| Nonnearshore Fixed Gear | 0.56 | 0.15 | 1.06 | 0.44 | 3.07 | 1.97 | 8.57 | 2.28 | 0.20 | 0.25 | 18.55 |
| Tribal At-Sea Hake | 0.04 | 0.04 | 0.05 | 0.00 | 0.01 | 0.59 | 0.76 | 0.03 | 1.16 | 0.00 | 2.68 |
| California Halibut | 0.07 | 0.25 | 0.03 | 0.02 | 0.01 | 0.02 | -- | 0.04 | 0.07 | 0.05 | 0.56 |
| Nearshore Fixed Gear | -- | -- | 0.01 | -- | -- | 0.02 | 0.08 | -- | 0.00 | 0.14 | 0.25 |

Table 3.3.5, continued

| Species and Sectors | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **MESOPELAGIC SPECIES** | | | | | | | | | | | |
| **Argentine Unid** | | | | | | | | | | | |
| NonTribal At-Sea Hake | – | -- | – | – | 0.00 | 0.00 | – | 0.00 | -- | – | 0.00 |
| **Barracudina Unid** | | | | | | | | | | | |
| NonTribal At-Sea Hake | 0.01 | 0.09 | 0.14 | 0.02 | 0.04 | 0.04 | 0.02 | 0.05 | 0.83 | 0.01 | 1.25 |
| Bottom trawl | 0.00 | -- | 0.00 | – | – | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 |
| Pink Shrimp | – | -- | – | – | 0.00 | – | – | – | 0.00 | – | 0.00 |
| **Blackchin Unid.** | | | | | | | | | | | |
| Bottom trawl | – | -- | – | – | – | – | – | – | 0.00 | – | 0.00 |
| **Blackdragon Unid.** | | | | | | | | | | | |
| Bottom trawl | – | -- | – | – | – | – | – | 0.00 | 0.00 | 0.00 | 0.00 |
| Nonnearshore Fixed Gear | – | -- | – | – | – | – | – | – | 0.00 | – | 0.00 |
| **Blacksmelt Unid.** | | | | | | | | | | | |
| NonTribal At-Sea Hake | – | -- | – | – | – | 0.01 | – | – | 0.07 | – | 0.08 |
| **Bristlemouth Unid.** | | | | | | | | | | | |
| Nonnearshore Fixed Gear | – | -- | – | – | – | – | – | – | -- | 0.01 | 0.01 |
| Bottom trawl | – | -- | – | – | – | – | – | 0 | -- | 0 | 0 |
| **Lanternfish Unid** | | | | | | | | | | | |
| NonTribal At-Sea Hake | 0.00 | 0.01 | 0.02 | 0.08 | 0.27 | 0.37 | 0.10 | 0.08 | 0.95 | 0.16 | 2.04 |
| Tribal At-Sea Hake | – | -- | – | – | – | – | – | 0.00 | 0.00 | 0.00 | 0.00 |
| Pink Shrimp | – | 0.06 | 0.01 | – | 0.86 | 0.06 | 0.07 | 0.01 | 0.06 | 0.04 | 1.17 |
| Bottom trawl | 0.00 | 0.00 | 0.03 | 0.01 | 0.02 | 0.03 | 0.05 | 0.03 | 0.01 | 0.01 | 0.19 |
| Nonearshore Fixed Gear | – | -- | – | – | – | – | – | – | 0.00 | – | 0.00 |
| **Lightfish Unid** | | | | | | | | | | | |
| Pink Shrimp | – | 0.00 | 0.00 | – | – | 0.05 | – | – | -- | 0.00 | 0.05 |
| **Longfin Dragonfish** | | | | | | | | | | | |
| NonTribal At-Sea Hake | – | -- | 0.00 | – | 0.01 | 0.01 | – | – | 0.00 | – | 0.02 |
| Bottom trawl | – | -- | – | – | – | 0.00 | – | – | 0.00 | – | 0.00 |
| Nonearshore Fixed Gear | – | -- | – | – | – | – | – | – | 0.00 | – | 0.00 |
| **Longnose Lancetfish** | | | | | | | | | | | |
| NonTribal At-Sea Hake | 0.00 | 0.01 | 0.01 | 0.12 | 0.53 | 1.86 | 0.13 | 0.07 | 0.41 | 0.02 | 3.16 |
| Bottom trawl | – | 0.01 | 0.03 | 0.01 | 0.02 | 0.09 | 0.08 | 0.05 | 0.01 | 0.00 | 0.30 |
| **Myctophidae** | | | | | | | | | | | |
| NonTribal At-Sea Hake | – | -- | – | – | – | – | – | – | 0.00 | 0.00 | 0.00 |
| **Pacific Argentine** | | | | | | | | | | | |
| Pink Shrimp | – | 0.45 | – | – | – | 0.00 | 0.00 | 0.02 | 0.01 | 0.00 | 0.48 |
| Bottom trawl | 0.00 | -- | 0.01 | – | 0.00 | – | – | – | -- | 0.00 | 0.01 |
| **Pacific Viperfish** | | | | | | | | | | | |
| Bottom trawl | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | – | 0.00 | 0.00 | 0.03 |
| Nonearshore Fixed Gear | 0.00 | -- | – | – | – | – | – | – | -- | 0.00 | 0.00 |
| Pink Shrimp | – | -- | – | – | 0.00 | – | – | – | -- | – | 0.00 |
| NonTribal At-Sea Hake | – | -- | 0.00 | 0.00 | – | 0.00 | – | – | -- | – | 0.00 |
| **Tubeshoulder Unid.** | | | | | | | | | | | |
| NonTribal At-Sea Hake | 0.00 | 0.00 | 0.01 | 0.00 | 0.02 | 0.06 | 0.02 | 0.02 | 0.14 | 0.04 | 0.31 |
| Bottom trawl | – | 0.00 | 0.00 | 0.00 | 0.13 | 0.02 | 0.11 | 0.01 | 0.00 | 0.00 | 0.27 |
| Pink Shrimp | – | -- | – | – | 0.00 | – | – | – | -- | – | 0.00 |
| Tribal At-Sea Hake | – | -- | – | – | – | – | – | – | 0.00 | – | 0.00 |
| **Viperfish Unid** | | | | | | | | | | | |
| NonTribal At-Sea Hake | – | 0.00 | 0.00 | 0.00 | 0.02 | 0.06 | 0.01 | 0.03 | 0.14 | 0.01 | 0.27 |
| Bottom trawl | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.03 | 0.01 | 0.01 | 0.09 |
| Pink Shrimp | – | -- | – | – | 0.00 | – | – | – | 0.00 | – | 0.00 |
| Nonearshore Fixed Gear | – | -- | 0.00 | – | – | – | – | 0.00 | 0.00 | 0.00 | 0.00 |
| **Silvery Hatchetfish** | | | | | | | | | | | |
| NonTribal At-Sea Hake | – | -- | – | – | – | 0.00 | – | – | -- | – | 0.00 |
| **White Barracudina** | | | | | | | | | | | |
| NonTribal At-Sea Hake | – | -- | – | – | 0.00 | 0.01 | 0.00 | 0.00 | 0.02 | 0.01 | 0.04 |

Table 3.3.5, continued

| Species and Sectors | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **OSMERID SMELTS** | | | | | | | | | | | |
| **Capelin** | | | | | | | | | | | |
| Bottom trawl | -- | -- | -- | -- | -- | -- | 0.03 | -- | -- | -- | 0.03 |
| Pink Shrimp | -- | -- | -- | -- | 0.02 | -- | -- | -- | -- | -- | 0.02 |
| **Longfin Smelt** | | | | | | | | | | | |
| California Halibut | -- | -- | -- | -- | -- | -- | 0.00 | -- | 0.01 | 0.00 | 0.01 |
| **Smelt Unid.** | | | | | | | | | | | |
| Pink Shrimp | 0.00 | 68.99 | 22.87 | -- | 6.37 | 27.30 | 0.57 | 2.54 | 15.21 | 23.88 | 167.73 |
| Bottom trawl | 0.12 | 0.85 | 0.15 | 0.03 | 0.01 | 0.02 | 0.00 | 0.02 | 0.03 | 0.10 | 1.33 |
| Nearshore Fixed Gear | 0.10 | 0.11 | 0.04 | 0.03 | 0.04 | 0.01 | 0.00 | -- | 0.00 | -- | 0.33 |
| Nonnearshore Fixed Gear | 0.01 | 0.14 | 0.02 | 0.13 | -- | 0.00 | -- | 0.01 | 0.00 | 0.02 | 0.33 |
| California Halibut | -- | -- | -- | 0.00 | -- | -- | -- | -- | 0.00 | 0.00 | 0.00 |
| At-sea whiting trawl | 0.00 | 0.00 | 0.00 | 0.00 | -- | 0.00 | 0.00 | -- | 0.00 | 0.00 | 0.00 |
| Tribal At-Sea Hake | 0.00 | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0.00 |
| Shoreside Hake | -- | -- | -- | -- | -- | 0.00 | -- | -- | -- | -- | 0.00 |
| Tribal Shoreside | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0.00 | 0.00 |
| **Smelt/Herring Unid.** | | | | | | | | | | | |
| At-sea whiting trawl | -- | -- | -- | -- | 0.00 | 0.04 | -- | -- | -- | -- | 0.04 |
| **Surf Smelt** | | | | | | | | | | | |
| Pink Shrimp | -- | -- | 1.91 | -- | -- | 0.20 | -- | 0.00 | 0.01 | -- | 2.12 |
| California Halibut | -- | -- | -- | -- | -- | -- | -- | 0.00 | -- | -- | 0.00 |
| Bottom trawl | -- | -- | -- | -- | -- | -- | 0.00 | -- | 0.00 | -- | 0.00 |
| **Whitebait Smelt** | | | | | | | | | | | |
| Pink Shrimp | -- | 0.21 | 1.73 | -- | 0.00 | 0.05 | 6.66 | 3.42 | 20.06 | 71.56 | 103.69 |
| Bottom trawl | -- | -- | -- | -- | -- | -- | 0.00 | -- | 0.00 | 0.00 | 0.00 |
| California Halibut | -- | -- | -- | -- | -- | -- | -- | -- | 0.00 | 0.00 | 0.00 |

### 3.3.3 Non-Fishing Human Activities Affecting Shared EC Species

This action will not regulate or otherwise affect non-fishing activities – see Section 4.3.3. Therefore, the effects of non-fishing human activities on Shared EC Species are only of interest to this analysis if those effects are significant when combined with the direct and indirect effects of this action. The cumulative effects of this action for Shared EC Species, when considered with past, present and reasonably foreseeable future actions, are considered in Section 4.4. This Section 3.3.3 briefly discusses those non-fishing human activities that may affect Shared EC Species.

Shared EC Species are similar to each other in their place in the food web and in having relatively brief lives and high fecundity. However, they have different habitat preferences from each other, which means that they can be affected to greater and lesser degrees by a wide variety of human activities. Nearshore and anadromous Shared EC Species include species from the osmerid smelt and silversides groups, as well as Pacific sand lance. The more pelagic Shared EC Species are round and thread herrings, mesopelagics, Pacific saury, and pelagic squids. The nearshore and anadromous Shared EC Species are more likely to be affected by non-fishing human activities, simply because they live in proximity to greater concentrations of humans. Non-fishing human activities identified under the ESA, MSA, and NEPA as having effects on species similar to Shared EC Species include:

- Climate change, ocean and freshwater effects
- Water quality, including: dredge material disposal, wastewater discharge with pharmaceutical, fertilizer, pesticide, and other chemicals, and discharges of oil, fire retardants, and other hazardous substances
- Coastal development, shoreline modification, and nearshore habitat alteration, including dredging and other channel disturbances
- Dams, other water diversions, and reduced freshwater flow
- Water intake structures

Non-fishing activities that introduce chemical pollutants, sewage, changes in water temperature, salinity, dissolved oxygen, and suspended sediment into the marine environment pose a risk to all Shared EC Species. Section 4.5 of the FEP identifies three major aspects of future climate change that will have direct effects on the CCE: ocean temperature, pH (acidity versus alkalinity) of ocean surface waters, and deep-water oxygen (or lack thereof, hypoxia). Although the effects of warming ocean temperatures have been identified as being negative for eulachon (NMFS 2013a), the likely effects of the three aspects of climate change identified by the FEP on the suite of Shared EC Species are unknown, as is whether the Shared EC Species can adapt to climate change. Pacific sand lance and atherinopsids that spawn in nearshore gravel and sand may be particularly affected by human activities that alter the quantity or quality of nearshore habitat. The negative effects of oil contamination of nearshore sand habitat on Pacific sand lance have been noted in scientific literature and were thoroughly studied in the wake of the 1989 Prince William Sound oil spill (Pinto et al. 1984; Robards et al. 2002).

The effects of shoreline modification and shoreline armoring have been particularly well-studied in Puget Sound, and documented as having negative effects on the productivity of osmerid smelts, Pacific sand lance, and other forage fish species (Rice 2006; Pentilla 2007). Dams, other water diversions, and reduced freshwater flow may impede anadromous osmerid smelt life cycles in the same way that they impede salmon life cycles. The 1996 Recovery Plan for the Sacramento-San Joaquin Delta Native Fishes particularly identified reduced freshwater flow, water diversions, and intake structures as affecting the abundance of delta and longfin smelt, both osmerids (USFWS 1996). The 2013 Federal Recovery Outline for Pacific Eulachon also identified reduced freshwater flow, dams and water diversions, and climate impacts on ocean conditions as threats to eulachon abundance (NMFS 2013a). While stock assessments conducted for the PFMC have benefited from data collected from coastal cooling water intakes at California electrical generating stations (e.g. Field 2013), the data are only available because power plants are entraining and impinging juvenile bocaccio and other rockfish, as well as Shared EC and other forage species (Chow et al. 1981; Grimaldo et al. 2009).

The more pelagic Shared EC Species may be primarily affected by water pollution, whether introduced by point or non-point sources from land, by ships or energy installations at sea, or by nearshore aquatic human activities like port operations and aquaculture. Actions under the jurisdiction of the Federal Energy Regulatory Commission (FERC) include permits for energy generating projects located in or immediately adjacent to the coastal waters of the U.S. West Coast. Most of the West Coast offshore energy projects are in the testing or planning phase for using wave or tidal energy, but analyses of the potential effects of these projects must take into account the effects of those projects on the biological environment.

In addition to non-fishing actions that may introduce new projects or pollutants into the marine environment, there are non-fishing conservation projects or regulations that may positively affect Shared EC Species, their predators, and other aspects of the biological environment. In 2012, the United States Coast Guard (USCG) established a standard for the allowable concentration of living organisms in ships' ballast water discharged in waters of the United States, with the intent of preventing and controlling invasions of aquatic nuisance species transported in ships' ballast water from elsewhere in the world (77 FR 17254, March 23, 1012). Invasive species often compete with native species for prey and habitat, making USCG efforts to limit their spread to U.S. waters beneficial to all native species, including Shared EC Species. In 2013, the U.S. Environmental Protection Agency (EPA) built on the USCG ballast water regulations and standards with general vessel permits for vessel discharges, limiting ballast water and pollutant discharge in U.S. waters.

Non-fishing conservation activities that may affect Shared EC Species within the U.S. West Coast EEZ also include conservation and recovery programs for marine mammals, birds, and fish listed as threatened or endangered under the ESA, and the science, education and conservation work of the five U.S. West Coast National Marine Sanctuaries. Strictly speaking, recovery and protection programs for species that prey upon Shared EC Species could be viewed as having negative effects on Shared EC Species by increasing the numbers of predators feeding upon Shared EC Species. However, this action focuses on protecting Shared EC Species in order to preserve a portion of the prey base for all higher trophic order species, making population increases of protected higher trophic order species one of the expected potential positive effects of the action over the long-term. The five U.S. West Coast National Marine Sanctuaries conduct science, education, and conservation programs within defined portions of the state and Federal marine waters, providing enhanced information and protections for those waters. In summer 2014, NOAA proposed expanding the Cordell Bank and Gulf of the Farallones National Marine Sanctuaries, which could increase the effects of sanctuary management programs on the waters of the U.S. West Coast EEZ.

# 4.0 Impacts on the Affected Environment

This EA analyzes the potential impacts of the alternatives for restricting future EEZ fisheries for currently unfished forage fish using either: the Federal list of authorized fisheries and gear (Alternative 1, No Action) or by bringing the species subject to this action into the FMPs as EC species (Alternatives 2 and 3). Each of the alternatives is described more fully in Chapter 2. The only regulation the Council has recommended for these species is to implement a moratorium on future directed fishing for these species, until the Council has had an adequate opportunity to review scientific information on the potential effects of fisheries for these species on the larger suite of the Council's conservation and management measures for the living marine resources of the U.S. West Coast EEZ. The aspects of the environment that could be affected by the proposed action analyzed in this EA are described in Chapter 3.

This Chapter 4 analysis focuses on the potential effects of the alternatives on: the physical environment; Shared EC Species; known predators of Shared EC Species, including any ESA listed and MMPA or MBTA protected species; and human communities, particularly state or tribal nearshore fisheries for Shared EC Species and existing Council-managed fisheries for species other than Shared EC Species. The direct and indirect impacts of the action alternatives are discussed for the physical environment in Section 4.1, for the biological environment in Section 4.2, and for the socio-economic environment in Section 4.3. Cumulative impacts are discussed in Section 4.4.

According to NEPA implementing regulations at 40 CFR 1508.8, direct effects of an action are "caused by the action and occur at the same time and place," while indirect effects are "caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems." A cumulative impact of an action is defined at 40 CFR 1508.7 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."

## 4.1 Impacts of the Alternatives on the Physical Environment

For the purposes of this action, negative effects on the physical environment are those that reduce the quality or quantity of habitat used by Shared EC Species or their predators. Shared EC Species and their predators have a wide variety of relationships with habitats within the CCE, from wholly pelagic species that may associate with waters of particular temperatures or salinities, to site-loyal demersal species that may associate with particular rock formations. Negative effects to the physical environment may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of that particular habitat type. Negative effects result from actions occurring within or outside of particular habitat types and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810).

Under Alternative 1 (no action), new fisheries for Shared EC species could begin in Federal waters more easily than under either of the action alternatives, although no new fishery is anticipated at this time. Alternative 1 is expected to have either no direct or indirect effect on the physical environment or a minor negative indirect effect if a fishery for a Shared EC species begins without the Council having an advance opportunity to develop regulations to restrict its effects on the physical environment.

Neither of the action alternatives (Alternative 2 or 3) proposes any new activity that would directly or indirectly affect or alter the physical environment in any way. Both of the action alternatives are expected to have minor positive indirect effects on the physical environment compared to the no action alternative, because they both would allow the Council greater opportunity to assess the potential effects of a new fishery on the environment than would be available under Alternative 1 (no action). If the Council considers a directed fishery for one or more of the Shared EC Species at some time in the future, the potential effects of that fishery on the physical environment would be analyzed at that time. To the extent that either the near-term or the long-term climate shifts described in Sections 3.1.1 and 3.1.3 may affect Shared EC Species populations or the populations of associated species, both of the action alternatives (Alternative 2 or 3) would mitigate for any climate-induced downward population trends for those species by ensuring that Shared EC Species populations are not targeted in Federal waters fisheries.

## 4.2 Impacts of the Alternatives on the Biological Environment

### 4.2.1 Shared EC Species

Shared EC Species are discussed in Section 3.2.1. Under Alternative 1 (no action), new fisheries for Shared EC species could begin in Federal waters more easily than under either of the action alternatives. There are no existing commercial fisheries targeting Shared EC Species in Federal waters and no new fisheries are expected at this time. Under Alternative 1 (no action), anyone wanting to begin a fishery for a Shared EC Species would notify the Council and could begin fishing for that species 90 days after the Council has received the notification. The Council could recommend new regulations, including complete prohibition, for the new fishery at any time during or after the 90-day notification period – See Section 2.1.1. Alternative 1 does not prevent the Council from acting to bring any new fishery into compliance with MSA fishery conservation and management requirements; therefore, it is not expected to have major negative direct or indirect effects on Shared EC Species. Because Alternative 1 could allow a fishery for a Shared EC Species to begin without advance Council action to ensure the fishery's long-term sustainability, there is some potential for the no action alternative to have moderate negative direct effects on Shared EC Species.

Both of the action alternatives (Alternative 2 and Alternative 3) would have the effect of restricting the future development of new directed commercial fisheries for Shared EC Species in Federal waters until the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem. To the extent that the action alternatives would protect Shared EC Species from an unmanaged target fishery that could occur between the end of the MSA-required 90-day notification period for new fisheries and the time that the Council and NMFS could implement new regulations managing such a fishery, both Alternative 2 and Alternative 3 are expected to have minor positive indirect effects on Shared EC Species compared to the no action alternative. As discussed in Section 3.3.2, incidental catch of Shared EC Species has been historically low; therefore, allowing incidentally-caught Shared EC Species to be retained in existing EEZ fisheries (Alternative 2) is not expected to have any measurably different effect on Shared EC Species than requiring incidentally-caught Shared EC Species to be discarded at sea (Alternative 3).

### 4.2.2 Council-Managed (FMP) Predators of Shared EC Species

Council-managed predators of Shared EC Species and their predator/prey connections to Shared EC Species, if known, are discussed in Section 3.2.2. None of the Council-managed predator species feed exclusively or predominantly on either the Shared EC Species as a group, or on any one of the Shared EC

Species. All of the Council-managed predator species are opportunistic feeders, meaning that they prey upon a wide variety of lower trophic level species, including Shared EC Species.

As discussed in Section 4.2.1, Alternative 1 (no action) has some potential to allow a new fishery for Shared EC Species to begin without advance Council action to ensure the fishery's long-term sustainability. The opportunistic feeding natures of Council-managed predators makes them less susceptible to changes in availability of any one prey species than would be the case for predators with more specialized diets. Therefore, the no action alternative could have minor negative indirect effects on Council-managed predators of Shared EC Species to the extent that it could allow a temporary reduction in the available prey base for those predators.

The potential effects of either of the action alternatives (Alternative 2 or Alternative 3) on Council-managed predators are likely to be minor and positive compared to the potential effects of the no action alternative. Both of the action alternatives (Alternative 2 and Alternative 3) would restrict the future development of new directed commercial fisheries for Shared EC Species in Federal waters until the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem. Therefore, although the action alternatives are likely to have minor effects over the long-term, those effects are likely to be indirect and positive for the Council-managed predators that prey upon Shared EC Species. As discussed in Section 3.3.2, incidental catch of Shared EC Species has been historically low; therefore, allowing incidentally-caught Shared EC Species to continue to be retained in existing EEZ fisheries (Alternative 2) is not expected to have any measurably different effect on Council-managed predators of Shared EC Species than requiring incidentally-caught Shared EC Species to be discarded at sea (Alternative 3).

### 4.2.3 Protected Species Predators of Shared EC Species

#### *4.2.3.1 ESA-listed finfish*

ESA-listed finfish predators of Shared EC Species and their predator/prey connections to Shared EC Species, if known, are discussed in Section 3.2.3.1. None of the ESA-listed finfish predator species feed exclusively or predominantly on either the Shared EC Species as a group, or on any one of the Shared EC Species. All of the ESA-listed finfish predator species are opportunistic feeders, meaning that they prey upon a wide variety of lower trophic level species, including Shared EC Species.

As discussed in Section 4.2.1, Alternative 1 (no action) has some potential to allow a new fishery for Shared EC Species to begin without advance Council action to ensure the fishery's long-term sustainability. The opportunistic feeding natures of ESA-listed finfish predators makes them less susceptible to changes in availability of any one prey species than would be the case for predators with more specialized diets. Therefore, the no action alternative could have minor negative indirect effects on ESA-listed finfish predators of Shared EC Species to the extent that it could allow a temporary reduction in the available prey base for those predators.

The potential effects of either of the action alternatives (Alternative 2 or Alternative 3) on ESA-listed finfish predators are likely to be minor and positive compared to the potential effects of the no action alternative. Both of the action alternatives (Alternative 2 and Alternative 3) would restrict the future development of new directed commercial fisheries for Shared EC Species in Federal waters until the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem. Therefore, although the action alternatives are likely to have minor effects over the long-term, those effects are also likely to be indirect and positive for the ESA-listed finfish predators that prey upon Shared EC

Species. As discussed in Section 3.3.2, incidental catch of Shared EC Species has been historically low; therefore, allowing incidentally-caught Shared EC Species to continue to be retained in existing EEZ fisheries (Alternative 2) is not expected to have any measurably different effect on ESA-listed finfish predators of Shared EC Species than requiring incidentally-caught Shared EC Species to be discarded at sea (Alternative 3).

#### *4.2.3.2 ESA-listed and MMPA-protected marine mammal species*

Marine mammal predators of Shared EC Species and their predator/prey connections to Shared EC Species, if known, are discussed in Section 3.2.3.2. Pinnipeds and those mysticete species that prey upon fish are opportunistic feeders, meaning that they prey upon a wide variety of lower trophic level species, including Shared EC Species. Mysticete diets tend to be dominated by euphausiids, with other species (including Shared EC Species) making up small proportions of their diets. Odontocetes also have varied diets, but feed more heavily on pelagic squids and mesopelagic fishes than pinnipeds and mysticetes. Pinnipeds and odontocetes also prey on Council-managed predator species that prey upon Shared EC Species, meaning that the effects of the alternatives on marine mammals may occur at more than one trophic level below those mammals.

As discussed in Section 4.2.1, Alternative 1 (no action) has some potential to allow a new fishery for Shared EC Species to begin without advance Council action to ensure the fishery's long-term sustainability. The opportunistic feeding natures of pinnipeds and mysticetes, and relative unimportance of Shared EC Species in mysticete diets, makes them less susceptible to changes in availability of any one prey species than would be the case for predators with more specialized diets. Odontocetes may be more susceptible to the potential effects of Alternative 1, should it have the effect of failing to restrict the future development of large-scale and long-term fisheries for the larger-bodied pelagic squid species. Therefore, the no action alternative could have minor negative indirect effects on pinnipeds, minor negative indirect or no effects on mysticetes, and moderate negative indirect effects on odontocetes to the extent that it could allow a temporary reduction in the available prey base for those predators.

The potential effects of either of the action alternatives (Alternative 2 or Alternative 3) on marine mammal predators are likely to be minor and positive compared to the potential effects of the no action alternative. Both of the action alternatives (Alternative 2 and Alternative 3) would restrict the future development of new directed commercial fisheries for Shared EC Species in Federal waters until the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem. Therefore, although the action alternatives are likely to have minor effects over the long-term, those effects are also likely to be indirect and positive for marine mammals that prey upon Shared EC Species. The potential effects of either of the action alternatives are expected to be minor, indirect, and positive for opportunistic feeding pinnipeds and for mysticetes with minimial dependence on Shared EC Species. The potential effects of either of the action alternatives could be moderate, indirect, and positive for odontocetes, should they restrict the future development of large-scale and long-term fisheries for the larger-bodied pelagic squid species. As discussed in Section 3.3.2, incidental catch of Shared EC Species has been historically low; therefore, allowing incidentally-caught Shared EC Species to continue to be retained in existing EEZ fisheries (Alternative 2) is not expected to have any measurably different effect on marine mammal predators of Shared EC Species than requiring incidentally-caught Shared EC Species to be discarded at sea (Alternative 3).

#### *4.2.3.3 Seabirds*

Seabird predators of Shared EC Species and their predator/prey connections to Shared EC Species, if known, are discussed in Section 3.2.3.3. Many seabird species are opportunistic feeders, meaning that they prey upon a wide variety of lower trophic level species, including Shared EC Species, although there are some notable exceptions. Like odontocetes, the highly migratory procelliformes prey upon pelagic squid and may have few prey alternatives in their high seas habitats. Some of the pelecaniformes and charadriiformes prey heavily on one or more of the Shared EC Species, such as rhinoceros auklet's strong preference for Pacific sand lance.

As discussed in Section 4.2.1, Alternative 1 (no action) has some potential to allow a new fishery for Shared EC Species to begin without advance Council action to ensure the fishery's long-term sustainability. The opportunistic feeding natures of most seabird species makes them less susceptible to changes in availability of any one prey species than would be the case for predators with more specialized diets. Those seabird species with heavy reliance on particular Shared EC Species as prey, such as rhinoceros auklets, may be more susceptible to the potential effects of Alternative 1, should it have the effect of failing to restrict the future development of large-scale and long-term fisheries for the currently unfished prey of those species. Therefore, the no action alternative could have minor negative indirect effects on opportunistic feeding seabirds, and moderate negative indirect effects on seabirds with diets specializing in one or more of the Shared EC Species.

The potential effects of either of the action alternatives (Alternative 2 or Alternative 3) on seabird predators are likely to be minor and positive compared to the potential effects of the no action alternative. Both of the action alternatives (Alternative 2 and Alternative 3) would have the effect of restricting the future development of new directed commercial fisheries for Shared EC Species in Federal waters until the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem. Therefore, although the action alternatives are likely to have minor effects over the long-term, those effects are also likely to be indirect and positive for seabirds that prey upon Shared EC Species. The potential effects of either of the action alternatives are expected to be minor, indirect, and positive for opportunistic feeding seabirds. The potential effects of either of the action alternatives could be moderate, indirect, and positive for seabirds that specialize in preying upon Shared EC Species. As discussed in Section 3.3.2, incidental catch of Shared EC Species has been historically low; therefore, allowing incidentally-caught Shared EC Species to continue to be retained in existing EEZ fisheries (Alternative 2) is not expected to have any measurably different effect on seabird predators of Shared EC Species than requiring incidentally-caught Shared EC Species to be discarded at sea (Alternative 3).

## 4.3 Impacts of the Alternatives on the Socio-Economic Environment

### 4.3.1 Directed Fisheries for Shared EC Species

The states of Washington, Oregon, and California have long histories of working both within and outside of the PFMC process to ensure that state fisheries laws and regulations are compatible with PFMC advice for Federal fisheries regulations. Similarly, the treaty Indian tribes with fishing rights to co-manage Pacific Ocean species also work within and outside of the PFMC process to implement cooperative conservation and management goals for jointly managed species. This cooperative work among PFMC process participants reduces regulatory confusion for the public and improves the effectiveness of conservation measures for managed species.

