CHANGES TO GROUNDFISH ESSENTIAL FISH HABITAT CONSERVATION AREAS AND BOUNDARIES OF THE TRAWL GEAR ROCKFISH CONSERVATION AREAS

Includes description of areas closed to groundfish bottom trawl fishing off the Pacific Coast and Amendment 28 to the Pacific Coast Groundfish Fishery Management Plan to refine and expand habitat closed areas and change the trawl rockfish conservation area

Preliminary Draft Environmental Impact Statement

Prepared by

National Marine Fisheries Service, West Coast Region

7600 Sand Point Way NE, BIN C15700

Seattle, WA 98115-0070

206-526-6150

and

Pacific Fishery Management Council

7700 NE Ambassador Place, Suite 101

Portland, OR 97220

503-820-2280

www.pcouncil.org

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LIST OF ACRONYMS

ABC	Acceptable biological catch
ACL	Annual catch limit
Act	Annual catch target
AOC	American Oceans Campaign
BAC	Block area closure
BTC	Bottom trawl closure
CBCM	Cape Blanco-Cape Mendocino
CBGCA	Cordell Banks Groundfish Conservation Area
CBNMS	Cordell Bank National Marine Sanctuary
CFPC	United States/Canada Border
CCA	Cowcod conservation area
CDFW	California Department of Fish and Wildlife
CFR	Code Federal Regulations
CMPC	Cape Mendocino-Point Conception
Council	Pacific Fishery Management Council
CPUE	Catch per unit of effort
DAC	Discrete area closure
DBRK	Darkblotched rockfish
DEIS	Draft environmental impact statement
DPS	Distinct population segment
DSC	Deep-sea coral
DSC&S	Deep sea coral and sponge
DSCRTP	Deep Sea Coral Data Portal (Database)
DSCRTP	Deep-Sea Coral Research and Technology Program
ECS	Ecosystem component species

EEZ	Exclusive Economic Zone
EFH	Essential fish habitat
EFHCA	EFH conservation area
EFP	Exempted fishing permit
EIS	Environmental impact statement
EM	Electronic monitoring
ESA	Endangered Species Act
ESU	Evolutionarily significant unit
fm	Fathom
FMA	Fishermen's Marketing Association
FMP	Fishery management plan
FPA	Final preferred alternative
ft	foot/feet
GAP	Groundfish Advisory Subpanel
GCA	Groundfish conservation area
GFNMS	Gulf of the Farallones National Marine Sanctuary
GIS	Geographic information system
GMT	Groundfish Management Team
GP	Greenpeace
HAPC	Habitat areas of particular concern
HFI	Habitat-forming invertebrates
HMS	Highly migratory species
HSP	Habitat suitability probability
IBQ	Individual bycatch quota
IFQ	Individual fishing quota
ITS	Incidental take statement

kg	kilogram
km	kilometer
LME	Large marine ecosystem
m	meter
m^2	miles squared
MBNMS	Monterey Bay National Marine Sanctuary
MBTA	Migratory Bird Treaty Act
MMPA	Marine Mammal Protection Act
MPA	Marine protected area
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MTC	Midwater Trawlers Cooperative
mt	metric ton
N	Need
NCCOS	National Center for Coastal and Ocean Science
NEPA	National Environmental Policy Act
nm	nautical miles
NMFS	National Marine Fisheries Service
NMS	National Marine Sanctuary
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of intent
NRDC	Natural Resources Defense Council
NWFSC	Northwest Fisheries Science Center
OA	Ocean acidification
OAH	Ocean acidification and hypoxia
Oceana et al.	Oceana/Natural Resources Defense Council/Oceana/Ocean Conservancy
OFL	Overfishing limit

OFS	Overfished species
OSU	Oregon State University
OY	Optimum yield
P	Purpose
PacFIN	Pacific Fishery Information Network
Panel	West Coast Ocean Acidification and Hypoxia Science Panel
PCCB	Point Chehalis-Cape Blanco
PCUSMB	Point Conception-United States/Mexico Border
PDEIS	Preliminary draft environmental impact statement
POP	Pacific Ocean perch
PPA	Preliminary preferred alternative
Project Team	EFH/RCA Project Team
RCA	Rockfish conservation area
ROA	Range of alternatives
SAFE	Stock assessment and fishery evaluation
SFFT	selective flatfish trawl
SSC	Scientific and Statistical Committee
trawl RCA	Groundfish trawl RCA
U&A	Usual and accustomed
USFWS	United States Fish and Wildlife Service
WCGOP	West Coast Groundfish Observer Program
YRF	Yelloweye rockfish

KEY TERMS AND CONCEPTS

Groundfish conservation areas (GCAs) are defined as follows: a geographic area defined by coordinates expressed in degrees latitude and longitude, wherein fishing by a particular gear type or types may be prohibited (50 Code of Federal Regulations [CFR] 660.11). GCAs include trawl rockfish conservation areas (RCAs), non-trawl RCAs, cowcod conservation areas (CCAs), and other spatial closures where fishing with certain gear types may be prohibited. Specific descriptions of the purposes and locations of GCAs are found at 50 CFR §660.60(c)(3), and regulations at 50 CFR §660.70 define coordinates for these polygonal GCAs: yelloweye RCAs, CCAs, waters encircling the Farallon Islands, and waters encircling the Cordell Banks. Essential fish habitat conservation areas (EFHCAs) may be present within the boundaries of a GCA.

The groundfish trawl RCA (trawl RCA) is defined as follows: a type of GCA closed to fishing by groundfish bottom trawl gear types, designed to minimize catch of overfished and other groundfish species.[1] The trawl RCA is a large-scale area extending along the entire length of the West Coast of the United States. The trawl RCA boundaries are lines that connect a series of latitude and longitude coordinates that approximate particular depth contours of the continental shelf from approximately 30 to 700 fathoms (fm). The Pacific Fishery Management Council (Council) may and does change trawl RCA boundaries seasonally according to conservation needs. Trawl RCAs are bounded by lines specifically defined by latitude and longitude coordinates established at 50 CFR §660.71 through §660.74. Although the boundary lines defined by the latitude and longitude coordinates are typically generalized approximations of depth, the trawl RCAs are not actually defined by depth contours, and the boundary lines that define the trawl RCA may close areas that are deeper or shallower than the actual depth contours. Vessels harvesting groundfishes using bottom trawl gear are subject to the trawl RCA restrictions all year round, and they may not fish in the trawl RCA or operate in the trawl RCA for any purpose other than transiting the area. Vessels harvesting groundfishes using midwater trawl gear are subject to trawl RCA restrictions from January 1 through May 15 and after, outside of the primary whiting season (approximately May until the sector allocation of Pacific whiting is harvested); they may not fish in the trawl RCA or operate in the trawl RCA for any purpose other than transiting the area during that time. Additionally, the trawl RCA serves as a management boundary, and certain bottom trawl gear configurations (e.g., selective flatfish trawl gear) are required for vessels fishing in the area shoreward of the trawl RCA. The trawl RCA partially overlaps with state waters of Washington and California. This document analyzes impacts relative to the 2015 trawl RCA that extends between the lines

[1] A type of groundfish conservation area, and part of the definition of "groundfish conservation area" at §660.11. Regulations at§660.112 prohibit certain types of activities for vessels with trawl gear on board.

approximating the 100 fm and the 150 fm depth contours, including the "modified 200 fm line" between 40° 10' N. latitude and 45° 46' N. latitude.

EFHCAs are defined as follows: Under the EFH regulatory guidance at 50 CFR §600.815, regional fishery management councils and the National Marine Fisheries Service (NMFS) must minimize, to the extent practicable, the adverse effects of fishing on EFH. EFHCAs are spatially discrete areas closed to bottom trawling and, in some cases, other types of bottom contact gear, to protect the important habitat features found there (50 CFR 660.11). EFHCAs, established as part of Amendment 19 to the Pacific Coast Groundfish Fishery Management Plan (FMP), are one of the management measures developed by the Council and NMFS to protect habitat, especially those that are important, rare, or vulnerable, from the adverse effects of the groundfish fishery. EFHCAs may overlap with a GCA or with other EFHCAs.

Bottom contacting gear means fishing gear designed or modified to make contact with the bottom. This includes, but is not limited to, beam trawl, bottom trawl, dredge, fixed gear, set net, demersal seine, dinglebar gear, and other gear (including experimental gear) designed or modified to make contact with the bottom. Gear used to harvest bottom dwelling organisms (e.g., by hand, rakes, and knives) are also considered bottom contact gear (see Figure 2-3 "Umbrella figure").

Bottom trawl gear means a trawl in which the otter boards or the footrope of the net are in contact with the seabed. It includes demersal seine gear and pair trawls fished on the bottom. Any trawl not meeting the requirements for a midwater trawl, at 50 CFR 660.130(b), is considered a bottom trawl.

Polygon means a spatially discrete area that is defined by latitude and longitude coordinates connected with straight lines. It may be a current EFHCA, a proposed area to designate as an EFHCA, or a portion of an existing EFHCA, depending on the alternative.

Priority habitat means one of five types of habitats drawn, in modified form, from the "complex sensitive habitats" described in the environmental impact statement (EIS) for Amendment 19 to the groundfish FMP. These habitats are listed below:

- Hard substrate, including rocky ridges and rocky slopes
- Habitat-forming invertebrates (HFI), which covers deep-sea corals (Class Anthozoa), sponges (Phylum Porifera), and sea pens (Order Pennatulacea)
- Submarine canyons and gullies
- Seamounts
- Areas where the probability of occurrence of an overfished species was at least 80 percent of the maximum probability of occurrence predicted by models that were created during the Groundfish EFH Synthesis process (NMFS 2013)

See Section 4.1.1.2.5 for a description of the metrics used to summarize these priority habitats.

The Trawl Rationalization Program (also called the Catch Share Program) means an individual fishing quota (IFQ) program for the shorebased trawl fleet and harvester cooperatives for the at-sea mothership and catcher-processor fleets. The catch shares system divides the portion of the annual catch limit (ACL) allocated to the trawl fishery into shares controlled by individual fishermen or groups of fishermen (coops). Bottom trawl gear is not used in the coops that harvest Pacific whiting with midwater trawl gear. Bottom trawl gear can be used to target and harvest groundfishes in the Shorebased IFQ Program.[2]

The Shorebased IFQ Program means vessels registered to a Federal limited entry permit with an endorsement for trawl gear and fishing for groundfishes under the terms of that permit. The number of limited entry permits is fixed, and additional permits cannot be developed; thus, the number of participating vessels has a maximum that cannot be exceeded. Harvest capacity of the existing fleet could expand if larger vessels were to replace smaller ones, but that would also be restricted by the vessel size limits associated with each limited entry permit. Harvest of groundfishes by participating vessels is limited by each individual's available IFQ (for IFQ species) and the vessel's trip limits for non-IFQ species.

[2] Other gear types are used in the Shorebased iFQ Program, including midwater gear to target Pacific whiting and midwater rockfish species and fixed gear under gear switching provisions.

1 INTRODUCTION

The groundfish fisheries in the exclusive economic zone (EEZ)[3] off the West Coast of the United States are managed under the Pacific Coast Groundfish Fishery Management Plan (FMP). The FMP was prepared by the Pacific Fishery Management Council (Council) and approved and implemented by the National Marine Fishery Service (NMFS) under the Magnuson-Stevens Fishery (MSA) Conservation and Management Act (18 U.S.C. 1801 *et seq.*). The FMP includes more than 100 species of groundfishes that are harvested using both commercial and recreational gear off the Washington, Oregon, and California coasts. This document presents a description and analysis of the proposed fishery management alternatives for Amendment 28 to the FMP. The alternatives include changes to the essential fish habitat conservation areas (EFHCAs), adjustments to the groundfish trawl rockfish conservation area (RCA; trawl RCA), and use of MSA authorities to prohibit bottom contact fishing activities in waters deeper than 3,500 meters (m).

The MSA mandates that each regional FMP describe and identify essential fish habitat (EFH) for the fishery (16 U.S.C. 1853(7)). EFH is defined as ‘‘those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity’’ (16 U.S.C. 1802(10)). Under this authority, NMFS and the Council have developed a comprehensive strategy to conserve EFH, including its identification and the implementation of measures to minimize adverse impacts on EFH from fishing, such as the establishment of EFHCAs, which are areas closed to certain types of bottom contact gear to protect the important habitat features found there.

The Council is considering revisions to the suite of EFHCAs established in Amendment 19, based on the periodic review that was completed in 2014. At that time, the Council concluded there was enough new information to warrant consideration of modifying the existing suite of EFHCAs. This action does not consider changes to EFH designations, only to boundaries and rules regarding certain EFHCAs. Some EFHCAs overlap with other bottom trawl closures (BTCs).

The trawl RCA, as described in Key Terms and Concepts, is an area extending along the entire length of the West Coast of the United States. It is closed to bottom trawling to protect overfished groundfish species. Fishing prohibitions associated with the trawl RCA are in addition to those associated with EFHCAs and other groundfish conservation areas (GCAs) such as the Cowcod Conservation Area (CCA) and the Cordell Bank Groundfish Conservation Area (CBGCA). The trawl RCA overlaps with some EFHCAs and the CBGCA.

[3] EEZ is defined in federal regulations at Section50 CFR 600.10.

The alternatives described and analyzed in this document pertaining to the groundfish trawl RCA use the configuration from 2015. Although the trawl RCA boundaries can change annually and in season, the EFH/RCA Project Team (Project Team) had to define a stable configuration for analytical purposes. The 2015 groundfish trawl RCA configuration was in place when the Project Team began developing the suite of alternatives and the analytical approach. Hence, the Project Team uses the 2015 groundfish trawl RCA configuration, described above in the definitions. Key Terms and Concepts includes a more detailed description of the groundfish trawl RCA. The Council is considering adjustments to the trawl RCA to provide greater access to target species while using the individual accountability of the trawl individual fishing quota (IFQ) program to be the primary mechanism to minimize bycatch of overfished species.

In Amendment 19, the Council intended to close waters deeper than 3,500 m to bottom trawling to minimize the adverse effects of fishing on EFH. Because the Council limited groundfish EFH to waters less than 3,500 m deep, however, it was not an appropriate EFH action, and NMFS it did not approve it. For Amendment 28, the Council and NMFS are now considering the discretionary authorities under MSA Section 303(b) to prohibit all bottom contact fishing activities deeper than 3,500 m. This action is being considered for the following reasons:

1) The species and their habitat needs are poorly understood at these depths.
2) The habitats at these depths have not yet been exposed to commercial bottom contact fishing gear, but they are likely to be sensitive to damage by bottom contact gear and slow to recover.
3) There is no current interest in using bottom contact gear at such depths due to gear limitations that make fishing there difficult, as well as the lack of a viable market for the benthic species found there.

Although no bottom fishing is currently occurring in these waters, this proposed closure is viewed as a precautionary measure to protect sensitive deep-sea habitats.

The National Environmental Policy Act (NEPA) of 1969 42 U.S.C. 4321 et seq.) requires that, prior to undertaking a major Federal action, the action agency conduct an analysis of the short- and long-term impacts on the human environment, which includes current biological, physical, social, and economic conditions. Given that Amendment 28 has the potential to affect physical, biological, social, and economic features of the human environment significantly, this Preliminary Draft Environmental Impact Statement (PDEIS) was prepared to inform both the Council, as it selects its preferred alternative, and the public. A draft environmental impact statement (DEIS) will be prepared after the Council takes final action and selects its final preferred alternative.

1.1 Document Organized

Chapter 1 describes the purpose and need of the action and the history of Council actions up to this point. It includes identification of the preliminary preferred alternatives (PPAs), and information generated during scoping following the issuance of the notice of intent (NOI).

Chapter 2 describes each alternative being considered.

Chapter 3 describes the affected environment. [This chapter will be submitted separately, and it is not included here.]

Chapter 4 describes the analytical approach, the metrics used to evaluate the direct, indirect, and cumulative effects of the alternatives on the environmental components of the action area, and the results of the analyses of the alternatives.

Chapter 5 analyzes the impacts of various combinations of the EFHCA and trawl RCA Alternatives and compares their impacts to each other, as well as to the No-action Alternative. Prior to Chapter 5, each alternative is evaluated as a stand-alone alternative, ignoring the potential interactions with the other alternatives. However, recognizing that the Council will likely select some combination of alternatives as a final preferred alternative (FPA), this chapter describes and analyzes example combinations of alternatives.

Chapter 6 describes the cumulative effects of the proposed action with reasonably foreseeable future actions. [This chapter will be submitted separately, and it is not included here.]

Chapter 7 describes this action's consistency with other applicable laws, including the Groundfish FMP and National Standard guidelines. It contains a brief description of each law and its relevance to the proposed action. [This chapter will be submitted separately, and it is not included here.]

Chapter 8 contains a list of preparers. [This chapter will be submitted separately, and it is not included here.]

Chapter 9 contains references to the literature cited in the document.

Appendices:

A. Habitat metrics, by geographic breaks and polygon
B. Habitat Metrics - Habitat Forming Invertebrates
C. Landings and Revenues by Alternative and by Polygon
D. Additional Methodology Descriptions
    D-1 Data Source Selection Process for Catch, Revenue, and Protected Resources
    D-2 Discrete Area Closure (DAC) Methodology/Hotspot Analysis
E Proposals for EFHCA Changes

1.2 Purpose and Need

The Council, in coordination with NMFS, has identified multiple purposes and needs for the proposed action. Each purpose (P) is paired with its associated need (N):

P1: Minimize the adverse effects of fishing on EFH to the extent practicable.

N1: Consider new information on seafloor habitats, the distribution of fishing effort, the distribution of deep-sea corals, and new ecosystem-related products as they relate to protecting EFH from the adverse effects of fishing.

P2:[4] Reconsider the purpose of RCAs as long-term closures to reduce catch of overfished species in the bottom trawl sector in light of the 2011 implementation of the Shorebased IFQ Program and the individual catch accountability that it provides.

N2: Consider transitioning from long-term RCA closures to the Shorebased IFQ Program as the primary catch control tool for IFQ species in the bottom trawl sector to provide the bottom trawl sector with increased flexibility to achieve optimum yield and economic efficiency.

P3: Protect benthic habitats, including deep-sea corals, from the adverse effects of fishing.

N3: Consider new discretionary MSA authorities under Section 303(b) that can be used to protect species and habitats, including deep-sea corals.

1.2.1 RCA Actions Prior to September 2014

Management of the groundfish trawl fishery changed from cumulative landing limits and area closures (i.e., command and control measures to reduce catch) to IFQ (i.e., individual accountability) in 2011. Given the new management regime, the Council received requests to reevaluate the trawl RCA (November 2011 Agenda Item E.7.b, Supplemental TRREC Report). At its April 2013 meeting, the Council considered the performance of the shorebased IFQ fishery in 2011 and 2012 and the progress to date in 2013. Based on this review, the Council recommended a 100 fm shoreward boundary and 150 fm seaward boundary for the trawl RCA for Period 6 in 2013 throughout 2014 in the area from 40°10' N. latitude to 48°10' N. latitude. The trawl RCA boundary adjustments were intended to provide greater access to target species, while allowing the individual accountability afforded by the IFQ program to minimize bycatch of overfished species. At its September 2013 meeting, the Council reaffirmed action taken in April after reviewing NMFS' draft environmental assessment (September 2013 Agenda Item G.6.b, Draft EA), advisory body reports, and public comment.

[4] P2 and N2 reflect updated text by Council action at the November 2016 meeting.

On April 17, 2014, NMFS partially approved the Council-recommended trawl RCA boundary adjustments (Agenda Item F.4.a, Attachments 1, 2, and 3, June 2015). NMFS disapproved the Council's recommendations in the area from 40°10' N. latitude to 45°46' N. latitude because the Council did not consider area-specific analysis and whether to mitigate the adverse effects on EFH caused by the proposed fishing activities, to the extent practicable, as required by MSA (16 U.S.C. 1853 (7)).

1.3 Action Area

Generally, the action area is the Pacific Coast of the United States EEZ, primarily seaward of Washington, Oregon, and California state territorial waters (3 nautical miles from shore; hereby referred to as "state waters"), with some exceptions. There are some areas within the EEZ that are not considered part of the action area because direct and indirect impacts are not anticipated from any of the alternatives described in Chapter 2. There are some areas of state waters that would be impacted by some of the alternatives described in Chapter 2. Those areas of exception are further described below, and all remaining areas of are considered to be part of the action area.

The Council and NMFS do not intend for any of the action alternatives described in Chapter 2 to revise state-issued regulations for state-managed species in state waters. Portions of state waters are included in the action area because the trawl RCA overlaps with state waters off Washington and California. However, areas of state waters that do not overlap any of the areas proposed for changes in Chapter 2 are not considered part of the action area.

The Council and NMFS do not intend for any of the action alternatives described in Chapter 2 to apply to tribal fisheries in usual and accustomed (U&A) fishing areas off Washington. Tribal U&A fishing areas for the Makah Tribe, the Quileute Tribe, the Hoh Tribe, and the Quinault Indian Nation are defined by latitude and longitude coordinates described in federal regulations at 50 CFR §660.4.[5] However, fishing data from the tribal U&A fishing areas off Washington (see History of Council Action) are used in the analysis, so this area is considered part of the action area. NMFS will continue to work with the tribes to ensure that adequate measures are in place to protect EFH within the U&A fishing area. If, in the future, additional measures were determined to be necessary, NMFS would follow the procedures outlined in 50 CFR §660.50(d).

[5] The EFH/RCA analysis uses the tribal U&A fishing area boundaries set forth in United States v. Washington, 2:09-sp-00001-RSM, (W.D. Wash. Sept. 3, 2015) (Amended Order Regarding Boundaries of Quinault & Quileute U&As) and published in the Federal Register on June 8, 2016 (81 FR 36807). Recently, the U.S. District Court for the Western District of Washington issued an order revising the western U&A boundaries for the Quileute and Quinault Tribes, pursuant to a remand by the U.S. Court of Appeals for the Ninth Circuit in Makah Indian Tribe v. Quileute Indian Tribe, 873 F.3d 1157 (9th Cir. 2017).

The action area does not include most of the "seaward of the 700 fm contour" EFHCA defined at 50 CFR 660.76. This EFHCA is a single, large, coastwide polygon (Figure 2-1, No-action Alternative Map) and is closed to bottom trawling. However, several small areas of this polygon overlap with some of the proposed EFHCA reopenings and they are, therefore, considered part of the action area.

1.4 History of Council Action

This section briefly describes the history of Council actions that led to the development of the alternatives in Amendment 28 and the analyses of those alternatives.

Pacific Coast groundfish EFH was first identified and described in 1998, in accordance with the 1996 MSA, and it was incorporated into the FMP as part of Amendment 11. In addition to describing EFH for Pacific Coast groundfish, Amendment 11 also defined optimum yield and overfishing rates and thresholds.

In 2006, Amendment 19 revised groundfish EFH as a response to a lawsuit by American Oceans Campaign (AOC v. Daley, 183 F. Supp. 2.d 1 (D.D.C. 2000)). The Council performed the following actions:

- It reaffirmed the 1998 designation of EFH.
- It established habitat areas of particular concern (HAPCs).
- It described the adverse effects on EFH from fishing and established EFHCAs to minimize those effects.
- It described the life history, habitat, and major prey items of groundfishes.
- It established a process for the review and revision of EFH.

The Council's periodic review of the EFH provisions in the groundfish FMP, required by NMFS' regulatory guidance (50 CFR §600.815(10)), began in December 2010. The preliminary findings of the review were presented to the Council in September 2012 (Agenda Item H.6.b, EFHRC Report). Based on these findings, the Council issued a request for proposals for changes to the groundfish EFH provisions in 2013. Eight proposals were submitted, two of which were subsequently withdrawn. The eight original proposals are as follows:

- Environmental Defense Fund (withdrawn)
- Fishermen's Marketing Association (FMA)
- Greenpeace (GP)
- Gulf of the Farallones National Marine Sanctuary (GFNMS)
- Marine Conservation Institute

- Monterey Bay National Marine Sanctuary (MBNMS)
- Oceana/Natural Resources Defense Council/Oceana/Ocean Conservancy (Oceana et al.)
- Olympic Coast National Marine Sanctuary (withdrawn)

The EFH review concluded in March 2014, when the Council determined that the new information, including the public proposals, warranted further consideration of changes to EFH components, and it established a process and schedule to develop and consider alternatives for those changes.

1.4.1 Council Actions September 2014 to Present

In September 2014, the Council opted to combine the potential EFHCA revisions and trawl RCA modification into a single FMP amendment. Although they have different purposes, both of them prohibit bottom trawl activities in specific areas, thereby providing direct (EFHCAs) or indirect (trawl RCA) habitat protections in those areas. In addition, by combining the two actions, it would allow the trawl RCA modifications to be considered in the context of EFH, which was a reason NMFS initially rejected RCA changes.

In April 2015, the Council established the scope of the action and formed the Project Team to develop the FMP amendment and NEPA documents. At this meeting, an additional proposal, in draft form, was submitted via public comment by a collaborative group of fishing interests and environmental groups (the "Collaborative") that included changes to the EFHCAs and elimination of the trawl RCA. A final proposal was submitted in November 2016.

In September 2015, the Council adopted a preliminary range of alternatives for analysis. The Project Team began developing analytical frameworks and metrics to assess the environmental impacts of the various alternatives.

In April 2016, the Project Team provided a progress report and a preliminary analysis of the fishery management alternatives for consideration. At that meeting, the Council established a range of alternatives (ROA) that addressed potential changes to the current EFHCA configuration and trawl RCA, as well as the closure of waters deeper than 3,500 m to bottom contact gear. For a full list of these alternatives, see the April 2016 Council Decision Document. The Council also eliminated EFHCA or trawl RCA changes within the combined tribal U&A off the coast of Washington from consideration.

In November 2016, the Council reviewed a draft analytical document that included analysis of habitat impacts, but did not yet include the economic impacts analysis. At this meeting, an additional proposal was submitted via public comment by the Midwater Trawlers Cooperative (MTC) that included changes to the EFHCAs off the coast of Oregon. The Council chose a partial suite of PPAs, pending further analysis of impacts by the Project Team, and it provided guidance to the Project Team for continuing the

analysis of alternatives. In particular, the Council directed the Project Team to include four additional EFH alternatives in the analysis: the MTC Proposal, Garibaldi Reef South, Rittenburg Bank Modifications, and the Potato Bank Correction. The Council's partial PPA for waters off California and Oregon included removing the trawl RCA and adopting block area closures (BACs; Alternative 2c). For waters off Washington, PPAs are the No-action Alternative for both EFHCA modifications and trawl RCA modifications.

1.5 Scoping

On February 1, 2016, NMFS published an NOI to prepare an EIS for Amendment 28 to the groundfish FMP (81 FR 5102). Through the NOI, NMFS sought comments from the public on the scope of issues to be addressed in the EIS, the range of alternatives to include in the EIS, and the types of habitats to prioritize for protection from the adverse effects of fishing gear. The comment period closed on March 2, 2016. Further public participation occurred throughout the Council's decision-making process. The NOI identified the Council meeting in Vancouver, Washington, held from April 9 to April 14, 2016, as an opportunity for public involvement. NMFS provided the Council with a summary of the comments received during the NOI comment period (Agenda Item F.5.b, Supplemental NMFS Report). The comments received during scoping were considered, and they helped the Council identify major issues and concerns.

2 DESCRIPTION OF ALTERNATIVES

This document considers a variety of alternatives intended to meet the purpose and need. The alternatives generally fall into one of several subject areas. Throughout the document, the alternatives are organized into the subject areas to which they pertain. The three subject areas are as follows: 1) EFHCA changes, 2) adjustments to the trawl RCA, and 3) use of MSA section 303(b) discretionary authorities.[6] The Project Team evaluated a combined No-action Alternative (that includes all three subject areas) and 11 individual action alternatives (Table 2-1). The Council will ultimately select an alternative(s) from each of the three subject areas. Therefore, we also analyzed four 'synthesis' combinations in Chapter 5 (Table 5-1) and compared them to each other and to the No-action Alternative. The combinations presented in Chapter 5 analyze the potential interactions of various combinations of the EFHCA and trawl RCA alternatives.

The action alternatives address changes to areas where vessels may fish with bottom trawl gear for three purposes, or subject areas. A single No-action Alternative is used to compare the action alternatives in all three subject areas. The No-action Alternative would 1) retain the current suite of EFHCAs intended to minimize the adverse effects of fishing on groundfish EFH (Subject Area 1), 2) retain the groundfish trawl RCA closures in place to control the catch of overfished species (Subject Area 2), and 3) continue to allow the use of bottom contact gear in waters deeper than 3,500 m (Subject Area 3). The No-action Alternative also assumes that harvest levels (e.g., annual catch limits), trawl gear restrictions, and the overall management scheme for the groundfish trawl fishery would remain similar to recent years. Discussion of other reasonably foreseeable future actions that may have cumulative effects with actions considered here can be found in Section 3.

While many areas off the West Coast are closed to groundfish bottom trawling (Figure 2-1), other maritime activities occur within bottom trawl closure areas. The types of activities allowed in some of these areas include fishing with non-groundfish trawl gear (e.g., pink shrimp trawl), midwater trawling, hook and line, and other non-trawl, groundfish fishing activities.

[6] Previous reports from the Project Team placed the alternatives in one of four subject areas: 1) EFHCA changes contained in public proposals, 2) new EFHCAs within current RCAs, 3) adjustments to the trawl RCA, and 4) use of MSA section 303(b) discretionary authorities. However, the Project Team determined that it was more logical to reorganize them into the three subject areas, combining all EFHFCA alternatives into a single subject area.

Table 2-1. Alternatives Considered

Subject Area	**No-action Alternative**	**Action Alternatives**						
1. EFHCA changes (re-openings and closures)	No-action Alternative Retains current suite of EFHCAs. Retains trawl RCA closures.	Alternative 1.a Collaborative	Alternative 1.b Oceana et al. 1/	Alternative 1.c MTC 2/	Alternative 1.d Garibaldi reef South 3/	Alternative 1.e Rittenburg Bank Modifications 4/	Alternative 1.f Potato Bank Correction	Alternative 1.g New EFHCAs in Washington 5/6/
2. Adjustments to Trawl RCA	Continues to allow use of bottom contact gear in waters deeper than 3,500 m (PPA for Washington).	Alternative 2.a Remove the trawl RCA (PPA for Oregon and California).		Alternative 2.b Remove the trawl RCA and, in Washington, implement discrete area closures (DACs).		Alternative 2.c Remove trawl RCA and implement block area closures (BACs) (PPA for Oregon and California).		
3. Use of MSA Sec. 303(b) discretionary authorities		Alternative 3.a Use MSA Sec. 303(b)(2)(A), 303(b)(2)(B), or 303(b)(12) to close waters deeper than 3,500 m to bottom contact gear, consistent with September 2015 Agenda Item H.8.a, Supplemental NMFS Report (PPA).						

1/ Alternative 1.b, Oceana et al. was modified per November 2016 Agenda item F4b CDFW report.
2/ Alternative 1.c, MTC, was modified by November 2016 F.4.a Supplemental GAP Report).
3/ Alternative 1.d, "None" appeared in F4a Project Team Report appendix table F4-a, November 2016).
4/ Alternative 1.e, Rittenburg Bank, in NMS report (November 2016, F4b, Supplemental NMS Report). http://www.pcouncil.org/wp-content/uploads/2016/11/F4c_Sup_PubCom2_FULL_ELECTRONIC_ONLY_NOV2016BB.pdf. They appear on page 32 of Agenda item F.4.c, Supplemental Public Comment 2, November 2016. This alternative should be considered mutually exclusive with the Rittenburg Bank polygons in Alternatives 1.a and 1.b.
5/ Alternative 1.g, New EFHCAs in Washington; this alternative is based on priority habitats within the No-action Alternative trawl RCA off Washington.
6/ The Project Team merged all EFHCA alternatives into a single subject area, meaning that Alternative 1.g is now listed along with the other EFH-related alternatives.

Off California, several non-groundfish trawl fisheries are subject to depth restrictions that are similar in time and place to the trawl RCA (the seaward boundary for these non-groundfish fisheries is a little deeper during winter months than it is for the groundfish fishery). These fisheries include the ridgeback prawn fishery and the California halibut (*Paralichthys californicus*) and sea cucumber trawl fisheries south of 38 degrees57.50' N. latitude.

Several marine sanctuaries, marine reserves, and marine conservation areas also occur within the action area. Generally, marine sanctuaries prohibit activities such as harassing, disturbing, or taking prohibited species (e.g., marine mammals, endangered species, etc.) and introducing invasive species.[7] Marine reserves and marine conservation areas may have restrictions more specific to fishing activities, including prohibiting commercial fishing or fishing for certain species entirely.[8] All national marine sanctuary program regulations would remain unchanged under any alternative.

Additional information regarding bottom trawl restrictions under the No-action Alternative in each of the three subject areas is provided in this section. Bottom trawl closures exist in the action area for a variety of reasons, and they have considerable spatial overlap (e.g., a single location may be closed to bottom trawling via multiple closures) (Figure 2-1). An example of the spatial overlap of bottom trawl closures is depicted in Figure 2-2. Where those BTCs overlap, the most stringent restrictions apply. For instance, pink shrimp trawling is allowed in the trawl RCA, but not the EFHCAs. It would, therefore, be prohibited in areas where they overlap. Also, a variety of fisheries may be affected by changes to bottom trawl closures under the action alternatives (Table 2-2).

[7] Olympic Coast National Marine Sanctuary (NMS) (Greater Farallones NMS (15 CFR 922.82), Monterey Bay NMS (15 CFR 922.@@), Channel Islands NMS (15 CFR 922.72), Cordell Bank NMS (15 CFR 922.112)

[8] Channel Islands Marine Reserve, within the NMS, regulations prohibit use of fishing gear. Channel Islands Marine Conservation Area, within the NMS, regulations only allow certain types of fishing activities; otherwise, the use of fishing gear is prohibited (15 CFR 922.73).

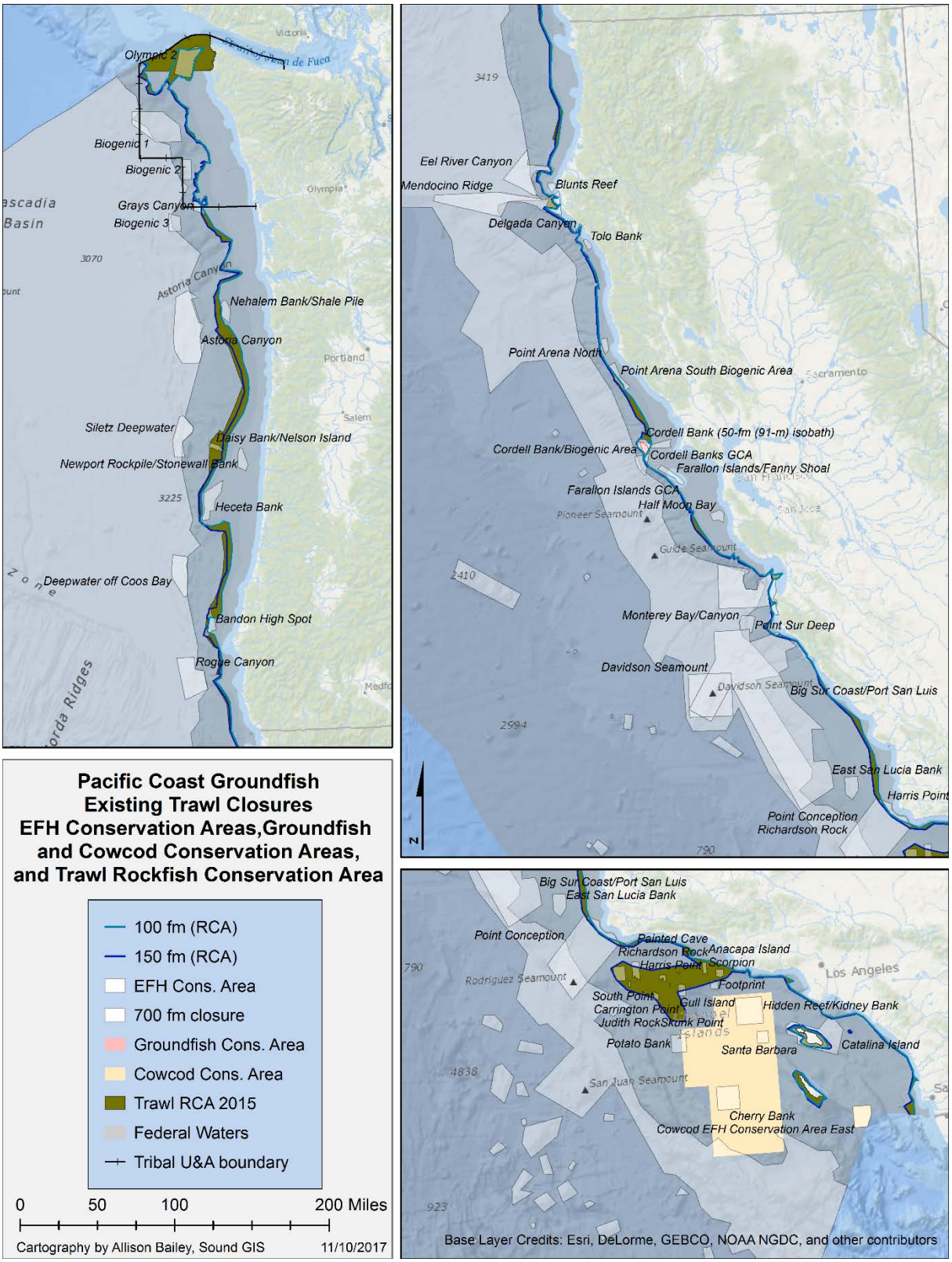

Figure 2-1. Existing Federal bottom trawl closures off the West Coast under the No-action Alternative.

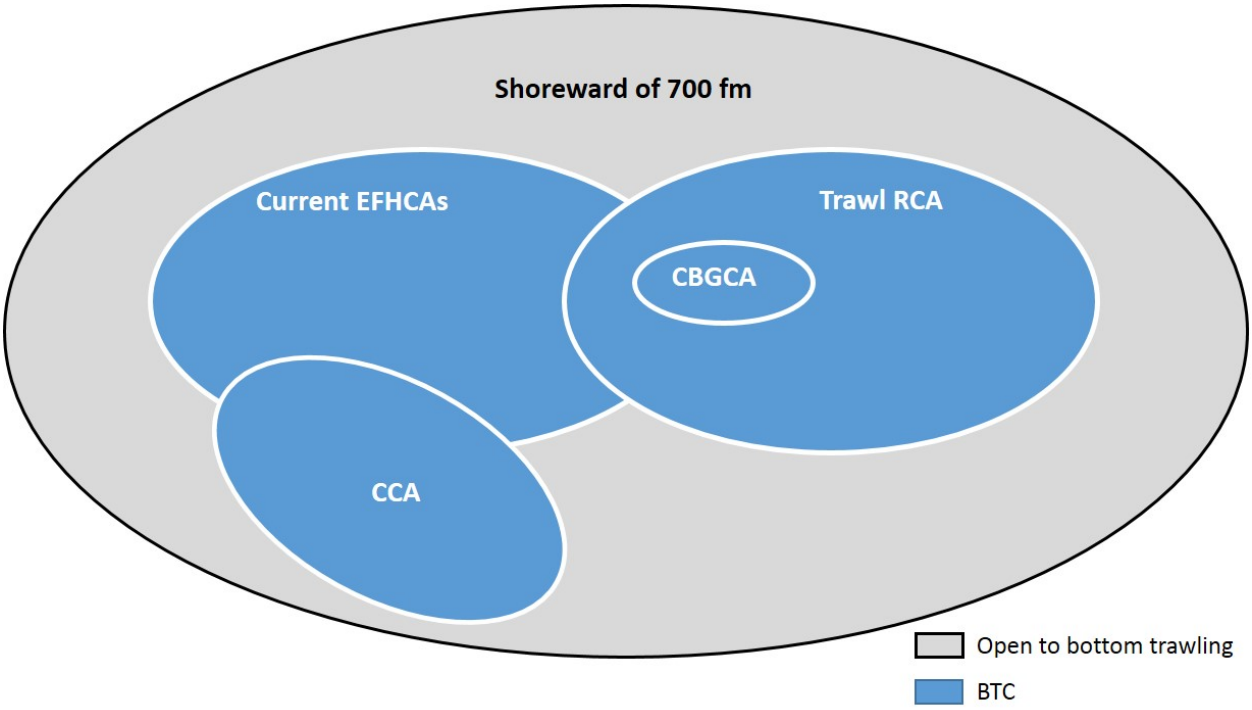

Figure 2-2. Conceptual Venn diagram showing overlap of bottom trawl closures. Note: The figure is not to scale, and it is not intended to evaluate relative impacts.

2.1.1 No-action Alternative Subject Area 1

The No-action Alternative would retain the current suite of EFHCAs intended to minimize the adverse effects of fishing on groundfish EFH (Subject Area 1): These EFHCAs prohibit certain types of bottom contact gear, which is defined as any gear that is designed to make contact with the bottom (Table 2-3, Figure 2-3). Of the 52 EFHCAs along the West Coast, 17 prohibit all forms of bottom contact gear and the remaining 35, including the "seaward of the 700 fm contour" closure,[9] prohibit bottom trawl gear. Of the 35 EFHCAs closed to bottom trawl gear, the 19 that are off the coast of California allow the use of demersal seine gear (NMFS 2005).[10] The seaward of the 700 fm

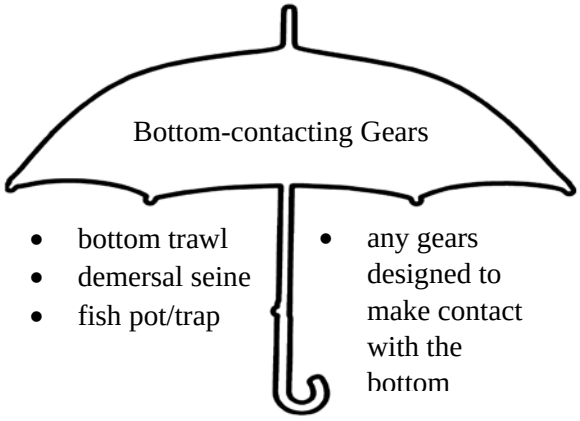

Figure 2-3. Examples of bottom contacting fishing gears.

[9] In 2006, as part of Amendment 19, the Council and NMFS closed waters seaward of a boundary line approximating the 700 fm contour to bottom trawling to protect EFH. This is commonly referred to as the 'bottom trawl footprint closure' or the 'seaward of the 700 fm contour' EFHCA.

[10] Demersal seine gear is described in Section 3.5.2 of the Amendment 19 EIS (NMFS 2005). It is considered a "small footrope trawl," but it is lighter in weight and has a small, light footrope.

contour closure overlaps completely or partially with 16 EFHCAs. Under the No-action Alternative, there would be no change in the current configuration of EFHCAs or their gear restrictions. Hence, bottom trawling (and in some cases, the use of any bottom contacting gear) would remain prohibited in those areas. Also, under the No-action Alternative, prohibitions would be maintained for the use of dredge gear, beam trawl gear, any bottom trawl gear with rollers greater than
19 inches (48 cm) within any area designated as groundfish EFH, and any bottom trawl gear with rollers larger than 8 inches (20 cm) shoreward of the 100 fm contour.

2.1.2 No-action Alternative Subject Area 2

The No-action Alternative would retain the trawl RCA closures to control the bycatch of overfished species and other groundfish species (Subject Area 2). Under the No-action Alternative, there would be no changes to the current trawl RCA configuration (Figure 2-4), and the use of the trawl RCA for management purposes would remain similar to recent years. For analytical purposes, the Project Team used the 2015 trawl RCA configuration (see definitions in Chapter 1) for comparison to the action alternatives. Although trawl RCA boundaries can be modified routinely, as needed, via inseason action, the boundaries and management approach under the No-action Alternative would remain in place. Hence, groundfish bottom trawling would remain prohibited in those areas.

2.1.3 No-action Alternative Subject Area 3

The No-action Alternative would continue to allow the use of bottom contact gear in waters deeper than 3,500 m (Subject Area 3). These waters are seaward of groundfish EFH and inside the United States EEZ (see Section 2.4.1 for more detail). These waters are found south of Cape Mendocino only ($40^{o}10'$ N. latitude) because the continental shelf is much narrower than it is to the north.

Table 2-2. Fishing activities that are restricted in the each of the three subject areas under the No-action Alternative. Y = yes, fishing is restricted; N = no, fishing is not restricted.

		EFHCAs (Subject Area 1)				
		Closed in any area designated as groundfish EFH	**Closed to bottom trawl**	**Closed to bottom contact gear**	**Trawl RCA (Subject Area 2)**	**Waters deeper than 3,500 m (Subject Area 3)**
Commercial	Groundfish bottom trawl	N	Y	Y	Y	N
	Footrope >19 inches	Y				N
	Groundfish midwater trawl	N	N	N	Sometimes[a/]	N
	Groundfish non-trawl gears that do not contact the bottom	N	N	N	N	N
	Groundfish non-trawl gears designed to contact the bottom (e.g., fish pot gear)	N	N	Y	N	N
	Demersal seine	N	Sometimes[b/]	Y	Y	?
	Pink shrimp trawl	N	Y	Y	N	N
	Ridgeback prawn trawl	N	Y	Y	Y	N
	California halibut trawl	N	Y	Y	Y	N
	Sea cucumber trawl	N	Y	Y	Y	N
	Salmon troll (hook and line)	N	N	N	N	N

[a/] North of 40 10' N. latitude, midwater trawling is prohibited in the trawl RCA in January through May (i.e., outside of the primary Pacific whiting season). South of 40 10' N. latitude, midwater trawling is prohibited within the trawl RCA and shoreward of the trawl RCA year-round. Midwater trawling is allowed inside the trawl RCA during the primary whiting fishing season.

[b/] Some EFHCAs that are closed to bottom trawl gear have an exception to allow fishing with demersal seine gear.

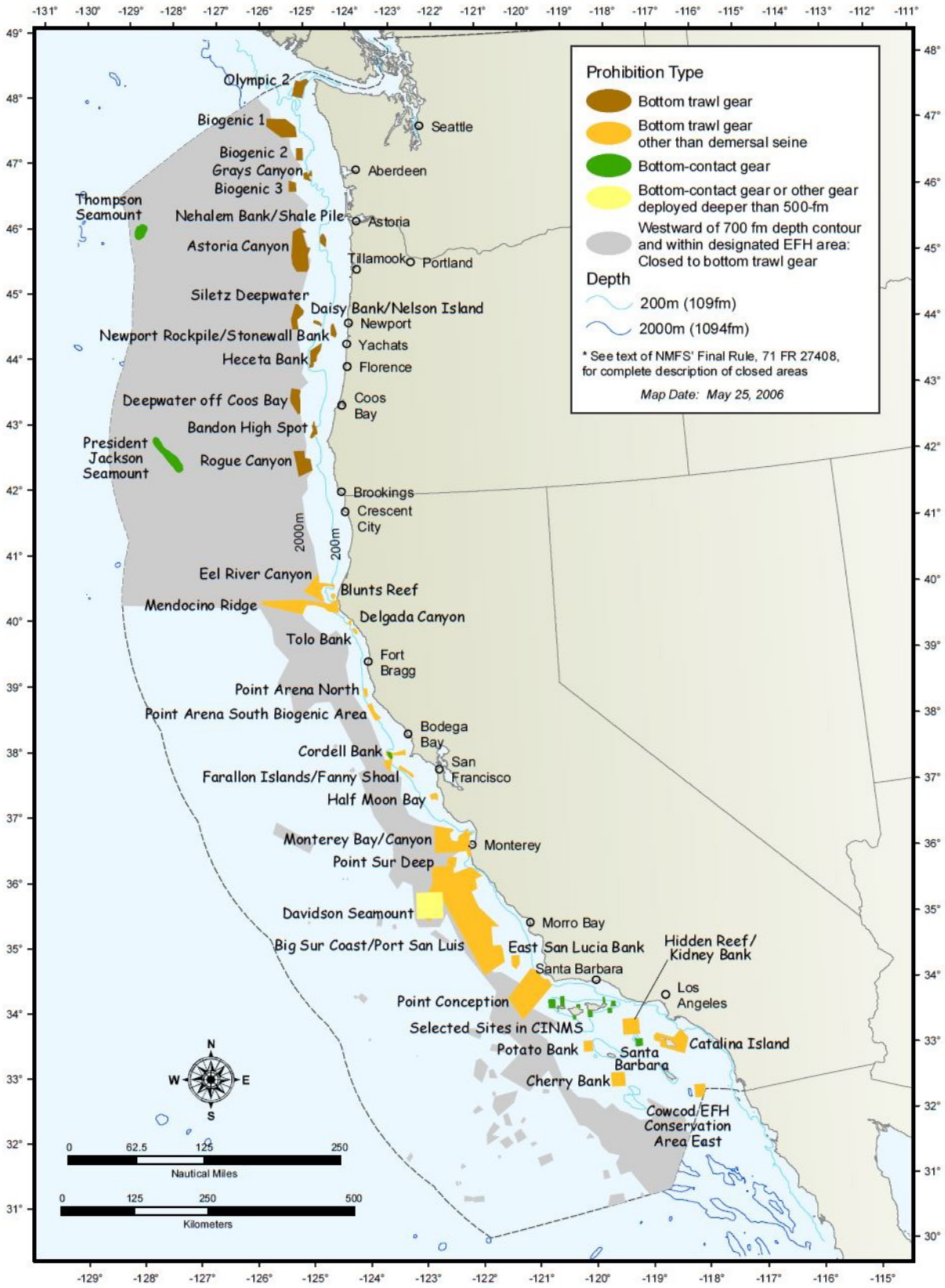

Figure 2-4. Existing EFHCAs under the No-action Alternative.