Bringing a new suite of species into the Council's FMPs requires examining both fisheries and fishery management processes to minimize disruption to state and tribal fisheries and to best ensure compatibility between those processes and Federal implementing regulations for this action. Section 3.3.1 discusses existing state and tribal fisheries for Shared EC Species. This section 4.3.1 addresses the potential effects of the alternatives on state and tribal fisheries and fisheries management processes for Shared EC Species. During its discussions of this action, the Council has particularly requested that this analysis address state regulatory processes that ensure conformance between state and Federal regulations; those processes are discussed in this section.

As shown in Figure 3.1 of Section 3.3.1, only the following species or species groups have (>0.01 mt, or >22 lb) landings over 1981-2013 in the PacFIN database: round herring, silversides, osmerid smelts, and pelagic squids (including Humboldt squid, which is not a Shared EC Species). For most of the Shared EC Species or species groups, these landings may not be from fisheries targeting those species or from fisheries within Federal waters. Shared EC Species may be taken incidentally in fisheries targeting other West Coast species, but landed for sale rather than discarded as bycatch. Although this EA discusses directed (3.3.1 and 4.3.1) and incidental (3.3.2 and 4.3.2) fisheries for Shared EC Species as if they could be separated from each other, those distinctions do not appear as clearly in actual fisheries and landings as they do in an analysis document. In addition, coastwide landings of Shared EC species or species groups often are not readily identifiable from state reporting systems (fish tickets). Landings of some of these species may be combined with landings of other species when reported on fish tickets, and such combinations may differ among states. For some species with very minor landings of no commercial value, some states do not require landings to be reported on fish tickets, and the particular species or species groups exempted differ among states. This Section 4.3.1 discusses the effects of the alternatives on state- or tribe-managed fisheries that may target Shared EC Species, primarily fisheries for pelagic squid species other than market squid and fisheries for osmerid smelts. Because the states and tribes have varying policies for addressing forage species, this section 4.3.1 also discusses any potential interacting effects between those state or tribal policies and the CEBA 1 alternatives.

#### *4.3.1.1 Effects of the alternatives on Washington fisheries for Shared EC Species and on state regulatory conformance processes*

No commercial fisheries authorized by Washington target the Shared EC Species in the Council management area. Some commercial fishing for osmerid smelts occurs in Puget Sound and may occur in state marine waters and in freshwater (e.g., eulachon). Limited recreational harvest of forage fish is allowed, but any recreational fishing is almost certain to occur in state waters. To target and deliver Shared EC Species into the state in commercial quantities, a vessel would likely need an emerging commercial fishery designation from the Director of the Washington Department of Fish and Wildlife or a new commercial fisheries license type to be created by Washington State Legislature. For forage fish, the Department manages fisheries according to a policy established by the Washington Fish and Wildlife Commission in 1998 (WDFW 1998). This policy requires the Department to take a precautionary approach to take into account the ecosystem value of species and other factors and to not just consider maximum sustainable yield as the management goal. For fisheries managed by the Council's FMPs, Washington's state regulations incorporate by reference key provisions of the Federal regulations implementing those FMPs.

Washington's ability to track landings of Shared EC Species is currently limited in that landings of most would be recorded under the miscellaneous marine fish category, squid (unspecified), or some other category that would not allow for definitive identification of a Shared EC Species landing. These general categories are nonetheless recorded so that increased landings of myctophids would show as an increase in landings of miscellaneous marine fish. However, such an increase in miscellaneous marine fish might come from several other species (e.g., grenadiers, eelpouts, etc.).

*Alternative 1*

The effects of choosing the No Action alternative on Washington are uncertain and dependent on future decisions made by the Department, the Council, the treaty Indian tribes, and others with the authority to alter laws and policies affecting fisheries based in the state. As the law stands now and discussed above, the Department would need to take some action in order to authorize directed fishing on the Shared EC

Species and delivery into the state, whether by emerging commercial fishery permit or other method. The Department's forage fish policy requires consideration of new commercial and recreational fishing interests when requested, yet also calls for a cautious approach when information on the status of a forage fish population and its role in the ecosystem is incomplete. Some quantity of the Shared EC species would continue to be caught incidentally to ongoing commercial fisheries and in some directed recreational fishing activities taking place in state waters. Some of the Shared EC Species, like the mesoplagics and the pelagic squids, are not covered by the Department's forage fish policy. All squid species may be harvested commercially with a license, yet no vessels are active off Washington and landing squid into the state. The mesopelagics would be considered unclassified fish species and would need to be classified as food fish and authorized for directed commercial harvest. Alternative 1 is unlikely to have any effect on Washington-based fisheries and could have minor, indirect, and negative effects on Washington fishery management practices, should Washington residents express interest in beginning a new fishery on a Shared EC Species.

*Alternative 2*

This alternative would accommodate current practices in the fisheries landing into Washington. While targeting of Shared EC Species is not authorized, incidental catches in other fisheries are not prohibited. The sardine fishery is an exception in that it only allows vessels to retain incidental catch of mackerel and jacks (*Scombridae* or *Carangidae*). Alternative 2 is unlikely to have any effect on Washington-based fisheries and could have minor, indirect, and positive effects on Washington fishery management practices because it is compatible with existing management practices.

*Alternative 3*

A requirement to discard Shared EC Species might affect the state's pink shrimp fishery and perhaps vessels participating in the Council's individual fishing quota (IFQ) fishery bottom trawl and whiting fisheries. These fisheries are the ones most likely to encounter Shared EC Species incidentally. It would be logistically difficult if not completely impractical to sort and discard many of the Shared EC Species in some of the fisheries given high volume of target species and other fishery operation practices. Alternative 3 could have minor, direct and negative effects on Washington-based fisheries and could have minor, direct, and negative effects on Washington fishery management practices, should Washington residents express interest in beginning a new fishery on a Shared EC Species.

*4.3.1.2 Effects of the alternatives on Oregon fisheries for Shared EC Species and on state regulatory conformance processes*

Under the general Oregon policy of marine fisheries being open unless specifically closed, commercial fishing for these species is allowed in marine waters off Oregon, with the exception of osmerid smelts. Allowable commercial fishing must also conform to requirements for the Federal list of authorized fisheries and gears at 50 CFR 600.725(v). Commercial fishing for osmerid smelts is prohibited and bycatch may not exceed 1% of the landing by weight (OAR 635-004-0545). None of the Shared EC Species are the target of Oregon commercial fisheries in marine waters. (Commercial fishing for eulachon may occur in the Columbia River, which is outside the scope of the proposed action.) In general, current fisheries occasionally take small amounts of these species, which have had no commercial value when landed. In most cases this bycatch is discarded at sea, but occasionally very small amounts may be inadvertently landed. In recent years, bycatch of these species, excluding unspecified squid species and eulachon, have been taken primarily in the whiting fishery, pink shrimp fishery, and groundfish trawl fishery.

For federally managed species under the Groundfish, CPS, and HMS FMPs, ODFW rules for state marine waters automatically conform to Federal regulations, (OAR 635-004-0275, 635-004-0375, and 635-004-0555). Each of these rules specify: "Where federal regulations refer to the fishery management area, that area is extended from shore to three nautical miles from shore coterminous with the Exclusive Economic Zone." Inland waters of Oregon (i.e., bays, estuaries and rivers) are not included in this provision. Also by rule (OAR 635-004-0215), ODFW defines the species within each of these FMPs as species covered under relevant state rules, and FMP EC species are included in these state definitions. For salmon, ODFW rules adopt Federal regulations by reference but do not automatically extend Federal regulations to state waters. The Salmon FMP does not currently identify any EC species, and therefore ODFW rules do not address conformance for EC species under the Salmon FMP. If EC species are added to the Salmon FMP, it is anticipated that Oregon rules would be amended, as necessary, to automatically conform to cover these species in state marine waters. Consequently, any Federal regulations developed to protect these Shared EC Species in the FMPs would automatically apply to state fisheries in the Pacific Ocean.

Both Alternative 2 and 3 affect development of new commercial fisheries by requiring approval from the Council and NMFS before a fishery may occur in Federal waters off Oregon. Given the state's automatic conformance with Federal rules, this requirement would also apply for such fishing in state waters. At present, a fisher may fish for and land any of the Shared EC Species, other than osmerid smelts, upon meeting the notification and gear requirements of the Federal list of authorized fisheries and gears. If either Alternative 2 or 3 is adopted, an EFP would be required to fish for a Shared EC Species in the EEZ. For state conformance, it is anticipated that Oregon rules would be amended to require an ODFW-issued experimental gear permit to fish entirely in state waters for a Shared EC Species or species group, even if an otherwise legal gear were intended for use. If issued, the permit would contain similar conditions and reporting requirements that the Council presumably would require in an EFP, as described in draft COP 24.

*Alternative 1*

Under Alternative 1 (no action), new Oregon fisheries for Shared EC Species could begin in Federal waters if they are in conformance with all current Federal requirements, such as the Federal list of authorized fisheries and gear. Oregon also may adopt more conservative measures than Federal regulations. No new fisheries are expected at this time and Alternative 1 is unlikely to have any effect on Oregon-based fisheries or fisheries management practices.

*Alternative 2*

Specifically for Alternative 2, the allowance for bycatch to be landed is consistent with current fishery practices for Oregon commercial fisheries. If adopted, Alternative 2 may have only a minor negative effect on current Oregon commercial fisheries. Additional species sorting and reporting at processing plants would be required under Alternative 2 to track landings of some Shared EC Species/species groups because they currently are not required to be reported on fish receiving tickets (OAR 635-006-0210). "Weighbacks" are fish or shellfish with no commercial value and a number of these species or species groups, usually with trace amounts of landings, are exempt from Oregon fish ticket reporting requirements. Shared EC Species or species groups that are not required to be reported on Oregon fish tickets include: barracudinas, myctophids, and squids other than market and Humboldt squid. Alternative 2 could have minor, indirect and negative effects on Oregon-based fisheries and Oregon fishery management practices if it results in increased recordkeeping and reporting requirements.

*Alternative 3*

For Alternative 3, bycatches of Shared EC Species must be discarded at sea. This alternative would also require more sorting at sea for most commercial fisheries, to eliminate any inadvertent landings of these species. Crew would need to be able to identify these species or species groups sufficiently well to sort and discard them. The shrimp trawl, bottom trawl, and whiting fisheries would be most affected. These fisheries frequently have large volumes of catch to sort and the added time and costs to more thoroughly sort the catch could reduce their fishing opportunity, product quality, and profits. For the whiting fishery, most vessels are allowed to discard non-IFQ or nongroundfish species at sea, but many choose not to do so in order to get whiting into the hold quickly to maintain product quality and production efficiency. Those whiting vessels that are classified as “maximized retention vessels” are allowed to discard minor operational amounts of catch at sea provided it is accounted for by an observer (75 FR 78344). Alternative 3 would have moderate, indirect and negative effects on Oregon-based fisheries and Oregon fishery management practices resulting from increased sorting, recordkeeping and reporting requirements. Alternative 3 is expected to have somewhat greater negative effects on Oregon-based fisheries and Oregon fishery management practices than on Washington fisheries and fishery management practices because the shrimp and whiting fleets have a greater presence in Oregon than Washington.

#### *4.3.1.3 Effects of the alternatives on California fisheries for Shared EC Species and on state regulatory conformance processes*

Commercial fishing is allowed for the Shared EC species off California, although there are regulations for the osmerid smelts and the atherinopsids pertaining to specific geographic areas, seasons, and use (e.g., live bait or aquaria trade). A review of the available information provided no evidence for directed commercial fisheries for the Shared EC species in Federal waters off California, and landings information indicates only the osmerid smelts have been commercially targeted in state waters in recent years. These fisheries primarily take place from shore or in very nearshore waters in the northern half of the state. With respect to interactions with FMP fisheries, a review of bycatch of the Shared EC Species in fisheries off California indicates bycatch is restricted to incidental or trace amounts of primarily round herring or smelt in the California halibut trawl, pink shrimp and Federal groundfish trawl fisheries.

Regulations in state waters for CPS, salmon and groundfish fisheries managed under Federal FMPs automatically conform to Federal regulations for those fisheries through state statutes (CCR, T.14, 159, 182, 189). The state’s regulations apply only when engaging in fishing for these Federal fisheries and to landings in those fisheries. The EC designation of these Shared EC species in the FMPs will have minimal impacts in the existing directed Federal fisheries due to their limited interaction as bycatch. The state’s target fisheries for Shared EC Species in state waters should not be affected by the autoconformance statutes.

Under all of the alternatives, a request to initiate a new directed fishery in Federal waters for the Shared EC species that resulted in NMFS and Council action to develop an EFP would also initiate action at the state level. If the new proposed directed fishery would only occur in Federal waters, then the state’s autoconformance regulations would apply. However, for the proposed fishery to also commence in state waters, the state’s rules or policies pertaining to experimental fishery permits, emerging fisheries, and forage fish would also apply following California Department of Fish and Wildlife (CDFW) and California Fish and Game Commission (CFGC) consideration.

The CFGC policy on emerging fisheries specifies that the CDFW Director shall make a determination as to whether a fishery is “emerging” by considering whether there have been increases in landings, experimental fishery permit applications, an increase in the efficiency of the gear used [in an existing fishery], or if there is evidence that the existing regulations are not sufficient to insure a stable, sustainable fishery. Prior to the Director’s determination of an emerging fishery, the CFGC may authorize take under a one year experimental gear permit intended to gain information on the fishery. This approach would also be consistent with the CFGC forage fish policy which would require collection of essential fishery information, prior to consideration of fishery initiation, which could be achieved via an experimental gear permit.

*Alternative 1*

Under this alternative, the initiation of a directed fishery in Federal waters for one of the Shared EC Species would still proceed as described in Section 2.1.1. Action at the state level related to the proposed fishery would depend on a variety of factors (e.g., where the fishery would occur [Federal only, or Federal and state waters], what gear was proposed, what level of fishery was proposed.) Current levels of any incidental landings of these species already occurring would likely continue. Any existing monitoring of these species would continue under the state's commercial fishery data collection programs. No new fisheries are expected at this time and Alternative 1 is unlikely to have any effect on California-based fisheries or fisheries management practices.

*Alternative 2*

Under Alternative 2, an incidental allowance for small amounts of Shared EC species would be consistent with current fishery practices for California's commercial CPS, salmon, HMS and groundfish fisheries. If adopted, Alternative 2 may have only a minor negative effect on current California commercial fisheries because of this bycatch retention allowance. California does have market codes for some of the Shared EC species, however, thread herring, mesopelagic fishes, Pacific sand lance, and pelagic squid would likely be coded to the "Unidentified Fish" category because they do not have any specific code (in the event any were retained.) Alternative 2 is unlikely to have any effect on California-based fisheries, but could have minor, indirect, and negative effects on California fishery management practices depending on whether it results in increased recordkeeping and reporting requirements.

*Alternative 3*

Under this Alternative, bycatch of Shared EC species must be discarded at sea. This requirement would require additional sorting at sea for commercial fisheries under FMPs where they were taken, to eliminate any inadvertent landings of these species. The California halibut, pink shrimp trawl, and bottom trawl fisheries would be most affected based on the available bycatch information. In addition, the discarding of the incidental amounts that might have been sold would contribute to wastage, and discarding these species would eliminate the ability to collect information on their interactions with FMP fisheries. Alternative 3 would have moderate, indirect and negative effects on California-based fisheries and California fishery management practices resulting from increased sorting, recordkeeping and reporting requirements. Alternative 3 is expected to have somewhat greater negative effects on California-based fisheries and California fishery management practices than on Washington fisheries and fishery management practices because there is a more diverse array of species taken and landed in California fisheries, increasing the complexity of sorting and landings recording requirements.

*4.3.1.4 Effects of the alternatives on treaty tribe fisheries for Shared EC Species and on tribal fishery management processes*

There are currently no treaty tribal fisheries that target Shared EC Species in Council managed waters (see 3.3.1.4) and development of any future fisheries on those species would occur through government-to-government procedures between NOAA and the affected tribes. The treaty tribes have a reserved right to develop directed fisheries on any species in their respective U&A fishing areas with harvestable surplus; therefore Alternative 1 (no action) has no effect on treaty tribe fisheries. Although the management alternatives considered here would likely influence harvest planning and management structures adopted by the tribes, they have no direct, constraining effect. If a treaty tribe does develop any fishery with potential effects on an EC species, the tribe would likely adopt management objectives most in line with Alternative 2 with regard to bycatch of Shared EC Species, because Alternative 3 might require too much at-sea sorting and would complicate management by requiring onerous monitoring and accounting procedures, expensive management infrastructure and could require regular estimates of total mortality of non-retained incidental catch. Therefore, Alternative 2 is expected to have no effect on tribal fisheries relative to the no action alternative, while Alternative 3 could have a minor, indirect negative effect on tribal fisheries were it adopted into tribal fisheries management programs. The four treaty tribes with offshore oceanic U&A fishing areas fish in waters off the northern coast of Washington State. Therefore, the potential effects of the alternatives are lower for the fisheries of treaty tribes than for non-tribal fisheries both because of their greater flexibility in tailoring regulations to local fishing conditions and because the diversity of species caught within their U&A fishing areas is less than the diversity of species found off the California coast.

### 4.3.2 EEZ Fisheries Taking Shared EC Species Indirectly

As discussed in Section 3.3.2, incidental catch of Shared EC Species in Council-managed fisheries is infrequent and small in quantity. Shared EC Species are not known to be incidentally caught in either the HMS or salmon fisheries; therefore, this section focuses on the potential effects of the alternatives on the CPS and groundfish fisheries.

Alternative 1 (no action) has some potential to allow a new fishery for Shared EC Species to begin without advance Council action to ensure the fishery's long-term sustainability. To the extent that fishing gear meeting the gear requirements of Federal groundfish or CPS regulations could directly or incidentally take Shared EC Species, the no action alternative could have minor, indirect, and positive effects on participants in EEZ fisheries that currently have incidental catches of Shared EC Species. Participants in those fisheries could more easily develop new fisheries for Shared EC Species under Alternative 1 (no action) than under either of the action alternatives. There have not been substantial historical U.S. West Coast landings of Shared EC Species. Barring notable shifts in composition of resident and transient species in the U.S. West Coast EEZ, it is unlikely that there are potentially important directed fishing opportunities for Shared EC Species in the EEZ. Therefore, although the effects of Alternative 1 (no action) on EEZ fisheries that have incidental catches of Shared EC Species are likely positive, those effects are minor, indirect and possibly non-existent.

Alternative 2 (preferred) would allow vessels that incidentally catch Shared EC Species to either discard that catch at sea or retain the catch for sale or other disposal on land, in keeping with the regulations for the target fishery. Alternative 2 could have neutral or no effects on fisheries participants because it will essentially allow them to continue to operate as they do now, but minor negative and indirect effects compared to the no action alternative for any fisheries participants that may be considering developing directed fisheries for Shared EC Species because it could require them to do more advance work with the Council as part of the fisheries development process.

Alternative 3 would require vessels that incidentally catch Shared EC Species to discard that catch at sea. Alternative 3 could have minor (off Washington and within U&A fishing areas of treaty tribes) or moderate (off Oregon and California), indirect, and negative effects compared to both Alternative 1 (no action) and Alternative 2 for participants in EEZ fisheries that do not sort their catch at sea, such as the CPS fisheries. To the extent that Alternative 3 would require changes in existing fishing practices that would result in a slowing down of fishing operations to sort catch at sea, Alternative 3 could increase the cost of fisheries operations for fisheries participants.

### 4.3.3 Non-Fishing Human Activities Affecting Shared EC Species

As mentioned in Section 3.3.3, neither the Alternative 1 (no action) nor the action alternatives propose to regulate or otherwise affect non-fishing activities. Therefore, none of the alternatives are expected to have any direct or indirect effects, positive or negative, on non-fishing activities.

## 4.4 Cumulative Effects Analysis

A cumulative effects analysis is required by the Council on Environmental Quality (CEQ) and the term "cumulative impact" is defined in Federal regulations at 40 CFR 1508.7 to mean "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." CEQ guidelines recognize that it is not practical to analyze the cumulative effects of an action from every conceivable perspective, but rather, the intent is to focus on those effects that are truly meaningful. In other words, if we know that we have taken or intend to take several separate actions within the same geographic area, NEPA directs us to look at all of the relevant actions together (cumulatively), so that we do not miss considering whether the actions *together* could have a significant impact on the human environment.

The CEQ provides an 11-step process for cumulative effects analyses that is woven into the larger NEPA process and into documents supporting a Federal action (CEQ 1997). Table 4.1 summarizes the CEQ 11-step cumulative effects analysis process and cites where those steps are documented within this EA. CEQ considers steps 1-4 to be part of scoping an action, steps 5-7 to be part of describing the affected environment for the action, and steps 8-11 to be part of determining the potential environmental consequences of the action. Because the CEQ's guidance on cumulative effects analyses anticipates both a process for the development of the Federal action and a document discussing and analyzing the action, several earlier sections of this EA are relevant to the broader cumulative effects analysis process.

**Table 4.1: CEQ Cumulative Effects Analysis Process and Documentation within this EA**

| | | **Steps in the process** | **Location within this EA** |
|---|---|---|---|
| Scoping | 1 | Identify the significant cumulative effects issues associated with the proposed action and define the assessment goals | Sections 1.2 and 4.4.1 |
| | 2 | Establish the geographic scope for the analysis | Section 4.4.2 |
| | 3 | Establish the time frame for the analysis | Section 4.4.3 |
| | 4 | Identify other actions affecting the resources, ecosystems, and human communities of concern | Section 4.4.4 |
| Describing the Affected Environment | 5 | Characterize the resources, ecosystems, and human communities identified in scoping in terms of their response to change and capacity to withstand stresses | Chapter 3 |
| | 6 | Characterize the stresses affecting these resources, ecosystems, and human communities and relations to regulatory thresholds | |
| | 7 | Define a baseline condition for the resources, ecosystems and human communities | |
| Determining the Environmental Consequences | 8 | Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities | Sections 4.4.1 and 4.4.4 |
| | 9 | Determine the magnitude and significance of cumulative effects | Section 4.4.5 |
| | 10 | Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects | Chapter 2 |
| | 11 | Monitor the cumulative impacts of the selected alternatives and apply adaptive management | Alternative 2 (preferred) includes monitoring and mitigation measures through EFP detailed in Section 7.5 |

### 4.4.1 Consideration of the Affected Resources

Chapter 3, *Description of the Affected Environment,* identifies the affected resources of the Shared EC Species environment. Therefore, this section discusses the significance of the cumulative effects of the action in relation to these affected resources:

1. Physical Environment
2. Biological Environment, including:
    a. Shared EC Species
    b. Council-Managed Predators of Shared EC Species
    c. ESA-Listed Predators of Shared EC Species
    d. Marine Mammal Predators of Shared EC Species
    e. Seabird Predators of Shared EC Species
3. Socioeconomic Environment

Fishing is, by definition, an extractive activity and the MSA values sustainably-managed marine fisheries as a source of food, employment, and recreation for U.S. citizens (16 U.S.C. 1801). The effects of a fisheries management action on the environment are generally considered significant if that action jeopardizes the sustainability of populations of target or non-target (including MMPA- and ESA-managed) species, causes substantial damage to ocean and coastal habitats, jeopardizes public safety, or if it substantially affects ecosystem function (summarized from NOAA Administrative Order 216-6). The Council's FEP discusses cause-and-effect relationships between human activities and resources, ecosystems, and human communities in its Chapter 4, Addressing the Effects and Uncertainties of Human Activities and Environmental Shifts on the Marine Environment. The FEP identifies the following potential effects on marine resources as important from a cumulative effects perspective:

1. Changes in the abundances of fish populations within the ecosystem
2. Changes in the abundances of the populations of non-fish organisms within the ecosystem
3. Changes in marine biophysical habitat that result from human activities
4. Changes in fishing community involvement in and fisheries dependence upon fisheries resources
5. Aspects of climate change expected to affect living marine resources within the ecosystem

Fishery-related actions other than the proposed action that may affect the Shared EC Species environment are described in Section 4.4.4.1. Non-fishery human activities that may affect the Shared EC Species environment are described in Section 4.4.4.2. Section 4.4.5 discusses the potential magnitude and significance of the effects of this action, when added to other past, present, and reasonably foreseeable future actions, and using the cause-and-effect relationships identified in the FEP as measures of the potential significance of the cumulative effects of this action.

### 4.4.2 Geographic Boundaries

The analysis of impacts focuses on actions related to lower trophic level species within the Council's geographic area of authority, the EEZ off the U.S. West Coast. The core geographic scope for each of the affected resources listed above is the Pacific Ocean. Although most of the Shared EC Species affected by this action do not migrate beyond the CCE, some do, and some of their predators migrate far beyond the EEZ and throughout the Pacific Ocean. For human communities, the core geographic boundaries are defined as those U.S. fishing communities directly involved in the harvest or processing of Council-managed resources, particularly those of the states of Washington, Oregon, and California.

### 4.4.3 Temporal Boundaries

The temporal scope of past and present actions for the affected resources begins with the implementation of the 1996 Sustainable Fisheries Act, which required the MSA Federal list of authorized fisheries and gear (50 CFR 600.725(v)), up to the present day. For endangered species and other protected resources, the scope of past and present actions is on a species-by-species basis and is largely between the 1980s and 1990s and the present, when NMFS began generating stock assessments for marine mammals and USFWS began ESA listing processes for seabirds. During this period, NMFS and USFWS also worked with West Coast states and tribes on the Delta smelt ESA listing (1993) and the eulachon ESA listing (2010). The temporal focus of future actions for all affected resources extends through the Council’s 2018 review of its FEP.

### 4.4.4 Actions Other than the Proposed Action

#### *4.4.4.1 Fishery-related Actions*

Historically, there have been no large-scale fisheries for Shared EC Species off the U.S. West Coast, and current fisheries for these species remain small and occur within nearshore waters. The Council’s management practices for FMP species are based in the statutory requirements of the MSA, which focus on ensuring that U.S. fishery resources and their habitats are conserved and maintained to provide optimum fishery yields on a continuing basis. The MSA’s fishery management process is intended to provide the Council and NMFS regular opportunities to assess the status of the fisheries and to make necessary adjustments to ensure that there is a reasonable expectation of meeting the MSA’s requirements and the objectives of the Council’s FMPs. To the degree the MSA-based regulatory regime is complied with, the cumulative impacts of past, present, and reasonably foreseeable future Federal fishery management actions on the affected resources should generally be associated with positive long-term outcomes. Constraining fishing effort through regulatory actions can often have negative short-term socioeconomic impacts. These impacts are usually necessary to bring about long-term sustainability of a given resource, which should, in the long-term, promote positive effects on human communities, especially those that are economically dependent upon the managed stocks.

The historic fishery management actions most relevant to this action are: Amendment 12 to the CPS FMP, which prohibited the development of fisheries for krill within the U.S. West Coast EEZ; West Coast fisheries management programs to address the 2010 NMFS determination to list southern Distinct Population Segment of Pacific eulachon as threatened under the ESA; the Council’s development of its FEP; and recent revisions (79 FR 76914, December 23, 2014) to the MSA Federal list of authorized fisheries and gear at 50 CFR 600.725(v).

Present and future fishery management actions potentially relevant to this action include Council processes for setting harvest levels and management measures for its FMU species, to the extent that harvests and gear used might affect the direct or indirect catch of Shared EC Species. Harvest setting processes for HMS and salmon are likely not relevant to this action, since the gear used in those fisheries is unlikely to take Shared EC Species either directly or indirectly. Recent and expected future groundfish actions that may affect Shared EC species include the 2015-2016 harvest specifications and management measures, and the potential 2017-2018 harvest specifications and management measures. Additionally, the action to revise regulations governing the use of chafing gear on groundfish trawl nets is expected to have minor effects on the physical environment and to have the potential to increase bycatch of smaller-sized incidentally caught species, like Shared EC Species (PFMC 2014b). Recent and expected future CPS actions that may affect Shared EC Species include the 2015 through 2018 harvest specifications for Pacific sardine and Pacific mackerel. The effects of harvest specifications and management measures for groundfish species and of harvest specifications for CPS species are more knowable for the near-term fishing years, 2015-2016 than for 2017-2018. In addition to these Council-generated fishery management actions, West Coast states, tribes, and NMFS continue to develop and implement eulachon conservation measures within state waters fisheries, in association with ESA-based recovery planning.

#### *4.4.4.2 Non-fishing Actions*

Non-fishing activities that introduce chemical pollutants, sewage, changes in water temperature, salinity, dissolved oxygen, and suspended sediment into the marine environment pose a risk to all of the identified affected resources. Human-induced non-fishing activities tend to be localized in nearshore areas and marine project areas where they occur. Examples of these activities include, but are not limited to, agriculture, port maintenance, coastal development, oil spills, marine transportation, marine mining, dredging, and the disposal of dredged material. Wherever these activities co-occur, they are likely to work additively or synergistically to decrease habitat quality and may indirectly constrain the sustainability of the managed resources, non-target species, and protected resources. Decreased habitat suitability would tend to reduce the tolerance of these species to the impacts of fishing effort. Mitigation of this outcome through regulations that would reduce fishing effort could then negatively impact human communities. The overall impact of non-fishing human activities on Shared EC Species and their habitats on a population level is unknown, but likely to be negative, since some portion of these species (osmerid smelt and silversides groups, as well as Pacific sand lance) rely on resources or habitat (e.g. nearshore spawning gravel and sand) negatively affected by these local non-fishing activities and live in close proximity to greater concentrations of humans. In addition, the more pelagic Shared EC Species (round and thread herrings, mesopelagics, Pacific saury, and pelagic squids) may be primarily affected by water pollution, whether introduced by point or non-point sources from land, by ships or energy installations at sea, or by nearshore aquatic human activities like port operations and aquaculture. Exposure of Shared EC Species to these non-fishing perturbations is likely high.

For many of the proposed non-fishing activities to be permitted under other Federal agencies (such as offshore energy facilities, etc.), those agencies would conduct examinations of potential impacts on the affected resources. Federal regulations at 50 CFR 600.930 impose an obligation on other Federal agencies to consult with the Secretary of Commerce on actions that may adversely affect EFH. The Council engages in this review process by making comments and recommendations on any Federal or state action that may affect managed species or their habitat, including EFH. Actions under the jurisdiction of the FERC include permits for energy generating projects located in or immediately adjacent to the coastal waters of the U.S. West Coast which must contain analyses of the potential effects of these projects on the biological environment.

In addition, under the Fish and Wildlife Coordination Act (Section 662), "whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose whatever, including navigation and drainage, by any department or agency of the U.S., or by any public or private agency under Federal permit or license, such department or agency first shall consult with the USFWS, Department of the Interior, and with the head of the agency exercising administration over the wildlife resources of the particular state wherein the activity takes place." NMFS and the USFWS also share responsibility for implementing the ESA, which requires NMFS to designate "critical habitat" for any species it lists under the ESA (i.e., areas that contain physical or biological features essential to conservation, which may require special management considerations or protection) and to develop and implement recovery plans for threatened and endangered species. The ESA provides another avenue for NMFS to review actions by other entities that may affect endangered and protected resources whose management units are under NMFS' jurisdiction. To the extent that ESA implementation results in improvements to critical habitat quality for listed species, those improvements should also have minor, indirect and positive effects on Shared EC Species.

In 2012, the USCG established a standard for the allowable concentration of living organisms in ships' ballast water discharged in waters of the United States, with the intent of preventing and controlling invasions of aquatic nuisance species transported in ships' ballast water that could compete with Shared EC species for prey and habitat. In 2013, the EPA built on the USCG ballast water regulations and standards with general vessel permits for vessel discharges, limiting ballast water and pollutant discharge in U.S. waters. These regulations would positively affect Shared EC Species, their predators, and other aspects of the biological environment. Another beneficial non-fishing action affecting the U.S. West Coast EEZ is the designation of five national marine sanctuaries. 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 sanctuaries' science, education, and conservation programs provide positive indirect effects on the marine environment, including Shared EC species. In April 2014, NOAA proposed expanding the Cordell Bank and Gulf of the Farallones National Marine Sanctuaries to an area north and west of their current boundaries, as well as to amend existing sanctuary regulations and add new regulations (ONMS 2014). Sanctuary protections would extend to an area that has important marine resources and habitats and is the source of nutrient-rich upwelled waters for the productive ocean areas protected by the existing sanctuaries. The extension of these protections would likely have indirect and positive effects on Shared EC Species, their predators, and other aspects of the marine environment if they prevent the installation of energy facilities that would otherwise negatively affect the environment.

The Bureau of Energy Management (BOEM) manages the exploration and development of offshore energy and marine mineral resources on the U.S. outer continental shelf, including renewable energy, oil and natural gas, and sand and gravel. The BOEM conducts and supports environmental studies that contribute to the body of knowledge along the outer continental shelf. Although these studies are primarily to inform policy decisions relating to the management of energy and marine mineral resources, they do contribute to the better understanding of the system and possibly how Shared EC Species are affected by the programs. Habitat and space-use conflicts among projects that BOEM supports (IEI 2012) may adversely affect Shared EC Species and their habitat, although projects undergo environmental review (e.g. NEPA, MSA, MMPA, ESA) before being approved for implementation.

In 2014, the EPA updated its regulations governing the permitting of cooling water intake structures that impinge and entrain fish and other aquatic organisms (79 FR 48300, August 15, 2015). The USFWS and NMFS conducted a joint ESA Section 7 Consultation Programmatic Biological Opinion on the regulations, examining the general and specific potential effects of the regulations revisions on species listed as threatened or endangered under the ESA (USFWS & NMFS 2014). Within that Biological Opinion, the agencies noted that power plants annually impinge and entrain tens of thousands of adult osmerid smelts, and millions of larvae and juveniles, in power plant cooling intakes throughout the U.S. Although there are relatively fewer power plant cooling intakes on the U.S. West Coast than elsewhere in the country, the Biological Opinion concluded that eulachon were likely to be exposed to adverse effects from cooling intake management processes permitted under the EPA's regulatory regime. The Biological Opinion explicitly addresses ESA-listed species, but also makes the general conclusion that osmerid smelts (a Shared EC Species group) are adversely affected by power plant impingement and entrainment.

The U.S. Navy's Northwest Training Range Complex (NWTRC) supports and conducts current, emerging, and future training and research, development, test and evaluation operations, while enhancing training resources through investment on the ranges. The NWTRC includes: offshore air, sea, and undersea space; nearshore air, land, sea, and undersea space; and inland airspace and land ranges. Offshore and nearshore operating areas within the CCE contain EFH for species managed under all four Council FMPs. Designated EFH for salmon, groundfish and coastal pelagic species encompasses all waters or substrate from the mean high water line, and upriver extent of saltwater intrusion in river mouths, along the coasts of Washington, Oregon, and California, and seaward to the boundary of the U.S. EEZ (200 miles, PFMC 1998; 2005a). The U.S. Navy consults with NMFS regarding NWTRC activities on a 5-year time period. In the most recent EFH consultation (NMFS 2010), NMFS concluded that the proposed action (naval readiness activities) would adversely affect EFH and included 3 conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects to EFH. Shared EC Species and their habitat may be similarly adversely affected by these naval actions.

As discussed in Section 3.1, major oceanographic shifts and both near- and long-term climate change within the CCE can affect the abundance and distribution of CCE organisms, including Shared EC Species and their predators. ENSO in particular may have effects on Shared EC Species and their predators within the temporal boundaries (through 2018) of this cumulative effects analysis. Both the positive and negative phases of ENSO can affect upwelling, seawater temperature, and primary and secondary production, all of which have ripple effects up through to the CCE's highest trophic levels. Shared EC Species, like other lower trophic level planktivores, serve as a trophic bridge between upwelling-based plankton abundance and the abundance of higher-order CCE piscivores. As discussed in Sections 3.2.2 and 4.2.2, most CCE predators are opportunistic feeders. In years when ENSO has negative effects on the productivity of some CCE planktivore species, including some Shared EC Species, it may have positive effects on the productivity of other planktivores. The net effect of near-term climate shifts on the predation patterns of higher-order CCE species will likely not be measurable until after they have occurred, but should be borne in mind within the broader scope of non-fishing activities with the potential to affect Shared EC Species and their environment.

### 4.4.5 Magnitude and and Direction of Impacts of Actions Other than the Proposed Action

In determining the magnitude and significance of the cumulative effects, the additive and synergistic effects of the proposed action, as well as past, present, and reasonably foreseeable future actions, must be taken into account. This section discusses the potential effects of these actions on each of the managed resources.

#### *4.4.5.1 Physical Environment*

Those past, present, and reasonably foreseeable future actions that may affect habitat (including EFH for FMP species) and the direction of those potential effects are listed in Table 4.2, below. Those actions with known direct or indirect negative effects listed in Table 4.2 are localized in nearshore areas and marine project areas where they occur. The magnitude of the negative effects of actions other than the proposed action on the physical environment may be small when considered in the context of the large geographic scope of this action; however, the negative and ongoing effects of such human activities as pollution may be severe in discreet locations. The potential effects of several non-fishing activities vary depending on the geographic scale and scope of those activities, whether those activities are likely to occur, and the scale and scope of the potential effects of the activities. As described above (Section 4.4.4.2), NMFS has several means by which it can review non-fishing actions of other Federal or state agencies that may affect NMFS's managed resources and the habitat on which they rely prior to permitting or implementing those projects. To the extent that NMFS and other agencies reach concurrence on measures needed to protect and preserve habitat, those review processes help to minimize the extent and magnitude of direct and indirect negative effects those actions could have on the physical environment.

Fishery management actions taken through FMP processes since 1996 have had positive trends in the cumulative effects of fisheries on habitat and EFH. The MSA requires, on an ongoing basis, that we base conservation and management measures on the best scientific information available (16 U.S.C. 1851(a)(2)) and that we consider actions to conserve and enhance EFH (16 U.S.C. 1855(b)). Together, those requirements anticipate a Federal fisheries management regime that results in additional direct and indirect positive effects on habitat through actions that protect EFH for federally-managed species and that protect the ecosystem services on which these species' productivity depends. Of the specific fishery management actions listed in Table 4.2, the 2015-2016 groundfish specifications and management measures may have minor negative effects for EFH between 40º10' N. latitude and 45º46' N. latitude because that action is likely to expand allowable fishing area for at least some trawl fishery participants (PFMC 2015). Additionally, the action to allow expanded use of chafing gear on groundfish trawl nets may also have minor negative effects on bottom habitat by allowing mid-water trawl nets to operate closer to the ocean floor and rock formations (PFMC 2014b). Taken as a whole, however, fisheries management within the EEZ has had a long-term positive and broad scope trend in minimizing the adverse effects of fishing gear on habitat and is expected to continue in that positive trend.

For habitat and EFH, there are direct and indirect negative effects from actions that may be localized or broad in scope; however, positive actions that have broad implications have been, and we anticipate will continue to be, taken to improve the condition of habitat. Some actions beyond the scope of NMFS and PFMC management, such as coastal population growth and climate change, will indirectly affect habitat and ecosystem productivity. Overall, non-fishing and fishing actions other than this action have had, or will have, a mix of positive, neutral or negative impacts on habitat, including EFH, depending on whether and how those actions increase human interactions with the physical environment. Fisheries actions have been, and we anticipate will continue to be, trending toward positive effects, as have many non-fisheries actions, such as the regulation of ballast water and other pollutants. The magnitude of the indirect effects of ongoing non-fishing activities on the physical environment of the U.S. West Coast EEZ is unpredictable and whether it trends towards positive or negative effects in the future will depend largely on our Nation's ability to mitigate for myriad small and often localized effects of anticipated coastwide increases in human populations.

**Table 4.2: Summary of the effects of past, present, and reasonably foreseeable future actions on *the physical environment.***

<table>
<tr><th>Action</th><th colspan="2">Past to the Present</th><th>Reasonably Foreseeable Future</th></tr>
<tr><td>Original FMPs and subsequent Amendments to the FMPs</td><td colspan="2">Indirect Positive</td><td></td></tr>
<tr><td>Update to the MSA List of Authorized Fisheries and Gear</td><td colspan="2">None</td><td></td></tr>
<tr><td>Oil contamination of nearshore sediments</td><td colspan="3">Uncertain and Infrequent – Direct Negative</td></tr>
<tr><td>Shoreline modification or armoring</td><td colspan="3">Direct Negative</td></tr>
<tr><td>Power plant intake entrainment</td><td colspan="3">Neutral</td></tr>
<tr><td>Offshore energy installation</td><td colspan="3">Uncertain – Likely Direct Negative</td></tr>
<tr><td>Offshore water pollution</td><td colspan="3">Uncertain – Likely Indirect Negative, Depending on Magnitude of Occurrence</td></tr>
<tr><td>Ballast water regulation</td><td colspan="3">Uncertain – Likely Indirect Positive</td></tr>
<tr><td>National marine sanctuary expansion</td><td colspan="3">Uncertain – Likely Indirect Positive and Minor</td></tr>
<tr><td>Recovery planning for ESA-listed species</td><td colspan="3">Uncertain – Likely Indirect Positive and Minor</td></tr>
<tr><td>Increased Navy training activities</td><td colspan="3">Uncertain – Likely Indirect Negative and Minor</td></tr>
<tr><td>2015-2016 Groundfish Biennial Harvest Specifications</td><td></td><td></td><td>Uncertain – Likely Negative and Minor</td></tr>
<tr><td>2017-2018 Groundfish Biennial Harvest Specifications</td><td></td><td></td><td>Unknown</td></tr>
<tr><td>Expanded opportunities for trawl chafing gear use in 2015 and beyond</td><td></td><td></td><td>Uncertain – Likely Negative and Minor</td></tr>
<tr><td>2015 through 2018 harvest specifications for Pacific sardine and Pacific mackerel</td><td></td><td></td><td>Neutral or None</td></tr>
<tr><td>Summary of past, present, and future actions excluding those proposed in this document</td><td colspan="3">Overall, actions have had, or will have, a mix of positive, neutral or negative impacts on habitat, including EFH, depending on whether and how those actions increase human interactions with the physical environment. While many trends in human effects on the physical environment are trending positive, some negative effects have yet to be resolved and some human activities have at least some chance of resulting in catastrophic accidents.</td></tr>
</table>

#### *4.4.5.2 Biological Environment*

Those past, present, and reasonably foreseeable future actions that may affect the biological environment and the direction of those potential effects are listed in Table 4.3, below. Those actions with known direct or indirect negative effects listed in Table 4.3 are localized in nearshore areas and marine project areas where they occur. The magnitude of the negative effects of actions other than the proposed action on the biological environment may be small when considered in the context of the large geographic scope of this action; however, the negative and ongoing effects of such human activities as pollution can be severe in discreet locations. The potential effects of several non-fishing activities vary depending on the geographic scale and scope of those activities, whether those activities are likely to occur, and the scale and scope of the potential effects of the activities. As described above (Section 4.4.4.2), NMFS has several means by which it can review non-fishing actions of other Federal or state agencies that may affect NMFS's managed resources prior to permitting or implementing those projects. To the extent that NMFS and other agencies reach concurrence on measures needed to protect and conserve managed species, those review processes help to minimize the extent and magnitude of direct and indirect negative effects those actions could have on the biological environment.

Fishery management actions taken through FMP processes since 1996 have had positive trends in the cumulative effects of fisheries on managed resources and associated organisms. The MSA requires, on an ongoing basis, that we base conservation and management measures on the best scientific information available, prevent overfishing, and minimize bycatch (16 U.S.C. 1851(a)), and that we rebuild overfished fish stocks (16 U.S.C. 1854(e)). Together, those and other MSA requirements anticipate a Federal fisheries management regime that results in ongoing direct and indirect positive effects on managed stocks and associated species. We anticipate that future fishery management actions, described in Table 4.3, will have neutral to positive effects on the managed resources, by continuing ongoing positive trends for fish stocks managed under the MSA. In addition, past fishery management actions taken through the Council process have had a positive cumulative effect on ESA-listed and MMPA-protected species through the reduction of fishing effort (potential interactions) and implementation of gear requirements for bycatch minimization. Of the specific fishery management actions listed in Table 4.3, the action to allow expanded use of chafing gear on groundfish trawl nets may have minor negative effects on smaller-sized bycatch species, including any incidentally-caught Shared EC Species, by preventing those species from escaping through the trawl net side panels (PFMC 2014b). Strictly, fisheries management actions that increase the direct harvest (fish) or incidental take (protected species) of predators of Shared EC species could be characterized as having indirect positive effects on Shared EC Species. However, taking the mandates of the ESA, MMPA, and MSA together, we consider fisheries management actions that allow harvest of targeted fish species at sustainable levels on a continuing basis while also reducing incidental take of protected species to have a positive effect on the larger biological environment. We anticipate that future management actions will continue to result in additional indirect positive effects on protected resources.

For the biological environment, there are direct and indirect negative effects from actions that may be localized or broad in scope; however, positive actions that have broad implications have been, and we anticipate will continue to be, taken to improve the conditions of managed and protected stocks. Some actions beyond the scope of NMFS and PFMC management, such as coastal population growth and climate change, will indirectly affect habitat and ecosystem productivity, which will then indirectly affect the abundance of managed and protected stocks. Overall, non-fishing and fishing actions other than this action have had, or will have, a mix of positive, neutral or negative impacts on the biological environment, depending on whether and how those actions increase human interactions with the biological environment. Fisheries actions have been, and we anticipate will continue to be, trending toward positive effects, as have many non-fisheries actions, such as the regulation of ballast water and other pollutants. The magnitude of the indirect effects of ongoing non-fishing activities on the biological environment of the U.S. West Coast EEZ is unpredictable and whether it trends towards positive or negative effects in the future will depend largely on our Nation's ability to mitigate for myriad small and often localized effects of anticipated coastwide increases in human populations.

**Table 4.3: Summary of the effects of past, present, and reasonably foreseeable future actions on *the biological environment*.**

| Action | Past to the Present | Reasonably Foreseeable Future |
|---|---|---|
| Original FMPs and subsequent Amendments to the FMPs | **Indirect Positive** | |
| Update to the MSA List of Authorized Fisheries and Gear | **Indirect Positive** | |
| Oil contamination of nearshore sediments | **Uncertain and Infrequent – Indirect Negative** | |
| Shoreline modification or armoring | **Indirect Negative** | |
| Power plant intake entrainment | **Direct Negative** | |
| Offshore energy installation | **Uncertain – Likely Direct Negative** | |
| Offshore water pollution | **Uncertain – Likely Indirect Negative, Depending on Magnitude of Occurrence** | |
| Ballast water regulation | **Uncertain – Likely Indirect Positive** | |
| National marine sanctuary expansion | **Uncertain – Likely Indirect Positive and Minor** | |
| Recovery planning for ESA-listed species | **Uncertain – Likely Indirect Positive and Minor** | |
| Increased Navy training activities | **Uncertain – Likely Indirect Negative and Minor** | |
| 2015-2016 Groundfish Biennial Harvest Specifications | | **Neutral to Minor Positive** |
| 2017-2018 Groundfish Biennial Harvest Specifications | | **Unknown** |
| Expanded opportunities for trawl chafing gear use in 2015 and beyond | | **Uncertain – Likely Negative and Minor** |
| 2015 through 2018 harvest specifications for Pacific sardine and Pacific mackerel | | **Neutral to Minor Positive** |
| **Summary of past, present, and future actions excluding those proposed in this document** | **Overall, actions have had, or will have, a mix of positive, neutral or negative impacts on the biological environment. While many trends in human effects on the biological environment are trending positive, some negative effects have yet to be resolved and some human activities have at least some chance of resulting in catastrophic accidents.** | |

#### *4.4.5.3 Socio-Economic Environment*

Those past, present, and reasonably foreseeable future actions, that may affect the socio-economic environment and the direction of those potential impacts, are summarized in Table 4.4 below. The magnitude of the negative effects of actions other than the proposed action on the socio-economic environment may be small when considered in the context of the large geographic scope of this action; however, the negative and ongoing effects of such human activities as pollution can be severe in discreet locations. On the whole, however, the magnitude of effects on human communities is expected to be limited due to a lack of exposure to the population at large. Several actions, indicated in Table 4.4 as having mixed potential effects, are likely to have negative effects on some communities and positive effects on other communities. As discussed above in Sections 4.4.5.1 and 4.4.5.2, NMFS has several means under which it can review the potential effects of non-fishing actions on managed resources. While NMFS can comment to other agencies when the agency believes that a potential non-fishing action may have a negative effect on a fishing community, NMFS does not have the same level of review authority for the interests of fishing communities as it does for species managed under the MSA, ESA, and MMPA.

Fishery management actions taken through FMP processes since 1996 have had both positive and negative effects on human communities. The historic decline of the abundance of U.S. West Coast salmon stocks, followed by the mid- and late-1990s listings of many of those stocks under the ESA, have had notable negative effects on the communities dependent upon salmon fisheries. Historic actions to bring U.S. West Coast fisheries management into compliance with the more conservative and sustainable conservation and management requirements of the 1996 Sustainable Fisheries Act amendments to the MSA also had short-term and notable negative effects on fishing communities dependent on groundfish resources. However, revenues from groundfish fisheries have increased in recent years, in keeping with rebuilt and more abundant West Coast groundfish stock abundance (PFMC 2015). CPS fishery management has also become more precautionary in recent years, although CPS stock abundance and availability is more closely associated than groundfish stocks with short-term environmental and climate shifts. Reasonably foreseeable future management actions are expected to continue trends of rebuilding groundfish and providing associated increases in groundfish harvest levels, and of basing CPS harvest levels on existing harvest control rules that attempt to maintain CPS biomass levels and to retain forage opportunities for CPS predators. Continued careful management of FMP resources should have a long-term trend of neutral to positive effects on human communities, except in years when resource availability is negatively affected by natural changes in the physical environment or by non-fishing human activities.

For the socio-economic environment, there are indirect negative effects from actions that may be localized or broad in scope; however, positive actions that have broad implications have been, and we anticipate will continue to be, taken to improve environmental health for all Americans. Some actions beyond the scope of NMFS and PFMC management, such as coastal population growth and climate change, will indirectly affect habitat and ecosystem productivity, which will then indirectly affect the health and welfare of human communities. Overall, non-fishing and fishing actions other than this action have had, or will have, a mix of positive, neutral or negative impacts on the socio-economic environment, depending on whether and how those actions regulate or otherwise revise human interactions with the broader human environment. Fisheries actions have been, and we anticipate will continue to be, trending toward positive effects, as have many non-fisheries actions, such as the regulation of ballast water and other pollutants. The magnitude of the indirect effects of ongoing non-fishing activities on the socio-economic environment associated with the U.S. West Coast EEZ is unpredictable and whether it trends towards positive or negative effects in the future will depend largely on our Nation's ability to mitigate for myriad small and often localized effects of anticipated coastwide increases in human populations, while also protecting the long-term interests of small businesses and coastal communities.

**Table 4.4: Summary of the effects of past, present, and reasonably foreseeable future actions on *human communities*.**

<table>
<tr><th>Action</th><th>Past to the Present</th><th>Reasonably Foreseeable Future</th></tr>
<tr><td>Original FMPs and subsequent Amendments to the FMPs</td><td>Mixed Positive and Negative</td><td></td></tr>
<tr><td>Update to the MSA List of Authorized Fisheries and Gear</td><td>None</td><td></td></tr>
<tr><td>Oil contamination of nearshore sediments</td><td colspan="2">Uncertain and Infrequent – Indirect Negative</td></tr>
<tr><td>Shoreline modification or armoring</td><td colspan="2">Indirect Positive</td></tr>
<tr><td>Power plant intake entrainment</td><td colspan="2">Uncertain – Likely Indirect Negative</td></tr>
<tr><td>Offshore energy installation</td><td colspan="2">Uncertain – Likely Mixed Depending on Project</td></tr>
<tr><td>Offshore water pollution</td><td colspan="2">Uncertain – Likely Indirect Negative, Depending on Magnitude of Occurrence</td></tr>
<tr><td>Ballast water regulation</td><td colspan="2">Uncertain – Likely Indirect Positive</td></tr>
<tr><td>National marine sanctuary expansion</td><td colspan="2">Uncertain – Likely Mixed Depending on Population</td></tr>
<tr><td>Recovery planning for ESA-listed species</td><td colspan="2">Uncertain – Likely Mixed Depending on Population</td></tr>
<tr><td>Increased Navy training activities</td><td colspan="2">Uncertain – Likely Mixed Depending on Population</td></tr>
<tr><td>2015-2016 Groundfish Biennial Harvest Specifications</td><td></td><td>Neutral to Minor Positive</td></tr>
<tr><td>2017-2018 Groundfish Biennial Harvest Specifications</td><td></td><td>Unknown</td></tr>
<tr><td>Expanded opportunities for trawl chafing gear use in 2015 and beyond</td><td></td><td>Neutral to Minor Positive</td></tr>
<tr><td>2015 through 2018 harvest specifications for Pacific sardine and Pacific mackerel</td><td></td><td>Neutral</td></tr>
<tr><td>Summary of past, present, and future actions excluding those proposed in this document</td><td colspan="2">Overall, actions have had, or will have, a mix of positive, neutral or negative impacts on the socio-economic environment, with positive overall trends in human health, and variable (some negative, some positive) trends in income derived from businesses associated with natural resource extraction.</td></tr>
</table>

### 4.4.6 Cumulative Effects of Preferred Action on all of the Affected Resources

Alternative 2 is the preferred action alternative (Chapter 2). The magnitude and significance of the cumulative effects, which include the additive and synergistic effects of the proposed action, as well as past, present, and reasonably foreseeable future actions, are discussed throughout this section.

The preferred alternative is not expected to directly or indirectly affect or alter the physical environment in any way. Alternative 2 could have minor positive indirect effects on the physical environment compared to the no action alternative, because it would allow the Council greater opportunity to assess the potential effects of a new fishery on the environment than would be available under Alternative 1 (no action). When these minor indirect effects on the physical environment are considered in addition to all of the past, present and reasonably foreseeable future effects, the cumulative effects of the preferred action are not significant.

The preferred alternative is not expected to have any direct effects on the biological environment. Alternative 2 is not expected to change fisheries harvest rates, the types of gears used off the U.S. West Coast, fishing seasons, or the geographical location of any fishery. Alternative 2 is expected to have indirect positive effects on a wide variety of predator species, including fish, marine mammals, and seabirds. Those predators that prey heavily on one or more of the Shared EC Species are most likely to benefit from this action. Alternative 2 will likely have minor, but still positive, effects on those opportunistic predators with widely varying diets that include Shared EC Species. When all of these direct and indirect biological effects are considered in addition to all of the past, present and reasonably foreseeable future effects, the cumulative effects of the preferred action are not significant.

The preferred alternative is not expected to have any direct effects on the socio-economic environment. Alternative 2 may result, either initially or eventually, in new or different landings notation or calculation tasks for fisheries participants or for state fisheries agency staff. Therefore, the potential indirect effects of Alternative 2 on human communities may be nonexistent, neutral, or minor and negative. When these minor indirect effects on the socio-economic environment are considered in addition to all of the past, present and reasonably foreseeable future effects, the cumulative effects of the preferred action are not significant.

**Table 4.5: Magnitude and significance of the cumulative effects; the additive and synergistic effects of the proposed action, as well as past, present, and reasonably foreseeable future actions.**

| Affected Resources Affected Resources | Status in 2014 | Magnitude of Net Impact of Past, Present, and Reasonably Foreseeable Future Actions | Magnitude of the Impact of the Preferred Action | Magnitude and Significance of Cumulative Effects |
|---|---|---|---|---|
| **Habitat** | Complex and variable (Section 3.1) | Mixed – Positive, Neutral, and Negative (Section 4.4.5.1) | Indirect - minor positive | None |
| **Biological Resources** | Complex and variable (Section 3.2) | Mixed – Positive, Neutral, and Negative (Section 4.4.5.2) | Indirect - minor positive | None |
| **Socio-economic/ Human Communities** | Complex and variable (Section 3.3) | Mixed – Positive, Neutral, and Negative (Section 4.4.5.3) | None to Indirect – minor negative | None |

## 4.5 Summary of Reasons for Adoption of the Final Preferred Alternative

To be addressed following final Council decision.

# 5.0 Consistency with FMPs and Applicable Laws

Chapter 5 considers the consistency of CEBA 1 with the FMPs and with the following applicable laws and requirements:

- Magnuson-Stevens Fishery Conservation and Management Act and FMPs (Section 5.1)
- Endangered Species Act (Section 5.2)
- Marine Mammal Protection Act (Section 5.3)
- Migratory Bird Treaty Act and E.O. 13186 (Section 5.4)
- Coastal Zone Management Act (Section 5.5)
- Administrative Procedure Act (Section 5.6)
- Paperwork Reduction Act (Section 5.7)
- Impacts of the action relative to federalism, E.O. 13132 (Section 5.8)
- Consultation and coordination with Indian Tribal Governments, E.O. 13175 (Section 5.9)
- Environmental justice, E.O. 12898 (Section 5.10)
- Regulatory Flexibility Act and E.O. 12866 (Section 5.11)

Consistency with NEPA requirements and a Finding of No Significant Impact (FONSI) are found in Chapter 6.

## 5.1 Magnuson-Stevens Fishery Conservation and Management Act (MSA) – National Standards, EFH, and Council FMPs

### 5.1.1 National Standards

Section 301 of the MSA requires that FMPs contain conservation and management measures that are consistent with ten National Standards, which are:

*National Standard 1: Conservation and management measures shall prevent overfishing while achieving on a continuing basis, the optimum yield from each fishery for the United States fishing industry.*

This action is intended to prevent the development of future fisheries for unfished forage fish species until the Council has had an opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities and the greater marine ecosystem. This action is explicitly precautionary and will restrict future fishing activity; therefore, this standard is not affected by the action.

*National Standard 2: Conservation and management measures shall be based on the best scientific information available.*

Information to understand the baseline conditions and potential impacts of the action were gathered from peer-reviewed literature, unpublished scientific reports, observer databases, and PacFIN landing reports. This analysis document has been reviewed by protected resources experts, as well as biology and economics experts.

*National Standard 3: To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.*

All stocks addressed within the action are, to the extent practicable, considered and managed as units throughout their ranges. Some of the Shared EC Species and their some of their predators have ranges that extend beyond the U.S. West Coast EEZ, making management throughout those species' ranges impracticable.

*National Standard 4: Conservation and management measures shall not discriminate between residents of different States. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges industry.*

The proposed measures to implement this action will not discriminate between residents of different states, nor will it allocate or assign any fishing privileges.

*National Standard 5: Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.*

This standard is not affected by the alternative actions.

*National Standard 6: Conservation and management measures shall take into account and allow for varations among, and contingencies in, fisheries, fishery resources, and catches.*

The Council's preferred alternative (Alternative 2) is explicitly designed to account for variations among fishery management practices within the U.S. West Coast EEZ and for variations among the different fishery management authorities, regulations, and requirements of the states of Washington, Oregon, and California, and the coastal treaty fishing tribes (See Section 4.3.1)

*National Standard 7: Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.*

The Council's preferred alternative (Alternative 2) is explicitly designed to minimize the costs of implementing this action by ensuring that it accommodates existing Federal fishery management practices, as well as the fishery management authorities, regulations, and requirements of the states of Washington, Oregon, and California, and the coastal treaty fishing tribes. This action does not duplicate any existing Federal conservation and management measure, or other Federal requirement.

*National Standard 8: 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 by utilizing economic and social data that meet the requirements of paragraph (2), 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.*

Participation of fishing communities in West Coast fisheries would not be affected by this action. As discussed in Section 4.3, the Council's preferred alternative (Alternative 2) is not expected to have economic impacts on fishing communities.