Table 2-3. No-action Alternative EFHCAs and the types of fishing restrictions within each area.

Name	Offshore of (State)	Trawl gears designed to make contact with the bottom			Closed to midwater trawl gear	Closed to non-groundfish trawl	Closed to groundfish non-trawl (not bottom contacting)
		Closed to bottom trawl	Closed to demersal seine	Closed to bottom contacting gear (including longline/pot/trap gear)			
EFH - Areas designated as EFH	Coastwide	X[c/]				X	
Seaward of the 700-fm contour [a/]	Coastwide	X	X			X	
Shoreward of the 100-fm contour [a/]	Coastwide	X[b/]				X	
Olympic 2	WA	X	X			X	
Biogenic 1	WA	X	X			X	
Biogenic 2	WA	X	X			X	
Grays Canyon	WA	X	X			X	
Biogenic 3	WA	X	X			X	
Thompson Seamount	OR	X		X		X	
Astoria Canyon	OR	X	X			X	
Nehalem Bank/Shale Pile	OR	X	X			X	
Siletz Deepwater	OR	X	X			X	
Daisy Bank/Nelson Island	OR	X	X			X	
Newport Rockpile/Stonewall Bank	OR	X	X			X	
Heceta Bank	OR	X	X			X	
Deepwater off Coos Bay	OR	X	X			X	
Bandon High Spot	OR	X	X			X	
President Jackson Seamount	OR	X		X		X	
Rogue Canyon	OR	X	X			X	
Eel River Canyon	CA	X				X	
Blunts Reef	CA	X				X	
Mendocino Ridge	CA	X				X	
Delgada Canyon	CA	X				X	

Table 2-3. No-action Alternative EFHCAs and the types of fishing restrictions within each area (continued).

Name	Offshore of (State)	Trawl gears designed to make contact with the bottom			Closed to midwater trawl gear	Closed to non-groundfish trawl	Closed to groundfish non-trawl (not bottom contacting)
		Closed to bottom trawl	Closed to demersal seine	Closed to bottom contacting gear (including longline/pot/trap gear)			
Tolo Bank	CA	X				X	
Point Arena North	CA	X				X	
Point Arena South Biogenic Area	CA	X				X	
Cordell Bank/Biogenic Area	CA	X				X	
Cordell Bank (50-fm isobath) [a/]	CA	X		X		X	
Farallon Islands/Fanny Shoal	CA	X				X	
Half Moon Bay	CA	X				X	
Monterey Bay/Canyon	CA	X				X	
Point Sur Deep	CA	X				X	
Big Sur Coast/Port San Luis	CA	X				X	
Davidson Seamount	CA	X		X		X	
East San Lucia Bank	CA	X				X	
Point Conception	CA	X				X	
Harris Point	CA	X		X		X	
Harris Point Exception	CA	X				X	
Richardson Rock	CA	X		X		X	
Scorpion	CA	X		X		X	
Painted Cave	CA	X		X		X	
Anacap Island	CA	X		X		X	
Carrington Point	CA	X		X		X	
Judith Rock	CA	X		X		X	
Skunk Point	CA	X		X		X	
Footprint	CA	X		X		X	
Gull Island	CA	X		X		X	

Table 2-3. No-action Alternative EFHCAs and the types of fishing restrictions within each area (continued).

Name	Offshore of (State)	Trawl gears designed to make contact with the bottom			Closed to midwater trawl gear	Closed to non-groundfish trawl	Closed to groundfish non-trawl (not bottom contacting)
		Closed to bottom trawl	Closed to demersal seine	Closed to bottom contacting gear (including longline/pot/trap gear)			
South Point	CA	X		X		X	
Hidden Reef/Kidney Bank	CA	X				X	
Catalina Island	CA	X				X	
Potato Bank	CA	X				X	
Santa Barbara	CA	X		X		X	
Cherry Bank	CA	X				X	
Cowcod EFH Conservation Area, East	CA	X				X	

[a/] Boundary lines approximating depth contours for the 700 fm line are defined at §660.76 and for the 100 fm line are defined at §660.73.

[b/] Fishing bottom trawl gear in this area shoreward of the 100 fm line is prohibited with footrope gear greater than 8 inches in diameter. North of 40 10' N. latitude, the only small footrope trawl gear allowed is selective flatfish trawl gear.

[c/] Fishing bottom trawl gear in this area designated as EFH is prohibited with footrope greater than 19 inches inTable 2 diameter (50 CFR 660.312).

2.2 Subject Area 1: Changes to EFHCAs

The changes to the existing suite of EFHCAs in Subject Area 1 would consist of revising the No-action Alternative EFHCAs to change their boundaries, remove them entirely, or add new EFHCAs. These areas are referred to throughout this document as "polygons." Some polygons may be stand-alone areas; i.e., they would represent the creation of an entirely new EFHCA or the complete elimination of an existing EFHCA. Others may be adjacent to, overlap with, or occur within existing EFHCAs. For example, an existing EFHCA may be partially reopened in some of its bounded area by one polygon, and it may have contiguous areas closed by another polygon. The types of polygons would vary among and between alternatives. They are described in more detail in this section.

Generally, the existing EFHCAs having their boundaries modified would retain the same gear restrictions that are in place under the No-action Alternative. New stand-alone EFHCAs would prohibit all bottom trawling, but demersal seines would be allowed in those polygons that are south of the Oregon-California state line. Areas that would be reopened by alternatives in this subject area would have all prohibitions on bottom trawling removed. The types of fishing restrictions would vary among and between the alternatives. They are described in more detail in this section.

Most of the Subject Area 1 alternatives would include closures and reopenings that overlap with other bottom trawl closures (i.e., the trawl RCA, the CCA, and the CBGCA) (Figure 2-6). Unless and until these other BTCs are modified to allow bottom trawling, the overlapping EFHCA changes would have no practical effect on bottom trawl prohibitions except for where they overlap with the trawl RCA and affect pink shrimp trawling. Therefore, the analyses considered only those proposed closures and reopenings that would not overlap with other BTCs and compared them to the current BTCs. A second approach was used for the habitat analysis only. That approach considered all proposed closures and reopenings, regardless of whether they would overlap with another BTC and compared them to the current suite of EFHCAs (Figure 2-7). A subset of the EFHCA alternatives was analyzed in combination with the elimination of the trawl RCA (Subject Area 2) in Chapter 5, Synthesis.

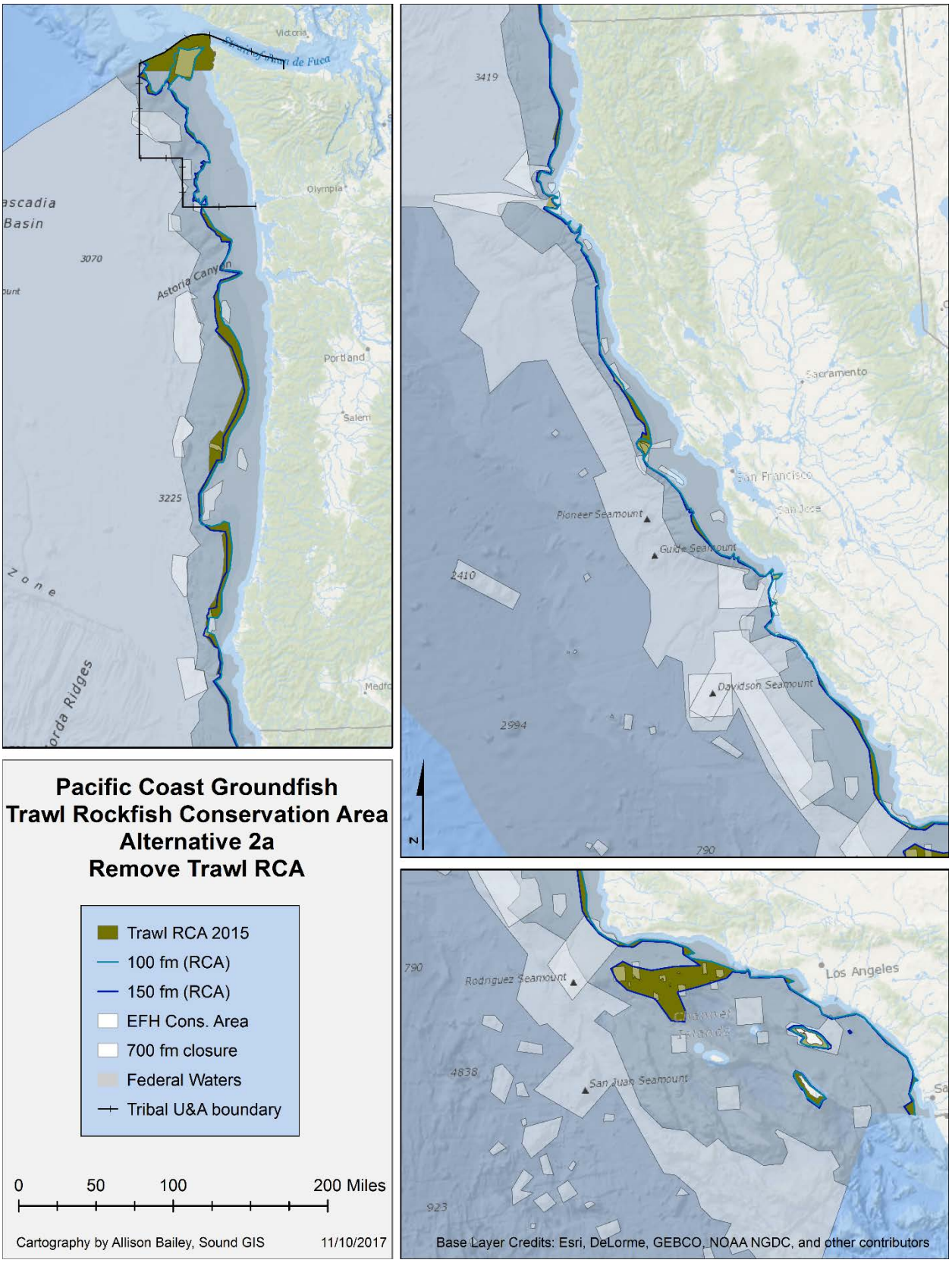

Figure 2-5. Existing trawl RCA closure under the No-action Alternative.

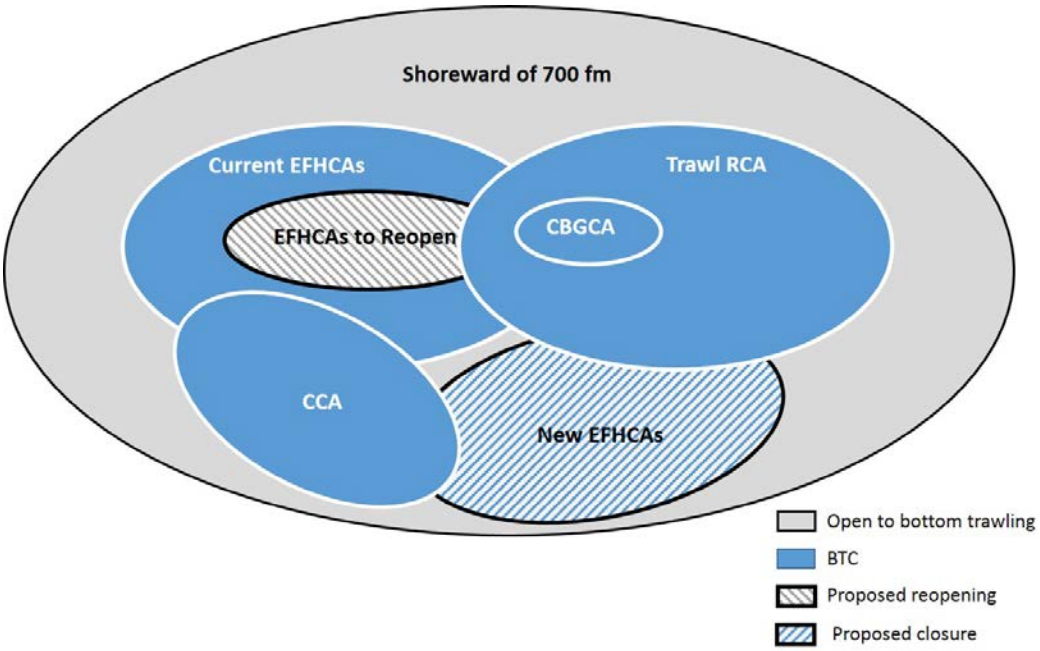

Figure 2-6. Conceptual Venn diagram showing overlap of proposed EFHCA closures and reopenings with other BTCs. Only the cross-hatched areas would be closed or reopened. Note: The figure is not to scale, and it is not intended to evaluate relative impacts.

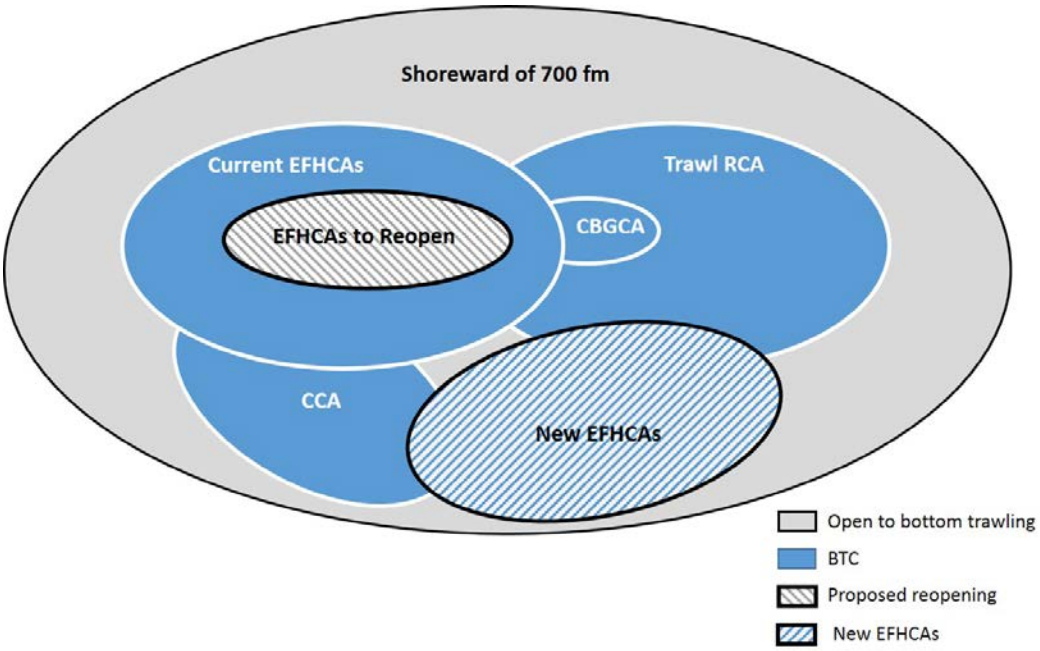

Figure 2-7. Conceptual Venn diagram showing extent of proposed closures and reopenings that would be included in calculating the extent of the changes to the No-action Alternative suite of EFHCAs. The cross-hatched areas represent the changes to the EFHCAs. Note: The figure is not to scale, and it is not intended to evaluate relative impacts.

2.2.1 Alternative 1.a: The Collaborative Alternative

This alternative would make a number of changes to the current suite of EFHCAs along the West Coast, from the United States/Canada border south to Point Conception, California (excluding the tribal U&As off Washington). It would contain 59 polygons: 43 closures, and 16 reopenings (Figure 2-2). Multiple boundary adjustments would be made to some EFHCAs (e.g., the Eel River Canyon EFHCA has four associated polygons: two would expand the closure into adjacent areas, and two would reopen portions of the EFHCA). Alternative 1.a would not propose any changes off the central Oregon coast or in the Southern California Bight. Thirty-five of the closures are off the coast of California and would allow demersal seine gear.

2.2.2 Alternative 1.b: The Oceana et al. Alternative

This alternative would make changes to the current suite of EFHCAs along the entire West Coast, from the United States/Canada border south to the United States/Mexico border (excluding the tribal U&As off Washington). It would contain 68 polygons: 61 closures and 7 reopenings (Figure 2-9). Multiple boundary adjustments would be made to some EFHCAs (e.g., the Heceta Ridge EFHCA would have two associated polygons, both of which would expand the closure into adjacent areas). Forty-five of the new closures are off the coast of California and would allow demersal seine gear. One area, the south Oregon footprint modification, extends north of Oregon-California border. This polygon would be closed to bottom trawl gear with the exception of demersal seine gear.

2.2.3 Alternative 1.c: The Midwater Trawlers Cooperative (MTC) Alternative

This alternative would make changes to the current suite of EFHCAs off the coast of Oregon, between the Columbia River to the north and Coos Bay to the south. It would contain 13 polygons: 9 closures and 4 reopenings (Figure 2-11 and Figure 2-11). Multiple boundary adjustments would be made to some EFHCAs (e.g., Daisy Bank would have four associated polygons: two would expand the closure into adjacent areas, and two would reopen portions).

2.2.4 Alternative 1.d: The Garibaldi Reef South Alternative

This alternative would add one new EFHCA off the north coast of Oregon. It would consist of a single polygon, approximately 8 square miles, which would create a new EFHCA off Cape Meare. This EFHCA would be designed to protect rocky reef habitat. This new EFHCA would prohibit bottom trawling in that area (Figure 2-8 and Figure 2-12).

2.2.5 Alternative 1.e: The Rittenburg Bank Alternative

This alternative would add a new EFHCA off the coast of San Francisco, California. It would consist of a single polygon that would create a new EFHCA (Figure 2-8 and Figure 2-13). This EFHCA would be designed to protect known rocky geological features and biogenic habitat. The new EFHCA would prohibit bottom trawling, except demersal seine, in that area.

2.2.6 Alternative 1.f: The Potato Bank Correction Alternative.

Potato Bank is an existing EFHCA, and its location and spatial extent were defined in Amendment 19. The original intent of Amendment 19 was to protect Potato Bank (also known as Nidever Bank). However, the published coordinates for this closure are incorrect, and the Potato Bank closure in the No-action Alternative does not actually encompass Potato Bank. Under this alternative, the polygon would be moved to the position that was originally intended (Figure 2-8 and Figure 2-14).[11] Gear restrictions within the Potato Bank EFHCA would stay the same as under the No-action Alternative; the use of bottom trawl gear, except demersal seine gear, would be prohibited.

2.2.7 Alternative 1.g: New EFHCAs in Washington

This alternative would define new EFHCAs that are closed to bottom trawling off the coast of Washington in areas that lie within the No-action Alternative trawl RCA[12] (Figure 2-8 and Figure 2-15). They would be based on the presence of priority habitats within the No-action Alternative trawl RCA from Point Chehalis to the Washington-Oregon state line. The priority habitat areas are pictured in Figure 2-15. Should the Council select this alternative as part of its FPA, the Project Team would request guidance on drawing the polygons for the new EFHCAs. Habitat metrics would then be generated for those specific polygons.

[11] The move of the Potato Bank EFHCA was also considered in the analysis as "removing one polygon and creating a new one of the exact same size." Regardless, metrics discussed in Chapters 4 and 5 that measure changes in areas closed to bottom trawling will not show a net change in area closed from this action alternative.
[12] Only identifies new EFHCAs outside of the tribal U&A areas.

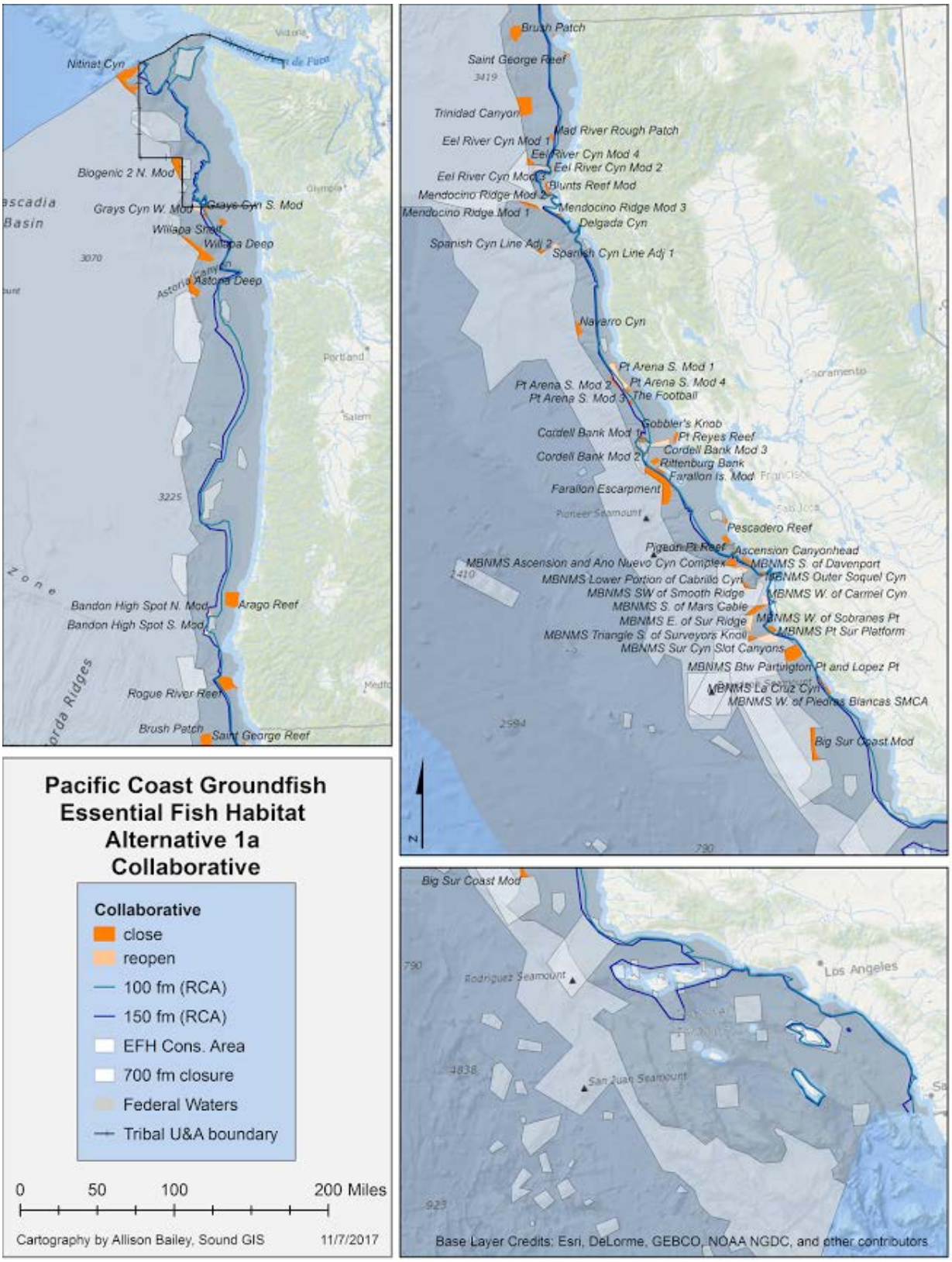

Figure 2-8. Alternative 1.a. the Collaborative Alternative.

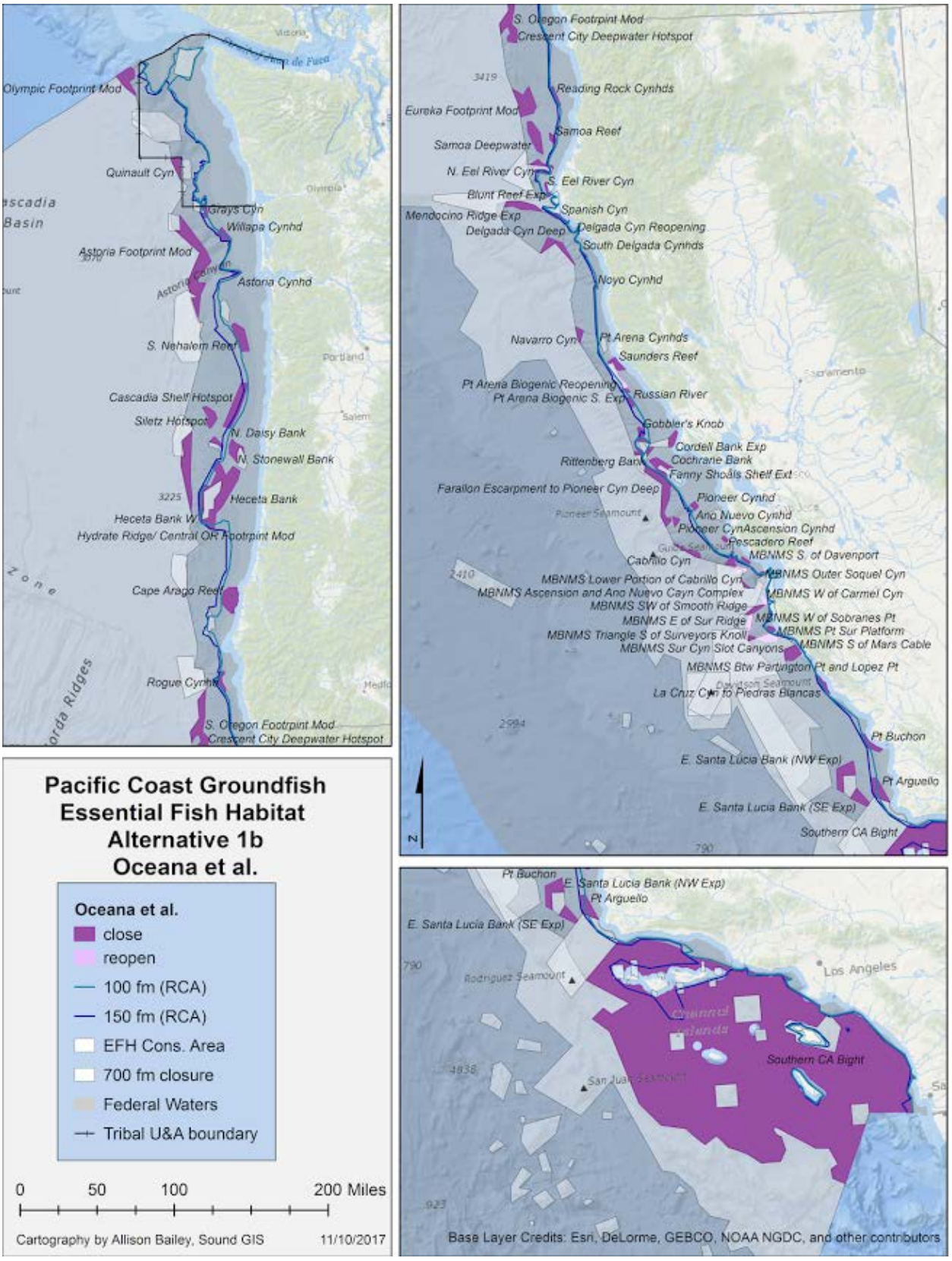

Figure 2-9. Alternative 1.b. the Oceana et al. Alternative.

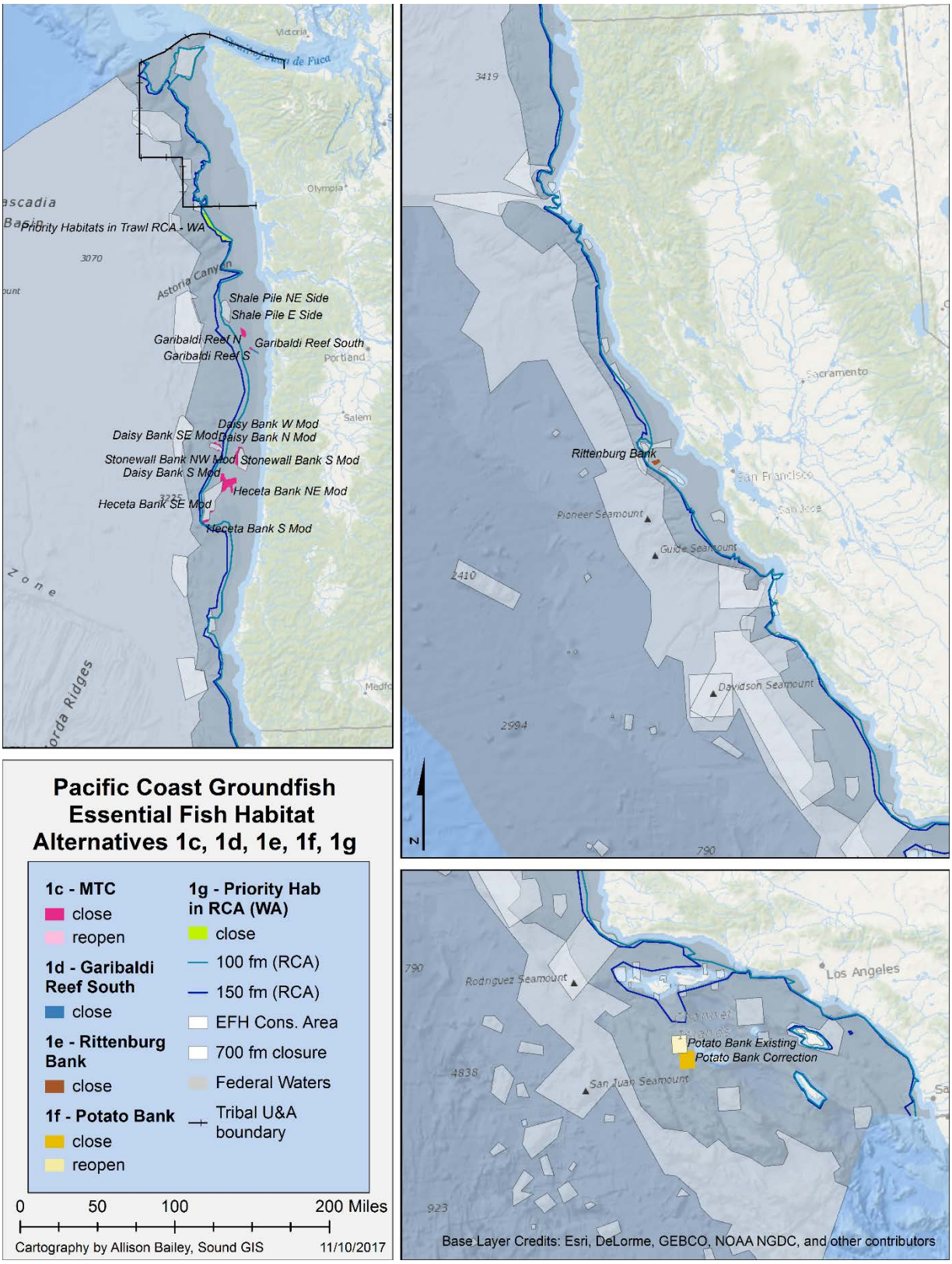

Figure 2-10. Map showing coastwide context for Alternatives 1c, 1d, 1e, 1f, and 1.g.

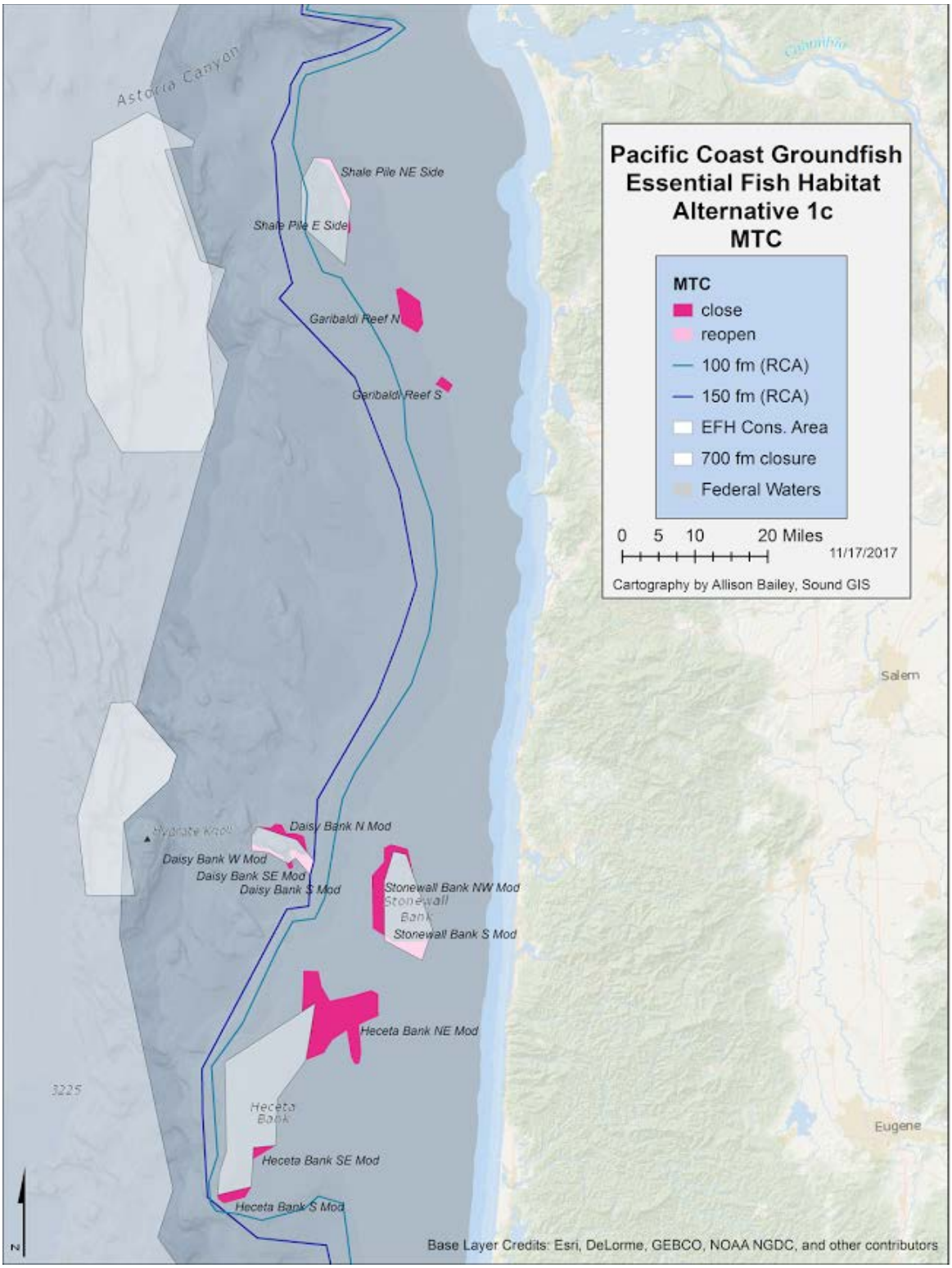

Figure 2-11. Alternative 1.c. the MTC Alternative.

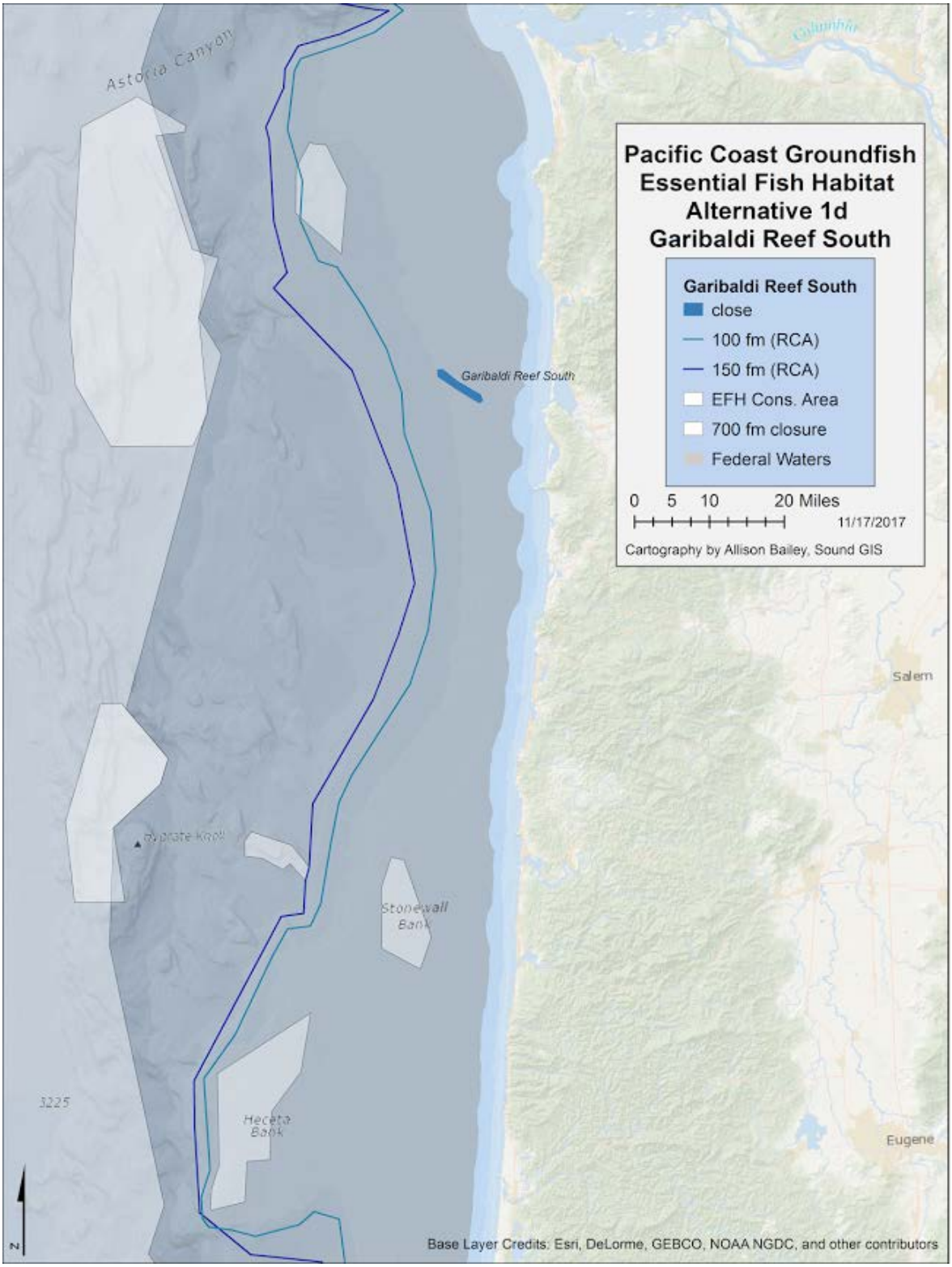

Figure 2-12. Alternative 1d: The Garibaldi Reef Alternative.

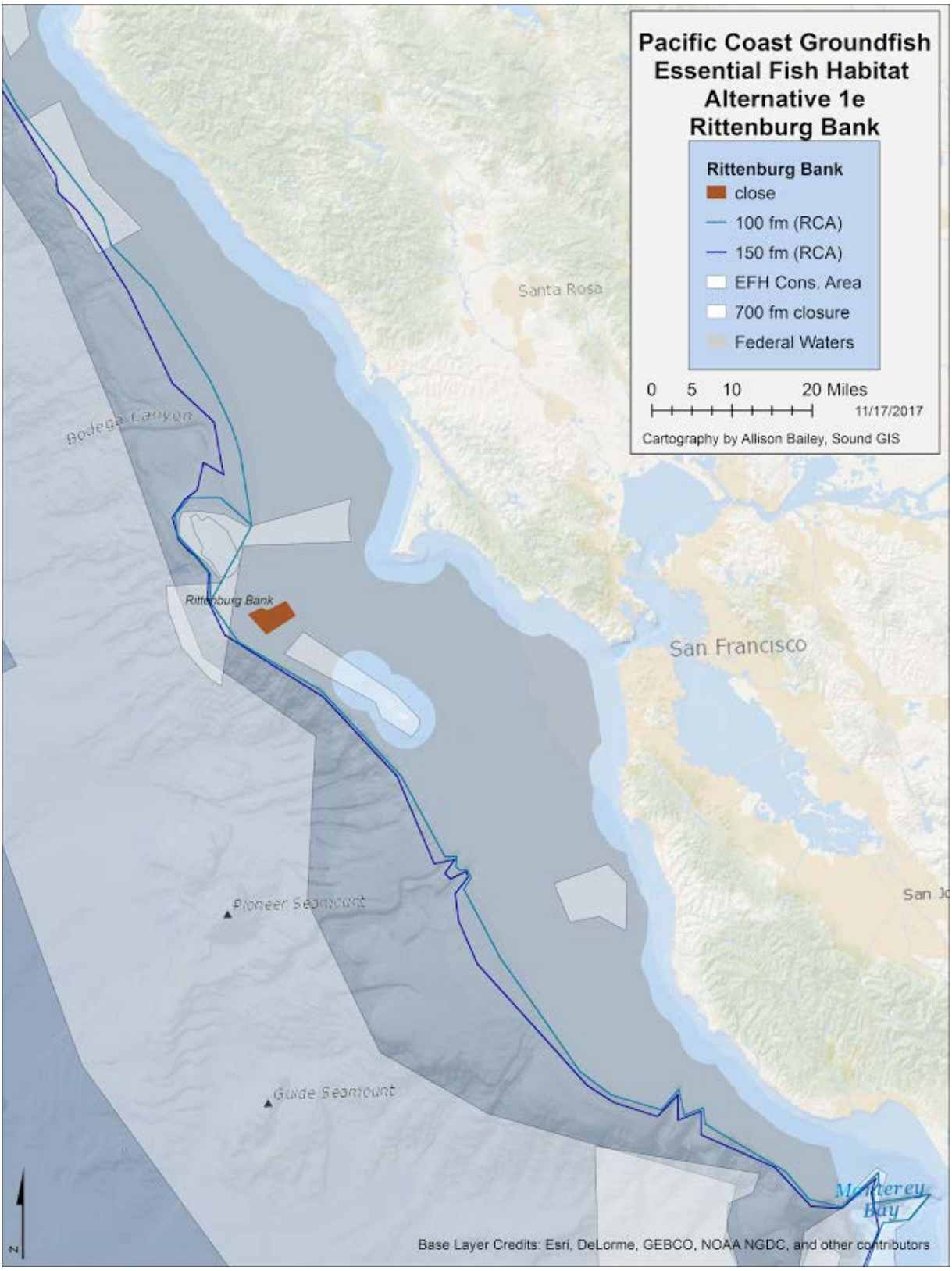

Figure 2-13. Alternative 1e, the Rittenburg Bank Alternative.

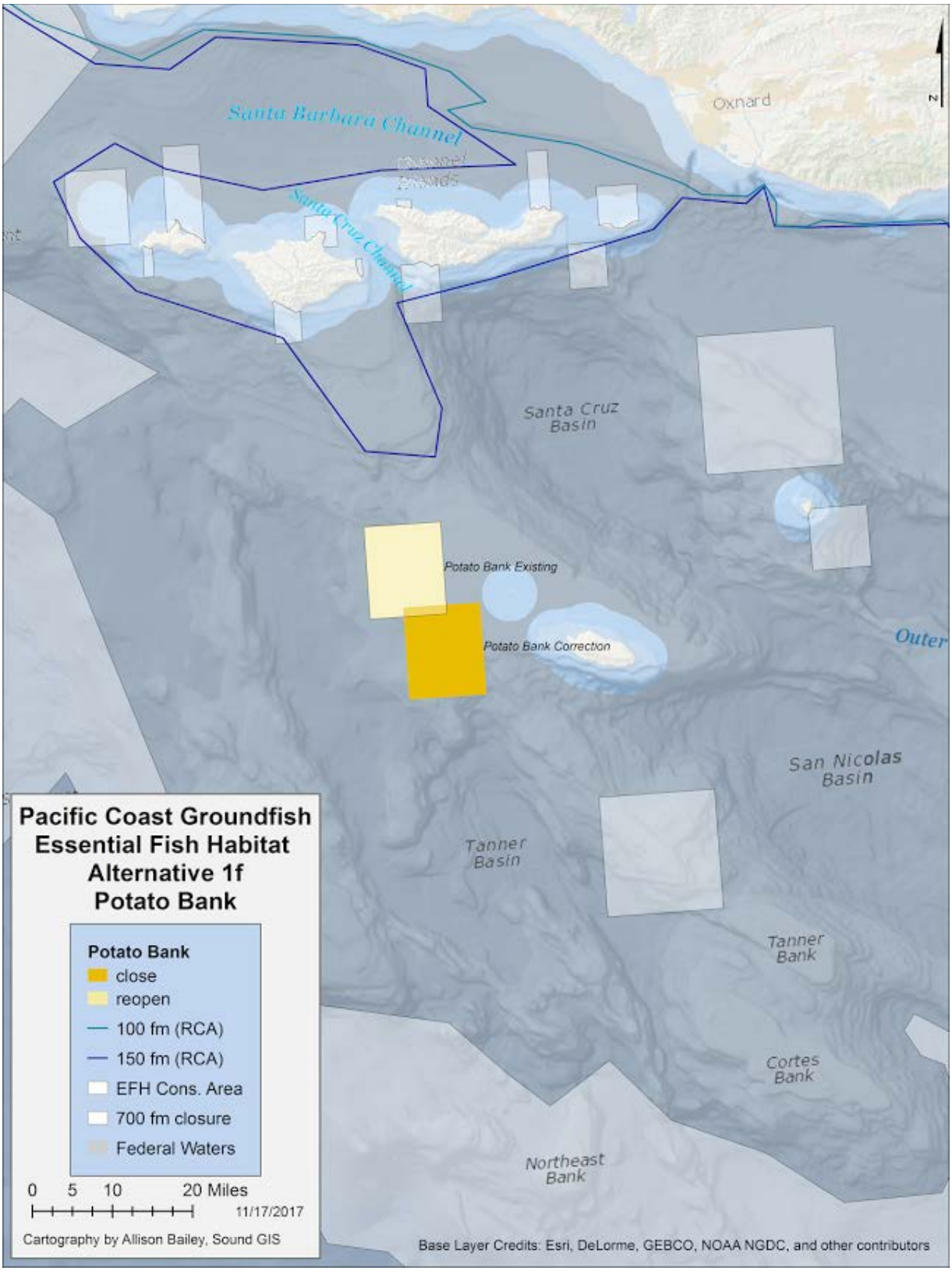

Figure 2-14. Alternative 1f: The Potato Bank Correction Alternative.