*National Standard 9: Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.*

No change in regulatory discard of any species is expected as a result of this action. The Council's preferred alternative (Alternative 2) is explicitly intended to allow retention of incidentally caught Shared EC Species, so as to prevent unnecessary discard of those species, which have historically been incidentally-caught in in West Coast fisheries in very small amounts.

*National Standard 10: Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.*

The proposed action is not expected to have any effect on the safety of human life at sea.

### 5.1.2 Essential Fish Habitat

Shared EC species will be brought into the FMPs as EC species; therefore, the Council and NMFS are not required to designate EFH for those species. Physical habitat within the CCE is broadly described in the FEP, sections of which this analysis document incorporates by reference – see Section 3.1. The purpose of the proposed action is to prohibit new directed commercial fishing in Federal waters on unmanaged, unfished forage fish species until the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem. Under Federal regulations at 50 CFR 600.815(a)(2)(ii), "Councils must act to prevent, mitigate, or minimize any adverse effect from fishing, to the extent practicable, if there is evidence that a fishing activity adversely affects EFH in a manner that is more than minimal and not temporary in nature..." This action places a proactive moratorium on the future development of fisheries that do not now exist and does not introduce or change any fishing activity. This action is not expected to have any effects on the physical environment, including EFH (See Sections 4.1 and 4.1.6). Therefore, the effects of this action on EFH are consistent with current regulations implementing the FMPs, and the effects of West Coast fisheries on EFH have not been re-evaluated for this action.

### 5.1.3 Fishery Management Plans

When the Council developed its FEP, it assessed the common themes between the goals and objectives of its four FMPs in order to develop objectives for the FEP itself. The FEP does not have the regulatory authority of the FMPs; however, it does bring together the Council's priorities and objectives for the ecosystem as a whole. Chapter 2 of the FEP notes that the four FMPs have five common themes consistent with an ecosystem-based fishery management: avoid overfishing, minimize bycatch, maintain stability in landings, minimize impacts to habitat, and accommodate existing fisheries sectors. Of these themes, the action is not expected to have any effects on habitat or on fisheries impacts to habitat (See Sections 4.1, 4.1.6, and 5.1.2). Beyond the ecosystem-based management themes common to the four FMPs, Objective 6 of the CPS FMP is to provide adequate forage for dependent species. This action is explicitly intended to preserve that portion of the CCE forage base made up by Shared EC Species and is compatible with CPS FMP Objective 6.

#### *5.1.3.1 Avoid Overfishing and Rebuild Depleted Stocks*

This action would neither increase nor decrease existing harvest rates in any U.S. West Coast EEZ fishery. This action is intended to prevent the future development of EEZ fisheries for Shared EC Species, which are not now targeted by commercial EEZ fisheries. To the extent that this action preserves the future forage base for depleted stocks targeted in FMP fisheries, it should indirectly aid in the rebuilding of those stocks.

Applicable FMP goals and objectives:

- CPS FMP at Objective 7 (Prevent overfishing);
- Groundfish FMP at Goal 1 (Conservation), Objective 2 (adopting harvest specifications and management measures consistent with resource stewardship responsibilities), Objective 3 (develop plans to rebuild overfished stocks);
- HMS FMP at Objective 10 (Prevent overfishing and rebuild overfished stocks);
- Salmon FMP at Objective 1 (Set exploitation rates consistent with stock conservation objectives, ESA consultation or recovery standards, or rebuilding plans)

#### *5.1.3.2 Minimize Bycatch*

This action would neither increase nor decrease existing bycatch rates in any U.S. West Coast EEZ fishery. The preferred alternative (Alternative 2) allows incidentally-caught Shared EC Species to be landed and sold, rather than discarded at sea. To the extent that this action maintains existing retention and landing practices for incidentally-caught Shared EC species, it will not affect the bycatch of Shared EC Species or of any other species.

Applicable FMP goals and objectives:

- CPS FMP at Objective 5 (Avoid discard);
- Groundfish FMP at Objective 11 (Reduce regulations-induced discard and economic incentives to discard fish, minimize bycatch);
- HMS FMP at Objective 9 (Minimize bycatch and avoid discard);
- Salmon FMP at Objective 4 (Minimize fishery mortalities for unlanded fish)

#### *5.1.3.3 Maintain Stability in Landings*

This action would neither increase nor decrease existing harvest rates in any U.S. West Coast EEZ fishery. This action is intended to prevent the future development of EEZ fisheries for Shared EC Species, which are not now targeted by commercial EEZ fisheries. To the extent that this action preserves the future forage base for stocks harvested in FMP fisheries, it should indirectly stabilize stock status for those species that prey upon Shared EC Species.

Applicable FMP goals and objectives:

- CPS FMP at Objective 5 (Avoid discard);
- Groundfish FMP at Objective 11 (Reduce regulations-induced discard and economic incentives to discard fish, minimize bycatch);
- HMS FMP at Objective 9 (Minimize bycatch and avoid discard);
- Salmon FMP at Objective 4 (Minimize fishery mortalities for unlanded fish)

#### *5.1.3.4 Accommodate Existing Fisheries Sectors*

This action would neither increase nor decrease existing harvest rates in any U.S. West Coast EEZ fishery. This action is intended to prevent the future development of EEZ fisheries for Shared EC Species, which are not now targeted by commercial EEZ fisheries. To the extent that this action preserves the future forage base for stocks harvested in FMP fisheries, it should indirectly stabilize stock status for those species that prey upon Shared EC Species.

Applicable FMP goals and objectives:

- CPS FMP at Objective 4 (Accommodate existing fishery segments);

- Groundfish FMP at Objective 11 (Minimize disruption to current fishing practices, marketing procedures, and the environment), Objective 16 (Provide for the sustained participation of fishing communities and minimize adverse economic impacts to the extent practicable);
- HMS FMP at Objective 3 (Minimize economic waste and adverse impacts on fishing communities to the extent practicable);
- Salmon FMP at Objective 3 (Maintain seasons that support continuance of established fisheries while meeting harvest allocation objectives)

## 5.2 Endangered Species Act

The Endangered Species Act of 1973 (ESA) was signed on December 28, 1973, and provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and the conservation of the ecosystems on which they depend. The ESA replaced the Endangered Species Conservation Act of 1969; it has been amended several times.

A "species" is considered endangered if it is in danger of extinction throughout all or a significant portion of its range. A species is considered threatened if it is likely to become an endangered species within the foreseeable future.

Federal agencies are directed, under section 7(a)(1) of the ESA, to use their authorities to carry out programs for the conservation of threatened and endangered species. Federal agencies must also consult with NMFS or USFWS, under section 7(a)(2) of the ESA, on activities that may affect a listed species. These interagency consultations, or "section 7 consultations," are designed to assist Federal agencies in fulfilling their duty to ensure Federal actions do not jeopardize the continued existence of a species or destroy or adversely modify critical habitat. Should an action be determined to jeopardize a species or result in the destruction or adverse modification of critical habitat, NMFS or USFWS will suggest Reasonable and Prudent Alternatives that would not violate section 7(a)(2).

The action considered within this document would prohibit the future development of fisheries for Shared EC Species and does not affect how or where existing fisheries for other species operate; therefore, the effects of any existing fisheries on species listed under the ESA or their habitats are not relevant to this action. However, the action does consider the role of Shared EC Species in the diets of an array of predator species, including predators listed as threatened or endangered under the ESA. Section 3.2.3 of this document discusses protected species predators of Shared EC Species, including those protected under the ESA, MMPA, and MBTA. Species listed under the ESA that are thought to prey upon at least some Shared EC Species within the West Coast EEZ are:

- Finfish – various ESUs (detailed in Table 3.2.1) of Chinook salmon, chum salmon, coho salmon, sockeye salmon, and steelhead trout;
- Mammals – Guadalupe fur seal, sperm whale, killer whale, blue whale, fin whale, humpback whale, North Pacific right whale, and sei whale;
- Seabirds – short-tailed albatross, least tern and marbled murrelet.

Section 4.2.3 of this document discusses the potential effects of the alternatives on protected species predators of Shared EC Species. ESA-listed oceangoing salmonid species collectively prey upon members of all of the Shared EC Species groups except for round and thread herring. For protected finfish, the proposed action is likely to have minor and positive effects over the long term, by preserving a portion of the forage base of protected finfish species. Odontocete whales and pinnipeds are more likely than baleen whales to prey upon Shared EC Species, which means that, among U.S. West Coast ESA-listed marine mammals, Guadalupe fur seals, sperm whales, and killer whales are most likely to benefit from this action.  For ESA-listed marine mammals, the effects of this action are expected to be minor and positive by preserving a portion of the mammals' forage base from future fisheries development.  Among the ESA-listed seabirds that may spend some portion of their lives within the U.S. West Coast EEZ, the short-tailed albatross is the most migratory and this action may have only minor positive benefits for that species.  For least terns and marbled murrelets, the action may have greater beneficial effects, by preserving some portion of the local forage base of these species.  As described in Chapter 4 of this document, all effects of the action on ESA-listed species are expected to be minor and positive.  Should future exploitation rates for Shared EC Species increase as a result of some future Council action, that action would ultimately be subject to consultation under the ESA to ensure that the action would not jeopardize any species listed at that time.  For this action, no adverse effects are expected on ESA-listed species; therefore, NMFS does not need to consult with either the USFWS or NMFS on this action.

## 5.3 Marine Mammal Protection Act

The MMPA of 1972 is the principal Federal legislation that guides marine mammal species protection and conservation policy in the United States. Under the MMPA, NMFS is responsible for the management and conservation of whales, dolphins, porpoises, seals, sea lions, and fur seals; while the USFWS is responsible for walrus, sea otters, and the West Indian manatee.

The Eastern Pacific stock of northern fur seal is considered depleted under the MMPA.  Additionally, any species listed as endangered or threatened under the ESA is automatically considered depleted under the MMPA. Off the U.S. West Coast, the Guadalupe fur seal and the Southern sea otter California stock are listed as threatened under the ESA and depleted under the MMPA. The sperm whale Washington, Oregon, and California stock, killer whale eastern North Pacific stock – Southern Resident DPS, blue whale eastern North Pacific stock, Fin whale California, Oregon, Washington stock, humpback whale Washington, Oregon, and California - Mexico Stock, North Pacific right whale eastern North Pacific stock, and sei whale eastern North Pacific stock are listed as endangered under the ESA and depleted under the MMPA.

This action does not affect where or how U.S. West Coast fisheries operate and would have no effect on levels of incidental fisheries' take of any species of marine mammals.  Therefore, this action does not affect the rankings of West Coast fisheries on the MMPA List of Fisheries (See 79 FR 77919, December 29, 2014).  As discussed in Sections 3.2.3.2 and 4.2.3.2, many marine mammals prey upon Shared EC Species.  This action is expected to have minor and positive effects on higher order predator species, such as cetaceans and pinnipeds, by preserving the forage base for these species.  The potential effects of the action are expected to be minor and positive for opportunistic feeding pinnipeds and for mysticetes with minimal dependence on Shared EC Species.  For odontocetes that prey more heavily on some Shared EC Species, the positive effects of the action may be greater than for other mammal species.  As described in Chapter 4 of this document, all effects of the action on marine mammals are expect to be minor and positive (pinnipeds and mysticetes) or moderate and positive (odontocetes).  No adverse effects are expected from the action on marine mammals.

## 5.4 Migratory Bird Treaty Act and E.O. 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds

The MBTA of 1918 was designed to end the commercial trade of migratory birds and their feathers that, by the early years of the 20th century, had diminished the populations of many native bird species. The MBTA states that it is unlawful to take, kill, or possess migratory birds and their parts (including eggs, nests, and feathers) and is a shared agreement between the United States, Canada, Japan, Mexico, and

Russia to protect a common migratory bird resource. The MBTA prohibits the directed take of seabirds, but the incidental take of seabirds does occur.

Executive Order (EO) 13186 supplements the MBTA by requiring Federal agencies to work with the USFWS to develop memoranda of agreement to conserve migratory birds. On June 14, 2012, NMFS and USFWS concluded a Memorandum of Understanding on avoiding, or where impacts cannot be avoided, minimizing to the extent practicable adverse impacts on migratory birds and strengthening migratory bird conservation through enhanced collaboration between NMFS and USFWS (NMFS and USFWS 2012). The MBTA, EO 13186, and the agencies' Memorandum of Understanding all focus on minimizing the incidental take of seabirds in fisheries.

This action does not affect where or how U.S. West Coast fisheries operate and would have no effect on levels of incidental fisheries' take of any species of seabird. As discussed in Sections 3.2.3.3 and 4.2.3.3, many seabirds prey upon Shared EC Species. This action is expected to have minor and positive effects on higher order predator species, such as seabirds, by preserving the forage base for these species. The potential effects of the action are expected to be minor and positive for most U.S. West Coast seabird species, which tend to be opportunistic feeders and rely on Shared EC Species for only a part of their diets. For those seabird species, such as rhinoceros auklet, that prey more heavily on one or more Shared EC Species, the positive effects of the action may be greater than for other seabird species. As described in Chapter 4 of this document, all effects of the action on seabirds are expect to be minor and positive (opportunistic feeders) or moderate and positive (heavy predators of Shared EC Species). No adverse effects are expected from the action on seabirds.

## 5.5 Coastal Zone Management Act

The Coastal Zone Management Act of 1972, as amended, provides measures for ensuring stability of productive fishery habitat while striving to balance development pressures with social, economic, cultural, and other impacts on the coastal zone. Section 307(c)(1) of the Federal Coastal Zone Management Act of 1972 requires that all Federal activities that directly affect the coastal zone be consistent with approved state coastal zone management programs to the maximum extent practicable. Pursuant to Coastal Zone Management Act regulations at 15 CFR 930.35, a negative determination may be made if there are no coastal effects and the subject action: (1) is identified by a state agency on its list, as described in §930.34(b), or through case-by-case monitoring of unlisted activities; or (2) which is the same as or is similar to activities for which consistency determinations have been prepared in the past; or (3) for which the Federal agency undertook a thorough consistency assessment and developed initial findings on the coastal effects of the activity. Accordingly, NMFS has determined that this action would have no effect on any coastal use or resources of any state. Letters documenting the NMFS negative determination, along with this document, will be sent to the coastal zone management program offices of the states of Washington, Oregon, and California.

## 5.6 Administrative Procedure Act

Sections 551-553 of the Federal Administrative Procedure Act establish procedural requirements applicable to informal rulemaking by Federal agencies. The purpose is to ensure public access to the Federal rulemaking process and to give the public notice and opportunity to comment before the agency promulgates new regulations.

The Administrative Procedure Act requires solicitation and review of public comments on actions taken in the development of an FMP and subsequent amendments and framework adjustments. Development of this document provided many opportunities for public review, input, and access to the rulemaking process. This action and the proposed FMP amendatory language were developed through a multi-stage process that was open to review by affected members of the public. The public had the opportunity to review and comment on this action during Council and advisory body meetings held on: June 20-26, 2012 in San Mateo, CA; June 18-25, 2013 in Garden Grove, CA; September 11-17, 2013 in Boise, ID; April 3-10, 2014 in Vancouver, WA; September 12-17, 2014 in Spokane, WA; and March 7-12, 2015 in Vancouver, WA. In addition, the public will have further opportunity to comment on this document once NMFS publishes a request for comments notice in the Federal Register.

## 5.7 Paperwork Reduction Act

The Paperwork Reduction Act requires that agency information collections minimize duplication and burden on the public, have practical utility, and support the proper performance of the agency's mission. There is no Paperwork Reduction Act collection associated with this action.

## 5.8 Information Quality Act

The proposed document includes: a description of the management issues, a description of the alternatives considered, and the reasons for selecting the management measures, to the extent that this has been done. These actions propose modifications to the Council's four FMPs that are consistent with the MSA and other existing applicable laws. As described in Section 1.3 (Schedule and Process for Developing CEBA 1) and Section 5.6 (Administrative Procedure Act), CEBA 1 was developed as part of a multi-stage process that involved review of the proposed FMP amendment language (Chapter 7) by affected members of the public, the Council, and its advisory bodies. The Federal Register notice that announces the proposed rule and implementing regulations for this action will be made available in printed publication and on the NMFS West Coast Region website (http://www.westcoast.fisheries.noaa.gov/).

## 5.9 Impacts of the Action Relative to Federalism: E.O. 13132

EO 13132, which revoked EO 12612, an earlier federalism EO, enumerates eight "fundamental federalism principles." The first of these principles states "Federalism is rooted in the belief that issues that are not national in scope or significance are most appropriately addressed by the level of government closest to the people." In this spirit, the EO directs agencies to consider the implications of policies that may limit the scope of or preempt states' legal authority. Preemptive action having such "federalism implications" is subject to a consultation process with the states; such actions should not create unfunded mandates for the states; and any final rule published must be accompanied by a "federalism summary impact statement." The Council process offers many opportunities for states (through their agencies, Council appointees, consultations, and meetings) to participate in the formulation of management measures. Preparers of this document include representatives from the state fish and wildlife or game agencies of the states of California, Idaho, Oregon, and Washington. State fishery management processes and regulations, and the interacting effects of Federal and state laws and regulations were carefully considered throughout the development of this action to prevent this action from having negative effects on state natural resource management programs. Section 3.3.1 of this document describes state marine waters fisheries for Shared EC Species and state fisheries management programs for marine waters off Washington, Oregon, and California. Section 4.3.1 of this document discusses the potential effects of the alternatives on state fisheries and fisheries management programs for marine waters off Washington, Oregon, and California. The proposed action does not have federalism implications subject to EO 13132.

## 5.10 Consultation and Coordination with Indian Tribal Governments: E.O. 13175

EO 13175 is intended to ensure regular and meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications, to strengthen the United States government-to-government relationships with Indian tribes, and to reduce the imposition of unfunded mandates upon Indian tribes. As discussed in Section 4.3.1.4 (Effects of the alternatives on treaty tribe fisheries for Shared EC Species and on tribal fishery management processes), the Council's preferred alternative for this action (Alternative 2) is unlikely to have any effect on tribal fisheries.

The Secretary of Commerce recognizes the sovereign status and co-manager role of Indian tribes over shared Federal and tribal fishery resources. In Section 302(b)(5), the MSA reserves a seat on the Council for a representative of an Indian tribe with Federally-recognized fishing rights from California, Oregon, Washington, or Idaho.

The U.S. government formally recognizes that the four Washington Coastal Tribes (Makah, Quileute, Hoh, and Quinault) have treaty rights to fish within the Council-managed area. Each of the treaty tribes has the discretion to administer their fisheries and to establish their own policies to achieve program objectives. In addition, other tribes with Federally-recognized fishing rights may be impacted by Council-area fisheries, including tribes from Puget Sound, the Columbia River, and the Klamath River. Accordingly, effects of the proposed action and other alternatives have been developed in consultation with the affected tribe(s) and, insofar as possible, with tribal consensus.

## 5.11 Environmental Justice: E.O. 12898

This EO provides that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." EO 12898 directs each Federal agency to analyze the environmental effects, including human health, economic, and social effects of Federal actions on minority populations, low-income populations, and Indian tribes, when such analysis is required by NEPA. Agencies are further directed to "identify potential effects and mitigation measures in consultation with affected communities, and improve the accessibility of meetings, crucial documents, and notices."

The proposed actions are not expected to affect participation in any existing fisheries, including any artisanal commercial, recreational, ceremonial, or subsistence fisheries that may occur within state marine waters or the U&A fishing area of treaty Indian tribes. Since the proposed action represents no changes relative to the current levels of participation in any fisheries, no negative economic or social effects in the context of EO 12898 are anticipated as a result. Therefore, the proposed action is not expected to cause disproportionately high and adverse human health, environmental or economic effects on minority populations, low-income populations, or Indian tribes.

## 5.12 Regulatory Flexibility Analysis

The Regulatory Flexibility Act (RFA) requires government agencies to assess the effects that regulatory alternatives would have on small entities, including small businesses, and to determine ways to minimize those effects. A fish-harvesting business is considered a "small" business by the Small Business Administration if it has annual receipts not in excess of $4.0 million. For related fish-processing businesses, a small business is one that employs 500 or fewer persons. For wholesale businesses, a small business is one that employs not more than 100 people. For marinas and charter/party boats, a small business is one with annual receipts not in excess of $6.5 million. If the projected impact of the regulation exceeds $100 million, it may be subject to additional scrutiny by the Office of Management and Budget.

*Regulatory Impact Review (Executive Order 12866)* - EO 12866, Regulatory Planning and Review, covers a variety of regulatory policy considerations and establishes procedural requirements for analysis of the benefits and costs of regulatory actions. It directs agencies to choose those approaches that maximize net benefits to society, unless a statute requires another regulatory approach. The agency must assess both the costs and the benefits of the intended regulation and, recognizing that some costs and benefits are difficult to quantify, propose or adopt a regulation only after reasoned determination the benefits of the intended regulation justify the costs. In reaching its decision, the agency must use the best reasonably obtainable information, including scientific, technical and economic data, about the need for and consequences of the intended regulation. NMFS requires the preparation of a regulatory impact review for all regulatory actions of public interest. The purpose of the analysis is to ensure the regulatory agency systematically and comprehensively considers all available alternatives, so the public welfare can be enhanced in the most efficient and cost-effective way. The regulatory impact review addresses many of the items in the regulatory philosophy and principles of EO 12866.

This action is not significant under EO 12866. This action will not have a cumulative effect on the economy of $100 million or more, nor will it result in a major increase in costs to consumers, industries, government agencies, or geographical regions. No significant adverse impacts are anticipated on competition, employment, investments, productivity, innovation, or competitiveness of U.S.-based enterprises.

*Regulatory Impact Review and the Regulatory Flexibility Act Analysis*- NMFS develops the necessary analysis and documentation needed to address these mandates as part of the Federal rulemaking process to implement this action. These analyses rely substantially on the contents of this EA and the socioeconomic impact evaluation in Chapter 4 and baseline information in Chapter 3, which have been developed in conjunction with NMFS West Coast Region staff to provide information needed for the Regulatory Impact Review and Regulatory Flexibility Act analyses. A separate Regulatory Impact Review and regulatory Flexibility Act Analyses will be prepared for the rulemaking to implement the final preferred alternative.

# 6.0 Consistency with the National Environmental Policy Act

## 6.1 National Environmental Policy Act

The CEQ has issued regulations specifying the requirements for NEPA documents (40 CFR 1500-1508), and NOAA's agency policy and procedures for NEPA can be found in NOAA Administrative Order 216-6 (NAO 216-6). The following are core elements of an EA (40 CFR §1508.9):

1. The need for the proposal – see Section 1.2,
2. Alternatives as required by NEPA §102(2)(E) – see Chapter 2,
3. The environmental impacts of the proposed action and the alternatives – see Chapter 4, and
4. The agencies and persons consulted – see Section 6.4.

## 6.2 Related NEPA Documents

This action grew out of the Council's Fishery Ecosystem Plan, which is not a NEPA document, but which should be considered a resource for this action: http://www.pcouncil.org/ecosystem-based-management/fep/. The model for a comprehensive, multi-FMP amendment comes from the South Atlantic Fishery Management Council's comprehensive ecosystem-based amendment process (http://safmc.net/Library/EcosystemHome). The following NEPA documents also provide information and analyses related to the effects of this proposed action:

- Environmental Assessment for Amendment 12 to the Coastal Pelagic Species FMP, Managing Krill as an Essential Component of the California Current Ecosystem (http://www.pcouncil.org/wp-content/uploads/CPS_Am12_Krill_DraftEA.pdf)
- Final Environmental Impact Statement for the 2015-2016 Groundfish Harvest Specifications and Management Measures and Amendment 24 to the Groundfish FMP http://www.westcoast.fisheries.noaa.gov/publications/nepa/groundfish/1516spexfeis.pdf
- Environmental Assessment for the Arctic Fishery Management Plan and Amendment 29 to the Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs (http://alaskafisheries.noaa.gov/analyses/arctic/earirfrfa0809final.pdf)
- Environmental Assessment for Amendment 96 to the FMP for Groundfish of the Bering Sea and Aleutian Islands Management Area and Amendment 87 to the FMP for Groundfish of the Gulf of Alaska to Comply with Annual Catch Limit Requirements.

Information may be incorporated by reference from these documents into this EA. CEQ regulations at 40 CFR 1502.21 state that "Agencies shall incorporate material into an environmental impact statement by reference with the effect will be to cut down on bulk without impeding agency and public review of the action. The incorporated material shall be cited in the statement and its content briefly described." When information from the above documents is incorporated, these procedures are followed within the body of this EA.

## 6.3 Finding of No Significant Impact (FONSI)

To be addressed following final Council decision.

## 6.4 List of Persons and Agencies Consulted

This action is a Council-recommended action that includes all interested and potential cooperating agencies, such as the USFWS, tribal government representatives, and state representatives from Washington, Oregon, California, and Idaho. The main authors for this document were the members of the Council's Ad Hoc Ecosystem Workgroup:

Mike Burner (Pacific Fishery Management Council staff), Yvonne deReynier (Chair, National Marine Fisheries Service), Larry Gilbertson (Quinault Nation Division of Natural Resources), Joshua Lindsay (National Marine Fisheries Service), Corey Niles (Washington Department of Fish and Wildlife), Cyreis Schmitt (Oregon Department of Fish and Wildlife), Richard Scully (Idaho Department of Fish and Game, Retired), and Deb Wilson-Vandenberg (Vice-Chair, California Department of Fish and Wildlife).

The Council's suite of advisory bodies reviewed and commented on this document during its development from the September 2013 through March 2015 meetings. Additionally, the following people were also consulted on or were involved in reviewing drafts of the document (alphabetical order by institution, then by last name):

California Department of Fish and Wildlife: Caroline McKnight

National Marine Fisheries Service: Robert Anderson, Mary Bhuthimethee, Sarah Biegel (NEPA Coordinator) Monica DeAngelis, Jennifer McCarthy, Brent Norberg, and Chris Yates of the West Coast Region; Kimberly Rivera of the Alaska Region; and Ric Brodeur, Isaac Kaplan, and Waldo Wakefield of the Northwest Fisheries Science Center.

NOAA General Counsel, Southwest: Judson Feder

Northwest Indian Fisheries Commission: Robert Jones

Oregon Department of Fish and Wildlife: Troy Buell, Robert Hannah, and Eric Schindler

Quinault Indian Nation Fisheries: E. Joseph Schumaker

University of Washington: Bryanda Wippel

Washington Department of Fish and Wildlife: Lorna Wargo and Jessi Doerpinghaus

The authors appreciate predator diet comments received from the Farallon Institute for Advanced Ecosystem Research: Thayer, Julie A., Amber I. Szoboszlai, and Spencer A. Wood. 2014. The California Current Predator Diet Database. Pangaea Data Publisher for Earth & Environmental Science (www.pangaea.de).

The authors also appreciate the aid of the following international experts, who were consulted on historic fishery-development efforts, worldwide, for fisheries with the potential to target mesopelagic fishes: Wojciech Pelczarski, Deputy Director, Sea Fisheries Institute in Gdynia, Poland; Geir Huse, Institute of Marine Research, Bergen, Norway, and Yimin Ye, Chief of the Marine and Inland Fisheries Branch, Fisheries and Aquaculture Branch, Food and Agriculture Organization, Rome.

Copies of this EA and MSA analysis and other supporting documents for this action are available from the Council website (www.pcouncil.org) and from Mike Burner, Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, OR 97220.

# 7.0 Draft FMP Amendment Language and Draft Council Operating Procedure 24

CEBA 1 includes the following FMP amendments: Amendment 15 to the CPS FMP, Amendment 25 to the Groundfish FMP, Amendment 3 to the HMS FMP, and Amendment 19 to the Salmon FMP. This section provides draft amendment language for each of the Council's four FMPs, plus draft COP 24 on EFPs for Shared EC Species. While there are many similarities between the FMPs, each FMP is organized somewhat differently from the others, which means that different sections of the FMPs will need to be changed to implement CEBA 1 for each FMP. However, the ultimate effect of the amendments will be the same for all FMP species and fisheries. Draft amendment language, below, would: update each FMP's list of FMP amendments, add the Shared EC Species as EC species to each FMP, and revise any relevant FMP discussion of ecosystem component species to explain the status of Shared EC Species and the process for evaluating any future fishery for those species through an EFP.

Chapter 7 is divided into five sections: 7.1 for CPS FMP Amendment 15, 7.2 for Groundfish FMP Amendment 25, 7.3 for HMS FMP Amendment 3, 7.4 for Salmon FMP Amendment 19, and 7.5 for COP 24 – *Proposed* Protocol for Consideration of Exempted Fishing Permits for Shared Ecosystem Component Species. Each section excerpts those paragraphs of each FMP that would be amended by this action. Any text that is to be added to an FMP is shown underlined, like this. Any text that is to be removed from an FMP is shown struck out, ~~like this~~. A row of three asterisks (* * *) indicates FMP text that is not re-printed here because it will not be affected by this action. Text written in small capitals, LIKE THIS, provides navigation instructions on which FMP text will be amended, but will not itself appear in the amended FMP. For example, navigation instructions might be something like "THIRD PARAGRAPH UNDER SECTION 3.3.3 WOULD BE REVISED TO READ AS FOLLOWS," with those instructions followed by the proposed revisions to FMP text.

Draft COP 24 is based on this action's Purpose and Need (Section 1.2) and on the Council's policy on the development of new fisheries for unfished species (FEP Appendix at A.1.1), and structured similarly to existing COPs associated with FMP fisheries: COP 19, *Protocol for Consideration of Exempted Fishing Permits for Groundfish Fisheries*; COP 20, *Protocol for Consideration of Exempted Fishing Permits for Highly Migratory Species Fisheries*; and COP 23, *Protocol for Consideration of Exempted Fishing Permits for Coastal Pelagic Species Fisheries*. Should a U.S. citizen want to develop targeted fisheries for Shared EC Species at some future time, COP 24 would provide the Council and the public a framework for evaluating the potential impacts of such a fishery to existing fisheries, fishing communities, and the greater marine ecosystem (See Section 1.2, Purpose and Need statement).