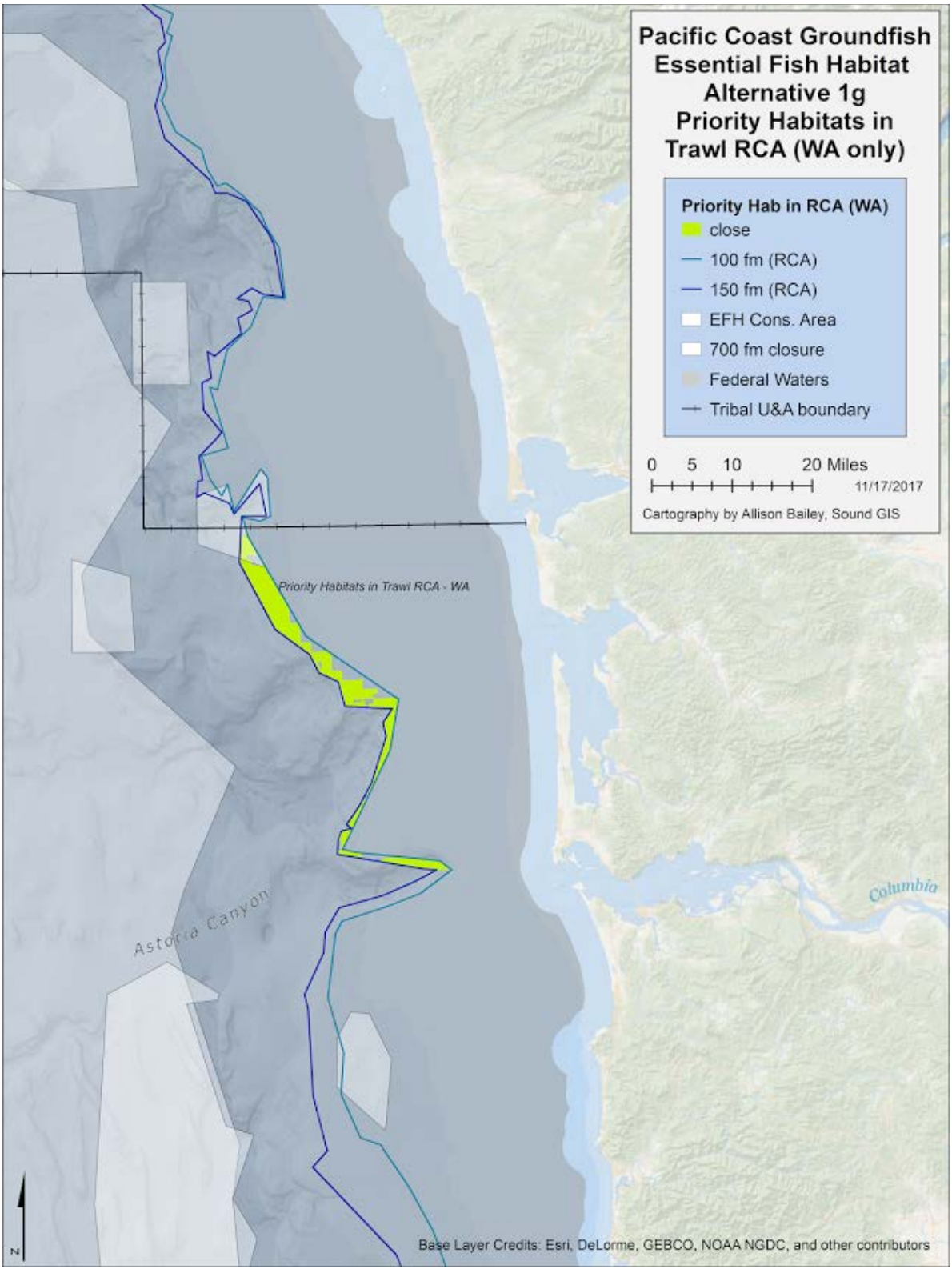

Figure 2-15. Alternative 1g: the new EFHCAs in Washington Alternative. Priority habitats would be used to define new EFHCAs.

2.3 Subject Area 2: Adjustments to the Groundfish Trawl RCA

The adjustments to the groundfish trawl RCA would either consist of eliminating it entirely (Alternative 2.a), or eliminating it and establishing other defined areas that could be closed (permanently or as needed) (Alternatives 2.b and 2.c). The types of closures and the species they are intended to manage would differ between the alternatives, as described below.

Some portions of the trawl RCA have remained closed since it was implemented in 2002. While depths and latitudes can change through time to meet fishery management needs, some depths have never been opened. Areas that were closed to groundfish bottom trawling for 3 or more years have provided habitat protections. However, the groundfish trawl RCA was designed to reduce and manage catch of overfished species. These alternatives would include reconsidering the purpose of RCAs as long-term closures to reduce catch of overfished species in the bottom trawl sector considering the 2011 implementation of the Shorebased IFQ Program and the individual catch accountability that it provides.

The trawl RCA overlaps with other bottom trawl closures (i.e., the EFHCAs, the CCA, and the CBGCA) (Figure 2-16). Unless, and until, these other BTCs are modified to allow bottom trawling, eliminating the trawl RCA would have no practical effect on bottom trawl prohibitions in those overlapping areas. Therefore, the analyses considered only the area of the trawl RCA that does not overlap with other BTCs. Elimination of the trawl RCA was analyzed in combination with a subset of the Subject Area 1 alternatives in Chapter 5, Synthesis.

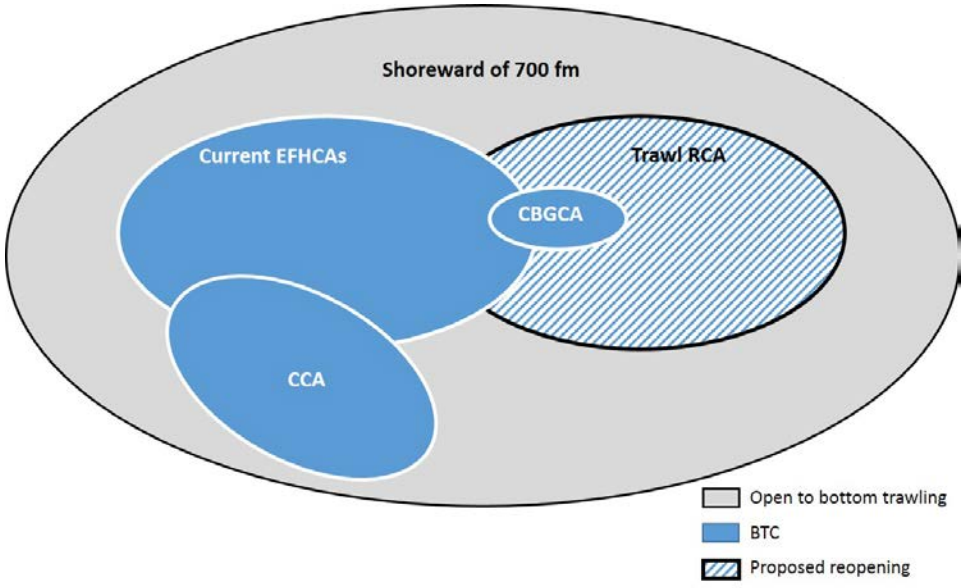

Figure 2-16. Conceptual Venn diagram showing the overlap of the trawl RCA with the other BTCs. Only the cross-hatched area would be reopened. Note: This figure is not to scale, and it is not intended to evaluate relative impacts.

2.3.1 Alternative 2.a Remove the trawl RCA.

This alternative would eliminate the entire trawl RCA outside of the tribal U&As, allowing access to vessels fishing with groundfish bottom trawl gear. This alternative would open areas extending from Point Chehalis, Washington, to the United States/Mexico border. Some of these areas have been closed to the commercial groundfish trawl fishery since 2002. All other fishing and gear types currently allowed to fish inside the trawl RCA (e.g., state-managed shrimp trawling and midwater trawling) could continue fishing if the trawl RCA were removed. Refer to Key Terms and Concepts for a description of the trawl RCA and its regulations. If the trawl RCA were removed, Section 6.6.1.1 of the FMP would still prohibit the use of bottom trawl gear with footrope diameter larger than 8 inches in diameter shoreward of the line approximating the 100 fm depth contour (as defined at 50 CFR §660.73).

The use of any bottom trawl gear except selective flatfish trawl gear (as defined at §660.11) is prohibited in the area shoreward of the trawl RCA. If the trawl RCA were removed, this restriction would have to be revised to prohibit the use of any bottom trawl gear except selective flatfish trawl gear shoreward of the line approximating the 100 fm depth contour (as defined at §660.73). The primary catch controls for vessels using bottom trawl gear within the Shorebased IFQ Program would be limited entry permits, IFQ, trip limits for non-IFQ species, and NMFS' authority to close the fishery to prevent the trawl sector in aggregate or the individual trawl sectors from exceeding an ACL, OY, ACT or formal allocation specified in the FMP or regulation.

This alternative would allow the use of large footrope bottom trawl gear on the continental shelf in depths as shallow as 100 fm. It is anticipated that additional information and discussion on this topic could occur after the publication of this PDEIS in the April 2018 briefing book.

2.3.2 Alternative 2.b Remove the trawl RCA and, in Washington, implement Discrete Area Closures (DACs).

This alternative would eliminate the trawl RCA, as described under Alternative 2.a, outside of the tribal U&A. In addition, discrete area closures (DACs) (Figure 2-17) in Washington would be available, either preseason or in-season, to reduce bycatch of overfished species by prohibiting fishing in one or more of five polygons by vessels using groundfish bottom trawl gear. Based on guidance from the SSC and the Council, the Project Team used available SSC-endorsed analytical tools to identify five DACs for darkblotched rockfish, yelloweye rockfish, and Pacific Ocean perch (POP). These DACs are in waters off the coast of Washington, and they are based on the probability of occurrence of suitable habitat. Cowcod and bocaccio were not included, as they are not considered overfished in waters north of 40°10' N. latitude.

In the latter half of 2017, darkblotched rockfish and POP had new stock assessments and were declared rebuilt. The 2019-2020 biennial harvest specifications and management measures will implement ACLs for these stocks that are no longer based on their respective rebuilding plans. Discussion of other reasonably foreseeable future actions that may have cumulative effects with actions considered here can be found in Section 3.

Areas were identified for inclusion in a DAC when they had a greater than 25 percent probability of being suitable habitat for one or more of the three species described above. Rectangular polygons were drawn to encompass those areas of greater than 25 percent habitat suitability probability (HSP). A detailed description of the methods used to determine DAC boundaries is available in Appendix A.

DACs would be open unless implemented under one of the following circumstances. DACs could be implemented preseason, based on conservation concerns for POP, darkblotched rockfish, or yelloweye rockfish, such as projected catch greater than the ACL. DACs could also be implemented inseason in response to new fishery information indicating an immediate need to reduce catch of one of these three species. Actions taken in-season would be based on Council recommendations or by NMFS' automatic action authority. Implementation of DACs must meet the procedural criteria in the FMP in Section 6.2. DAC implementation would be designated as a routine management measure for the Shorebased IFQ Program.

NMFS could use an automatic action, per the procedure detailed at Section 6.2.A of the FMP, only if the action were non-discretionary. A non-discretionary action would be possible if a situation that had been anticipated was encountered, and a specific action to address the situation was already prescribed in regulation. For example, if the Shorebased IFQ Program allocation and/or ACL for yelloweye rockfish were projected to be reached or exceeded, an automatic action could be put in regulation that would require NMFS to implement the two DACs based on yelloweye rockfish HSP (Yelloweye 1 and Yelloweye 2. If a situation were to arise that would not meet the automatic action criteria, it would likely fall into the category of actions described at Section 6.2.B. This would commonly include inseason actions to adjust routine management measures after a single Council meeting and via single *Federal Register* notice. The Council would have the discretion to consider implementing either a single DAC or multiple DACs, depending on the issue and conservation need. DACs based on darkblotched rockfish HSP should be considered for conservation of darkblotched rockfish. DACs based on POP HSP should be considered for conservation of POP. DACs based on yelloweye rockfish HSP should be considered for conservation of POP. The Council could make a recommendation for inseason implementation of one or multiple DACs. Implementation of the DACs recommended by the Council would close those areas to bottom trawl gear when the regulatory change is published by NMFS in the *Federal Register,* similar to

other changes to routine management measures (e.g., trip limits). Implementation procedures described for DACs here under Alternative 2b would be the same for BACs under Alternative 2c.

2.3.3 Alternative 2.c: Remove the trawl RCA and implement BACs.

This alternative would eliminate the trawl RCA outside of tribal U&As. In Federal waters, BACs would be available as a harvest management tool to prohibit fishing by vessels using groundfish bottom trawl gear at certain depths and latitudes. The waters off the West Coast, seaward of the state waters out to the 700 fm contour line, would be divided into 20 separate BACs (Figure 2-18), using existing depth contours and latitudes in regulation (Table 2-4).

Initially, these BACs would be open to fishing groundfish with bottom trawl gear, but they could be closed in the future to reduce harvest of groundfish species or protected species, particularly salmon. BACs are intended to be an inseason management tool for controlling harvest of target or non-target species, but they are not intended to be used for habitat protection.

BACs could be implemented preseason based on anticipated needs to reduce the harvest of target or non-target species. BACs could also be implemented inseason in response to new fishery information indicating an immediate need to reduce catch of a particular species or species complex. The Council could, if necessary, use the BACs to reinstate the trawl RCA. Procedures for implementation of BACs automatically or through inseason action would be the same as those described for Alternative 2.b.

BACs could be closed in any combination. For example, a single BAC could be closed in response to a sudden localized increase in yelloweye rockfish catch, or several BACs could be closed in response to higher than expected salmon bycatch levels in certain depths and latitudes.

BACs and DACs (described in Alternative 2.b are similar, but differ in several ways, as described in Table 2-4. The 20 block areas may be closed in any combination that is determined to meet the management needs, for a variety of groundfish and non-groundfish species. The five DACs off Washington are fixed polygons that were developed based on habitat data. Common to both area closures, they can be either closed to bottom trawling or open to bottom trawling; their location, and type of fishing restrictions cannot be modified inseason.

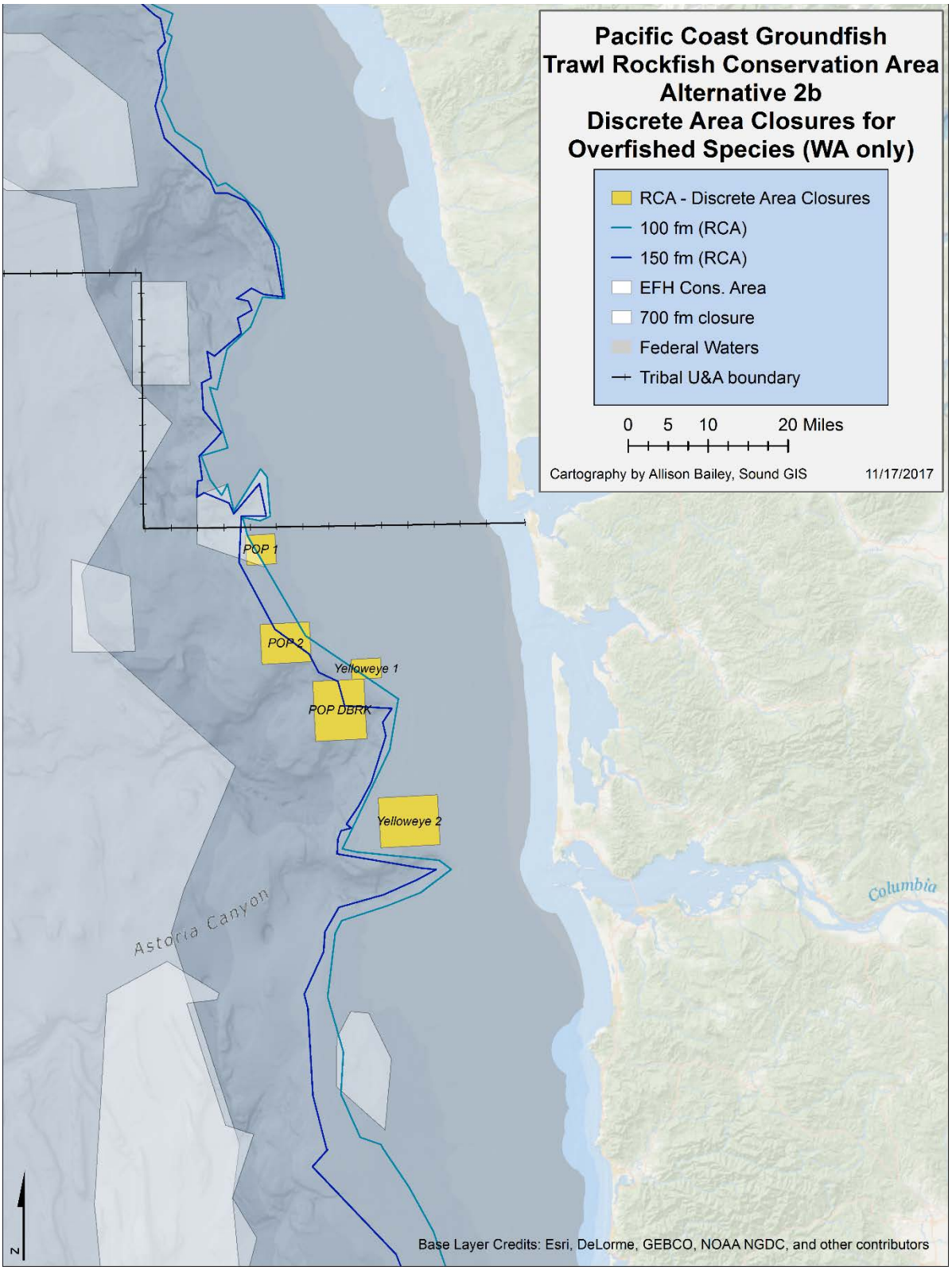

Figure 2-17. Discrete area closures that would be implemented under Alternative 2.b, the Remove the trawl RCA and, in Washington, implement DACs Alternative.

Table 2-4. Comparison of Alternative 2.b (DACs) and Alternative 2.c (BACs).

	Alternative 2.b **DACs**	**Alternative 2.c** **BACs**
Location	Washington Coast	Coastwide
Fishing Restriction	Closed to bottom trawling	Closed to bottom trawling
Number of areas	Five polygons	Twenty blocks
Defined by:	Polygons	East-west boundaries are defined by lines approximating depth contours (in four depth-bins ranging from 100 fm to 700 fm[a/]); North-south boundaries are defined by the northern and southern boundaries of the EEZ and four latitudes of interest.[b/]
Maximum extent	Closing all five polygons off the Washington coast	Closing all 20 blocks closes the entire EEZ out to 700 fm, except for the tribal U&A.
Purpose:	Protect darkblotched rockfish, POP and yelloweye rockfish	Control catch of species and/or species groups, including reducing salmon bycatch
Timing	Open until closed; may be closed pre-season or in-season.	Open until closed; may be closed pre-season or in-season.
Basis	HSP	Depth-bins and latitudes

[a/] Four depth bins are 0 to 30, 30 to 100, 100 to150, and 150 to 700.

[b/] Latitudes are Point Chehalis, Washington, Cape Blanco, Oregon, and Cape Mendocino and Point Conception, California. These latitudes are defined at 50 CFR 660.11 as "commonly used geographic coordinates."

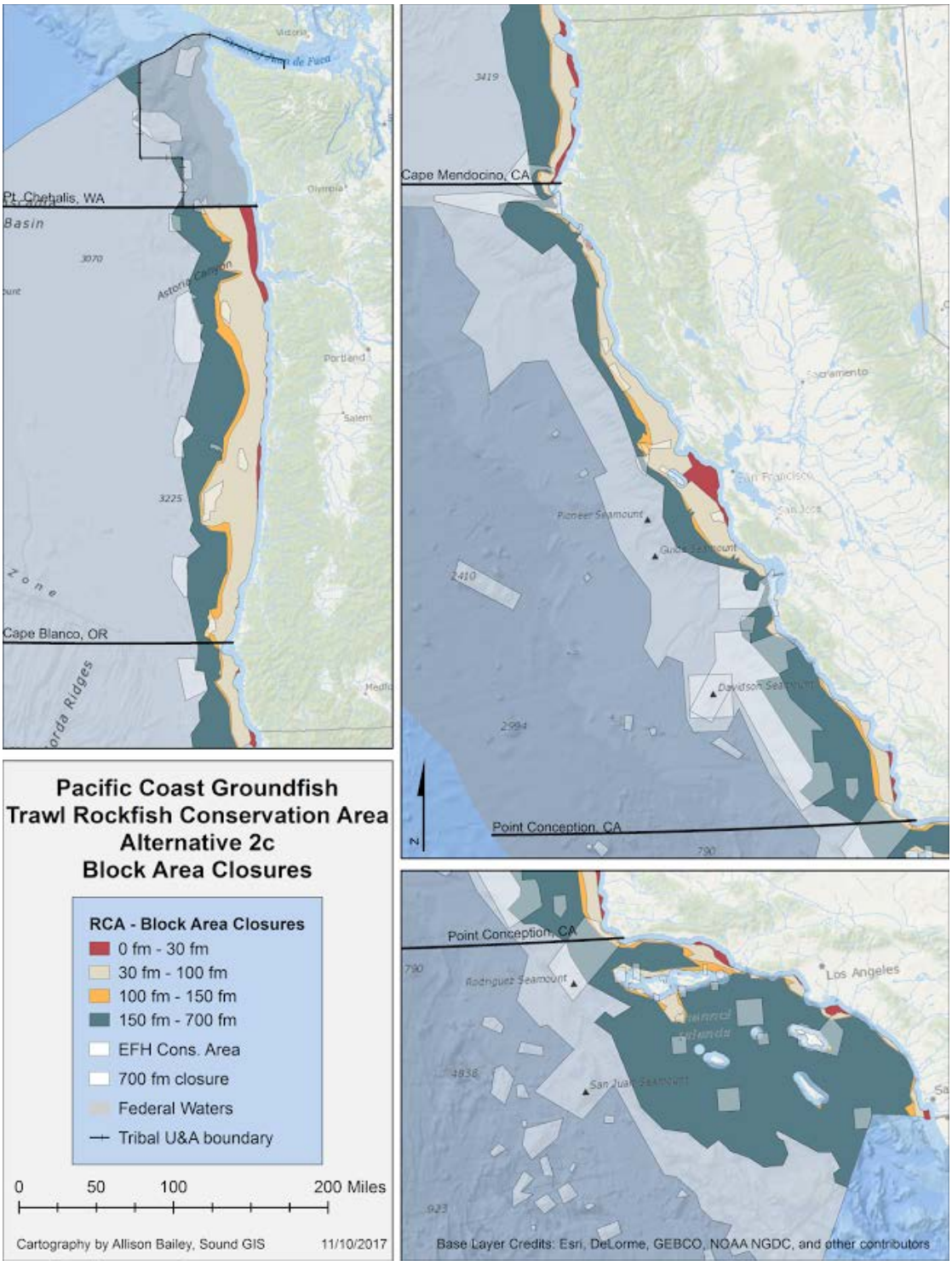

Figure 2-18. BACs that would be implemented under Alternative 2.c: Remove trawl RCA and implement BACs Alternative.

2.4 Subject Area 3: Use of MSA Sec. 303(b) discretionary authorities

The sections below describe discretionary authorities to close waters deeper than 3,500 m to bottom contact fishing gear. There is also discussion of exceptions to Alternative 3.a closures.

2.4.1 Alternative 3.a: Use MSA discretionary authorities to close waters deeper than 3,500 m to bottom contact fishing gear.

Alternative 3.a would use one of the discretionary authorities under MSA Section 303(b) to prohibit all fishing with bottom contact gear (described in Key Terms and Concepts) in waters deeper than 3,500 m (Figure 2-19). These would specifically include MSA Sections 303(b)(2)(A), 303(b)(2)(B), and 303(b)(12). These waters are seaward of groundfish EFH and shoreward of the EEZ (Figure 2-19). The discretionary authorities allow regional fishery management councils to designate zones where fishing is limited or not permitted, identify zones to protect deep-sea corals, and implement management measures to conserve target and non-target species and habitats.