## 7.1 CPS FMP – Amendment 15 Revisions to the FMP

Amendment 15 to the CPS FMP would amend these sections of the FMP:

- 1.1 *History of the Fishery Management Plan* updated to briefly describe Amendment 15
- 1.2 *Stocks in the Fishery Management Plan* amended to add Shared EC Species
- 1.4 *Ecosystem Component Species* amended to add prohibition language for Shared EC Species
- 2.2.8 *Exempted Fishing* updated to reference potential EFPs for Shared EC Species
- 5.1.7 *Incidental Catch Allowance for Shared EC Species*, new section to describe potential incidental allowances for Shared EC Species

## Coastal Pelagic Species Fishery Management Plan

***

# 1.0 INTRODUCTION

## 1.1 History of the Fishery Management Plan

TO BE ADDED AFTER AMENDMENT 13 DESCRIPTION; AMENDMENT 14 DESCRIPTION TBD.

Amendment 15 was approved in 2015 and added a suite of lower trophic level species to the FMP's list of ecosystem component (EC) species. Consistent with the objectives of the Council's FMPs and its Fishery Ecosystem Plan, Amendment 15 prohibits future development of commercial fisheries for the suite of EC species shared between all four FMPs (Shared EC Species) until and unless the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem.

## 1.2 Stocks in the Fishery Management Plan

### *1.2.1 Fishery Management Unit*

Table 1-1. Stocks managed under this FMP ~~include~~:

| Common Name | Scientific Name |
|---|---|
| Pacific sardine | *Sardinops sagax* |
| Pacific (chub) mackerel | *Scomber japonicus* |
| Northern anchovy | *Engraulis mordax* |
| Central and northern subpopulations | |
| Market squid | *Loligo opalescens* |
| Jack mackerel | *Trachurus symmetricus* |
| Krill or euphausiids | *All Species in West Coast EEZ* |
| Including these eight dominant species. | *Euphausia pacifica* |
| First two species are common and are | *Thysanoessa spinifera* |
| most likely to be targeted by fishing | *Nyctiphanes simplex* |
| | *Nematocelis difficilis* |
| | *T. gregaria* |
| | *E. recurva* |
| | *E. gibboides* |
| | *E. eximia* |

Stocks may be added or removed from the management unit through the framework process described in Section 2.0.

### *1.2.2 Ecosystem Component Species*

Table 1-2 EC species under the CPS FMP ~~include~~:

| Common Name | Scientific Name |
|---|---|
| Pacific herring | *Clupea pallasii* |
| ~~Jacksmelt~~ | ~~*Atherinopsis californiensis*~~ |

Table 1-3 EC species shared between all four of the Council's FMPs, including the CPS FMP.

| Common Name | Scientific Name |
|---|---|
| Round herring | *Etrumeus teres* |
| Thread herring | *Opisthonema libertate, O. medirastre* |
| Mesopelagic fishes | Families: *Myctophidae, Bathylagidae, Paralepididae, and Gonostomatidae* |
| Pacific sand lance | *Ammodytes hexapterus* |
| Pacific saury | *Cololabis saira* |
| Silversides | *Atherinopsidae* |
| Smelts | *Osmeridae* |
| Pelagic squids | Families: *Cranchiidae, Gonatidae, Histioteuthidae, Octopoteuthidae, Ommastrephidae* except Humboldt squid*, Onychoteuthidae, and Thysanoteuthidae* |

***

## 1.4 Ecosystem Component Species

Several criteria should be met for a species to be included in the EC category (Section 660.310(d)(5)(i)). These are: 1) be a non-target stock/species; 2) not be subject to overfishing, approaching overfished, or overfished and not likely to become subject to overfishing or overfished in the absence of conservation and management measures; and, 3) not generally retained for sale or personal use, although "occasional" retention is not by itself a reason for excluding a species from the EC category. Identifying and including EC species in ~~the~~ an FMP is not mandatory but may be done for a variety of purposes: Data collection; For ecosystem considerations related to specification of OY for the associated fishery; As considerations in the development of conservation and management measures for the associated fishery; and/or to address other ecosystem issues.

A 2010 review of bycatch species in CPS fisheries confirmed that incidental catch and bycatch in CPS fisheries is dominated by other CPS and that bycatch/incidental catch of non-CPS is extremely low. However, jacksmelt and Pacific herring are infrequently caught with CPS gear and were therefore added to the FMP under Amendment 13 to ensure continued monitoring of incidental catch and bycatch of these species in CPS fisheries through sampling and logbook programs. This information will continue to be reported in the Stock Assessment and Fishery Evaluation (SAFE) report.

The Council intends to continue and expand its consideration of ecological factors when developing SDCs and management measures for CPS management unit species. These considerations are expected to evolve as improved information and modeling of ecological processes become available. These considerations will likely include predator- prey relationships and the overall status and role of forage species including ~~these~~ the ~~-~~two EC species in Table 1-2.

### 1.4.1 Shared Ecosystem Component Species

No directed commercial fisheries may begin for any Shared EC Species (Table 1-3) until and unless the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem.

***

## 2.0 FRAMEWORK MANAGEMENT

***

#### *2.2.8 Exempted Fishing*

"Exempted fishing" is defined to be fishing practices that are new to the fishery or not allowed under the FMP. Under this FMP, the NMFS Regional Administrator may authorize the targeted or incidental harvest of CPS for experimental or exploratory fishing that would otherwise be prohibited. The NMFS Regional Administrator may restrict the number of experimental permits by total catch, time, or area. The NMFS Regional Administrator may also require any level of industry-funded observer coverage for these experimental permits. EFP proposals targeting management unit species or CPS EC species will be subject to the protocol for EFPs for CPS Fisheries (Council Operating Procedure 23). EFP proposals targeting EC species shared between all four FMPs, including the CPS FMP, will be subject to the protocol for Shared EC Species (Council Operating Procedure 24). Exempted fisheries for euphausiids (krill) will not be considered.

## 5.0 BYCATCH, INCIDENTAL CATCH, AND ALLOCATION

***

NEW SECTION TO BE ADDED UNDER ALTERNATIVE 2 (*INCIDENTAL RETENTION ALLOWED*).

#### 5.1.7 Incidental Catch Allowance for Shared EC Species

Shared EC Species could continue to be taken incidentally without violating Federal regulations, unless regulated or restricted for other purposes, such as with bycatch minimization regulations for eulachon recovery. The targeting of Shared EC Species is prohibited.

## 7.2 Groundfish FMP – Amendment 25 Revisions to the FMP

Amendment 25 to the Groundfish FMP would amend these sections of the FMP:

- Section 1.1 *History of the FMP* updated to briefly describe Amendment 25
- Section 1.2 *How This Document is Organized* amended at the description of Chapter 3 of the FMP to add mention of EC species, in addition to the fishery management unit species already mentioned
- Section 2.2 *Operational Definition of Terms* amended to revise the definition of "Ecosystem Component Species" to include EC species that are shared between all four FMPs
- Section 3.1 *Species Managed by this Fishery Management Plan* amended to include Shared EC Species
- Section 4.4.4 *Ecosystem Component Stocks Without OFL Values* amended to add a paragraph on Shared EC Species
- Section 6.5.2.1 *Endangered Species Act Species* amended to add a sentence on eulachon
- Chapter 8 *Experimental Fisheries* amended to reference potential EFPs for Shared EC Species

**Pacific Coast Groundfish Fishery Management Plan for the California, Oregon, and Washington Groundfish Fishery**

* * *

**1.1 History of the FMP**

* * *

ADD A FINAL PARAGRAPH TO THIS SECTION THAT READS AS FOLLOWS:

<u>Amendment 25 was approved in 2015 and added a suite of lower trophic level species to the FMP's list of ecosystem component (EC) species. Consistent with the objectives of the Council's FMPs and its Fishery Ecosystem Plan, Amendment 25 prohibits future development of directed commercial fisheries for the suite of EC species shared between all four FMPs until and unless the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem.</u>

**1.2 How This Document is Organized**

* * *

REVISE THIRD BULLET DESCRIBING CHAPTER 3 TO READ AS FOLLOWS:

<u>Chapter 3 specifies the geographic area covered by this plan and lists the plan's Fishery Management Unit (FMU) species and Ecosystem Component (EC) species, including those EC species shared between all four of the Council's FMPs.</u>

* * *

**2.2 Operational Definition of Terms**

REVISE DEFINITION OF "ECOSYSTEM COMPONENT SPECIES" TO READ AS FOLLOWS:

Ecosystem Component Species are FMP species that are not actively managed in the fishery (i.e., no harvest specifications are specified for these species). Ecosystem component species are not targeted, are not generally retained for sale or personal use, are not subject to overfishing, and are not overfished or approaching an overfished condition (see section 4.4.4 for more detail). This FMP includes both EC species that are specific to the Groundfish FMP and EC species that are shared between all four of the Council's FMPs (referred to as "Shared EC Species").

* * *

### 3.1 Species Managed by this Fishery Management Plan

* * *

INSERT NEW TABLE 3-3 AND EXPLANATORY TEXT TO READ AS FOLLOWS:

Table 3-3 lists EC species shared between all four of the Council's FMPs, including the Groundfish FMP.

**Table 3-3. Common and scientific names of EC species shared between all four of the Council's FMPs.**

| Common Name | Scientific Name |
|---|---|
| Round herring | *Etrumeus teres* |
| Thread herring | *Opisthonema libertate, O. medirastre* |
| Mesopelagic fishes | Families: *Myctophidae, Bathylagidae, Paralepididae, and Gonostomatidae* |
| Pacific sand lance | *Ammodytes hexapterus* |
| Pacific saury | *Cololabis saira* |
| Silversides | *Atherinopsidae* |
| Smelts | *Osmeridae* |
| Pelagic squids | Families: *Cranchiidae, Gonatidae, Histioteuthidae, Octopoteuthidae, Ommastrephidae* except Humboldt squid*, Onychoteuthidae, and Thysanoteuthidae* |

No directed commercial fisheries may begin for any Shared EC Species until and unless the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem.

* * *

### 4.4.4 Ecosystem Component Stocks Without OFL Values

* * *

INSERT A NEW FINAL PARAGRAPH IN SECTION 4.4.4. TO READ AS FOLLOWS:

EC species include both those species exclusive to this FMP (Section 3.2) and those species shared between all four of the Council's FMPs (Section 3.3). EC species shared between all four FMPs may not become the subject of directed commercial fisheries until and unless the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem. The Council may have additional data and analysis requirements for changing the species categorization of EC species that are shared between all four FMPs, beyond those requirements already applying to EC species specific to the Groundfish FMP.

* * *

#### 6.5.2.1 Endangered Species Act Species

Marine species protected under the ESA that are not otherwise protected under either the MMPA or the MBTA (see below) include various salmon and sea turtle species, as well as eulachon. Threatened and endangered Pacific salmon runs are protected by a series of complex regulations affecting marine and terrestrial activities. In the west coast groundfish fisheries, management measures to reduce incidental salmon take have focused on the Pacific whiting fisheries, which have historically encountered more salmon than the non-whiting groundfish fisheries. Salmon bycatch reduction measures include marine protected areas (MPA) where Pacific whiting fishing is prohibited (See Section 6.8.7), and an at-sea observer program intended to track whiting and incidental species take inseason (See Section 6.4.1.1). Sea turtles are rare in areas where groundfish fisheries are prosecuted and no incidental take of sea turtles has been documented in any directed groundfish fishery. Eulachon sometimes occurs as incidental catch in the groundfish bottom trawl and at-sea whiting fisheries, and mortalities result from encounters with fishing gear. However, eulachon bycatch and bycatch mortality is low (or non-existent) in most years, and is monitored through the at-sea observer program.

* * *

## Chapter 8 Experimental Fisheries

* * *

REVISE THE 4TH INTRODUCTORY PARAGRAPH OF CHAPTER 8 TO READ AS FOLLOWS:

EFP applicants may have their proposals reviewed through the Council process in accordance with Council Operating Procedure #19, Protocol for Consideration of EFPs for Groundfish Fisheries, which applies to EFP proposals targeting management unit species (Table 3-1) or Groundfish EC species (Table 3-2). EFP proposals targeting EC species shared between all four FMPs, including the Groundfish FMP, will be subject to the protocol for Shared EC Species, Council Operating Procedure #24. ~~This~~ These protocols include~~s~~ requirements for EFP submission, proposal contents, review and approval, and progress reporting. The Council will give priority consideration to those EFP applications that: * * *

## 7.3 HMS FMP – Amendment 3 Revisions to the FMP

Amendment 3 to the HMS FMP would amend these sections of the FMP:

- Section 1.1 *Purpose of This Document* updated to briefly describe Amendment 3
- Section 3.3 *Species Included in the FMP as Ecosystem Component Species* amended to include Shared EC Species
- Section 6.1.11 *Exempted Fishing Permits* amended to reference potential EFPs for Shared EC Species

### Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species

* * *

**1.1 Purpose of This Document**

The FMP includes important species of tunas, billfish and sharks which are harvested by West Coast HMS fisheries. A complete list of species in the management unit is provided in Chapter 3. The FMP has been amended ~~once~~ <u>three times</u>. Amendment 1, approved in 2007, addresses overfishing of bigeye tuna, a management unit species. Amendment 1 also reorganized the FMP, which in its prior form was combined with the Final Environmental Impact Statement evaluating the effects of its implementation. The reorganized FMP is a more concise document containing those elements required by the Magnuson-Stevens Fishery Conservation and Management Act describing the management program. Amendment 2, approved in 2011, made FMP provisions (principally in Chapters 3-5) consistent with the revised National Standard 1 Guidelines (50 CFR 600.310) adopted pursuant to the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006<u>. Amendment 3, adopted in 2015, added a suite of lower trophic level species to the FMP's list of ecosystem component (EC) species. Consistent with the objectives of the Council's FMPs and its Fishery Ecosystem Plan, Amendment 3 prohibits future development of directed commercial fisheries for the suite of EC species shared between all four FMPs ("Shared EC Species") until and unless the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem</u>.

* * *

**3.3 Species Included in the FMP as Ecosystem Component Species**

* * *

HMS FMP EC species are:

Bigeye thresher shark, *Alopias superciliosus*
Common mola, *Mola mola*
Escolar, *Lepidocybium flavobrunneum*
Lancetfishes, *Alepisauridae*
Louvar, *Luvarus imperialis*
Pelagic sting ray, *Dasyetis violacea*
Pelagic thresher shark, *Alopias pelagicus*
Wahoo, *Acathocybium solandri*

Bigeye and pelagic thresher sharks are landed by the drift gillnet fishery but in small amounts compared to common thresher and mako sharks. Originally included in the FMP as managed species, largely because of concern that they have poor resilience to fishing, they were re-designated EC species under FMP Amendment 2, because of the low number caught in west coast commercial and recreational fisheries.

EC species shared between all four Council FMPs, including the HMS FMP are:

Round herring, *Etrumeus teres*
Thread herring, *Opisthonema libertate*, *O. medirastre*
Mesopelagic fishes of the families *Myctophidae*, *Bathylagidae*, *Paralepididae*, and *Gonostomatidae*
Pacific sand lance, *Ammodytes hexapterus*
Pacific saury, *Cololabis saira*
Silversides, *Atherinopsidae*
Smelts of the family *Osmeridae*
Pelagic squids (families: *Cranchiidae*, *Gonatidae*, *Histioteuthidae*, *Octopoteuthidae*, *Ommastrephidae* except Humboldt squid, *Onychoteuthidae*, and *Thysanoteuthidae*)

No directed commercial fisheries may begin for any Shared EC Species until and unless the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem.
* * *

### 6.1.11 Exempted Fishing Permits

* * *

First paragraph under subsection "Additional FMP Requirements for an Exempted Fishing Permit" would be revised to read as follows:

Additional FMP Requirements for an Exempted Fishing Permit. This FMP places additional requirements for authorizing an EFP for targeting HMS species, including EC species shared between all four Council FMPs. An EFP proposal will be required to follow a specific Council protocol and be reviewed by the Council prior to application to NMFS. EFP proposals targeting management unit species or HMS EC species will be subject to the protocol for EFPs for HMS Fisheries (Council Operating Procedure 20). EFP proposals targeting EC species shared between all four FMPs, including the HMS FMP, will be subject to the protocol for Shared EC Species (Council Operating Procedure #24). The ~~intent of the protocol is~~ protocols are intended to ensure the Council has adequate information on all aspects of the proposed fishery and has adequate time to consider, review and formulate recommendations. ~~This protocol~~ These protocols will be available from the Council. ~~It~~ They will require additional detailed information and analysis beyond those specifically required for a NMFS EFP. The protocols will specify timing for submissions and timing for Council review.

* * *

## 7.4 Salmon FMP – Amendment 19 Revisions to the FMP

Amendment 19 to the Salmon FMP would amend these sections of the FMP:

- *Introduction, Table 1, and Section 1* updated to briefly describe Amendment 19
- 1.1 *Stock Classification and Table 1-4* amended to include Shared EC Species in the FMP
- 1.4 *Ecosystem Component Species* amended to add prohibition language for Shared EC Species
- 6.6.6 *Experimental Fishing* updated to reference potential EFPs for Shared EC Species

**Pacific Coast Salmon Fishery Management Plan for Commercial and Recreational Salmon Fisheries Off the Coasts of Washington, Oregon, and California**

### Introduction

*******

The primary amendment issues since 1984 have included specific spawner escapement goals for Oregon coastal natural (OCN) coho and Klamath River fall Chinook (Amendments 7, 9, 11, 13, and 15), non-Indian harvest allocation (Amendments 7, 9, 10, and 14), inseason management criteria (Amendment 7), habitat and essential fish habitat (EFH) definition (Amendments 8, 14, and 18), safety (Amendment 8), status determination criteria (SDC) (Amendments 10, 14, 16, and 17), management objectives for stocks listed under the Endangered Species Act (ESA) (Amendments 12 and 14), bycatch reporting and priorities for avoiding bycatch (Amendment 14), selective fisheries (Amendment 14 and 17), stock classification (Amendment 16 and 17), annual catch limits (ACLs) and accountability measures (AMs) (Amendment 16), de minimis fishing provisions (Amendments 15 and 16). Amendment 19 was approved in 2015 and added a suite of lower trophic level species to the FMP's list of ecosystem component (EC) species. Consistent with the objectives of the Council's FMPs and its Fishery Ecosystem Plan, Amendment 19 prohibits future development of directed commercial fisheries for the suite of EC species shared between all four FMPs (Shared EC Species) until and unless the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem.

***

SECOND PAGE OF TABLE 1 AS FOLLOWS

| DOCUMENT | CONTENT SUMMARY |
|---|---|
| *** | |
| **Amendment 17**<br>(Effective January 1, 2013) | 1) Minor corrections from Amendment 16 and updating language to reflect current practices.<br>2) Approval of maximum fishing mortality threshold for Quillayute fall coho. |
| **Amendment 18**<br>(Effective date TBD) | Update to reflect new information on EFH, including criteria for impassable barriers; addition of HAPCs; adjustments to geographic extent of EFH; addition of non-fishing activities and conservation measures; minor typographical adjustments and clarifications. |
| **Amendment 19**<br>(Effective date TBD) | Update to add a suite of lower trophic level species to the FMP's list of ecosystem EC species and to prohibit future development of commercial fisheries for the suite of EC species shared between all four FMPs (Shared EC Species) until and unless the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem. |

# 1 What the Plan Covers

ADD A PARAGRAPH AT THE END OF THE SECTION AS FOLLOWS

The FMP also includes a suite of EC species that are shared between all four FMPs (Shared EC Species) and prohibits future development of directed commercial fisheries for those species until and unless the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem.

## 1.1 Stock Classification

ADD A PARAGRAPH AT THE END OF THE SECTION AS FOLLOWS

To the extent practicable, the Council has partitioned the coastwide aggregate of Chinook, coho, and pink salmon into various stock components and complexes with specific conservation objectives. A detailed listing of the individual stocks and stock complexes managed under this plan are provided in Tables 1-1, 1-2, and 1-3. Stocks designated as hatchery stocks rely on artificial production exclusively, while those designated as natural stocks have at least some component of the stock that relies on natural production, although hatchery production and naturally spawning hatchery fish may contribute to abundance and spawning escapement estimates. Table 1-4 lists the non-target Shared EC Species that are not in the fishery, for which future fishery development is prohibited until and unless the Council has had an adequate opportunity to both assess the scientific information relating to any proposed directed fishery and consider potential impacts to existing fisheries, fishing communities, and the greater marine ecosystem.

***

TABLE 1-4 WOULD BE ADDED TO SECTION 1 FOLLOWING TABLE 1-3

**Table 1-4. Common and scientific names of EC species shared between all four of the Council's FMPs.**

| Common Name | Scientific Name |
|---|---|
| Round herring | *Etrumeus teres* |
| Thread herring | *Opisthonema libertate, O. medirastre* |
| Mesopelagic fishes | Families: *Myctophidae, Bathylagidae, Paralepididae, and Gonostomatidae* |
| Pacific sand lance | *Ammodytes hexapterus* |
| Pacific saury | *Cololabis saira* |
| Silversides | *Atherinopsidae* |
| Smelts | *Osmeridae* |
| Pelagic squids | Families: *Cranchiidae, Gonatidae, Histioteuthidae, Octopoteuthidae, Ommastrephidae* except Humboldt squid, *Onychoteuthidae, and Thysanoteuthidae* |

# 6 Measures to Manage the Harvest

***

### *6.6.6 Experimental Fisheries*

***

SECOND PARAGRAPH IN THIS SECTION AMENDED AS FOLLOWS

The Secretary may not allow any recommended experimental fishery unless he or she determines that the purpose, design, and administration of the experimental fishery are consistent with the goals and objectives of the Council's fishery management plan, the national standards of the MSA, and other applicable law. Each vessel that participates in an approved experimental fishery will be required to carry aboard the vessel the letter of approval, with specifications and qualifications (if any), issued and signed by the Regional Administrator of NMFS. EFP proposals targeting EC species shared between all four FMPs, including the Salmon FMP, will be subject to the protocol for Shared EC Species (Council Operating Procedure 24).

## 7.5 *Proposed* Council Operating Procedure 24 – Protocol for Consideration of Exempted Fishing Permits for Shared Ecosystem Component Species

DEFINITION

An exempted fishing permit (EFP) is a one-year Federal permit, issued by the National Marine Fisheries Service (NMFS), which authorizes a party to engage in an activity that is otherwise prohibited by the Magnuson-Stevens Fishery Conservation and Management Act or other fishery regulations, for the purpose of collecting limited experimental data. The Pacific Fishery Management Council's (Council's) four fishery management plans allows for EFPs for Shared Ecosystem Component (Shared EC) species, consistent with Federal regulations at 50 CFR§600.475. EFPs can be issued to Federal or state agencies, marine fish commissions, or other entities, including individuals. An EFP applicant need not be the owner or operator of the vessel(s) for which the EFP is requested. The NMFS Regional Administrator may require any level of industry-funded observer coverage for these permits.

PURPOSE

This Council Operating Procedure (COP) provides a standard process for the Council, its advisory bodies, and the public to consider EFP proposals for Shared EC Species. The specific objectives of a proposed exempted fishing activity may vary. EFPs can be used to explore ways to develop stock surveys and assessments, explore the potential for a new non-tribal commercial fishery on Shared EC Species, or to evaluate current and proposed management measures. The scope of this COP is limited to EFP proposals for exempted commercial fisheries intended to target species identified in all four of the Council's FMPs as Shared EC Species.

PROTOCOL

A. Submission

1. The Council and its advisory bodies [Ecosystem Advisory Subpanel (EAS), Scientific and Statistical Committee (SSC), and any applicable FMP-specific advisory bodies] should review EFP proposals prior to issuance; the advisory bodies may provide comment on methodology and relevance to management data needs and make recommendations to the Council accordingly. The public may also comment on EFP proposals.
2. Completed applications for EFPs from individuals or non-government agencies for Council consideration must be received by the Council for review at least two weeks prior to the November Council meeting.
3. Applications for EFPs from Federal or state agencies must meet the briefing book deadline for the November Council meeting.

B. Proposal Contents

1. EFP proposals must contain sufficient information for the Council to determine:
    a. There is adequate justification for an exemption to the regulations;
    b. The potential impacts of the exempted activity have been adequately identified;
    c. The exempted activity would be expected to provide information useful to management and use of Shared EC Species and other Council-managed resources.
2. Applicants must submit a completed application in writing that includes, but is not limited to, the following information:
    a. Date of application;
    b. Applicant's names, mailing addresses, and telephone numbers;

c. A statement of the purpose and goals of the experiment for which an EFP is needed, including a general description of the arrangements for the disposition of all species harvested under the EFP;
d. Valid justification explaining why issuance of an EFP is warranted;
e. A statement of whether the proposed experimental fishing has broader significance than the applicant's individual goals;
f. An expected total duration of the EFP (i.e., number of years proposed to conduct exempted fishing activities);
g. Number of vessels covered under the EFP;
h. A description of the species (target and incidental) to be harvested under the EFP and the amount(s) of such harvest necessary to conduct the experiment; this description should include harvest estimates of overfished species and protected species;
i. A description of a mechanism, such as at-sea fishery monitoring, to ensure that the harvest limits for targeted and incidental species are not exceeded and are accurately accounted for;
j. A description of the proposed data collection and analysis methodology;
k. A description of how vessels will be chosen to participate in the EFP;
l. For each vessel covered by the EFP, the approximate time(s) and place(s) fishing will take place, and the type, size, and amount of gear to be used;
m. The signature of the applicant;
n. The Council and/or its advisory bodies may request additional information necessary for their consideration.

C. Review and Approval

1. The EAS will review EFP proposals in November and make recommendations to the Council for action; the Council will consider those proposals for preliminary action. Final action on EFPs will occur at the March Council meeting. Only those EFP applications that were considered in November may be considered in March; EFP applications received after the November Council meeting for the following calendar year will not be considered.
2. EFP proposals must contain a mechanism, such as at-sea fishery monitoring, to ensure that the harvest limits for targeted and incidental species are not exceeded and are accurately accounted for. Also, EFP proposals must include a description of the proposed data collection and analysis methodology used to measure whether the EFP objectives will be met.
3. The Council will give priority consideration to those EFP applications that:
   a. Emphasize resource conservation and management with a focus on evaluating the effects of harvesting Shared EC Species on the larger California Current Ecosystem;
   b. Can assess the potential effects of a directed fishery for one or more Shared EC Species on:
      i. Any Council-managed species;
      ii. Species that are the prey of any: Council-managed species, marine mammal species, seabird species, sea turtle species, or other ESA-listed species;
      iii. Habitat that is identified as essential fish habitat or otherwise protected within one of the Council's FMPs, critical habitat identified or protected under the Endangered Species Act, or habitat managed or protected by state or tribal fishery or habitat management programs;
      iv. Species that are subject to state or tribal management within 0-3 miles offshore of Washington, Oregon, or California;
      v. Species that migrate beyond the U.S. EEZ.
   c. Encourage full retention of fishery mortalities;
   d. Involve data collection on fisheries stocks and/or habitat;
   e. Encourage innovative gear modifications and fishing strategies to reduce bycatch;
4. The EAS review will consider the following questions:
   a. Is the application complete?

b. Is the EFP proposal consistent with the goals and objectives of the Council's Fishery Ecosystem Plan and FMPs?
c. Does the EFP account for fishery mortalities, by species?
d. Can the harvest estimates of overfished species and/or protected species be accommodated?
e. Does the EFP meet one or more of the Council's priorities listed above?
f. Is the EFP proposal compatible with the Federal observer program effort?
g. What infrastructure is in place to monitor, process data, and administer the EFP?
h. How will achievement of the EFP objectives be measured?
i. If this EFP is a re-issue of a previously issued EFP, what are the benefits to the fisheries management process to continue an EFP that began the previous year?
j. If integrating data into management is proposed, what is the appropriate process?
k. What is the funding source for at-sea monitoring?
l. Has there been coordination with appropriate state and Federal enforcement management and science staff?

5. SSC Review:
    a. All EFP applications should first be evaluated by the EAS for consistency with the goals and objectives of the Fishery Ecosystem Plan and the Council's FMPs;
    b. The SSC will evaluate the scientific merits of the application and will specifically evaluate the application's: (1) problem statement; (2) data collection methodology; (3) proposed analytical and statistical treatment of the data; and (4) the generality of the inferences that could be drawn from the study.

D. Other considerations

1. EFP candidates or participants may be denied future EFP permits under the following circumstances:
    a. If the applicant/participant (fisher/processor) has violated past EFP provisions; or has been convicted of a crime related to commercial fishing regulations punishable by a maximum penalty range exceeding $1,000 within the last three years;
    b. Within the last three years assessed a civil penalty related to violations of commercial fishing regulations in an amount greater than $5,000;
    c. Has been convicted of any violation involving the falsification of fish receiving tickets including, but not limited to, mis-reporting or under-reporting of fisheries landings. Documented fish receiving tickets indicating mis-reporting or under-reporting of fisheries landings will not qualify for consideration when fish reporting documents are used as part of the qualifying criteria for EFPs.

E. Report Contents

1. The EFP applicant must present a preliminary report on the results of the EFP and the data collected (including catch data) to the EAS at the November Council meeting of the following year.
2. A final written report on the results of the EFP and the data collected must be presented to the EAS and the Council at the March Council meeting. Those EFPs containing data analysis that could benefit from a scientific review may be forwarded to the SSC for comment.
3. The final report should include:
    a. A summary of the work completed;
    b. An analysis of the data collected;
    c. Conclusions and/or recommendations;
    d. Timely presentation of results is required to determine whether future EFPs will be recommended.

## 8.0 Sources


Abitía-Cárdenas, L.A., F. Galván-Magaña and J.Rodriquez-Romero. 1997. Food habits and energy values of prey of striped marlin, *Tetrapturus audux,* off the coast of Mexico. Fishery Bulletin 95:360-368.

Abitía-Cárdenas, L.A., A. Muhlia-Melo, V. Cruz-Escalona, and F. Galván-Magaña. 2002. Trophic dynamics and seasonal energetics of striped marlin, *Tetrapturus audux*, in the southern Gulf of California, Mexico. Fisheries Research 57:287-295.