2.4.2 Exceptions to 3.a closures

Exceptions could be made to this prohibition, but only if a permittee or vessel owner were to apply for, and receive, approval from the Council to do so via a groundfish EFP. Fishing with bottom contact gear without an EFP could only be authorized through an FMP amendment and changes in regulation. If this action were chosen as part of the FPA, issuance of an EFP would follow the groundfish EFP process described in Council Operating Procedure 19, Protocol for Consideration of Exempted Fishing Permits for Groundfish Fisheries. NMFS, in considering approval of an EFP, must ensure that the activities are consistent with applicable laws, including measures to protect EFH.

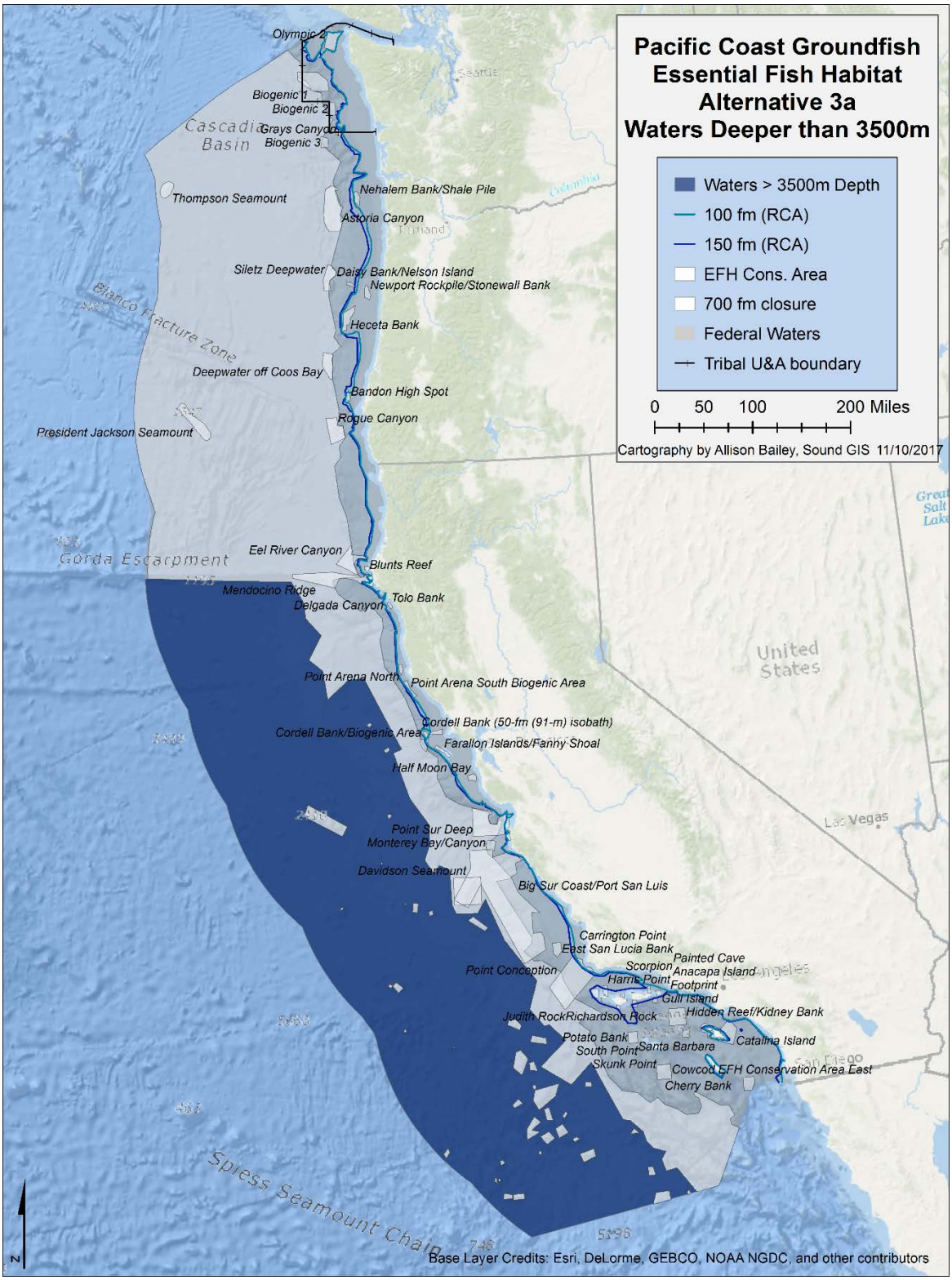

Figure 2-19. Alternative 3.a, waters deeper than 3,500 m.

3 AFFECTED ENVIRONMENT

Currently being developed.

4 ANALYSIS OF IMPACTS

This chapter contains descriptions of the analytical approach applied to the alternatives in Section 4.1. Section 4.2 describes how the alternatives were analyzed.

4.1 Description of Analytical Approach and Methods

This section first describes the analytical approach applied to the alternatives. It also contains a description of the potential effects of those alternatives. The analyses focus on a series of metrics used to evaluate the effects of the alternatives on benthic marine habitat, fish resources, protected resources, and economics. For each alternative, the metrics were summarized over five different levels: 1) by alternative (alternative-wide), 2) on a state-by-state basis, 3) by latitudinal areas and depth zones, 4) by each port or port group, and 5) by the individual polygons in the alternative. Not all levels were analyzed in each resource. For example, the habitat metrics are not analyzed by state.

4.1.1 Habitat

The sections below describe how the habitat effects of the alternatives were analyzed.

4.1.1.1 Criteria for Evaluating the Consequences of the Alternatives on Benthic Habitats

A full analysis of the consequences of each of the alternatives on benthic habitats would require detailed information on the following:

1) The current condition of the habitat
2) The impact on benthic habitat from closing or reopening areas to bottom trawling
3) The changes to the location and intensity of the bottom trawling effort that would result from the alternative
4) The spatial extent, geographic distribution, and ecosystem function provided by the discrete habitats that would be affected

The lack of comprehensive information on the first three types of information constrains our analysis of the effects of the alternatives on the spatial extent of the habitat types in the closures and openings, the net change to the extent of the habitat types that would be protected from bottom trawling, and the geographic distribution of those protections. Therefore, the analysis will rely on best available information, which is the extent of each habitat type in the areas to be closed or reopened by each alternative, as represented by the habitat metrics described below. Consistent with principles established in the EIS for Amendment 19 (NMFS 2005) to address the limited information on the ecosystem function of these habitat types, this analysis takes an approach to habitat protection that assumes, in the absence of definitive research, that it is beneficial to protect some portion of each habitat type and that higher levels of protection (by relative

area) are more beneficial than lower levels (NMFS 2005). This analysis also compares the extent of the priority habitats that will be reopened, as they have had 10 to 16 years to recover from past trawling. Therefore, alternatives that protect more types of habitats, those that protect a greater net spatial extent of the priority habitats, or those that reopen a lower spatial extent of the priority habitats, are viewed as providing greater habitat benefits than those that protect fewer types, protect a lower net spatial extent of priority habitats, or reopen more priority habitats. The extent of habitat protection will be determined by the net changes in the metrics described below when both the closures and reopenings are considered. When the net changes are positive, the effects of the alternative are viewed as beneficial, and when they are negative, the effects of the alternative are viewed as adverse. Those alternatives with more positive (or fewer negative) changes will be viewed as more beneficial to habitat than those with fewer positive (or more negative) changes.

As noted by the West Coast Governors' Agreement on Ocean Health (Johnson et al. 2010), while some high-resolution seafloor mapping has occurred along the West Coast, much of the region still lacks comprehensive maps to support improved management of marine resources and coastal communities. Johnson et al. (2010) estimated that the 2010 cost to map only state waters would exceed $20 million. While much of that has been completed, high-resolution mapping with multi-beam echosounders outside of state waters is limited to a number of relatively small areas, with most of the seafloor remaining to be mapped (Waldo Wakefield, email sent to Galeeb Kachra, NMFS West Coast Region November 8, 2017, regarding the need for, and the costs to conduct, comprehensive seafloor mapping along the West Coast). The costs to conduct such mapping would be extraordinarily high due to the sheer extent of Federal waters along the West Coast. The cost to collect multibeam sonar data on the outer shelf and upper slope seafloor to a depth of 1,300 m was estimated, in 2010, to be approximately $15 million, with another $10 million to ground-truth the data (Goldfinger et al. 2010). This estimate did not cover the cost for mapping the deeper waters. Although a plan to produce a comprehensive map of West Coast seafloor habitats was developed in 2015 (Yoklavich and Wakefield 2015), the project was shelved due to NOAA budget constraints.

Seafloor maps have improved significantly since Amendment 19, but they rely heavily on interpolated substrate type from adjacent surveys that were often conducted before the advent of high-resolution multibeam sonar and from core samples, resulting in a low level of confidence. As noted above, areas where substrate is mapped with high confidence occur primarily within state waters, with scattered areas in Federal waters. Given these caveats, the current seafloor habitat maps represent the best information available, and they form the basis of the habitat analysis.

4.1.1.2 Habitat Metrics

The sections below describe aspects of habitat metrics.

4.1.1.2.1 Spatial extent of closures and reopenings

This metric describes the spatial extent of the areas that would be closed or reopened to bottom trawling, in square miles (mi^2). Net changes in the spatial extent were calculated as "closed minus reopened." Alternative boundary data are available via the NWFSC FRAM Data Warehouse at the following website: https://www.nwfsc.noaa.gov/data/map.

4.1.1.2.2 Substrate composition of areas proposed for closures and reopenings

This metric describes the spatial extent, in mi^2 and the proportion of the seafloor area covered by each of three substrate types: 1) hard bottom, 2) mixed bottom, and 3) soft bottom. Where substrate data are lacking, the substrate type is listed as "unknown."

Oregon State University (OSU) developed the substrate data in two versions. Version 3.6 of the substrate data covers the entire West Coast and was used for areas in central and southern California. Version 4.0 contains limited updates to the Version 3.6 data that resulted from work with the Bureau of Ocean and Energy Management. Version 4.0 was used for areas off northern California, Oregon, and Washington (https://www.webapps.nwfsc.noaa.gov/server/rest/services/FRAM/EFH_Habitat_Induration_v4_v361/MapServer).

4.1.1.2.3 Submarine Canyons and Gullies

This metric represents the spatial extent (mi^2) of submarine canyons and gullies. Submarine canyons and gullies were delineated as part of the geologic mapping for the Groundfish EFH process in 2005 (http://marinehabitat.psmfc.org/physical-habitat.html), and OSU updated the version for areas off northern California, Oregon, and Washington, as described in Section 4.1.1.2.2, above. The boundaries for submarine canyon walls, canyon floors, and gullies were extracted from these data sets and overlaid with the EFHCA alternatives.

4.1.1.2.4 Seamounts

This metric represents the spatial extent (mi^2) of sea mounts, which were delineated as part of the Groundfish EFH process in 2005 (http://marinehabitat.psmfc.org/physical-habitat.html). For this metric, the boundaries from 2005 were supplemented by additional seamounts within the Pacific Coast EEZ that were delineated by GRID-Arendal (http://geonode.grida.no/layers/geonode:seamounts or http://www.grida.no/publications/story-maps/map/6596.aspx). Because the analysis found that seamounts

do not occur in the areas to be closed or reopened under the EFHCA alternatives or within the trawl RCA, they will not be discussed further.

4.1.1.2.5 Overfished species (OFS)

This metric represents the area (mi^2) where the probability of occurrence of an overfished species was at least 80 percent of the maximum probability of occurrence predicted by models that were created during the Groundfish EFH Synthesis process (NMFS 2013). The Northwest Fisheries Science Center (NWFSC) and the National Center for Coastal and Ocean Science (NCCOS) each developed a set of gridded species models for a select group of groundfish species (for more information, see the following website: http://efh-catalog.coas.oregonstate.edu/synthesis/). These groups included three overfished species: darkblotched rockfish, POP, and yelloweye rockfish. From these models, we used the predicted probability of occurrence for the following three overfished species: darkblotched rockfish and yelloweye rockfish from the NWFSC models and POP from the NCCOS models. The predicted probability of occurrence of each species was overlaid with a 1 km grid cell. Any grid cell that had at least 80 percent of the maximum probability of occurrence score for that species was considered priority habitat. Cowcod (*Sebastes levis*), another overfished species, was not modelled and was, therefore, not included in this metric.

Recently, NMFS declared two of the three species, darkblotched rockfish and POP, rebuilt. Therefore, while this metric identifies area with high probability of occurrence of these two species, it may overestimate the area with a high probability of species that are actually overfished.

4.1.1.2.6 Habitat-forming invertebrates

Two HFI metrics were developed that summarized the presence or bycatch of deep-sea corals (Class Anthozoa), sponges (Phylum Porifera), and sea pens (Order Pennatulacea). Presence and bycatch are detailed below.

Presence. The first metric summarizes presence data, compiled by NOAA's Deep-Sea Coral Research and Technology Program (DSCRTP; https://deepseacoraldata.noaa.gov/). Data points represent the geographic locations of in situ observations, the midpoint of underwater vehicle transects, or NMFS trawl survey events in which observations or catch were summarized. A 1 km grid (0.39 mi^2) was overlaid on the DSCRTP records for each taxonomic group. With the exception of the NMFS trawl survey data, only those records with a locational accuracy of less than 1 km were included in the analysis. The number of grid cells within, or overlapping with, each polygon with presence data (defined as at least one record) were then counted for each taxonomic group. The lack or the absence of consistent abundance data precludes the ability to determine, in a standardized way, the relative importance of individual areas to

corals, sponges, or sea pens. A more detailed description of the methods employed are found in Appendix A.

Bycatch. The second metric summarizes standardized bycatch of deep-sea corals, sponges, and sea pens recorded in the United States Pacific Coast bottom trawl fishery by the West Coast Groundfish Observer Program (WCGOP). For bottom trawls, standardized catch is typically defined by catch (weight) per unit effort (distance fished) (CPUE) for individual tows. A 0.5 km grid (0.01 mi^2) was overlaid on the fishery, and the mean bycatch CPUE for each taxon was calculated for each cell. For each taxonomic group, cells that exceeded the coastwide median bycatch CPUE of that group were counted. A more detailed description of the methods employed is found in Appendix A, Habitat Metrics, by Geographic Break and Polygon.

The data behind these two metrics were collected for different purposes using different methods. Therefore, they are unlikely to show the same pattern of distribution due to the different data sources, interpretations, and areas over which the data were collected. Presence consists of point data for positive observations, while the bycatch consists of data collected along a tow line that includes negative observations (i.e., no HFI in the tow). In addition, the sampling intensities and the sampling area vary significantly between the two data sets: the Presence data are based largely on targeted sampling and the NWFSC trawl survey, while the bycatch data were collected from commercial bottom trawling over the entire area that is fished.

4.1.2 Fish Resources

This section describes the approach and methods used to assess impacts of the alternatives on fish resources for the No-action Alternative and each of the alternatives in the three Subject Areas. Fish resources fall within multiple categories, and they include all those finfish and shellfish resources that occur in the Action Area that may be affected by the proposed action. Two levels of analysis are taken. The first level is qualitative, encompassing discussion across all fish resources for each alternative. The second level is quantitative, encompassing the impacts to fish resources harvested with bottom trawl gear within the Action Area; thus, the quantitative analysis of the effects of the alternatives on fish resources focuses on groundfish stocks managed under the FMP, including overfished[13] and economically important species.[14]

[13] For the purposes of this analysis, overfished species included cowcod and yelloweye rockfish.

[14] For the purposes of this analysis, economically Important Species included Dover sole, sablefish, petrale sole, shortspine thornyhead, longspine thornyhead, yellowtail rockfish, longnose skate, lingcod, arrowtooth flounder, Pacific cod, bocaccio, darkblotched rockfish, and POP.

A qualitative approach is taken to assess the impacts of the alternatives across all fish resources. Academic studies have explained potential positive effects on fish resources from closed areas such as an increase in species richness, size, and productivity within the area boundaries (Lester et al. 2009; Lubchenco and Grorud-Colvert 2015; Vandeperre et al. 2011), as well as larval seeding of surrounding areas (Thompson et al. 2017). The data to evaluate these effects on an alternative-by-alternative basis do not exist. Therefore, these potential effects are analyzed qualitatively. The approach makes several assumptions:

1. Areas that prohibit use of bottom trawl gear will benefit fish resources that utilize any part of habitat in that area because habitat improvements will benefit fish populations that live there; the more mi^2 of habitat protected, the better it will be for fish resources.
2. Trawlable habitat that reopens to bottom trawling will have some level of harvest with bottom trawl gear, and operation of the fisheries in these areas will impact benthic habitats; the more mi^2 of habitat that are reopened, the worse it will be for fish resources.
3. Overall effort and total harvest with bottom trawl gear will continue to be limited by fishery management measures to promote healthy fisheries and prevent overfishing.

Harvest has not approached the allocations for many groundfish species that are managed with IFQ in recent years (Council 2017; see Table 1). Factors that may limit attainment are anticipated to continue under every alternative (e.g., multi-species fishery, weak stock management, shifting market conditions, etc.), but it is uncertain how the effects of limiting factors might change under the any of the alternatives. Harvest of the full ACL for groundfish species is the anticipated "highest" negative impact that the fleet could have on groundfish fish resources from directed harvest activities. Higher attainment of trawl allocations and/or ACLs is considered in more detail in Section 4.2.3, Economic Resources.

A limitation of the qualitative analysis is that not all mi^2 of habitat are equally beneficial to all fish resources. Impacts on fish resources of equal-size, closed/reopened areas are unlikely to be absolutely neutral for each species because of specific habitat characteristics of the polygons. Specific characteristics would include those for which EFH is designated. The definition is as follows: ''those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity'' (16 U.S.C. 1802(10)). Specific characteristics would also depend on whether the affected areas are considered trawlable (e.g., soft bottom) habitat. Several questions were asked. The first question is as follows:

Would benefits of protecting XXX mi^2 offset a reopening of the same size?

To attempt to address questions like this, a quantitative approach was taken to assess the impacts to groundfish species from closures/openers. Groundfish species harvested with bottom trawl gear were the primary focus of the quantitative analysis described below.

The second question is as follows:

How would potential changes in location of fishing impact fish resources?

To answer this question, we used groundfish bottom trawl landing weight data described below:

Effort, landings (weight), and ex-vessel revenue associated with areas to be opened and closed are used in the context of fishery-wide data to provide quantitative information that informs the qualitative analysis. Effort is derived from logbook data, and it measures the time spent and specific locations used by bottom trawl vessels engaged in relevant fishing activity. Landings are derived from the PacFIN database, and they are a measure of the weight of fish being delivered to buyers in the port groups. Ex-vessel revenues are also derived from the PacFIN database; they measure the gross value of the fish being delivered to buyers in the port groups.

Data used include treaty (landings made by Native Americans under rights secured by treaties with the United States government) and non-treaty commercial groundfish bottom trawl fishery landings (round weight) associated ex-vessel revenue and effort (trawl hours) from trips conducted in open areas inside and outside the tribal U&A areas. Only non-treaty data are used to quantify the catch from areas potentially affected by the action alternatives, but combined treaty and nontreaty information is used to put those effects in the context of the entire bottom trawl commercial fishery. For the non-treaty landings weight, PacFIN fish tickets have been adjusted using state logbook information to assign fishing locations. No logbook records are associated with treaty fishery landing records.

Using these fishery data, we only reviewed the landing weights of groundfish that were from areas that would close and areas that would reopen under each alternative. Because most of the areas to be reopened have been closed for more than 15 years, only older fishery data (1997 to 2001) could be used to inform such a location-specific analysis. For areas to be reopened, historical information on the fishing grounds are from a different fishery, market, and management era, and they may no longer represent the current or future fishery under the proposed action. Percentages indicate relative importance of a fishing area under the conditions present during the period used for of the evaluation. Most of the areas to be closed have been open to bottom trawling in recent years, and fishery data from more recent time periods (2011 to

2014[15]) were available to inform this harvest levels from these areas. Because of the need to use two different data sets, the analysis of each alternative is divided into two parts: 1) areas that would be closed and 2) areas that would be reopened. Landing weights provide a metric to estimate the relative impacts of each alternative to fish resources.

Efforts are made to describe whether an alternative would include areas more likely to be used by particular groundfish species based on depth, latitude, and bottom type characteristics. Historical catch of species within an area is analyzed as a percentage of the coastwide catch of the species by bottom trawl. Providing historical catch from areas to be reopened gives us a sense of the relative importance of an area to the fishery.

Analyses are presented for each alternative. To the extent practicable, these data are presented on a finer north-south spatial scale than coastwide, broken into four sections of coast by latitudes of interest (i.e., latitudinal zones). Also, to the extent practicable, these data are presented at different depths (i.e., depth bins). If an alternative is not specific to such a breakout (e.g., Alternatives 1.c and 1.g do not propose polygons across depth bins or latitudes), only coastwide data are presented. A discussion of the impacts of each alternative is included in Section 4.3.2, Fish Resources.

Efforts are made to describe whether an alternative would include areas more likely to be used by particular groundfish species based on depth, latitude, and bottom type characteristics. Historical catch of species within an area is analyzed as a percentage of the coastwide catch of the species by bottom trawl. This gives a sense of the relative amount of harvest that was sourced from the area to be closed and that may occur in the areas to be opened. To the extent practicable, these data are presented on a finer north-south spatial scale than a coastwide scale; they are broken into four sections of coast by latitudes of interest (i.e., latitudinal zones). Also, to the extent practicable, these data are presented at different depths (i.e., depth bins). If an alternative is not specific to such a breakout (e.g., Alternatives 1.c and 1.g do not propose polygons across depth bins or latitudes), only coastwide data are presented.

4.1.3 Economic Resources

The sections below outline economic issues associated with the alternatives. The approach, metrics, data sources and data development, and data limitations are discussed in the subsections below.

4.1.3.1 Approach to Assessing Effects

The approach for the analysis is primarily qualitative. Where possible, some quantitative information is provided to help inform the qualitative analysis. Under the no-action alternative, some ocean areas would

[15] a period that, at the time this analysis was started, included all completed PacFIN data years since implementation of trawl rationalization in 2011

remain open to bottom trawl fishing, and other areas (some RCA areas closed since 2002) would remain closed to bottom trawling. The area closures in the current fishery are discussed qualitatively in the context of recent changes to the management regime. Quantitative information is provided showing both conditions in the current fishery and how those conditions have changed from the time prior to EFH/RCA closures. The evaluation of the action alternatives is conducted through a general qualitative economic analysis (Section 4.2.3.2, Action Alternatives: General Qualitative Analysis) which is then informed with quantitative information on the recent and past importance of fishing grounds to be opened or closed.

Providing information on the past importance of the fishing grounds for which closures and reopenings are proposed under the action alternatives required two distinct approaches: one for areas proposed for closure and another for areas proposed for reopening. For areas that are currently open, but that are proposed for closure under an alternative, most recent fishery data were used: bottom trawl fishery activity conducted from 2011 to 2014, a period that, at the time this analysis was started, included all completed PacFIN data years since implementation of trawl rationalization in 2011. No recent data are available for areas that are currently closed, since there has been no recent bottom trawl fishing in the area. The most recent period of activity in which these areas were open, prior to establishment of trawl RCAs and EFHCAs and consequent closure of the areas to bottom trawl fishing, was 1997 to 2001. Quantitative information on proposed reopenings cannot be summed with the results for proposed closures because data differences prevent direct, quantitative comparison.

The data for each time period contribute to the qualitative analysis only by providing indicators of the potential importance of particular grounds within the context of conditions present at the time—an importance that will vary depending on an array of other factors influencing the choices of fishermen. The net economic changes expected from any particular opening and closing are not possible to estimate quantitatively because the data and models are not available and developed to predict how fishermen will redeploy, increase, or decrease their effort, or how the resultant catches will change.

The 2011 to 2014 data used for new closures may indicate the amount of activity that closures potentially displaced. However, it is difficult to predict how fishing behavior would change in response to reconfiguring open and closed areas under each alternative because of the dynamic nature of the current trawl IFQ fishery and the involvement of vessels engaged in the non-whiting trawl fishery in other fisheries off the West Coast (e.g., whiting IFQ, at-sea whiting, Dungeness crab, etc.) or Alaska (Gulf of Alaska groundfish trawl, Bering Sea/Aleutian Islands groundfish trawl, etc.). In response to the loss of some fishing grounds, some operators may choose to increase their vessels' involvement in one or more of these other fisheries and lease or sell their IFQ to other operators involved in the West Coast groundfish fishery who may use different strategies or participate on different areas of the coast.

The 1997 to 2001 data used for reopenings indicate something about the size of the new opportunities that might arise with availability in these areas, but they do not indicate how much of any activity in the newly opened area will simply be relocation of existing activity and how much will manifest as expanded catch. While many factors may alter the importance of these grounds if reopened, an important issue will be that reopened grounds may provide the fishing areas to which vessels will move when displaced by closures. Based on this factor, a reopened area might be more important when some areas are closed than would be indicated by data summarized from a time when there were few, if any, area restrictions.

Relative efficiencies and other economic advantages of one fishing ground over another would have to be known to predict fishermen's responses to opening and closing and to determine net effects. These relative advantages/disadvantages are likely to depend on multiple factors that include alternative fishing opportunities, vessel specific performance, time of year, and individual fishermen's knowledge, preferences, and risk tolerances. The modeling and determinations would require data beyond what are currently available. See Section 4.2.3.2, Action Alternatives: General Qualitative Analysis, for additional discussion of factors influencing vessel choices. Limitations on use of the quantitative data are further discussed in Section 4.1.4.3, Protected Resources.

Summary qualitative discussions of net economic effects for each action alternative are presented in sections following the general qualitative analysis of the action alternatives. They are also addressed in Chapter 5, along with the synthesis of the effects of combinations of multiple alternatives.

4.1.3.2 Metrics

The following metrics are used to indicate past importance of the fishing grounds that may be opened or closed: effort (hours of bottom trawling), landings (round weight pounds), and ex-vessel value/revenues[16] (inflation-adjusted 2015 dollars[17]). These metrics were chosen because they are readily available from existing fishery databases, and they are comparable over time, as discussed in the following section.

As described in the previous section, landings in terms of round weight pounds and ex-vessel value in inflation-adjusted 2015 dollars have been summarized for two periods: 2011 to 2014 (to describe catch in areas that are currently open) and 1997 to 2001 (to describe catch in areas currently closed). The basis for choosing these periods is described above. To the degree that recent effort, landings, and ex-vessel values reflect what would continue to occur under the No-action Alternative, they can be characterized as

[16] "Ex-vessel revenue" in this case consists of the round weight landings times the ex-vessel price. It represents the gross revenue received from the buyer by a fishing vessel making a landing.

[17] Ex-vessel revenue presented in the tables is inflation-adjusted to 2015 dollars using the GDP implicit price deflator. The base year used is 2015 because it is the year in which the primary datasets were compiled for this analysis.

measures of fishing activity that would be displaced from the closed areas. For areas to be reopened, historical information on the fishing grounds comes from a different fishery, market, and management era (one with relatively few area restrictions), and this information may no longer represent the current or future fishery under the proposed action.

Landings weight and ex-vessel values are presented both as absolute values (round weight pounds and ex-vessel dollars) and as percentages of non-whiting bottom trawl groundfish landings weight and value over the corresponding period. Percentages indicate relative importance of a fishing area under the particular conditions present during the period used for of the evaluation. Additionally, percentages place potential changes in proportion to total activity, aiding in overcoming distortions caused by differences in the relative size of the fishery in the two different periods and displaying the importance of an area within the context of the fishery of the time.

Landings weight and ex-vessel value are provided for all species combined. Additional breakouts of landings weight and ex-vessel value by species and/or market category are included in Appendix A. Landings weight and values associated with the areas proposed for closures and openings are grouped at the aggregated port area, state, and coastwide levels.[18] Information is presented in aggregate to enable use of confidential data. Port groups are derived from the input-output model for Pacific Coast Fisheries (IO-PAC) and are as follows: North Washington Coast; Puget Sound; South and Central Washington Coast; Astoria, Newport; Coos Bay; Brookings; Crescent City; Eureka; Fort Bragg, California; San Francisco; Monterey; and Morro Bay.[19] These groups are described in greater detail in a 2011 NOAA Technical Memorandum (Leonard and Watson 2011; Table 9).

4.1.3.3 Data Sources and Data Development

For the economic metrics described above, data on weight and effort were acquired as described in Section 4.1.2, Fish Resources. Ex-vessel value was developed by multiplying the round weight landings times the ex-vessel price. It represents the gross revenue (ex-vessel revenue) received from the buyer by a fishing vessel making a landing. Ex-vessel revenue has been inflation-adjusted to 2015 dollars by using the gross domestic product (GDP) implicit price deflator. The base year of 2015 is used because it is the year in which the primary datasets for this analysis were compiled. Effort is reported in terms of catch

[18] To aid the reader in understanding high-level summary impacts, the analysis in this chapter provides aggregated non-whiting trawl groundfish landings and revenue data by the port group of landing. Appendix A contains more detailed, species-specific information. Available effort data are insufficiently detailed to associate overall historical effort or effort in areas proposed to be reopen or closed with individual species landings. This is because effort is a measure of the time a vessel's trawl net is in the water, and it is not differentiated by how long it took to catch and land any species caught during a trip, or to which port the most time-consuming catch was delivered.

[19] IO-PAC is used in some contexts to estimate gross changes in economic contributions and the economic impacts of policy, environmental, or other changes that affect fishery harvest.

location, since it is through the mechanism of changing restrictions of catch locations that the action alternatives will have their impacts.

4.1.3.4 Data Limitations in the Economic Analysis

Limitations on the data used in the economic analysis included the following:

- Difficulties in assigning tows to specific locations
- Uncertainties about the relation between fishing area data used as quantitative indicators for each historic period and the effects of closures (1997 to 2001 and 2011 to 2014)
- The inappropriateness of summing data from the two periods in the above bullet

One of the challenges with the logbook data was determining the location to which to assign particular tows. The location of non-tribal trawl fishing effort was obtained from landings tickets matched to logbook data. The logbook-reported coordinates of the set (starting) point defined the location for each bottom trawl tow and any resulting catch. Since a trawl tow moves and may last several hours, some error is associated with using this method to assign effort location and depth (Appendix A). Alternative methods such as using the end point rather than the set point or calculating the geographic average of the reported set point and end point coordinates may change the assignment of catch and effort to different locations and/or depths. However, analysts determined that using the end point rather than the set point to infer location would not reduce the bias, and the location-averaging method was unnecessarily complex for this application. Bias introduced by using any one of these methods to infer individual tow locations would likely average out when combining the thousands of tow records in the project dataset.

Uncertainties about responses to closures are discussed above in Section 4.1.4.1, Approach to Assessing Effects, and they limit interpretation of these quantitative data. Some areas proposed to be reopened have been closed since 2002 and, therefore, lack recent fishery history data. As a proxy, this analysis uses data from 1997 to 2001, a period when those areas were open, to gain a general sense of how important a particular area was to the industry historically. While we cannot predict the actual activity associated with any specific reopening, we can reflect the relative level of fishing activity that occurred in an area prior to its closure. The 2011 to 2014 data are used to indicate landings associated with the effort that would be displaced from a particular area proposed for closure. Should an area be closed to fishing, the effort previously exerted in that area could be displaced and dispersed over areas that remain open or that disappear. Some combination of these two effects could also occur.

Further, data for the two periods cannot be compared to each other. The magnitude of the metrics used in this analysis (effort, landings weight, and revenue) are generally larger from 1997 to 2001 than from 2011 to 2014. As shown in Figure 4-1, the number of participating vessels, landings, and revenue declined

steadily from the start of the limited entry permit program in 1994 through 2003, after which there was a sharp decline in vessel participation due to a federally sponsored buyback program. A second drop in the number of vessels occurred during the transition to catch shares in 2011. With a much larger fleet, and relatively fewer restrictions prior to rebuilding plans, the bottom trawl fishery during 1997 to 2001 does not reflect the more recent period. Total coastwide participation (number of vessels), landings, and inflation-adjusted revenue were lower by 76 percent, 48 percent, and 45 percent, respectively, during the 2011 to 2014 period compared with 1997. As of 2017, all but yelloweye rockfish and cowcod south of 40°10' N. latitude were declared rebuilt, which should increase opportunities for fishermen to access target stocks in future years, compared to the first years of the catch share program.

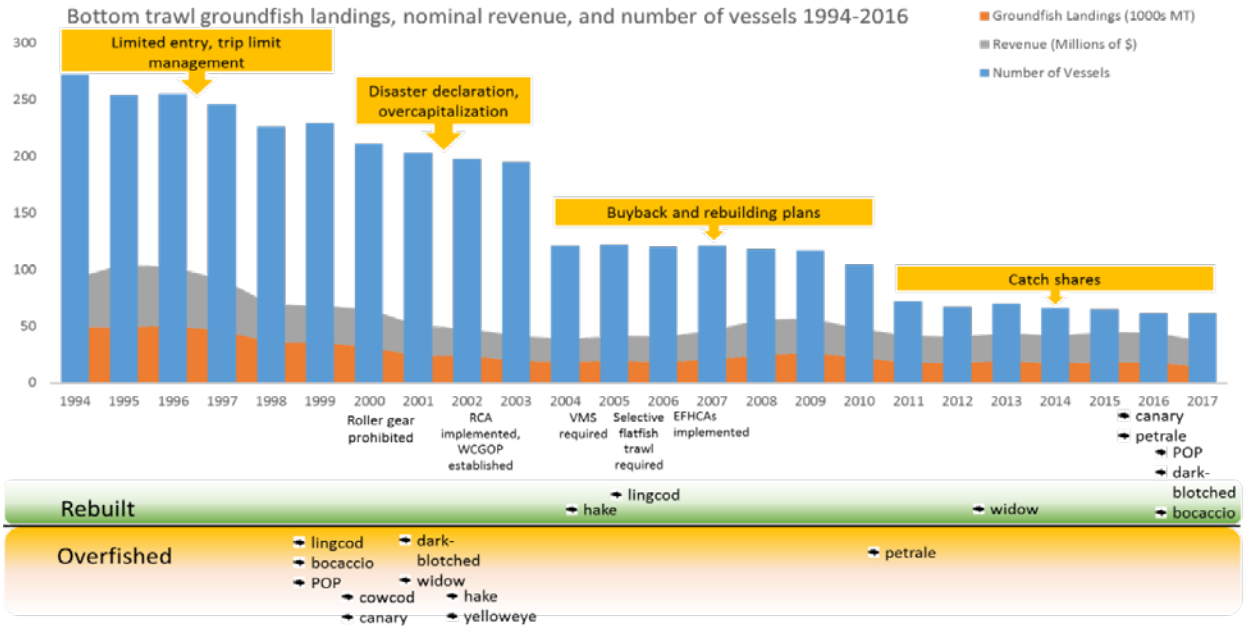

Figure 4-1. Timeline of major events and management of non-whiting groundfish

As previously mentioned, readers may be tempted to view the values or percentages reported under a given alternative and conclude a gain or loss in absolute terms. Quantitative information on proposed reopenings cannot be summed with the results for proposed closures, because data differences prevent direct quantitative comparison. The available data represent vessel activity during different periods, management regimes, gear types, environmental conditions, conservation concerns, markets, combinations of open and closed areas, and other factors. The metrics are intended to inform the qualitative analysis by providing quantitative indicators of the relative importance of fishing grounds in the past within the context of conditions of those times.

4.1.4 Protected Resources

As described in Chapter 3, protected resources include Endangered Species Act-listed (ESA-listed) species, marine mammals, and sea birds. This section summarizes the analytical approach and methods used for assessing the impacts of the action alternatives on these resources.

4.1.4.1 Criteria for Evaluating the Consequences of the Alternatives on Protected Resources

The WCGOP monitors and summarizes protected species interactions each year in annual reports and stock assessment review documents. Monitoring by the WCGOP started in 2002. From 2002 to 2010, the WCGOP monitored 20 percent of all trips with human observers. Since 2011, all bottom-trawl trips had human observers aboard the vessel, or the vessel had an electronic monitoring (EM) system as part of a program. Monitoring data (species and count), coupled with the location of interactions observed from 2011 to 2014 were used for spatial analysis of interactions with all protected species (see Appendix "Data Source Selection Process" and Section 4.1.4.2 for data source selection and limitations discussions). These data sets are the most recent fishery interaction information available to summarize annual estimates and to conduct a spatial analysis coastwide for a comprehensive look at the fishery.

Observed interactions for salmon, green sturgeon, and eulachon from fishing year 2015 were added to the annual estimates to provide the most recent fishery information. Annual seabird and marine mammal interaction estimates were not available for 2015. We did not spatially analyze the 2015 data due to time constraints.

We provide numbers or weight of species observed in the bottom-trawl fishery from areas that are currently open to fishing (No-action Alternative), including the Tribal U&A. We also provide data for proposed closures under each alternative that are outside the trawl RCA and outside the Tribal U&A. We use information collected during monitoring to provide a qualitative discussion about potential impacts of all the alternatives.

Since we do not find a pattern of repeated interactions with salmon, marine mammals, or seabirds that suggest interactions may occur in a particular area of the EEZ, we assume that observed interactions for these species groups are evenly dispersed throughout the EEZ. We also assume that the size of the area is related to the number of observed interactions. Green sturgeon and eulachon are found at certain depth ranges and latitudes; therefore, we do not assume that they are evenly dispersed. As such, we anticipate interaction based on where openings and closings are proposed relative to the depth and latitude of these proposals. Again, we assume that the size of the area in those depth bins and latitudes is related to the number of interactions that have occurred. Since we do not have observer data for the proposed openings, we apply the assumptions to these areas. That means that the larger the area, the more likely an interaction

might occur, and vice versa. We cannot provide accurate predictions for the number of species that may be impacted under each alternative. Instead we describe what has been observed under the No-action Alternative, then speculate whether interactions under each action alternative could be similar to, increase, or decrease from what has been observed under the No-action Alternative.

This analysis only discusses potential impacts on those species that have been observed in the fishery. Several ESA-listed species and marine mammals have not interacted with the bottom trawl fishery; therefore, they are not discussed further in this document. This includes, but is not limited to, unobserved salmon (including steelhead), marine turtles, marine mammals, and seabirds. Instead, we rely on NMFS and United States Fish and Wildlife Service (USFWS) recent ESA determinations, and NMFS Marine Mammal Protection Act (MMPA) determinations regarding potential interactions with the bottom trawl fishery (Chapter 3).

Critical habitat is designated for several species, but we focus on green sturgeon. NMFS recent opinions and determinations provide details regarding the impacts of the bottom trawl fishery on designated critical habitats (Chapter 3). The analysis in this document discusses where the fishery may operate under the alternatives and if the fishery would overlap with these designated areas.

4.1.4.2 Data Limitations

This analysis covers 2011 to 2015 because the fishery was monitored at nearly 100 percent.

From 2002 to 2010, the WCGOP monitored approximately 20 percent of all bottom trawl trips. This data set was not used since the entire fleet was not observed, and it is not possible to assess the amount of interactions that occurred at fine spatial scales. There was no observer program prior to 2002; therefore, we do not have any interaction estimates. EFHCAs were established in 2006, and the trawl RCA was established in 2003. From 2002 to 2010, only 20 percent of groundfish bottom trawl trips were observed, and all observations were made outside these closed areas. Therefore, we do not have observed trips inside these closed areas or prior to their implementation. This analysis does not use data from 2016 to 2017 because the data were not yet available when we began this analysis.

In 2015, qualified vessels could choose EM rather than observers. NMFS placed observers on EM vessels to sample at least 20 to 30 percent of all EM trips and will continue to sample at this rate. Observers collected scientific information and samples, as well as protected species interactions. Under the EM program, NMFS will continue to provide an annual estimate for protected species interactions based on data WCGOP observers collect, but NMFS may also use other sources as necessary and appropriate to create estimates. NMFS will continue to require fishermen to report interactions in their logbooks and may crosscheck logbooks with video for potential large marine mammal interactions and other

identifiable interactions. Implementation of the action alternatives in this document would not change the EM program or NMFS' plans to observe EM vessels.

The presence of an interaction in the past for a particular area does not mean it may occur again with certainty in the same area. We cannot examine the dataset by species to i

dentify areas with consistent interactions because the dataset is from a short period. This makes it challenging to speculate on expected interactions in each area under the proposals. Instead, we rely on the location of individual species, the number of interactions observed, and interaction trends to qualitatively discuss future impacts under each alternative.

4.1.5 State-managed Fishery Resources

Four state-managed fisheries on the West Coast use bottom trawl gear to target non-groundfish species. These fisheries are managed by their respective states (Washington, Oregon, and California), and they operate in both state and Federal waters. They target pink shrimp (coastwide), California halibut, ridgeback prawn, and sea cucumber. These fisheries are prohibited from fishing inside EFHCAs. The pink shrimp fishery may fish in the trawl and non-groundfish trawl RCAs.

The non-groundfish trawl RCA completely overlaps the groundfish trawl RCA. Where the non-groundfish trawl RCA is established (south of 40°10' N. latitude), there is a general overlap with the groundfish trawl RCA except in the area from 40°10' N. latitude to 38°00' N. latitude during the fishing periods from November to December and from January to February. The seaward boundary of the non-groundfish trawl RCA range expands from 100 fm to 150 fm to 100 fm to 200 fm during these periods. In this area of the coast, the groundfish trawl RCA, remains at the 100 fm to 150 fm range throughout the year. Since the state-managed fisheries (pink shrimp, California halibut, ridgeback prawn, and sea cucumber) are already prohibited from the area of the trawl RCA due to the overlap of the non-groundfish trawl RCA, and because Alternatives 2b and 2c will not apply to these fisheries, we do not expect these fisheries to be impacted by the RCA alternatives. Therefore, these fisheries are not discussed any further relative to the RCA alternatives.

EFH alternatives could impact these fisheries, however. Therefore; we qualitatively examined the potential impact of the EFH action alternatives on these fisheries. We do not provide landings and revenue for these fisheries or quantify impacts on protected species. Instead we provide a qualitative analysis of the areas in which these fisheries operate relative to the areas that are proposed to be closed or opened. We then examine whether these fisheries could impact fish and protected resources as a result of implementation of the alternatives.

4.1.6 Analytical Levels

The Project Team conducted a multi-level analysis of the EFHCA and trawl RCA alternatives. For each alternative, there are five levels of analysis, which are described in greater detail below: 1) by the net effects of the alternatives (alternative-wide); 2) on a state-by-state basis; 3) by latitudinal areas and depth zones; 4) by each port or port group; and 5) by the individual polygons in the alternative.

The higher-level analyses sum comparable metrics for the individual polygons across the appropriate level. The net effect of the alternative on the habitat, but not economic or other metrics, was calculated. Net change in environmental protection was calculated as "areas closed minus areas reopened." Positive values indicate a net increase in habitat protections and negative values indicate a net decrease in habitat protections. We did not calculate the net effects on the economic metrics, because the difference in time periods and associated fisheries makes those metrics inappropriate to compare.

4.1.6.1 Alternative-wide Analysis

The alternative-wide analysis summarizes data (when available) and impacts of all polygons in the proposed alternative. This is a big picture analysis that broadly describes how each alternative would impact environmental and economic resources and were used to conduct a relative comparison of the overall effects of the alternatives.

4.1.6.2 State-by-State Analysis

To evaluate impacts on individual states, the economic metrics have been summarized by state. There is some overlap between state boundaries and port groups, and landings into a particular state do not necessarily mean that the fishing occurred off that state. However, we provide total landings and revenue by state to illustrate the impacts on an individual state.

4.1.6.3 Geographic Break Analysis (Latitudinal Zones/Depth Zones)

This analysis divides the West Coast into five latitudinal zones and four depth zones, for a total of 20 separate latitudinal/depth zones (Figure 4-2). The latitudinal zones are based on existing latitudinal breaks the Council currently uses. The depth zones are based on the April 2015 recommendations by the Groundfish Management Team, and they are the same as the trawl RCA block area closures described under Alternative 3d. This analysis sums the individual metrics within each latitudinal zone and depth zone to illustrate the spatial distribution of the changes made by each alternative.

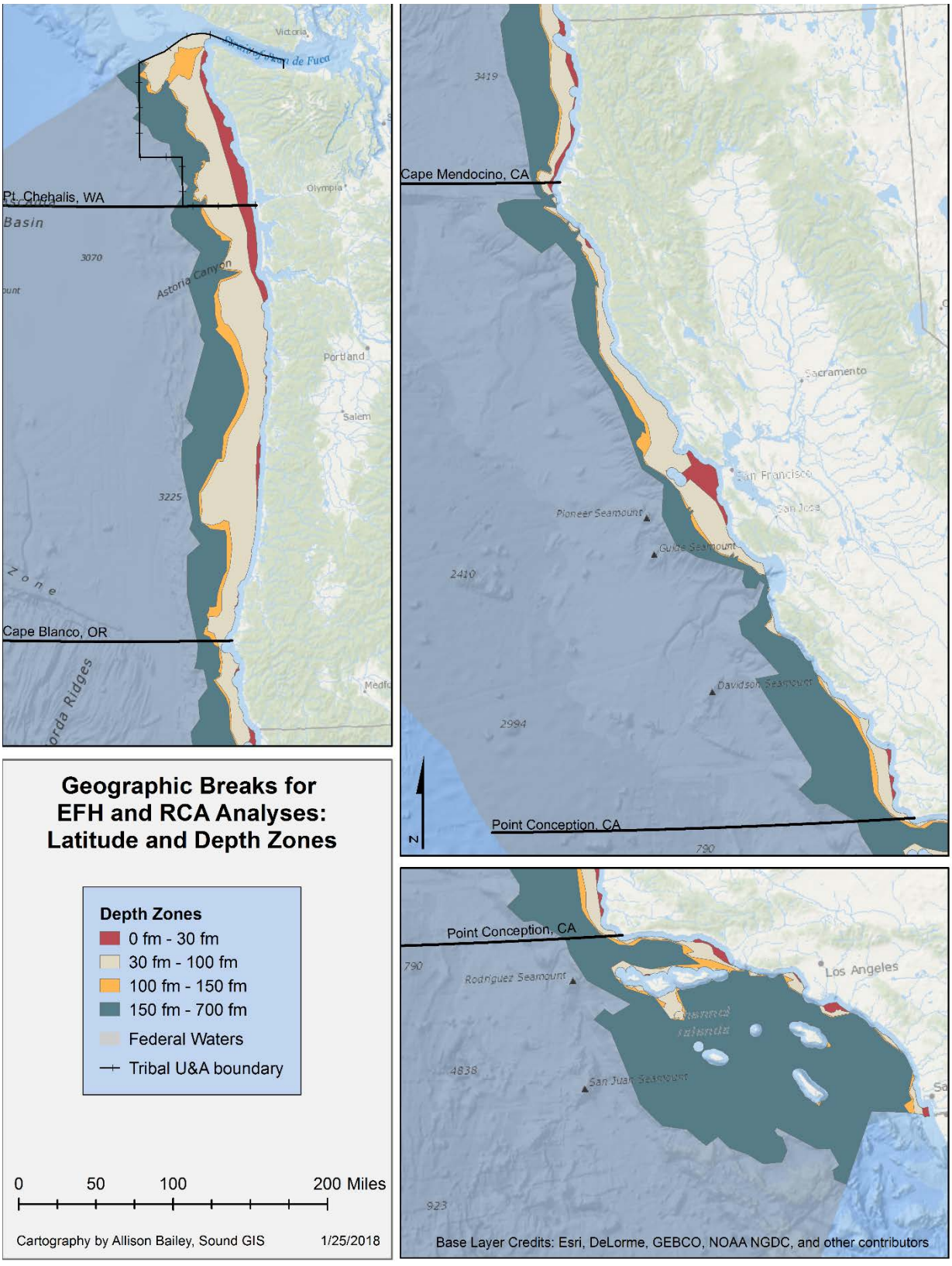

Figure 4-2. Latitudinal breaks and depth zones used in the analysis.