Ackman, R.G., S.N. Hooper, S. Epstein and M. Kelleher. 1972. Wax esters of Barracudina lipids: A potential replacement for sperm whale oil. Journal of the American oil chemists society. Vol. 29, issue 6 pp 378-382.

Adams, P.B. 1987. The diet of widow rockfish (*Sebastes entomelas*) in Northern California. Pages 37-41 *in* W.H. Lenarz and D.R. Gunderson (eds.), Widow rockfish: Proceedings of a workshop, 11-12 December 1980, Tiburon, CA. U.S. Dept. Commer., NOAA Technical Memorandum. NMFS-48.

Adams, J., J.Y. Takekawa, and H.R. Carter. 2004. Stable foraging areas and variable chick diet in Cassin's auklets (*Ptychoramphus aleuticus*) off southern California. Canadian Journal of Zoology 82: 1578-1595.

Ahlstrom, E.H. 1969. Mesopelagic and bathypelagic fishes in the California current region. U.S. Bureau of Commercial Fisheries. Fishery-oceanography center. La Jolla, CA. California Marine Resource commission. California Cooperative Oceanic Fisheries Investigation (CalCOFI) report 13:39-44.

Ainley, D.G., D.W. Anderson, and P.R. Kelly. 1981. Feeding Ecology of Marine Cormorants in Southwestern North America. The Condor 83: 120-131.

Ainley, D.G., L.B. Spear, S.G. Allen, and C.A. Ribic. 1996. Temporal and Spatial Patterns in the Diet of the Common Murre in California Waters. The Condor 95: 691-705.

Al-Humaidhi, A.W., M.A. Bellman, J. Jannot, and J. Majewski. 2012. Observed and estimated total bycatch of green sturgeon and Pacific eulachon in 2002-2010 U.S. West Coast fisheries. West Coast Groundfish Observer Program. NMFS, NWFSC, Seattle WA. 27 pages.

Allaby, M. 1999. "Bathylagidae." A Dictionary of Zoology. http://www.encyclopedia.com/doc/1O8-Bathylagidae.html. Accessed October 14, 2014.

Allain, V. 2005. Diet of four tuna species of the Western and Central Pacific Ocean. SPC Fisheries Newsletter #114, p 30-33.

Allen, J.D. 2008. Size-Specific Predation on Marine Invertebrate Larvae. Biological Bulletin 214: 42-49.

Allen, L.G., and E.E. DeMartini. 1983. Temporal and spatial patterns of nearshore distribution and abundance of the pelagic fishes off San Onofre-Oceanside, California. Fishery Bulletin, U.S. 81 (3):569-586.

Anderson, D.W. and F. Gress. 1983. Status of a Northern Population of California Brown Pelican. The Condor 85: 79-88.

Antonelis, G.A. and M.A. Perez. 1984. Estimated annual food consumption by northern fur seals in the California Current. California Cooperative Oceanic Fisheries Investigation (CalCOFI) Report XXV: 135-145.

Antonelis, G.A., M.S. Lowry, D.P. DeMaster, and C.H. Fiscus. 1987. Assessing Northern Elephant Seal Feeding Habits by Stomach Lavage. Marine Mammal Science 3: 308-322.

Arimitsu, M.L., J.F. Piatt, M.A. Litzow, A.A. Bookire, M.D. Romano and M.D. Robards. 2008. Distribution and spawning dynamics of capelin (*Mallotus villosus*) in Glacier Bay, Alaska: a cold water refugium. Fisheries Oceanography 17: 137-146.

Arnott, S.A. and G.D. Ruxton. 2002. Sandeel recruitment in the North Sea: demographic, climatic and trophic effects. Marine Ecology Progress Series 238: 199-210.

Auth, T.D. 2009. Importance of far-offshore sampling in evaluating the ichthyoplankton community in the Northern California Current. California Cooperative Oceanic Fisheries Investigation (CalCOFI) 50: 107-117.

Aydin, K.Y., G. A. McFarlane, J.R. King, B.A. Megrey, and K.W. Myers. 2005. Linking oceanic food webs to coastal production and growth rates of Pacific salmon (*Oncorhnchus* spp.), using models on three scales. Deep-Sea Research 52: 757-780.

Bakun, A. 1990. Global climate change and intensification of coastal ocean upwelling. Science 247: 198-201.

Baltz, D.M. and G.V. Moorjohn. 1977. Food Habits and Niche Overlap of Seabirds Wintering on Monterey Bay, California. The Auk 94: 526-543.

Barlow, J., M. Kahru, B.G. Mitchell. 2008. Cetacean biomass, prey consumption, and primary production requirements in the California Current ecosystem. Marine Ecology Progress Series 371: 285–295.

Baxter, J.L. 1960. A Study of The Yellowtail *Seriola Dorsalis* (Gill). California Fish Bulletin No. 110:34-42.

Beacham, T. 1986. Type, Quantity, and Size of Food of Pacific Salmon (*Oncorhynchus*) in the Strait of Juan de Fuca, British Columbia. Fishery Bulletin 84: 77-89.

Beamish, R.J., K.D. Leask, O.A. Ivanov, A.A. Balanov, A.M. Orlov, and B. Sinclair. 1999. The ecology, distribution, and abundance of midwater fishes of the Subarctic Pacific. Progressive Oceanographer 43:399–442.

Beaudreau, A.H. and T. E. Essington. 2009. Development of a new field-based approach for estimating consumption rates of fishes and comparison with a bioenergetics model for lingcod (*Ophiodon elongatus*). Canadian Journal of Fisheries and Aquatic Sciences 66: 565-578.

Benson, S. R., T. Eguchi, D. G. Foley, et al. 2011. Large-scale movements and high-use areas of western Pacific leatherback turtles, *Dermochelys coriacea*. Ecosphere 2(7):art84. doi:10.1890/ES11-00053.1.

Bertram, D.F. and G.W. Kaiser. 1993. Rhinoceros auklet (*Cerorhinca monocerata*) Nestling Diet May Gauge Pacific Sand Lance (*Ammodytes hexapterus*) Recruitment. Canadian Journal of Fisheries and Aquatic Sciences 50: 1908-1915.

Bertram, D.F., D.L. Mackas, and S.M. McKinnell. 2001. The seasonal cycle revisted: interannual variation and ecosystem consequences. Progress in Oceanography 49: 283-307.

Bograd, S. J., C. G. Castro, E. Di Lorenzo, D. M. Palacios, H. Bailey, W. Gilly, and F. P. Chavez. 2008. Oxygen declines and the shoaling of the hypoxic boundary in the California Current. Geophysical Research Letters 35: L12607. doi:10.1029/2008GL034185.

Bograd, S.J., I. Schroeder, N. Sarkar, X. Qiu, W.J.Sydeman, and F. B. Schwing. 2009. Phenology of coastal upwelling in the California Current. Geophysical Research Letters 36. L01602, doi:10.1029/2008GL035933.

Bower, J. R. and T. Ichii. 2005. The red flying squid (*Ommastrephes bartramii*): A review of recent research and the fishery in Japan. Fisheries Research 76: 39-55.

Bower, J. R. and K. Miyahara. 2005. The diamond squid (*Thysanoteuthis rhombus*): A review of the fishery and recent research in Japan. Fisheries Research 73: 1-11.

Briggs, K.T., W.B. Tyler, D.B. Lewis, P.R. Kelly, and D.A. Croll. 1983. Brown Pelicans in Central and Northern California. Journal of Field Ornithology 54: 353-373.

Brodeur, R.D. 1990. A synthesis of the food habits and feeding ecology of salmonids in marine waters of the North Pacific. FRI-UW-9016, Fisheries Research Institute, University of Washington, Seattle, 38 pages.

Brodeur, R.D., J.C. Buchanan, and R.L. Emmett. 2014. Pelagic and demersal fish predators on juvenile and adult forage fishes in the northern California Current: spatial and temporal variations. CalCOFI Reports 55: 96-114.

Brodeur, R. D., J.P. Fisher, R.L. Emmett, C.A. Morgan and E. Casillas. 2005. Species composition and community structure of pelagic nekton off Oregon and Washington under variable oceanographic conditions. Marine Ecology Progress Series 298:41-57.

Brodeur, R.D., H.V. Lorz, W.G. Pearcy. 1987. Food Habits and Dietary Variability of Pelagic Nekton off Oregon and Washington, 1970-1984. U.S. Dept. Commer., NOAA Technical Memorandum NMFS 57.

Brodeur, R.D., S. McKinnell, S.K. Nagasawa, W.G. Pearcy, V. Radchenko, and S. Takagi, 1999. Epipelagic nekton of the North Pacific Subarctic and Transition Zones. Progressive Oceanographer 43: 365–397.

Brodeur R.D., W.G. Pearcy. 1984. Food Habits and Dietary Overlap of Some Shelf Rockfishes (Genus *Sebastes*) from the Northeastern Pacific Ocean. Fishery Bulletin 82:269-293.

Brodeur R.D., W.G. Pearcy. 1990. Trophic relations of Juvenile Pacific Salmon off the Oregon and Washington Coast. Fishery Bulletin 88:617-636.

Brodeur, R.D., and O. Yamamura, editors. 2005. Micronekton of the North Pacific. PICES Scientific Report No. 30. North Pacific Marine Science Organization, Sidney, B.C.

Brown, E. 2002. Life history, distribution, and size structure of Pacific capelin in Prince William Sound and the northern Gulf of Alaska. ICES Journal of Marine Science 59: 983-996.

Brown, R.F. and B.R. Mate. 1983. Abundance, movements, and feeding habits of harbor seals, Phoca vitulina, at Netarts and Tillamook Bays, Oregon. Fishery Bulletin. 81: 291-301.

Buckley, T.W., G.E. Tyler, D.M. Smith, P.A. Livingston. 1999. Food Habits of Some Commercially Important Groundfish off the Coasts of California, Oregon, Washington and British Columbia. U.S. Dept. Commer., NOAA Technical Memorandum NMFS-AFSC-102.

Burkett, E.E. 1995. Marbeled Murrelet Food Habits and Prey Ecology. Pages 223-246 *in* United States Department of Agriculture Forest Service General Technical Report PSW-152.

Bush, S. L., B.H. Robison, and R. L. Caldwell. 2009. Behaving in the Dark: Locomotor, Chromatic, Postural, and Bioluminescent Behaviors of the Deep-Sea Squid *Octopoteuthis deletron* Young 1972. Biological Bulletin 216: 7-22

Byrne R., J. Avise. 2009. Multiple paternity and extra-group fertilizations in a natural population of California grunion (*Leuresthes tenuis*), a beach-spawning marine fish. Marine Biology 156 (8):1681-1690.

Byrne, R. H., S. Mecking, R.A. Feely and X. Liu. 2010. Direct observations of basin-wide acidification of the North Pacific Ocean. Geophysical Research Letters 37(2).

California Department of Fish and Game (CDFG). 2001. California's Living Marine Resources: A Status Report California's Living Marine Resources: Status of the Fisheries Report for 2001. 593 pages.

CDFG. 2009. Report to the Fish and Game Commission: A Status Review of the Longfin Smelt (*Spirinchus thaleichthys*) in California. 131 pages.

CDFG. 2013. Status of the Fisheries Report: An Update Through 2011. 227 pages.

Carretta, J.V., E. Oleson, D.W. Weller, A.R. Lang, K.A. Forney, J. Baker, B. Hanson, K. Martien, M.M. Muto, M.S. Lowry, J. Barlow, D. Lynch, L. Carswell, R.L. Brownell Jr., D. K. Mattila, and M.C. Hill. 2013. U.S. Pacific Marine Mammal Stock Assessments: 2012. U.S. Dept. Commer.,NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-504. 378 pages. Available at http://www.nmfs.noaa.gov/pr/sars/region.htm

Cayan, D.R. and D.H. Peterson. 1989. The influence of North Pacific atmospheric circulation on streamflow in the west. Geophysical Monograph 55: 375-397.

Checkley, D.M. and J.A. Barth. 2009. Patterns and processes in the California Current System. Progress in Oceanography 83: 49–64.

Chen, C-S, Chiu, T-S. 2003. Variations of life history parameters in two geographical groups of the neon flying squid, *Ommastrephes bartramii*, from the North Pacific. Fisheries Research 63: 349-366.

Cherel, Y. and N. Klages. 1997. A review of the food of albatrosses. Pages 113-136 *in* Robertson, G. and R. Gales (eds.), Albatross Biology and Conservation. Surrey Beatty & Sons, Chipping Norton.

Chow, W., I.P. Murarka, and R.W. Brocksen. 1981. Entrainment and Impingement in Power Plant Cooling Systems. Water Pollution 53: 965-973.

Christiansen, J., K. Praebel, S.I. Siikavuopio, and J. E. Carscadden. 2008. Facultative semelparity in capelin *Mallotus villosus* (Osmeridae) – an experimental test of a life history phenomenon in a sub-arctic fish. Journal of Experimental Marine Biology and Ecology 360: 47-55.

Clark F.N. 1929. The Life History of the California Jack Smelt, *Atherinopsis californiensis*. California Division of Fish and Game Fish Bulletin 16. 22 pages.

Clarke, M.R. 1996. Cephalopods as prey III. Cetaceans. Philosophical Transactions of the Royal Society of London B 351: 1053-1065.

Collette, B. B., and C. E. Nauen. 1983. Scombrids of the world. FAO Fisheries Synopsis 125. 137 pages.

Collis, K., D. Roby, D. Craig, S. Adamy, J. Adkins, and D. Lyons. 2002. Colony Size and Diet Composition of Piscivorous Waterbirds on the Lower Columbia River: Implications for Losses of Juvenile Salmonids to Avian Predation. Transactions of the American Fisheries Society 131: 537-550.

Condit, R. and B. LeBoeuf. 1984. Feeding Habits and Feeding Grounds of the Northern Elephant Sea. Journal of Mammology 65: 281-290.

Coto, A., E. Medina and O. Bernal. 2010a. *Opisthonema libertate*. In: IUCN 2013. IUCN red list of threatened species. Version 2013. Available at www.iucnredlist.org

Coto, A., E. Medina and O. Bernal. 2010b. *Opisthonema medirastre*. In: IUCN 2013. IUCN red list of threatened species. Version 2013. Available at www.iucnredlist.org

Cox, K. 1949. Pacific saury. The Commercial Fish Catch of California for the Year 1947 With an Historical Review 1916 - 1947. California Division of Fish and Game Fish Bulletin 74. p. 122.

Craig, P.C. 1984. Fish Use of Coastal Waters of the Alaskan Beaufort Sea: A Review. Transactions of the American Fisheries Society 111: 265-282.

Crane, K. Environmental Scientist, California Department of Fish and Wildlife, telephone, October 2013. Personal communication with D. Wilson-Vandenberg regarding recreational fishing for surf smelt.

Crozier, L.G., A.P. Hendry, P.W. Lawson, T.P. Quinn, N.J. Mantua, J. Battin, R.G. Shaw and R.B. Huey. 2008. Potential responses to climate change in organisms with complex life histories: evolution and plasticity in Pacific salmon. Evolutionary Applications 1: 252–270.

Daly, E.A., T.D. Auth, R.D. Brodeur, and W.T. Peterson. 2013. Winter ichthyoplankton biomass as a predictor of early summer prey fields and survival of juvenile salmon in the northern California Current. Marine Ecology Progress Series 484: 203-217.

Daly, E.A., R.D. Brodeur, and L.A. Weitkamp. 2009. Ontogenetic Shifts in Diets of Juvenile and Subadult Coho and Chinook Salmon in Coastal Marine Waters: Important for Marine Survival? Transactions of the American Fisheries Society 138: 1420-1438.

Davidson, P.C., D.M. Checkley Jr., J.A. Koslow, and J. Barlow 2013. Carbon export mediated by mesopelagic fishes in the northeast Pacific Ocean. Progress in Oceanography. 116: 14-30.

Davis, N. D., K.Y. Aydin, and Y. Ishida. 2000. Diel Catches and Food Habits of Sockeye, Pink, and Chum Salmon in the Central Bering Sea in Summer. North Pacific Anadromous Fish Commission Bulletin 2: 99-109.

Davoren, G. K. and A.E. Burger. 1999. Differences in prey selection and behavior during self-feeding and chick provisioning in rhinoceros auklets. Animal Behaviour 58: 853-863.

Denlinger, L.M. 2006. Alaska Seabird Information Series. Unpublished Report, USFWS Migratory Bird Management, Nongame Program, Anchorage, AK. 92 pages. Available at http://www.fws.gov/alaska/mbsp/mbm/seabirds/pdf/asis_complete.pdf.

Di Lorenzo, E., N. Schneider, K.M. Cobb, P.J.S. Franks, K. Chhak, A.J. Miller, J.C. McWilliams, S.J. Bograd, H. Arango, E. Churchitser, T.M. Powell, and P. Rivière. 2008. North Pacific Gyre Oscillation links ocean climate and ecosystem change. Geophysical Research Letters 35(8).

Dodson, J.J., S. Tremblay, F. Colombani, J.A. Carscadden, and F. Lecomte. 2007. Trans-Arctic dispersals and the evolution of a circumpolar marine fish species complex, the capelin (*Mallotus villosus*). Molecular Ecology 16: 5030-5043.

Doney, S.C., M. Ruckelshaus, J.E. Duffy, J. P. Barry, F. Chan, C. A. English, H. M. Galindo, J. M. Grebmeier, A. B. Hollowed, N. Knowlton, J. Polovina, N. N. Rabalais, W. J. Sydeman, and L. D. Talley. 2012. Climate change impacts on marine ecosystems. Annual Review in Marine Science 4: 11-37.

Drazen, J.C., T. W. Buckley, and G. R. Hoff. 2001. The feeding habits of slope dwelling macrourid fishes in the eastern North Pacific. Deep-Sea Research 48: 909-935.

Dufault, A., K. Marshall, and I. Kaplan. 2009. A Synthesis of Diets and Trophic Overlap of Marine Species in the California Current. U.S. Dept. Commer., NOAA Technical Memorandum NMFS-NWFSC-103. 44 pages.

Dumbauld, B.R., D.L. Holden, and O.P. Langness. 2008. Do sturgeon limit burrowing shrimp populations in Pacific Northwest Estuaries? Environmental Biology of Fishes 83: 283-296.

Dunham, J.S. and D.A. Duffus. 2002. Diet of Gray Whales (*Eschrichtus robustus*) in Clayoquot Sound, British Columbia, Canada. Marine Mammal Science 18: 419-437.

Ebert, D. A., J.J. Bizzarro, S.C. Brown, M.D. Boyle, and G.M. Cailliet. 2008. Diet and trophic ecology of skates in the Gulf of Alaska (*Raja* and *Bathyraja* spp.): ecological information for ecosystem-based management of demersal resources. North Pacific Research Board Project 621 Final Report. 57 pages.

Emmett R.L., S.A. Hinton, S.L. Stone, M.E. Monaco. 1991. Distribution and abundance of fishes and invertebrates in west coast estuaries, Volume II: Species life history summaries. ELMR Report No

8. 329 p. Available from: NOAA/NOS Strategic Environmental Assessments Division. Rockville, MD.

Emmett, R.L. and G. Krutzikowsky. 2008. Nocturnal feeding of Pacific hake and jack mackerel off the mouth of the Columba River, 1998-2004: implications for juvenile salmon predation. Transaction of the American Fisheries Society 137: 657-676.

Environmental Protection Agency (EPA) of the United States, Office of Federal Activities. 1999. Consideration of Cumulative Impacts in EPA Review of NEPA Documents. EPA 315-R-99-002. Washington, D.C. 22 pages.

Eschmeyer, W.N., E.S. Herald, H. Hammann and K. Smith. 1983. A field guide to Pacific Coast fishes of North America. Houghton Mifflin, Boston. 352 pages.

Essential Fish Habitat Review Committee (EFHRC). 2012. Pacific Coast Groundfish 5-Year Essential Fish Habitat Report to the Pacific Fishery Management Council, Phase 1: New Information. 452 pages.

Etnoyer, P. and L. Morgan. 2005. Habitat-forming deep-sea corals in the Northeast Pacific Ocean. Pages 331-343 *in* A. Freiwald and J.M. Roberts (eds). Cold-water corals and ecosystems. Springer, New York, NY.

Executive Order 12612. The President of the United States. Federalism guidelines. October 26, 1987.

Executive Order 12866. The President of the United States. Regulatory planning and review. September 30, 1993.

Executive Order 12898. The President of the United States. Federal actions to address environmental justice in minority populations and low-income populations. February 11, 1994.

Executive Order 13132. The President of the United States. Federalism. August 4, 1999.

Executive Order 13175. The President of the United States. Consultation and coordination with Indian tribal governments. November 6, 2000.

Executive Order 13186. The President of the United States. Responsibilities of federal agencies to protect migratory birds. January 10, 2001.

Feder, H.M., C.H. Turner, C. Limbaugh. 1974. Observations on fishes associated with kelp beds in southern California. Calif Fish Bull 160:101-103.

Federal Register, Volume 74 No. 59444. November 17, 2009. A final rule removing the brown pelican (*Pelecanus occidentalis*) From the Federal List of Endangered and Threatened Wildlife.

Federal Register, Volume 75 No. 78344. December 15, 2010. A final rule implementing additional program details for the trawl rationalization program.

Federal Register, Volume 77 No. 17254. March 23, 2012. Standards for Living Organisms in Ships' Ballast Water Discharged in U.S. Waters.

Federal Register, Volume 78 No. 65844. November 1, 2013. USFWS updated its *List of Migratory Birds* protected under the Migratory Bird Treaty Act.

Federal Register, Volume 79 No. 46214. August 7, 2014. Proposed rule to update Federal list of authorized fisheries and gear issued under section 305(a) of the Magnuson-Stevens Fishery Conservation and Management Act.

Federal Register, Volume 79 No. 50589. August 25, 2014. Proposed rule for the National Marine Fisheries Service to publish its proposed List of Fisheries for 2015, as required by the Marine Mammal Protection Act.

Fiedler, P.C., S. B. Reilly, R. P. Hewitt, D. Demer, V. A. Philbrick, S. Smith, W. Armstrong, D. A. Croll, B. R. Tershy, B. R. Mate. 1998. Blue whale habitat and prey in the California Channel Islands. Deep-Sea Research II 45: 1781-1801.

Field, L.J. 1988. Pacific sand lance, *Ammodytes hexapterus*, with notes on related *Ammodytes* species. Pages 15-33 *in* Wilimovsky, N.J., L.S. Incze, and S.J. Westrheim (eds.), Species Synopses: life histories of selected fish and shellfish of the northeast Pacific and Bering Sea. Washington Sea Grant, Seattle, USA.

Field, J. C. 2013. Status of bocaccio, *Sebastes paucispinis*, in the Conception, Monterey and Eureka INPFC areas as evaluated for 2013. 78 pages. Available at http://www.pcouncil.org/wp-content/uploads/Bocaccio_2013_Assessment_Update.pdf

Field, J.C., R.C. Francis, and K.Y. Aydin. 2006. Top-down and bottom up dynamics: linking a fisheries-based ecosystem model with climate hypotheses in the Northern California Current. Progressive Oceanographer 68:238–270.

Fiscus, C.H., D.W. Rice, and A.A. Wolman. 1989. Cephalopods from the Stomachs of Sperm Whales taken off California. U.S. Dept. Commer., NOAA Technical Memorandum NMFS 83. Available at http://spo.nwr.noaa.gov/tr83opt.pdf

Fitch, J.E. and R.B. Brownell, Jr. 1968. Fish Otoliths in Cetacean Stomachs and Their Importance in Interpreting Feeding Habits. Journal Fisheries Research Board of Canada. 25(12): 2561-2574.

Flinn, R.D., A.W. Trites, and E.J. Gregr. 2002. Diets of Fin, Sei, and Sperm Whales in British Columbia: An Analysis of Commercial Whaling Records, 1963-1967. Marine Mammal Science 18: 663-679.

Food and Agriculture Organization (FAO). 1997. Review of the state of world fishery resources: Section 2. Lanternfishes: A potential fishery in the northern Arabian Seas. Marine Fisheries Circular No. 920 FIRM/C920. Rome. ISSN 0429-9329.

FAO. 2010. Cephalopods of the World: An Annotated and Illustrated Catalogue of Cephalopod Species Known to Date (Volume 2. Myopsid and Oegopsid Squids). P. Jereb and C. Roper (eds.). Rome. 649 pages.

FAO. 2013. FAO Yearbook. Fishery and Aquaculture Statistics. 2011. ISSN 2070-6057. Rome 76 pages. Available at http://www.fao.org/docrep/019/i3507t/i3507t.pdf

Ford, J.K.B., G.M. Ellis, L.G. Barrett-Lennard, A.B. Morton, R.S. Palm, and K.C. Balcolm III. 1998. Dietary specialization in two sympatric populations of killer whales (*Orcinus orca*) in coastal British Columbia and adjacent waters. Canadian Journal of Zoology 76: 1456-1471.

Frederiksen, M., S. Wanless, M.P. Harris, P. Rothery, and L.J. Wilson. 2004. The role of industrial fisheries and oceanographic change in the decline of North Sea black-legged kittiwakes. Journal of Applied Ecology 41: 1129-1139.

Fréon, P., J. Arístegui, A. Bertrand, R.J.M. Crawford, J.C. Field, M.J. Gibbons, J. Tam, L. Hutchings, H. Masski, C. Mullon, M. Ramdani, B. Seret, and M. Simier. 2009. Functional group biodiversity in Eastern Boundary Upwelling Ecosystems questions the wasp-waist trophic structure. Progress in Oceanography 83: 97-106.

Fritzsche, R.A., R.H. Chamberlain, and R. A. Fisher. 1985. Species Profile: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Pacific Southwest): California Grunion. U.S. Fish and Wildlife Service Biological Report 82 (11.28). 12 pages.

Frost, K.J. and Lowry, L.F. 1981. Foods and trophic relationships of cetaceans in the Bering Sea. Pages 825-836 *in* Hood, D.W., and Calder, J.A. (eds.), The eastern Bering Sea Shelf: Oceanography and Resources. Vol.2. University of Washington Press, Seattle, USA.

Furness, R.W. 2002. Management implications of interactions between fisheries and sandeel-dependent seabirds and seals in the North Sea. ICES Journal of Marine Science 59: 261-269.

Gabriel, W.L. and W.G. Pearcy. 1981. Feeding Selectivity of Dover Sole, *Microstomus pacificus*, off Oregon. Fishery Bulletin 79: 749-763.

Gaskin, D. E. 1982. The Ecology of Whales and Dolphins. Heinemann, London. 459 pages.

Gilly, W, J.M. Beman, S.Y. Litvin and B. Robison. 2013. Oceanographic and biological effects of shoaling of the oxygen minimum zone. Annual Reviews in Marine Science 5:393–420. doi: 10.1146/annurev-marine-120710-100849.

Gladics, A.J., R.M. Suryan, R.D. Brodeur, L.M. Segui, and I.Z. Filliger. 2014. Constancy and change in marine predator diets across a shift in oceanographic conditions in the northern California Current. Marine Biology 161: 837-851.

Glaser S.M. 2009. Foraging ecology of North Pacific albacore in the California Current System. Ph.D. Dissertation, University of California, San Diego. 213 pages.

Gjøsæter, J. and K. Kawaguchi. 1980. A review of the world resources of mesopelagic fish. FAO Fisheries Technical Paper 193:1-150.

Gould, P., P. Ostrom, and W. Walker. 1997a. Trophic relationships of albatrosses associated with squid and large-mesh drift-net fisheries in the North Pacific Ocean. Canadian Journal of Zoology 75: 549-562.

Gould, P., W. Walker, and P. Ostrom. 1997b. Foods of Northern Fulmars Associated with High-Seas Drift Nets in the Transitional Region of the North Pacific. Northwestern Naturalist 78: 57-61.

Green-Ruiz, Y. and D. Acal-Sánchez. 1987. Distribution and abundance of fish larvae and estimation of spawning biomass of *Etrumeus teres* (Dekay) in the Gulf of California, April 1985. Ciencias Marinas 13(3): 69-96.

Greenstreet, S.P.R., E. Armstrong, H. Mosegaard, H. Jensen, I.M. Gibb, H.M. Fraser, B.E. Scott, G.J. Holland, and J. Sharples. 2006. Variation in the abundance of sandeels *Ammodytes marinus* off southeast Scotland: an evaluation of area-closure fisheries management and stock abundance assessment methods. ICES Journal of Marine Science 63: 1530-1550.

Grimaldo, L.F., T. Sommer, N. Van Ark, G. Jones, E. Holland, P.B. Moyle, B. Herbold, and P. Smith. 2009. Factors Affecting Fish Entrainment into Massive Water Diversions in a Tidal Freshwater Estuary: Can Fish Losses be Managed? North American Journal of Fisheries Management 29: 1253-1270.

Grinols, R.B. and C.D. Gill. 1968. Feeding behavior of three oceanic fishes (*Oncorhynchus kisuch*, *Trachurus symmetricus*, and *Anoplopoma fimbria*) from the Northeastern Pacific. Journal of the Fisheries Research Board of Canada 25:825-827.

Groot, C., L. Margolis, and W.C. Clarke, editors. 1995. Physiological Ecology of Salmon. Vancouver: UBC Press. 510 pages.

Grover, J.J. and B.L. Olla. 1983. The Role of the Rhinoceros Auklet (*Cerorhinca monocerata*) in Mixed-Species Feeding Assemblages of Seabirds in the Strait of Juan de Fuca, Washington. The Auk 100: 979-982.

Gustafson, R.G., M.J. Ford, D. Teel, and J.S. Drake. 2010. Status review of eulachon (*Thaleichthys pacificus*) in Washington, Oregon, and California. U.S. Dept. Commer., NOAA Technical Memorandum NMFS-NWFSC-105, 360 pages.

Hannah, R. W. and S. A. Jones. 2007. Effectiveness of bycatch reduction devices (BRDs) in the ocean shrimp (*Pandalus jordani*) trawl fishery. Fisheries Research 85: 217-255.

Hannah, R. W. Research Biologist. Oregon Department of Fish and Wildlife, Newport, OR. January 16, 2014. Personal communication with Cyreis Schmitt regarding forage fish bycatch.

Hanni, K.D., D.J. Long, R.E. Jones, P. Pyle, and L.E. Morgan. 1997. Sightings and Strandings of Guadalupe Fur Seals in Central and Northern California, 1988-1995. Journal of Mammology 78: 684-690.

Hanson, M.T. and R.H. DeFran. 1993. The behaviour and feeding ecology of the Pacific coast bottlenose dolphin, *Tursiops truncates*. Aquatic Mammals 19: 127-142.

Harley, C.D.G., A.R. Hughes, K.M. Hultgren, B.G. Miner, C.S. Thomber, L.F. Rodriguez, L. Tomanek, and S.L. Williams. 2006. The impacts of climate change in coastal marine systems. Ecology Letters 9: 228–241.

Hashimoto, H. 1984. Population structure of the sand eel around Japan. Bulletin of the Japanese Society of Scientific Fisheries. 50: 1357-1365.

Hatch, S.A. 1993a. Ecology and population status of Northern fulmars *Fulmaris glacialis* of the North Pacific. Pages 82-92 *in* Vermeer, K., K.T. Briggs, K.H. Morgan, and D. Siegel-Causey (eds.), The status, ecology, and conservation of marine birds of the North Pacific. Canadian Wildlife Service, Victoria, Canada.

Hatch, S.A. 1993b. Status and ecology of kittiwakes (*Rissa tridactyla* and *R. brevirostris*) in the North Pacific. Pages 140-153 *in* Vermeer, K., K.T. Briggs, K.H. Morgan, and D. Siegel-Causey (eds.), The status, ecology, and conservation of marine birds of the North Pacific. Canadian Wildlife Service, Victoria, Canada.

Hatch, S.A. 2013. Kittiwake diets and chick production signal a 2008 regime shift in the Northeast Pacific. Marine Ecology Progress Series 477: 271-284.

Haynes, T.B., R.A. Ronconi, and A.E. Burger. 2007. Habitat Use and Behavior of the Pacific Sand Lance (*Ammodytes hexapterus*) in the Shallow Subtidal Region of Southwestern Vancouver Island. Northwestern Naturalist 88: 155-167.

Hedd, A., D.F. Bertram, J.L. Ryder, and I.L. Jones. 2006. Effects of interdecadal climate variability on marine trophic interactions: rhinoceros auklets and their fish prey. Marine Ecology Progress Series 309: 263-278.

Herke, W. H. and B. D. Rogers. 1993. Maintenance of the estuarine environment. Pages 263-286 *in:* C. C. Kohler and W. A. Hubert (eds.) Inland Fisheries Management in North America. American Fisheries Society, Bethesda, Maryland.

Herrick, Jr, S.F., J.G. Norton, R. Hannesson, U.R. Sumaila, M. Ahmed and J.Pena-Torres. 2009. Global production and economics of small pelagic fish. Pages 256-274 *in*: Checkley, D.M., C. Roy, J. Alheit, and Y. Oozeki (eds.), Climate Change and Small Pelagic Fish. Cambridge University Press, UK.

Hickey, B.M. 1998. Coastal oceanography of Western North America from the tip of Baja California to Vancouver Island. Pages 345-393 *in:* A.R. Robinson and K.H. Brink (eds.) The Sea, Volume 11. Wiley and Sons: New York.

Hills, S. and C. Fiscus. 1988. Cephalopod Beaks from the Stomachs of Northern Fulmars (*Fulmaris glacialis*) Found Dead on the Washington Coast. The Murrelet (69): 15-20.

Hipfner, J.M. and M. Galbraith. 2013. Spatial and temporal variation in the diet of the Pacific sand lance *Ammodytes hexapterus* in waters off the coast of British Columbia, Canada. Journal of Fish Biology 83: 1094-1111.

Hobson, E.S. 1986. Predation on the Pacific Sand Lance, *Ammodytes hexapterus* (Pisces: Ammodytidae), during the Transition between Day and Night in Southeastern Alaska. Copeia 1986: 223-226.

Holt, C.A. and N. Mantua. 2009. Defining the spring transition: Regional indices for the California Current System. Marine Ecology Progress Series 393: 285-299.

Horn, M.H. and L.G. Allen. 1985. Fish community ecology in southern California bays and estuaries. In: A. Yanez-Aranciba (ed.), Fish Community Ecology in Estuaries and Coastal Lagoons: Towards and Ecosystem Integration. DR. (R) UNAM, Mexico. Pages 169-190.

Horn M.H., A.K Gawlicka, D.P German, E.A. Logothetis, J.W. Cavanaugh, K.S. Boyle. 2006. Structure and function of the stomachless digestive system of three related species of New World silverside fishes (*Atherinopsidae*) representing herbivory, omnivory, and carnivory. Marine Biology 149 (5):1237-1245.

Hoss, D. E. and G. W. Thayer. 1993. The importance of habitat to the early life history of estuarine dependent fishes. American Fisheries Society Symposium 14:147-158.

Hoving, H.J., S.L. Bush, and B.H. Robison. 2012. A shot in the dark: same-sex sexual behavior in a deep-sea squid. Biology Letters 8: 287-290.

Huang, W, N.C.H. Lo, T Chiu and C Chen. 2007. Geographical distribution and abundance of Pacific saury, *Cololabis saira* (Brevoort) (*Scomberesocidae*), Fishing Stocks in the Northwestern Pacific in Relation to Sea Temperatures. Zoological Studies 46(6): 705-716.

Hubbs, C.L. 1925. A revision of the *osmerid* fishes of the North Pacific. Proceedings of the Biological Society of Washington 38: 49-56.

Hubbs, C.L. and R.L. Wisner. 1980. Revision of the sauries (Pisces, *Scomberesocidae*) with description of two new genera and one new species. Fishery Bulletin (77): 521–566.

Huff, D.D., S.T. Lindley, P.S. Rankin, and E.A. Mora. 2011. Green sturgeon physical habitat use in the coastal Pacific Ocean. PLoS ONE 6(9): e25156. doi: 10.1371/journal.pone.0025156.

Hunt, G.L. and M.W. Hunt. 1976. Exploitation of Fluctuating Food Resources by Western Gulls. The Auk 93: 301-307.

Hunt, G.L. Jr., H. Kato and S.M. McKinnell. 2000. Predation by marine birds and mammals in the subarctic North Pacific Ocean. PICES Scientific Report No. 14.

Hunt, S.L., T.J. Mulligan, and K. Komori. 1999. Oceanic feeding habits of Chinook salmon, *Onchorhynchus tshawytscha*, off northern California. Fishery Bulletin 97: 717-721.

Ilves, K.L. and E.B. Taylor. 2008. Evolutionary and biogeographical patterns within the smelt genus *Hypomesus* in the North Pacific Ocean. Journal of Biogeography 35: 48-64.

Industrial Economics, Inc. 2012. Identification of Outer Continental Shelf renewable energy space-use conflicts and analysis of potential mitigation measures. U.S. Department of the Interior, Bureau of Ocean Energy Management, Herndon, VA. OCS Study BOEM 2012-083. 414 pages. Available at http://www-csgc.ucsd.edu/BOOKSTORE/Resources/BOEM_Renewable_Energy_Space_Use_Conflicts_Report_for_CA.pdf

Irigoien, X., T.A. Klevjer, A Rostad, U. Martinez, G. Boyra, J.L. Acuna, A. Bode, F. Eschevarria, J.I. Gonzales-Gordilla, S. Hernandez-Leon, S. Agusti, D.L. Aksnes, C. Duarte and S. Kaartveti. 2014. Large mesopelagic fishes biomass and trophic efficiency in the open ocean. Nature Communications. Macmillan Publishers Ltd. Pages 1-10.

Johnson, A.G. and H.F. Horton. 1972. Length-Weight Relationship, Food Habits, Parasites, and Sex and Age Determination of the Ratfish, *Hydrolagus colliei* (Lay and Bennett). Fishery Bulletin 70: 421-429.

Jones, B.C. and G.H. Geen. 1977. Food and Feeding of Spiny Dogfish (*Squalus acanthias*) in British Columbia Waters. Journal of the Fisheries Research Board of Canada 34: 2067-2078.

Jorgensen, E.M. 2007. Identification, Distribution and Relative Abundance of Paralarval Gonatid Squids (*Cephalopoda: Oegopsida: Gonatidae*) from the Gulf of Alaska, 2001–2003. Journal of Molluscan Studies 73: 155–165.

Kaartvedt, S., A. Staby and D.L. Aksnes 2012. Efficient trawl avoidance by mesopelagic fishes causes large underestimate of their biomass. Marine Ecology Progress Series. Vol 456: 1-6.

Kao, J.S. 2000. Diet, Daily Ration and Gastric Evacuation of the Leopard Shark (*Triakis semifasciata*). M.S. Thesis, California State University, Hayward. 104 pages.

Kato, S. 1992. Pacific saury. Pages 199-201 *in* W.S. Leet, C.M. Dewees, and C.W. Haugen (eds.), California's living marine resources and their utilization. California Sea Grant Extension Publication UCSGEP-92-12, Davis, CA.

Kaeriyama, M., M. Nakamura, R. Edpalina, J.R. Bower, H. Yamaguchi, R.V. Walker, and K.W. Myers. 2004. Change in feeding ecology and trophic dynamics of Pacific salmon (*Oncorhynchus* spp.) in the central Gulf of Alaska in relation to climate events. Fisheries Oceanography 13: 197-207.

Kasamatsu, F. and S. Tanaka. 1991. Annual changes in prey species of minke whales taken off Japan 1948-87. Nippon Suisan Gakkaishi 58: 637-651.

Kawakami, T. 1980. A review of sperm whale food. Scientific Reports of the Whales Research Institute 32: 199-218.

Keitt, B.S., B.R. Tershy and D.A. Croll. 2003. Breeding biology and conservation of the Black-vented Shearwater *Puffinus opisthomelas*. Ibis 145: 673-680.

Ketchen, K.S. and C.R. Forrester. 1966. Population Dynamics of the Petrale Sole, *Eopsetta jordani*, in waters off western Canada. Fisheries Research Board of Canada Bulletin No. 153. 195 pages.

Kitagawa, M., T. Azumaya, K. Myers, and M. Kaeriyama. 2005. Spatial Comparison of the Feeding Ecology of Sockeye (*Oncorhynchus nerka)* and Pink Salmon (*O. gorbuscha*) in the Ocean during the Summer of 2003. North Pacific Anadromous Fish Commission Technical Report No. 6.

Kitaguchi, T. 1979. A taxonomic study of sand lances (genus *Ammodytes*) in the waters of the northern coast of Hokkaido, Japan. Scientific Reports of Hokkaido Fisheries Experimental Station 21:17-30.

Kock, K.H. 2000. Understanding CCAMLR approach to management. Commission for the Conservation of Antarctic Marine Living Resources. Hobart, Australia. 70 pages.

Kubodera, T., H. Watanabe, and T. Ichii. 2007. Feeding habits of the blue shark, *Prionace glauca*, and salmon shark, *Lamna ditropis*, in the transition region of the Western North Pacific. Reviews in Fish Biology and Fisheries 17: 111-124.

Laidig, T.E., P.B. Adams, and W.M. Samiere. 1997. Feeding Habits of Sablefish, *Anoplopoma fimbria*, off the Coast of Oregon and California. Pages 65-79 *in* M.S. Wilkins and M.W. Saunders (eds.), Biology and management of sablefish, *Anoplopoma fimbria*: Papers from the international symposium. U.S. Dept. Commer., NOAA Technical Report NMFS 130.

Lance, M. M. and S.J. Jeffries. 2009. Harbor seal diet in Hood Canal, South Puget Sound and the San Juan Island Archipelago. Contract Report to Pacific States Marine Fisheries Commission for Job Code 497; NOAA Award No. NA05NMF4391151. Washington Department of Fish and Wildlife, Olympa WA. 30 pages.

Lander, M.E., F.M.D. Gulland, and R.L. DeLong. 2000. Satellite tracking a rehabilitated Guadalupe fur seal (*Arctocephalus townsendi*). Aquatic mammals 26.2: 137-142.

Lang, G.M. and P.A. Livingston. 1986. Food habits of key groundfish species in the Eastern Bering Sea slope region. NOAA Technical Memorandum NMFS-AFSC-67. 112 pages.

LeBrasseur, R. J. 1966. Stomach Contents of Salmon and Steelhead Trout in the Northeastern Pacific Ocean. Journal of the Fisheries Research Board of Canada. 23: 85-100.

Light, J.T. 1985. Food and feeding of steelhead trout in the epipelagic waters of the North Pacific Ocean. (Document submitted to the annual meeting of the INPFC, Tokyo, Japan, November 1985.) Fisheries Research Institute, FRI—UW-85O7, University of Washington, Seattle. 25 pages.

Litzow, M.A., J.F. Piatt, A.A. Abookire, A.K. Prichard, and M.D. Robards. 2000. Monitoring temporal variability in sandeel (*Ammodytes hexapterus*) abundance with pigeon guillemot (*Cepphus columba)* diets. ICES Journal of Marine Science 57: 976-986.

London, J.M., M.M. Lance, and S.J. Jeffries. 2002. Observations of Harbor Seal Predation on Hood Canal Salmonids from 1998 to 2000. Contract Report to Pacific States Marine Fisheries Commission for Contract 02-15; NOAA Award No. NA17FX1603. Washington Department of Fish and Wildlife, Olympa WA. 20 pages.

López-Martinez, J., M. O. Nevárez-Martinez, R.E. Molina-Ocampo, and F.A. Manrique-Colchado. 1999. Overlap in the Type and Suze of the Prey that Compose the Diet of the Pacific Sardine *Sardinops caeruleus* (Girard, 1856), Thread Herring *Opisthonema libertate* (Gunther, 1867) and Northern Anchovy *Engraulis* mordax (Girard, 1856) in the Gulf of California. Ciencias Marinas 25: 541-556.

Love, M.S. 2011. Certainly More than You Want to Know About the Fishes of the Pacific Coast. Really Big Press, Santa Barbara. 650 pages.

Lowry, M.S. 2011. Photographic catalog of California marine fish otoliths: Prey of California sea lions (*Zalophus californianus*). U.S. Dept. Commer., NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-483.

Lynn, R. J., S.J. Bograd, T.K. Chereskin and A. Huyer. 2003. Seasonal renewal of the California Current: The spring transition off California. Journal of Geophysical Research: Oceans (1978–2012): 108(C8).

Macy, P.T., J.M. Wall, N.D. Lampsakis, J.E. Mason. 1978. Resources of non-salmonid pelagic fishes of the Gulf of Alaska and eastern Bering Sea. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Outer Continental Shelf Energy Assessment Program; part 1. 355 pages.

Mann, K.H. and J.R.N. Lazier. 1996. Dynamics of Marine Ecosystems. Blackwell: Cambridge. 496 pages.

Mantua, N. and R.C. Francis. 2004. Natural climate iInsurance for Pacific Northwest salmon and salmon fisheries: Finding our way through the entangled bank. American Fisheries Society Symposium 43: 121–134.

Mantua, N.J., S.R. Hare, Y. Zhang, J.M. Wallace and R.C. Francis. 1997. A Pacific interdecadal climate oscillation with impacts on salmon production. Bulletin of the American Meteorological Society 78(6): 1069-1079.

Mantua, N.J. and S.R. Hare. 2002. The Pacific Decadal Oscillation. Journal of Oceanography 58(1): 35-44.

Markaida, U. and F. Hochberg. 2005. Cephalopods in the Diet of Swordfish (*Xiphias gladius*) Caught off the West Coast of Baja California, Mexico. Pacific Science 59: 25-41.

Markaida, U. and O. Sosa-Nishizaki. 2010. Food and feeding habits of the blue shark *Prionace glauca* caught off Ensenada, Baja California, Mexico, with a review on its feeding. Journal of the Marine Biological Association of the United Kingdom 90: 977-994.

Martin K.L.M., Moravek C.L., Martin A.D., Martin R.D. 2011. Community based monitoring improves management of essential fish habitat for beach spawning California Grunion. Bayed A, editor. Sandy beaches and coastal zone management. Proceedings of the Fifth International Symposium on Sandy Beaches, 19th-23rd October 2009, Rabat, Morocco. Travaux de l'Institut Scientifique, Rabat, série générale, 2011, no. 6:65-72.

Martin, K.L.M. and D.L. Swiderski. 2001. Beach spawning in fishes: phylogenic tests of hypotheses. American Zoologist 41: 526-537.

McClatchie, S., R. Goericke, R. Cosgrove, G. Auad and R. Vetter. 2010. Oxygen in the Southern California Bight: Multidecadal trends and implications for demersal fisheries. Geophysical Research Letters 37(19).

Mecklenburg, C.W., T.A. Mecklenburg, and L.K. Thorsteinson. 2002. Fishes of Alaska. Betheseda: American Fisheries Society. 1037 pages.

Mendelssohn, R., F. B. Schwing, and S. J. Bograd. 2003. Spatial structure of subsurface temperature variability in the California Current, 1950-1993. Journal of Geophysical Research 108: doi:10.1029/2002JC001568.

Meyer, T.L., R.A. Cooper, and R.W. Langton. 1979. Relative Abundance, Behavior, and Food Haibts of the American Sand Lance, *Ammodytes Americanus*, from the Gulf of Maine. Fishery Bulletin 77: 243-253.

Miller, A.K. and W.J. Sydeman. 2004. Rockfish response to low-frequency ocean climate change as revealed by the diet of a marine bird over multiple time scales. Marine Ecology Progress Series 281: 207-216.

Miller, D. J. and R.N. Lea. 1972. Guide to the coastal marine fishes of California. California Department of Fish and Game Fish Bulletin 157. 235 pages.

Miller, T.W. and R.D. Brodeur. 2007. Diets of and trophic relationships among dominant marine nekton within the northern California Current ecosystem. Fishery Bulletin 105: 548-559.

Miller, T.W., R.D. Brodeur, G. Rau, and K. Omori. 2010. Prey dominance shapes trophic structure of the northern California Current pelagic food web: evidence from stable isotopes and diet analysis. Marine Ecology Progress Series 420: 15-26.

Miyahara, K., T. Ota, T. Goto, and S. Gorie. 2006. Age, growth and hatching season of the diamond squid *Thysanoteuthis rhombus* estimated from statolith analysis and catch data in the western Sea of Japn. Fisheries Research 80: 211-220.

Miyahara, T., T. Ota, N. Kohno, Y. Ueta, and J. Bower. 2005. Catch fluctuations of the diamond squid *Thysanoteuthis rhombus* in the Sea of Japan and models to forecast CPUE based on analysis of environmental factors. Fisheries Research 72:71-79.

Moore, S.E., K.M. Wynne, J.C. Kinney, and J.M. Grebmeier. 2007. Gray whale occurrence and forage southeast of Kodiak Island, Alaska. Marine Mammal Science 23: 419-428.

Moore, S. Commercial fisherman, telephone, September 2012. Personal communication with D. Wilson-Vandenberg regarding Pacific saury schooling and fishery initiation.

Morton, A. 2000. Occurrence, Photo-Identification and Prey of Pacific White-Sided Dolphins (*Lagenorhynchus obliquidens*) in the Broughton Archipelago, Canada 1984-1998. Marine Mammal Science 16: 80-93.

Moser, H.G. and Ahlstrom, E.H. 1974. Role of larval stages in systematic investigations of marine teleosts: The Myctophidae, a case study. Fisheries Bulletin 72(2): 391-413.

Moteki, M., M. Arai, K. Tsuchiya, and H. Okamoto. 2001. Composition of piscine prey in the diet of large pelagic fish in the eastern tropical Pacific Ocean. Fisheries Science 67: 1063-1074.

Nagasawa, K. and A. Nishimura. 1997. Myctophids in the Bering Sea: Distribution, abundance and significance as food for salmonids. Pages 357-350*in* Forage fishes in Marine Ecosystems. Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems. University of Alaska Sea Grant College Program. Report No. 97-01.

Nafpaktitis, B.G., R.H. Backus, J.E. Craddock, R. L. Haedrich, B. Robison and C. Karnella. 1997. The families *Neoscopelidae* and *Myctophidae*. Pages 1-265 *in* Part 7 of the Monograph Series, Fishes of the Western North Atlantic. Sears Foundation for Marine Research, New Haven: Yale University 1977.

National Marine Fisheries Service (NMFS). 2010. Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Northwest Training Range Complex on the Coasts of Northern California, Oregon, and Washington from February 2010 until February 2015. NMFS No. 2009/07443. 19 pages.

NMFS. 2012. California Current Integrated Ecosystem Assessment: Phase II. P. Levin and B. Wells (eds.) http://www.noaa.gov/iea/.

NMFS. 2013a. Federal Recovery Outline: Pacific Eulachon Southern Distinct Population Segment. 24 pages. Available at http://www.westcoast.fisheries.noaa.gov/publications/protected_species/other/eulachon/eulachon_recovery_outline_070113.pdf.

NMFS. 2013b. Groundfish Essential Fish Habitat Synthesis: A Report to the Pacific Fishery Management Council. NOAA NMFS Northwest Fisheries Science Center, Seattle, WA, April 2013. 107 pages. Available at http://swfsc.noaa.gov/publications/CR/2013/2013NMFS.pdf

NMFS. 2013c. Appendix to Groundfish Essential Fish Habitat Synthesis: A Report to the Pacific Fishery Management Council. NOAA NMFS Northwest Fisheries Science Center, Seattle, WA, April 2013. 378 pages. Available at http://swfsc.noaa.gov/publications/CR/2013/2013NMFS.pdf

NMFS. 2013d. Final Recovery Plan for the North Pacific Right Whale (*Eubalaena japonica*). National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD. 84 pages. Available at http://www.nmfs.noaa.gov/pr/recovery/plans/rightwhale_northpacific.pdf

National Marine Fisheries Service and United States Fish and Wildlife Service (NMFS and USFWS). 2012. Memorandum of Understanding Between the U.S. Department of Commerce and U.S. Department of Interior to promote the conservation of migratory bird populations. July 16, 2012. 17 pages. Available at http://www.fws.gov/migratorybirds/Partnerships/NMFS%20MOU.pdf

National Oceanic and Atmospheric Administration Administrative Order (NAO) 216-6. Department of Commerce. NOAA's agency policy and procedures for NEPA.

Naughton, M. B., D. S. Pitkin, R. W. Lowe, K. J. So, and C. S. Strong. 2007. Catalog of Oregon seabird colonies. U.S. Department of Interior, Fish and Wildlife Service, Biological Technical Publication FWS/BTP-R1009-2007, Washington, D.C.

Neilson, J.L. and C.M. Gabriele. 2008. Annual Progress Report: Results of Humpback Whale monitoring in Glacier Bay and adjacent waters: 2008. Glacier Bay National Park & Preserve, Division of Resource Management. 24 pages.

Nesis, K.N. 1997. Gonatid Squids in the Subarctic North Pacific: Ecology, Biogeography, Niche Diversity and Roles in the Ecosystem. Pages 243-324 *in* Blaxter, J., A. Southward, A. Gebruk, E. Southward, and P. Tyler (eds.), Advances in Marine Biology: The Biogeography of the Oceans. Academic Press, New York.

Newell, C.L. and T.J. Cowles. 2006. Unusual gray whale *Eschrichtius robustus* feeding in the summer of 2005 off the central Oregon Coast. Geophysical Research Letters 33, L22S11, doi:10.1029/2006GL027189, 2006. 5 pages.

Nigmatullin, C., A. A. Arkhipkin, R. Sabirov. 1995. Age, growth and reproductive biology of diamond-shaped squid *Thysanoteuthis rhombus* (Oegopsida: Thysanoteuthidae). Marine Ecology Progress Series 124: 73-87.

Office of National Marine Sanctuaries. 2014. Cordell Bank and Gulf of the Farallones National Marine Sanctuaries Expansion Draft Environmental Impact Statement. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries, Silver Spring, MD. Available at http://farallones.noaa.gov/manage/pdf/expansion/CBNMS-GFNMS_DEIS_2014web.pdf

Ohizumi, H., T. Kuramochi, T. Kubodera, M. Yoshioka and N. Miyazaki. 2003. Feeding habits of Dall's porpoise (Phocoenoides dalli) in the subarctic North Pacific and the Bering Sea basin and the impacts of predation on mesopelagic micronekton. Deep Sea Research Part I: Oceanographic Research Papers. Vol. 50, issue 5, pages 593-610.

Olson, R. and F. Galván-Magaña. 2002. Food habits and consumption rates of common dolphinfish (*Coryphaena hippurus*) in the eastern Pacific Ocean. Fishery Bulletin 100: 279-298.

Oozeki, Y., A. Takasuka, H. Kubota and M. Barange. 2007. Characterizing spawning habitats of Japanese sardine (*Sardinops melanostictus*), Japanese anchovy (*Engraulis japonicas*), and Pacific round herring (*Etrumeus teres*) in the northwestern Pacific. CalCOFI Reports 48: 191-203.

Oregon Administrative Rule (OAR) 635-004-0215. January 1, 2014. Definitions as used in Division 004 regulations.

OAR 635-004-0275. August 4, 2014. Groundfish scope, inclusion, and modification of rules.

OAR 635-004-0375. September 15, 2014. Coastal pelagic and smelt species scope, inclusion, and modification of rules.

OAR 635-004-0545. July 1, 2012. Smelt fishery prohibitions.

OAR 635-004-0555. July 1, 2012. Highly migratory species scope, inclusion, and modification of rules.

OAR 635-006-0210. January 1, 2014. Fish receiving ticket regulations for all fish.

Orlov, A. 2007. Some Data on the Distribution and Biology of the Boreal Clubhook Squid *Moroteuthis robusta* (Verrill, 1876)(Onychoteuthidae, Teuthida) in the Northwest Pacific. Pages 423-433 *in* Landman, N, R. Davis, and R. Mapes (eds.) Cephalopods Present and Past: New Insights and Fresh Perspectives. Springer: Netherlands.

Orr, A.J., A.S. Banks, S. Mellman, H.R. Huber, R.L. DeLong, and R.F. Brown. 2004. Examination of the foraging habits of Pacific harbor seal (*Phoca vitulina richarsi*) to describe their use of the Umpqua River, Oregon, and their predation on salmonids. Fishery Bulletin 102: 108-117.

Ostrand, W.D., T.A. Gotthardt., S. Howlin, and M. Robards. 2005. Habitat Selection Models for Pacific Sand Lance (*Ammodytes hexapterus*) in Prince William Sound, Alaska. Northwestern Naturalist 86: 131-143.

Pacific Fishery Management Council (PFMC). 1998. Amendment 8: (To the northern anchovy fishery management plan) incorporating a name change to: The Coastal Pelagic Species Fishery Management Plan. Available at http://www.pcouncil.org/wp-content/uploads/cpsa8_apdx_a.pdf

PFMC. 2000. Identification and description of essential fish habitat, adverse impacts, and recommended conservation measures for salmon. Appendix A to Amendment 14, Pacific Coast Salmon Fishery Management Plan. Available at http://www.pcouncil.org/wp-content/uploads/99efh2.pdf

PFMC. 2003. Appendix F to the U.S. West Coast Highly Migratory Species Fishery Management Plan: Life History Accounts and Essential Fish Habitat Descriptions. Available at http://www.pcouncil.org/wp-content/uploads/HMS_AppF.pdf

PFMC. 2005a. Amendment 19 to the Pacific Coast Groundfish Fishery Management Plan. Pacific Fishery Management Council, Portland, Oregon (November). Available at http://www.pcouncil.org/wp-content/uploads/A18-19Final.pdf

PFMC. 2005b. Appendix B, Part 2, to the Pacific Coast Groundfish Fishery Management Plan for the California, Oregon and Washington Groundfish Fishery: General Life History Descriptions. Available at http://www.pcouncil.org/wp-content/uploads/GF_FMP_App_B2.pdf

PFMC. 2011a. Status of the Pacific Coast Coastal Pelagic Species Fishery and Recommended Acceptable Biological Catches: Stock Assessment and Fishery Evaluation. 85 pp, plus appendices. Available at http://www.pcouncil.org/coastal-pelagic-species/stock-assessment-and-fishery-evaluation-safe-documents/

PFMC. 2011b. Amendment 13 to the Coastal Pelagic Species Fishery Management Plan: Address Revised National Standard 1 Guidelines (Environmental Assessment and Regulatory Impact Review Included). 63 pages. Available at http://www.pcouncil.org/wp-content/uploads/Amendment_13_EA_FINAL.pdf

PFMC. 2013. Pacific Coast Fishery Ecosystem Plan for the U.S. Portion of the California Current Large Marine Ecosystem. Available at http://www.pcouncil.org/ecosystem-based-management/fep/

PFMC. 2014a. Ecosystem Initiative 1: Protecting Unfished and Unmanaged Forage Fish Species of the U.S. Portion of the California Current Large Marine Ecosystem. Agenda Item I.1.a, Attachment 1, April 2014. 50 pages.

PFMC. 2014b. Trawl Rationalization Trailing Actions: Chafing Gear Environmental Assessment. 189 pages. http://www.westcoast.fisheries.noaa.gov/publications/nepa/groundfish/misc_ea/chafing-ea-final.pdf

PFMC. 2015. Harvest Specifications and Management Measures for 2015-2016 and Biennial Periods Thereafter: Final Environmental Impact Statement. 1089 pages. Available at http://www.westcoast.fisheries.noaa.gov/publications/nepa/groundfish/1516spexfeis.pdf

Parrish, R.H., C.S. Nelson and A. Bakun. 1981. Transport mechanisms and reproductive success of fishes in the California Current. Biological Oceanography 1(2): 175-203.

Paxton, J.R and W.N. Eschmeyer, editors. 1998. Encyclopedia of fishes. Academic Press, San Diego, CA. 260 pages.

Pearcy, W.G. 1972. Albacore Oceanography off Oregon – 1970. Fishery Bulletin 71: 489-504.

Pearcy. W.G. 1977. Variations in abundance of sound scattering animals off Oregon. Pages 647–666 *in* Andersen, N.R. and B.J. Zahuranec (eds.), Oceanic sound scattering prediction. Plenum Press, New York.

Pearcy, W.G., Brodeur, R.D., Shenker, J.M., Smoker, W.W. and Y. Endo. 1988. Food habits of Pacific salmon and steelhead trout, midwater trawl catches and oceanographic conditions in the Gulf of Alaska, 1980–1985. Bulletin of the Ocean Research Institute 26: 29–78.

Pearcy, W.G. and D. Hancock. 1978. Feeding Habits of Dover Sole, *Microstomus pacificus*; Rex Sole, *Glyptocephalus zachirus*; Slender sole, *Lyopsetta exilis*; and Pacific sanddab, *Citharichthys sordidus*, in a Region of Diverse Sediments and Bathymetry off Oregon. Fishery Bulletin 76: 641-651.

Penttila, D. 2007. Marine Forage Fishes in Puget Sound. Washington Department of Fish and Wildlife Technical Report 2007-03. 24 pages.

Pereyra, W.T., F.E. Carvey Jr. and W.G. Pearcy. 1969. *Sebastodes flavidus*, a shelf rockfish feeding on mesopelagic fauna, with consideration of the ecological implications. Journal of the Fisheries Research Board of Canada, 1969, 26(8): 2211-2215.

Pinkas, L., M. Oliphant, and I. Iverson. 1971. Food Habits of Albacore, Bluefin Tuna, and Bonito in California Waters. California Department of Fish and Game Fish Bulletin 152. Available at http://content.cdlib.org/view?docId=kt8290062w&brand=calisphere&doc.view=entire_text.

Pinto, J. M., W. H. Pearson, and J. W. Anderson. 1984. Sediment preferences and oil contamination in the Pacific sand lance *Ammodytes hexapterus*. Marine Biology 83: 193-204.

Pitman, R.L., W.A. Walker, W.T. Everett, and J.P. Gallo-Reynoso. 2004. Population, status, foods and foraging of Laysan albatrosses *Phoebastria immutabilis* nesting on Guadalupe Island, Mexico. Marine Ornithology 32: 159-165.

Pool, S.S., R.D. Brodeur, N.L. Goodman, and E.A. Daly. 2008. Abundance, distribution, and feeding patterns of juvenile coho salmon (*Oncorhyncus kisutch*) in the Juan de Fuca Eddy. Estuarine, Coastal and Shelf Science 80: 85-94.

Preti, A., S. Smith, and D. Ramon. 2001. Feeding Habits of the Common Thresher Shark (*Alopias vulpinus*) Sampled from the California-Based Drift Gill Net Fishery, 1998-1999. CalCOFI Reports 42: 145-152.

Preti A., C.U. Soykan, H. Dewar, R.J. David Wells, N. Spear, S. Kohin. 2012. Comparative feeding ecology of shortfin mako, blue and thresher sharks in the California Current. Environ Biol Fish 95:127-146.

Quast, J. C. 1968. Observations on the food of the kelp-bed fishes. Pages 109-142 *in* North, W. J. and C. L. Hubbs (eds.), Utilization of kelp-bed resources in southern California. California Department of Fish and Game Fish Bulletin 139.

Quinn, T. 1999. Habitat Characteristics of an Intertidal Aggregation of Pacific Sandlance (*Ammodytes hexapterus*) at a North Puget Sound Beach in Washington. Northwest Science 73: 44-49.

Quinn, T., B. Miller, R. Wingert. 1980. Depth Distribution and Seasonal and Diel Movements of Ratfish, *Hydrolagus colliei*, in Puget Sound, Washington. Fishery Bulletin 78: 816-821.

Reeves, Randall R., P.J. Clapham, R.L. Brownell, Jr., and G.K. Silber. 1998. Recovery Plan for The Blue Whale (*Balaenoptera musculus*). Publications, Agencies and Staff of the U.S. Department of Commerce: Paper 118. 39 pages. Available at http://digitalcommons.unl.edu/usdeptcommercepub/118

Rice, C.A. 2006. Effects of Shoreline Modification on a Northern Puget Sound Beach: Microclimate and Embryo Mortality in Surf Smelt (*Hypomesus pretiosus*). Estuaries and Coasts 29: 63-71.

Richards, S.W. 1965. Description of the postlarvae of the sand lance (*Ammodytes*) from the east coast of North America. Journal of the Fisheries Research Board of Canada 22(5): 1313-1317.

Riemer, S.D., B.E. Wright, and R.F. Brown. 2011. Food habits of Steller sea lions (*Eumetopias jubatus*) off Oregon and northern California, 1986-2007. Fishery Bulletin 109: 109-369.

Robards, M.D. and J.F. Piatt. 1999. Biology of the Genus *Ammodytes*, the Sand Lances. Pages 1-16 *in* Robards, M.D., M.F. Willson, R.H. Armstrong, and J.F. Piatt (eds.), Sand Lance: A Review of Biology and Predator Relations and Annotated Bibliography. U.S. Department of Agriculture Forest Service Research Paper PNW-RP-521.

Robards, M.D., J.A. Anthony, G.A. Rose, and J.F. Piatt. 1999a. Changes in proximate composition and somatic energy content for Pacific sand lance (*Ammodytes hexapterus*) from Kachemak Bay, Alaska relative to maturity and season. Journal of Experimental Marine Biology and Ecology 242: 245-258.

Robards, M.D., J.A. Anthony, J.F. Piatt, and G.A. Rose. 1999b. Maturation, fecundity, and intertidal spawning of Pacific sand lance in the northern Gulf of Alaska. Journal of Fish Biology 54: 1050-1068.

Robards, M.D., G.A. Rose, and J.F. Piatt. 2002. Growth and abundance of Pacific sand lance, *Ammodytes hexapterus*, under differing oceanographic regimes. Environmental Biology of Fishes 64: 429-441.

Robertson, I. 1974. The Food of Double-Crested and Pelagic Cormorants at Mandarte Island, British Columbia, with Notes on Feeding Ecology. The Condor 76: 346-348.

Robinson, C.L.K., D. Hrynyk, J.V. Barrie, and J. Schweigert. 2013. Identifying subtidal burying habitat of Pacific sand lance (*Ammodytes hexapterus*) in the Strait of Georgia, British Columbia, Canada. Progress in Oceanography 115: 119-128.

Robinson, H. J., G.M. Cailliet, and D.A. Ebert. 2007. Food habits of the longnose skate, *Raja rhina* (Jordan and Gilbert 1880), in central California waters. Environmental Biology of Fishes 80: 165-179.

Roby, D.D., K. Collis, and D.E. Lyons. 2003. Conservation and Management for Fish-Eating Birds and Endangered Salmon. USDA Forest Service General Technical Report PSW-GTR-191. 5 pages.

Rose, G.A. 2005. Capelin (*Mallotus villosus*) distribution and climate: a sea “canary” for marine ecosystem change. ICES Journal of Marine Science 62: 1524-1530.

Rosenfeld, J.A. and R.D. Baxter. 2007. Population dynamics and distribution patterns of longfin smelt in the San Francisco Estuary. Transactions of the American Fisheries Society 136: 1577-1592.

Roth, J.E., N. Nur, P. Warzybok, and W.J. Sydeman. 2008. Annual prey consumption of a dominant seabird, Common Murre, in the California Current. Research Final Reports, California Sea Grant College Program, UC San Diego. 13 pages.

Roth, J.E., W.J. Sydeman, and P.L. Martin. 2005. Xantus’s Murrelet Breeding Relative to Prey Abundance and Oceanographic Conditions in the Southern California Bight. Marine Ornithology 33: 115-121.

Ruggerone, G.T. and J.L. Nielsen. 2004. Evidence for competitive dominance of Pink salmon (*Oncorhynchus gorbuscha*) over other Salmonids in the North Pacific Ocean. Reviews in Fish Biology and Fisheries 14: 371-390.

Scavia, D., J.C. Field, D.F. Boesch, R.W. Buddemeier, D.R. Cayan, V. Burkett, M. Fogarty, M. Harwell, R. Howarth, C. Mason, D.J. Reed, T.C. Royer, A.H. Sallenger, and J.G. Titus. 2002. Climate change impacts on U.S. coastal and marine ecosystems. Estuaries 25: 149-164.

Schabetsberger, R., C.A. Morgan, R.D. Brodeur, C.L. Potts, W.T. Peterson, and R.L. Emmett. 2003. Fisheries Oceanography 12: 523-540.

Schwing, F.B. and R. Mendelssohn. 1997. Increased coastal upwelling in the California Current system. Journal of Geophysical Research 102: C2: 3421. doi:10.1029/96JC03591

Sedberry, G.R. and J.A. Musick. 1978. Feeding Strategies of Some Demersal Fishes of the Continental Slope and Rise off the Mid-Atlantic Coast of the USA. Marine Biology 44: 357-375.

Shamshak, G.L. and J. L. Anderson. 2008. Future aquaculture feeds and feed costs: the role of fish meal and fish oil. Pages 73-96 *in* Rubino, M. (ed.), Offshore Aquaculture in the United States: Economic Considerations, Implications & Opportunities. U.S. Dept. of Commer., NOAA Technical Memorandum NMFS F/SPO-103.

Sherr, E.B., B.F. Sherr and P.A.Wheeler. 2005. Distribution of coccoid cyanobacteria and small eukaryotic phytoplankton in the upwelling ecosystem off the Oregon coast during 2001 and 2002. Deep Sea Research II 52(1): 317-330.

Shimose, T., H. Watanabe, T. Tanabe, and T. Kubodera. 2013. Ontogenetic diet shift of age-0 year Pacific bluefin tuna *Thunnus orientalis*. Journal of Fish Biology 82: 263-276.

Smith, J.W. 1994. Biology and Fishery for Atlantic Thread Herring, *Opisthonema oglinum*, along the North Carolina Coast. Marine Fisheries Review 56: 1-7.

Smithsonian Tropical Research Institute (STRI). 2013. Shorefishes of the Eastern Pacific online information system.

Song, K-J, and C.I. Zhang. 2014. Stomach contents of bycaught minke whales (*Baleanoptera acutorostrata*) in Korean waters. Marine Biology Research 10: 400-406.

Stiassny, M.L.J. 1997. Myctophidae. Lanternfishes. Version 01 January 1997 (under construction). http://tolweb.org/Myctophidae/15174/1997.01.01 in The Tree of Life Web Project, http://tolweb.org/. Accessed 21 October 2014.

Strong, C.S. 2010. Population and Productivity Monitoring of Marble Murrelets in Oregon During 2009. Final Report to the U.S. Fish and Wildlife Service, Cooperative Agreement no. 13420-9-J901. Oregon State Office, Portland OR. 15 pages.

Stroud, R.K., C.H. Fiscus, and H. Kajimura. 1981. Food of the Pacific white-sided dolphin, *Lagenorhynchus obliquidens*, Dall's porpoise, *Phocoenoides dalli*, and northern fur seal, *Callorhinus ursinus*, off California and Washington. Fishery Bulletin 78: 951-959.

Suntsov, A.V, and R.D. Brodeur. 2008. Trophic ecology of three dominant myctophid species in the northern California Current region. Marine Ecology Progress Series 373: 81-96.

Tacon, A.G.J. and M. Metian. 2008. Global overview on the use of fish meal and fish oil in industrially compounded aquafeeds: Trends and future prospects. Aquaculture 285, 146–158.

Talent, L.G. 1984. Food Habits of Wintering Brandt's Cormorants. The Wilson Bulletin 96: 130-134.

Tamura, T. and Y. Fujise. 2002. Geographical and seasonal changes of the prey species of minke whale in the Northwestern Pacific. ICES Journal of Marine Science 59: 516-528.

Thayer, J., D. F. Bertram, S.A. Hatch, M.J. Hipfner, L. Slater, W.J. Sydeman, and Y. Watanuki. 2008. Forage fish of the Pacific Rim as revealed by diet of a piscivorous seabird: synchrony and relationships with sea surface temperature. Canadian Journal of Fisheries and Aquatic Sciences 65: 1610-1622.

Therriault, T.W., D.E. Hay, and J.F. Schweigert. 2009. Biological overview and trends in pelagic forage fish abundance in the Salish Sea (Strait of Georgia, British Columbia). Marine Ornithology 37: 3-8.

Thomas, G.L., J. Kirsch, and R.E. Thorne. 2002. Ex Situ Target Strength Measurements of Pacific Herring and Pacific Sand Lance. North American Journal of Fisheries Management 22: 1136-1145.

Thompson, C.W., E. R. Donelan, M. M. Lance and A. E. Edwards. 2002. Diet of Caspian Terns in Commencement Bay, Washington. Waterbirds: The International Journal of Waterbird Biology 25: 78-85.

Tinus, C.A. 2012. Prey preference of lingcod (*Ophiodon elongatus*), a top marine predator: implications for ecosystem-based fisheries management. Fishery Bulletin 110: 193-204.

Tissot, B.N., M.M. Yoklavich, M.S. Love, K. York, and M. Amend. 2006. Benthic invertebrates that form habitat on deep banks off southern California, with special reference to deep sea corals. Fishery Bulletin 104: 167-181.

Tsarin, S.A. 1997. Myctophids of the sound scattering layer and their place in pelagic food webs. In: Forage Fishes in Marine Ecosystems, pp 271-275. Alaska Sea Grant College Program Report. Fairbanks, AK.

Tsuchiya, K., H. Okamoto, and Y. Uozumi. 1998. Cephalopods eaten by pelagic fishes in the tropical East Pacific, with special reference to the feeding habitat of pelagic fish. La mer 36: 57-66.

Tsuchiya, K. and T. Okutani. 1991. Growth stages of *Moroteuthis robusta* (Verrill, 1881) with the re-evaluation of the genus. Bulletin of Marine Science 49: 137-147.

Tseng, C, N. Su, C. Sun, A.E. Punt, S. Yeh, D. Liu and Wei Su. 2013. Spatial and temporal variability of the Pacific saury (*Cololabis saira*) distribution in the northwestern Pacific Ocean. ICES Journal of Marine Science:70(5):991-999.

Tyler, H.R., Jr. and W.G. Pearcy. 1975. The feeding habits of three species of lanternfishes (family *Myctophidae*) off Oregon, USA. Marine Biology. 32: 7–11.

U.S. Code of Federal Regulations. Title 40 Part 1500-1508. July 1, 2011.

U.S. Code of Federal Regulations. Title 40 Part 1508.7. July 1, 2012.

U.S. Code of Federal Regulations. Title 50 Part 600.310. October 1, 2012.

U.S. Code of Federal Regulations. Title 50, Part 600.725(v). October 1, 2012.

U.S. Code of Federal Regulations. Title 50, Part 600.747(c)(2)(i). October 1, 2007.

U.S. Code of Federal Regulations. Title 50, Part 600.810. October 1, 2012.

U.S. Code of Federal Regulations. Title 50, Part 600.930. October 1, 2013.

U.S. Code of Federal Regulations. Title 50, Part 660.76. October 1, 2013.

United States Fish and Wildlife Service (USFWS). 1983. California Brown Pelican Recovery Plan. Portland, OR. 179 pages. Available at http://www.fws.gov/ecos/ajax/docs/recovery_plan/830203b.pdf

USFWS. 1985. Revised California Least Tern Recovery Plan. Portland, OR. 100 pages. Available at http://ecos.fws.gov/docs/recovery_plan/850927_w%20signature.pdf

USFWS. 1996. Recovery Plan for the Sacramento/ San Joaquin Delta Native Fishes. Portland, OR. 195 pages. Available at http://ecos.fws.gov/docs/recovery_plan/961126.pdf

USFWS. 1997. Recovery Plan for the Marbled Murrelet. Portland, OR, 286 pages. Available at http://www.fws.gov/wafwo/species/Fact%20sheets/USFWS%20Recovery%20Plan%201997.pdf

USFWS. 2005. Regional Seabird Conservation Plan, Pacific Region. Migratory Birds and Habitat Program, Pacific Region, Portland OR. 262 pages. Available at http://www.fws.gov/pacific/migratorybirds/PDF/Seabird%20Conservation%20Plan%20Complete.pdf

USFWS. 2008a. Short-tailed Albatross Recovery Plan. Anchorage, AK, 105 pages. Available at http://www.fws.gov/alaska/fisheries/endangered/pdf/stal_recovery_plan.pdf

USFWS. 2008b. Birds of Consevation Concern 2008. Arlington, Virginia. 85 pages. Available at http://www.fws.gov/migratorybirds/NewReportsPublications/SpecialTopics/BCC2008/BCC2008.pdf

USFWS. 2013. Species assessment and listing priority assignment form for delta smelt (*Hypomesus transpacificus*). 33 pages. Available at https://ecos.fws.gov/docs/species/uplisting/doc4320.pdf

USFWS. 2014. Southern Sea Otter (*Enhydra lutris nereis*) Stock Assessment Report. USFWS, Ventura, CA. 14 pages. Available at http://www.fws.gov/ventura/docs/species/sso/SSO%20Final%20SAR%202014%201-22.pdf

USFWS and NMFS. 2014. Endangered Species Act Section 7 Consultation Programmatic Biological Opinion on the United States Environmental Protection Agency's Issuance and Implementation of the Final Regulations Section 316(b) of the Clean Water Act. 339 pages. http://water.epa.gov/lawsregs/lawsguidance/cwa/316b/upload/Final-316b-Biological-Opinion-and-Appendices-May-19-2014.pdf

Valinassab, T., Pierce, G.J. and K. Johannesson. 2007. Lantern fish (*Benthosema pterotum*) resources as a target for commercial exploitation in the Oman Sea. Journal of Applied Ichthyology. Vol. 23, pages 573-577.

Valle, C. Sr. Environmental Scientist Supervisor, California Department of Fish and Wildlife, telephone, April 2013. Personal communication with D. Wilson-Vandenberg regarding albacore tuna bycatch.

Vandepeer, F and D.A. Methven. 2007. Do bigger fish arrive and spawn at the spawning grounds before smaller fish: Cod (*Gadus morhua*) predation on beach spawning capelin (*Mallotus villosus*) from coastal Newfoundland. Estuarine, Coastal and Shelf Science 71: 391-400.

Vermeer, K. 1980. The Importance of Timing and Type of Prey to Reproductive Success of Rhinoceros Auklets, *Cerorhinca monocerata*. Ibis 122: 343-350.

Vermeer, K. 1982. Comparison of the diet of the glaucous-winged gull on the east and west coasts of Vancouver Island. The Murrelet 63: 80-85.

Vipin, P.M., R. Ravi, T.J. Fernandez, K. Pradee, R.M. Boopendranath, and M.P. Remesan. 2011. Distribution of Myctophid resources in the Indian Ocean. Reviews in Biology and Fisheries. DOI: 10.1007/s11160-011-9244-4 Vol. 22, issue 2, pages. 423-436.

Voss, N. A. 1980. A Generic Revision of the Cranchidae (Cephalopoda: Oegopsida). Bulletin of Marine Science 30: 365-412.

Voss, N. A., K.N. Nesis, and P.G. Rodhouse. 1998. The Cephalopod Family Histioteuthidae (Oegopdida): Sytematics, Biology, and Biogeography. Pages 293-372 *in* Voss, N.A., M. Vecchione, R.B. Toll, and M. J. Sweeney (eds.), Systematics and Biogeography of Cephalopods. Smithsonian Institution Press, Washington, D.C., USA.

Walker W.A., Leatherwood, J.S., Goodrich, K.R., Perrin, W .F., and Stroud, R.K. 1986. Geographical variation and biology of the Pacific white-sided dolphin, *Lagenorhynchus obliquidens*, in the north-eastern Pacific. Pages 441-465 *in* Bryden, M. and R. Harrison (eds.), Research on dolphins. Oxford University Press, Oxford, U.K.

Walker, W.A., M.B. Hanson, R.W. Baird and T.J. Guenther. 1998. Food habits of the harbor porpoise, *Phocoena phocoena*, and Dall's porpoise, *Phocoenoides dalli*, in the inland waters of British Columbia and Washington. Pages 63-75 *in* Marine Mammal Protection Act and Endangered Species Act Implementation Program 1997. AFSC Processed Report 98-10

Walker, W.A., J.G. Mead, R. L. Brownell, Jr. 2002. Diets of Baird's Beaked Whales, *Berardius bairdii*, in the Southern Sea of Okhotsk and off the Pacific Coast of Honshu, Japan. Marine Mammal Science 18: 902-919.

Wang, J.C.S. 1986. Fishes of the Sacramento-San Joaquin Estuary and adjacent waters, California: A guide to the early life histories. Interagency Ecological Study Program for the Sacramento-San Joaquin Estuary, Technical Report 9.

Waples, R. 1991. Definition of "Species" Under the Endangered Species Act: Application to Pacific Salmon. NOAA Technical Memorandum NMFS F/NWC-194. Available at http://www.nwfsc.noaa.gov/publications/scipubs/techmemos/tm194/waples.htm.

Washington Department of Fish and Wildlife (WDFW). 1998. Forage Fish Management Policy, Goals and Plan (POL-C3012). Available at http://wdfw.wa.gov/commission/policies/c3012.html

Watanabe, H., T. Kubodera, T. Ichii, and S. Kawahara. 2004a. Feeding habits of neon flying squid *Ommastrephes bartramii* in the transitional region of the central North Pacific. Marine Ecology Progress Series 266: 173-184.

Watanabe, H., T. Kubodera, S. Masuda, and S. Kawahara. 2004b. Feeding habits of albacore *Thunnus alalunga* in the transitional region of the central North Pacific. Fisheries Science 70: 573-579.

Watanabe, H. T. Kubodera, M. Moku, and K. Kawaguchi. 2006. Diel vertical migration of squid in the warm core ring and cold water masses in the transition region of the western North Pacific. Marine Ecology Progress Series 315:187-197.

Watanabe, H., T. Kubodera, and K. Yokawa. 2009. Feeding ecology of the swordfish *Xiphias gladius* in the subtropical region and transition zone of the western North Pacific. Marine Ecology Progress Series 396: 111-122.

Watson, W. and E.M. Sandknop. 1996. *Clupeidae*: herrings. Pages 159-171*in* H.G. Moser (ed.), The early stages of fishes in the California Current Region. CalCOFI Atlas 33. Allen Press, Inc. 1505 pages.

Wehle, D.H.S. 1982. Food of Adult and Subadult Tufted and Horned Puffins. The Murrelet 63: 51-58.

Weise M.J. and J.T. Harvey. 2008. Temporal variability in ocean climate and California sea lion diet and biomass consumption: implications for fisheries management. Marine Ecology Progress Series 373: 157–172.

West, J.E. 1997. Protection and Restoration of Marine Life in the Inland Waters of Washington State. Puget Sound/Georgia Basin Environmental Report Series: Number 6. 144 pages. Available at http://dfw.wa.gov/publications/01035/wdfw01035.pdf

Whitehead, P.J.P. 1985. FAO species catalogue Vol. 7. Clupeoid fishes of the world. An annotated and illustrated catalogue of the herrings, sardines, pilchards, sprats, anchovies and wolfherrings. Part I *Chirocentridae*, *Clupeidae* and *Pristagasteridae*. PAO Fish Synopsis (125)Vol. 7, Pt.1: 303 pages.

Whitmire, C.E. and Clarke M.E. 2007. State of Deep Coral Ecosystems of the U.S. Pacific Coast: California to Washington. Pages 109-154 *in* S.E. Lumsden, Hourigan T.F., Bruckner A.W. and Dorr G. (editors) The State of Deep Coral Ecosystems of the United States. NOAA Tech. Memo., CRCP-3, Silver Spring, MD 365 pages. http://coris.noaa.gov/activities/deepcoral_rpt/Chapter3_PacificCoast.pdf

Wilson, M.T. 2009. Ecology of small neritic fishes in the western Gulf of Alaska. I. Geographic distribution in relation to prey density and the physical environment. Marine Ecology Progress Series 392: 223-237.

Wilson, P.R. 1985. Seasonality in diet and breeding success of the Jackass Penguin *Spheniscus demersus*. Journal of Ornithology 126: 53-62.

Willson, M.F., R.H. Armstrong, M.D. Robards, and J.F. Piatt. 1999. Sand Lance as Cornerstone Prey for Predator Populations. Pages 17-44 *in* Robards, M.D., M.F. Willson, R.H. Armstrong, and J.F. Piatt (eds.), Sand Lance: A Review of Biology and Predator Relations and Annotated Bibliography. U.S. Department of Agriculture Forest Service Research Paper PNW-RP-521.

Witteveen, B.H., R.J. Foy, K.M. Wynne, and Y. Tremblay. 2008. Investigation of foraging habits and prey selection by humpback whales (*Megaptera novaeangliae*) using acoustic tags and concurrent fish surveys. Marine Mammal Science 24: 516-534.

Xinjun, C., C. Yong, T. Siquan, L. Bilin, and Q. Weiguo. 2008. An assessment of the west winter-spring cohort of neon flying squid (*Ommastrephes bartramii*) in the Northwest Pacific Ocean. Fisheries Research 92: 221-230.

Yang, M-S., and M. W. Nelson. 2000. Food habits of the commercially important groundfishes in the Gulf of Alaska in 1990, 1993, and 1996. U. S. Dep. Commer., NOAA Technical Memorandum NMFS-AFSC-112, 174 pages.

Yatsu, A., S. Midorikawa, T. Shimada, and Y. Uozumi. 1997. Age and growth of the neon flying squid (*Ommastrephes bartramii*) in the North Pacific Ocean. Fisheries Research 291: 257-270.

Yeh, S.W., J.S. Kug, B. Dewitte, M.H. Kwon, B.P. Kirtman and F.F. Jin. 2009. El Niño in a changing climate. Nature 461: 511-U70.

Zeppelin, T.K. and R.R. Ream. 2006. Foraging habitats based on the diet of female northern fur seals (*Callorhinus ursinus*) on the Pribilof Islands, Alaska. Journal of Zoology 270:565-576.

Zertuche-Gonzales, J.A., O. Sosa-Nishizaki, J.G.V. Rodriguez, R.M. Simanek and C. Yarish. 2008. Marine science assessment of capture-based tuna (Thunnus orientalis) aquaculture in the Ensenada region of northern Baja California, Mexico. Publications. Paper 1. Available at http://digitalcommons.uconn.edu/ecostam_pubs/1

Zylinsky, S. and S. Johnsen. 2014. Visual cognition in deep-sea cephalopods: what we don't know and why we don't know it. Pages 223-243 *in* Darmaillacq, A.-S., L. Dickel, and J. Mather (eds.), Cephalopod Cognition. Cambridge University Press, UK.

# Appendix

At its April 2013 meeting, the Council adopted its FEP and FEP appendix. The FEP appendix considers a series of potential cross-FMP ecosystem-based management initiatives that the Council could consider for future action. This document discusses initial alternatives and provides background information in support of FEP Initiative 1: Protecting Unfished and Unmanaged Forage Fish Species. As discussed in Chapter 2, Alternatives, the FEP appendix provides the Council's policy on the development of new fisheries for unfished species within the U.S. West Coast EEZ. That policy is found at Section A.1.1 of the FEP Appendix and is repeated here for reference:

### *A.1.1 Council Policy on the Development of New Fisheries for Unfished Species*

*Under Title II of the MSA, there is no allowable level of foreign fishing for species currently unfished within the U.S. West Coast Exclusive Economic Zone (EEZ). Fishing vessels and fish processors of the U.S. have the capacity to harvest and process the levels of optimum yield of all species subject to Council FMPs.*

*U.S. citizens wishing to initiate new fisheries for West Coast EEZ species that are not subject to Council FMPs, nor explicitly permitted by the list of fisheries described in the Magnuson-Stevens Fishery Conservation and Management Act (MSA) at 16 U.S.C. §1855 and in federal regulations at 50 CFR 600.725(v), are urged to approach the Council with an application for an Exempted Fishing Permit (EFP,) accompanied by a science plan for that EFP fishery, describing the data to be collected by the EFP fishery and the likely analyses needed to assess the potential effects of converting the fishery to an FMP fishery over the long-term. EFP fishery data and analyses should, at a minimum, assess: the amount and type of bycatch species associated with the EFP gear, including protected species, such as marine mammals, sea turtles, sea birds, or species listed as endangered or threatened under the Endangered Species Act (ESA); how the gear will be deployed and fished, and its potential effects on EFH, including the portions of the marine environment where the gear will be deployed (surface, midwater, and bottom). The Council and its advisory bodies will review the results of the EFP to assess whether the information provided is adequate to determine the potential effects of the fishery on the Council's conservation and management measures. Depending on the quality of information received, and on the potential effects of the fishery on the Council's conservation and management measures, the Council will either reissue the EFP, or discontinue the EFP and initiate development of an FMP, FMP amendment, or regulatory amendment process to either prohibit the new fishery from the EEZ, or introduce the new fishery to the EEZ.*

*U.S. citizens wishing to bypass the EFP process to initiate new fisheries for West Coast EEZ species that are not subject to Council FMPs, nor explicitly permitted by the list of fisheries described in the MSA at 16 U.S.C. §1855 and in federal regulations at 50 CFR 600.725, may do so by following the Council notification process described at 50 CFR 600.747. However, that notification is required to be reviewed by the Council and NMFS for the potential effects of new fisheries on the Council's conservation and management measures for, at a minimum, FMP species, protected species, and for the habitat of managed and protected species. A review conducted in the absence of the scientific data that could be provided by an EFP would be necessarily precautionary.*

*Whether introduced via the EFP process, or via the notification process at 50 CFR 600.747, the Council would view new fisheries as having the potential to affect its conservation and management measures if those fisheries had an effect on:*

- *Any Council-managed species;*
- *Species that are the prey of any: Council-managed species, marine mammal species, seabird species, sea turtle species, or other ESA-listed species;*
- *Habitat that is identified as EFH or otherwise protected within one of the Council's FMPs, critical habitat identified or protected under the ESA, or habitat managed or protected by state or tribal fishery or habitat management programs;*
- *Species that are subject to state or tribal management within 0-3 miles offshore of Washington, Oregon, or California;*
- *Species that migrate beyond the U.S. EEZ.*