Latitudinal Zones

- United States/Canada Border-Point Chehalis (CFPC)
- Point Chehalis-Cape Blanco (PCCB)
- Cape Blanco-Cape Mendocino (CBCM)
- Cape Mendocino-Point Conception (CMPC)
- Point Conception-United States/Mexico Border (PCUSMB)

Depth Zones[20]

- State waters boundary to 30 fm (Nearshore)
- 30 fm to 100 fm (Shelf)
- 100 fm to 150 fm (Slope)
- 150 fm to 700 fm (Slope)

4.1.6.4 Port/Port Group Analysis

This analysis summed the economic metrics attributed to each port or port group across each alternative to show how the economic effects would be distributed across the West Coast's fishing communities. As described in Section 4.1.4.1, we used the list of port groups (Figure 4-4) and ports (Table 4-3) in Leonard et al. (2011).

[20] Areas within these depth contours that occur within state waters are excluded from analysis. Other than in Washington State, the 30 fm line is frequently within state waters and the 100 fm and 150 fm lines occasionally cross into state waters, particularly in California.

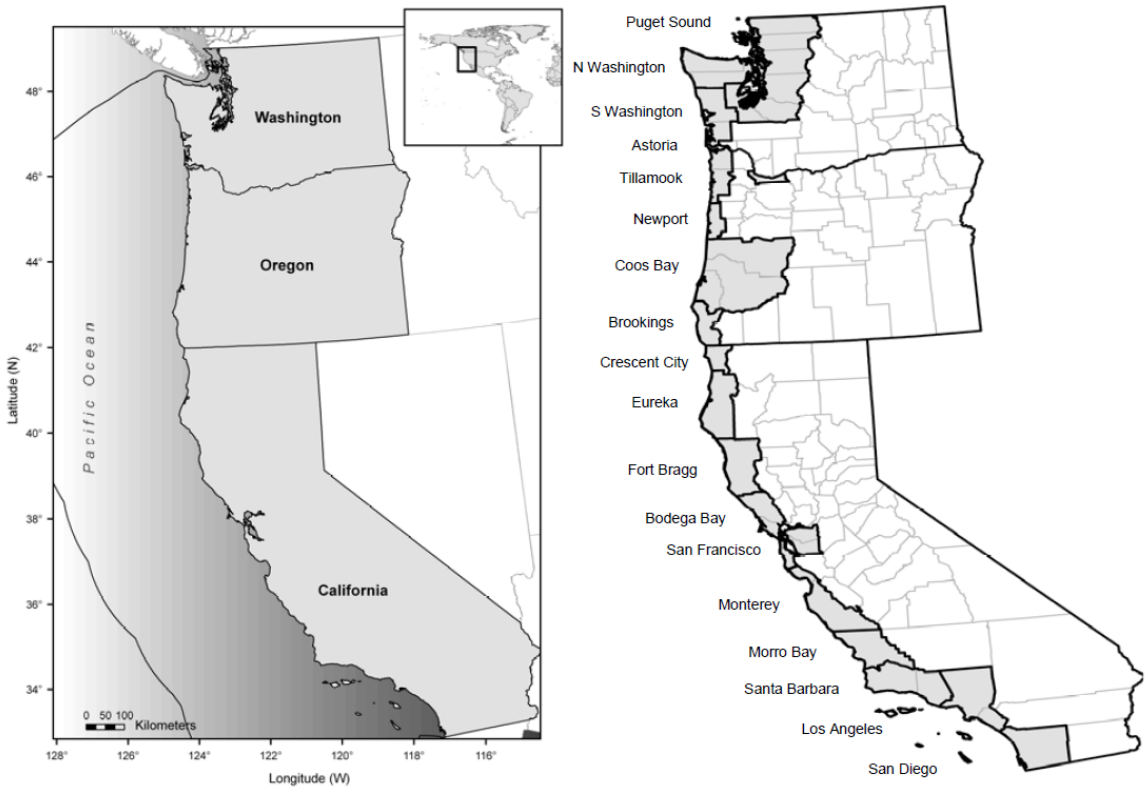

Figure 4-3. Port groups used in the economic analysis (from Leonard et al. 2011)

Table 4-1. Port groups and ports used in analyzing effects of the action alternatives on economic resources (from Leonard et al. 2011).

State	IO-PAC Port Group	Port name
California	Bodega Bay	Bodega Bay
		Point Reyes
		Sausalito
		Tomales Bay
		Other Sonoma, Marin County outer coast ports
	Crescent City	Crescent City
	Eureka	Eureka
		Fields Landing
		Other Humboldt County ports
		Trinidad
	Fort Bragg	Albion
		Point Arena
		Fort Bragg
		Other Mendocino County ports
	Los Angeles	Dana Point
		Long Beach
		Newport Beach

Table 4-1. Port groups and ports used in analyzing effects of the action alternatives on economic resources (from Leonard et al. 2011) (continued)

State	IO-PAC Port Group	Port name
		Other Los Angeles, Orange County ports
		San Pedro
		Terminal Island
		Wilmington
	Monterey	Santa Cruz
		Monterey
		Moss Landing
		Other Santa Cruz, Monterey County ports
	Morro Bay	Avila
		Morro Bay
		Other San Luis Obispo County ports
	San Diego	Oceanside
		Other San Diego County ports
		San Diego
	San Francisco	Alameda
		Berkeley
		Oakland
		Other San Francisco Bay, San Mateo County ports
		Princeton/Half Moon Bay
		Richmond
		San Francisco
	Santa Barbara	Port Hueneme
		Other Santa Barbara, Ventura County ports
		Oxnard
		Santa Barbara
		Ventura
Oregon	Astoria	Astoria
		Cannon Beach
		Pseudo port code for Columbia River
		Gearhart/Seaside
	Tillamook	Nehalem Bay
		Netarts Bay
		Pacific City
		Tillamook/Garibaldi
	Brookings	Brookings
		Gold Beach
		Port Orford
	Columbia River	Columbia River pseudo port code
	Coos Bay	Bandon
		Charleston (Coos Bay)

Table 4-1. Port groups and ports used in analyzing effects of the action alternatives on economic resources (from Leonard et al. 2011) (continued)

State	IO-PAC Port Group	Port name
		Florence
		Winchester Bay
	Newport	Depoe Bay
		Newport
		Waldport
Washington	North WA coast	La Push
		Neah Bay
		Port Angeles
		Sequim
		Port Townsend
	Puget Sound	Anacortes
		Bellingham Bay
		Blaine
		Everett
		Friday Harbor
		La Conner
		Olympia
		Other north Puget Sound ports
		Seattle
		Shelton
		Tacoma
	South and central WA coast	Copalis Beach
		Grays Harbor
		Ilwaco/Chinook
		Other Columbia River ports
		Willapa Bay
		Westport

4.1.6.5 Polygon Analysis

This analysis presents the metrics, individually, for each polygon in each alternative. This analysis allows comparison of the impacts of the individual polygons within and between alternatives. The Council can use the analysis to refine its FPA.

4.2 Analysis of Alternatives by Resources

The sections below contain descriptions of the effects on habitat, fish resources, protected resources, economic resources. They are described in the context of alternatives.

4.2.1 Habitat Analysis

This section presents the alternative-wide analyses of the effects of each alternative on benthic habitats for each alternative. See Appendix A for the analyses by geographic breaks and polygons.

4.2.1.1 No-action Alternative

The No-action Alternative would maintain the current configuration of bottom trawl closures on the West Coast, as described in Section 2.1. These bottom trawl closures include the EFHCAs and GCAs. The metrics of the No-action Alternative on habitat are analyzed here to evaluate the effects of maintaining the status quo and to serve as a benchmark for understanding the effects of the other alternatives.

The current commercial groundfish BTCs consist of the EFHCAs established by Amendment 19, the trawl RCA, the CCA, and the CBGCA (Figure 2-4). Table 4-2 shows the habitat metrics for the No-action Alternative, and it identifies areas that are EFHCA-only, trawl RCA-only, CCA-only, and where two or more BTCs overlap. As described in Section 2.1, the No-action alternative excludes all EFHCAs seaward of the 700 fm contour, including the "seaward of the 700 fm contour" EFHCA.

The No-action Alternative would maintain the current habitat protections provided by the combined BTCs across a total of 14,485 mi^2. Of this, 4,514 mi^2 (31 percent) is EFHCA-only, 3,485 mi^2 (24 percent) is trawl RCA-only, 4,185 mi^2 (29 percent) is CCA-only, and 2,301mi^2 (16 percent) is covered by two or more of the BTCs.

As expected by the purpose of the different trawl closures, the largest amount of hard substrate (816 mi^2) and canyon habitat (445 mi^2) is found in the EFHCAs, while the largest amount of OFS (849 mi^2) is found in the trawl RCA.

Presence of HFI is more or less equally distributed among the EFHCAs and trawl RCA, with lower numbers in the CCA. In contrast, HFI bycatch is more than double in the trawl RCA than in either the EFHCAs or CCA.

Also, as described in Section 2.1, the No-action Alternative would also continue to allow bottom-contact gear in 123,487 mi^2 of waters deeper than 3,500 m. Spatial extent is the only habitat metric available for waters deeper than 3,500 m.

Table 4-2. Habitat metrics for bottom trawl closures shoreward of 700 fm under the No-action Alternative. BTC = bottom trawl closures, which include EFHCAs, trawl RCA, CCA, and CBGCA. Two or more BTCs indicate overlap of BTCs. % = percent of spatial extent in that column.

Metric					**Bottom Trawl Closure Type**				
					EFHCA-only	**Trawl RCA-only**	**CCA-only**	**Overlap**	**Total**
Spatial extent (mi^2)					4,514	3,485	4,185	2,301	14,485
Substrate Type	Hard			mi^2	816	95	246	159	1,315
				%	18.1	2.7	5.9	6.9	9.1
	Mixed			mi^2	55	102	38	150	345
				%	1.2	2.9	0.9	6.5	2.4
	Soft			mi^2	3,604	3,283	3,901	1,983	12,770
				%	79.8	94.2	93.2	86.1	88.2
	Unknown			mi^2	40	5	0	10	54
				%	0.9	0.1	0.0	0.4	0.4
Priority Habitats	Canyon			mi^2	445	188	47	94	775
				%	9.9	5.4	1.1	4.1	5.4
	OFS			mi^2	69	849	0	29	948
				%	1.5	24.4	0.0	1.3	6.5
	Habitat-Forming Invertebrates	Presence	DSC	Count	203	252	121	391	967
			Sponge	Count	361	552	162	428	1,503
			Sea Pens	Count	400	290	28	219	937
		Bycatch	DSC	Count	1,354	3,541	0	137	5,032
			Sponge	Count	1,403	5,628	0	195	7,226
			Sea Pens	Count	953	4,627	0	207	5,787

4.2.1.1.1 Summary of the Habitat Effects of the No-action Alternative

Under the No-action Alternative, there would be no change in the current protections benthic habitats. These protections are provided by the commercial bottom trawl prohibitions established by the four types of BTCs. Bottom trawling has been prohibited in the CCA since 2002, the CBGCA since 2005, and the EFHCA since 2006. Commercial groundfish bottom trawling has been prohibited in the trawl RCA since 2002.

Over the 11 to 17 years that these areas have been closed to bottom trawling, the habitats within them have had an opportunity to recover. The potential for recovery of these habitats, and the speed at which it has occurred, depends on the type of habitat, the degree to which it had been impacted by past trawling, and the conditions of the surrounding areas (i.e., trawled versus untrawled) (Hiddink et al. 2017).

While state-managed pink shrimp trawling is prohibited in the EFHCAs, it is allowed in areas of the trawl RCA that do not overlap with an EFHCA and may be impacting those habitats. Although, as described in Section 4.1.1, it is difficult to determine the amount of past trawl effort in each habitat type, available information allows for a general estimate of the state of recovery for most habitat types. Soft substrates, which make up 88 percent of the total area closed to bottom trawling, is the most resilient and the fastest to recover, with full recovery possible in as little as one year. Areas of soft substrate where state-managed trawling has not occurred, and HFI are not present, have likely fully recovered from past trawling (NMFS 2013), regardless of the intensity of that trawling. Full recovery is not expected in the areas where state-managed trawling occurs, but the degree of recovery cannot be predicted. Hard and mixed substrates without HFI require approximately 3 years to recover (NMFS 2013), and have, again, likely fully recovered in areas where state-managed trawling is not occurring. The most sensitive types of habitat are those with HFI, and they may require decades to hundreds of years to fully recover from bottom-trawl impacts. Because the closures have been in place for less than two decades, it is likely that habitats with HFI have not fully recovered. However, because we do not know the degree to which they were impacted by past trawling, which was significantly more intense and used more damaging gears than current fisheries, or current state-managed trawling, we cannot estimate when full recovery will occur.

The No-action Alternative would continue protections from bottom trawling and allow the more sensitive types of habitats in the BTCs (i.e., habitat-forming invertebrates) to continue their recovery trajectory. Over the long term, habitats are expected to recover and ecosystem functions would be expected to improve. Improved ecosystem function could lead to increased biological production, including that of some managed groundfish, relative to the areas that are currently fished. Because most marine species have pelagic eggs and larvae, and many have mobile juveniles and adults, the benefits of increased

biological production would not be confined to the closures, but they would be more broadly distributed as these life stages disperse into adjoining areas (Thompson et al., 2017).

The No-action Alternative would also continue to permit the use of bottom-contact fishing gear in waters deeper than 3,500 m. At present, however, there is no fishing with such gear in these waters. This is due to several factors, including the relatively low biomass of fishes, the lack of a market for the fishes that live there, and the depth imitations of the current fishing gear. It is unlikely that any fishery using bottom-contact fishing gear would develop in these waters for the foreseeable future, and the habitats in these areas would remain pristine. Should a fishery develop, however, the impacts on these sensitive habitats would depend on the type of gear used and the location and intensity of the effort. The most damaging of the bottom-contact gear would be bottom trawling, but fixed gear could also impact these habitats if conducted in the areas of HFI. Because we cannot anticipate what type of gear would be used or the location and intensity of the fishing effort, it is not possible to predict impacts on habitat with any certainty.

4.2.1.2 Alternative 1.a. the Collaborative Alternative

As described in Section 2.2.1, this alternative would make a number of changes to the current suite of EFHCAs along the West Coast, and would consist of 59 polygons: 43 closures and 16 reopenings.

Change in BTCs (non-overlapping proposed EFHCAs). The alternative-wide habitat metrics for Alternative 1.a, the Collaborative Alternative, are shown in Table 4-3. The Collaborative Alternative would increase the total area of BTCs by 749 mi^2, for a net change of plus 5.2 percent compared to the No-action Alternative. These gains in protections from bottom trawling, relative to the No-action alternative, would be spread across all other habitat metrics, but to varying degrees.

The largest relative increase in substrate protections is for mixed substrate (plus 14.7 percent, 51 mi^2), followed by hard substrate (plus 7.4 percent, 97 mi^2). Although soft substrate shows the smallest relative increase (plus 4.7 percent), it represents the largest portion of the net area closed by this alternative (600 mi^2).

Among the priority habitats, canyons would see the largest relative increase in protections (plus 27.0 percent, 209 mi^2), and OFS would see the smallest increase (plus 0.9 percent, 9 mi^2). All priority habitats would increase from plus 7.2 percent (sponge presence) to plus 17.5 percent (sponge bycatch).

Changes in total EFHCAs. This alternative would increase EFHCA-specific protections, including those areas that overlap with other BTCs, by 748 mi^2. The habitat metrics, across all habitat types, are similar to those described above when other BTCs are excluded because net changes in the metrics (closed minus reopened) are generally small in the areas that overlap with other BTCs. However, given that the

EFHCAs are a subset of the BTCs, the relative percentage increases are generally two or more times greater. For example, the net change in the spatial extent of coastwide BTCs is plus 5.2 percent, while the net increase in the spatial extent of coastwide EFHCAs is plus 12.9 percent.

The closures contained 0.2 percent of the 2011 to 2014 trawl effort. The reopenings contained 0.4 percent of the 1997 to 2001 trawl effort.

Table 4-3. Habitat metrics for Alternative 1.a, the Collaborative Alternative. The proposed EFHCA changes are separated into those that do not overlap with other BTCs, and those that do. = Bottom trawl closures. Net changes to total BTCs reflects the net changes in the closures that do not overlap with other BTCs. Net change to total EFHCAs includes those areas that overlap with other BTCs. % Closed and % Reopened = percent of area closed or reopened by the alternative. Net mi^2 = Closed minus Reopened. Net Change is relative to the No-action Alternative for BTCs and EFHCAs shoreward of 700 fm.

Metric					**No Overlap with Other BTCs**		**Overlap with Other BTCs**		**Net Change in Total BTC**	**Net Change in Total EFHCA**
					Closed	**Reopened**	**Closed**	**Reopened**		
Spatial extent (mi^2)				mi^2	959	211	34	35	749	748
				%					5.2	12.9
Substrate Type	Hard			mi^2	98	1	6	4	97	100
				%	10.3	0.5	17.9	10.1	7.4	11.3
	Mixed			mi^2	51	-	2	-	51	53
				%	5.3	-	6.3	-	14.7	29.0
	Soft			mi^2	810	210	26	32	600	595
				%	84.5	99.5	75.7	89.9	4.7	12.7
	Unknown			mi^2	-	-	-	-	-	-
				%	-	-	-	-	-	-
Priority Habitats	Canyon			mi^2	252	43	3	2	209	210
				%	26.3	20.3	7.7	6.6	27.0	42.6
	OFS			mi^2	10	1	4	4	9	8
				%	1.0	0.5	11.9	12.3	0.9	8.6
	Habitat Forming Invertebrates	Presence	DSC	Count	102	6	34	5	96	125
				%					10.8	35.7
			Sponges	Count	107	8	30	8	99	121
				%					7.2	23.4
			SeaPens	Count	109	38	22	4	71	89
				%					8.1	20.2
		Bycatch	DSC	Count	902	35	52	59	867	860
				%					17.5	60.4
			Sponges	Count	1,030	69	26	7	961	980
				%					13.5	64.8
			SeaPens	Count	699	73	21	-	626	647
				%					10.9	58.1

4.2.1.2.1 Summary of Effects on Habitat of Alternative 1.a, the Collaborative Alternative

Alternative 1.a, the Collaborative Alternative, would directly affect habitat along the West Coast by 1) protecting the habitat in the closures from further degradation by bottom trawls and by 2) exposing the habitat that has been recovering since the areas were closed in 2006 to future degradation by commercial bottom trawls in the reopenings.

As described above, Alternative 1.a, the Collaborative Alternative, would increase overall benthic habitat protections by 749 mi^2 by closing an additional 959tooth mi^2 and reopening 211 mi^2 with gains in EFH protections across all the habitat metrics (Table 4-3). The areas to be either closed or reopened would consist, primarily, of soft substrate, the substrate type least sensitive to bottom trawling and fastest to recover. For all priority habitats except for OFS, the percent increase over current protections would be above 4.7 percent, with HFI habitats showing the greatest increase. The low extent of the priority habitats that would be reopened by this alternative means that the recovery that has occurred since then would remain largely intact, and EFH protections for those habitat types would be increased by the closures in this alternative.

The increase in habitat protections are spread across all latitudinal and most depth zones, as well as most of the habitat types within those zones (Appendix A). When net losses of a habitat type occurred in a depth zone, those losses were relatively small compared to the gains of that habitat type in other depth zones and the alternative as a whole.

The net increase in EFH protections across all habitat types will, in the long term, allow the recovery of those habitats and the restoration of ecosystem functions. As a result, biological production, including that of managed groundfish, would likely increase. Because most marine species have pelagic eggs and larvae, and many have mobile juveniles and adults, the benefits of increased biological production would not be confined to the closures, but they would be more broadly distributed as these life stages disperse into adjoining areas (Thompson et al., 2017).

While it is not possible to compare the trawl effort that will be displaced by the closures directly with the effort that may be restored by the reopenings, some general statements can be made about the effects of the Collaborative Alternative on trawl effort. First, the effort that would be displaced by the closures would represent a very small percentage (0.2 percent) of the 2011 to 2014 effort. This effort occurred in 16 of the 40 proposed closures, and those 16 closures had 0.05 percent or less of the coastwide effort. If this small amount of effort were to shift to other currently open areas or to areas that would be reopened, it would not significantly increase the pressures on benthic habitats, and the negative effects on benthic habitat from this shift in effort would likely be minimal.

Although it is not possible to predict the location or intensity of bottom trawling that would occur in the areas to be reopened, they were identified by the group that submitted the Collaborative Alternative as being important historical fishing grounds, and 0.4 percent of the 1997 to 2001 coastwide trawl effort occurred there. Therefore, it is reasonable to assume that those areas will be fished to some extent. However, because 99 percent of the area is soft substrate, which is the most resilient type of habitat, and fishermen generally avoid high-relief areas to protect their gear and to reduce bycatch of some limiting stocks, the negative effects of these reopenings on benthic habitat would likely be minimal.

Overall, Alternative 1.a, the Collaborative Alternative, would result in short- and long-term net benefits for groundfish EFH on the West Coast, as a whole, as well as in most of the geographic breaks. Two geographic breaks would see relatively small decreases in habitat protections: PCCB 100 fm to 150 fm (minus 3 mi^2) and CMPC deeper than 700 fm (minus 10 mi^2).

For a comparison of Alternative 1.a, the Collaborative Alternative, with the other action alternatives under Subject Area 1, see Section 4.2.1.7.

4.2.1.3 Alternative 1.b. the Oceana et al. Alternative

As described in Section 2.2.2, this alternative would make a number of changes to the current suite of EFHCAs along the West Coast, and would consist of 68 polygons: 61 closures and 7 reopenings.

Change in BTCs (non-overlapping EFHCAs). The alternative-wide habitat metrics for Alternative 1.b, the Oceana, et al. Alternative, are shown in (Table 4-4).. This alternative would increase the total area of BTCs by 14,238 mi2, almost doubling the BTCs under the No-action Alternative (plus 98 percent). These gains in protections from bottom trawling, relative to the No-action alternative, would be spread across all other habitat metrics, but to varying degrees.

The largest increase in substrate protections is for soft substrate (13,102 mi^2, plus 103 percent), followed by hard substrate (943 mi^2, plus 71.7 percent), and mixed substrate (149 mi^2, plus 43.2 percent).

All priority habitats would see gains in protections ranging from a high of plus 109 percent for DSC bycatch (5,430 grid cells) to a low of plus 6.4 percent for OFS (61 mi^2)..

Change in EFHCAs. The Oceana, et al. Alternative would increase EFHCA-specific protections, including those areas that overlap with other BTCs, by 19,495 mi^2, more than tripling the area of EFHCAs under the No-action alternative (plus 338 percent). Gains would be made across all habitat metrics.

The largest increase in substrate protection would be for soft substrate (17,971 mi^2, plus 385 percent), followed by hard substrate (1,270 mi^2, plus 143 percent), and mixed substrate (207 mi^2, plus 113 percent).

All priority habitats would see increases in protections, ranging from a high of plus 430 percent for sponge bycatch (6,500 grid cells) to a low of plus 143 percent for hard substrate (1,270 mi^2).

Table 4-4. Habitat metrics for Alternative 1.b, the Oceana et al. Alternative BTC = Bottom trawl closures. % Closed and % Reopened = percent of area closed or reopened by the alternative. Net mi2 = Closed minus Reopen. Net Change is relative to the No-action Alternative. "-" = true zero; 0 = <1 mi^2; 0.0=<0.1%.

Metric					**No Overlap with Other BTCs**		**Overlap with Other BTCs**		**Net Change in Total BTC**	**Net Change in Total EFHCA**
					Closed	**Reopened**	**Closed**	**Reopened**		
Spatial extent (mi^2)				mi^2	14,380	143	5,257	-	14,238	19,495
				%					98.3	337.7
Substrate Type	Hard			mi^2	943	0	328	-	943	1,270
				%	6.6	0.3	6.2	-	71.7	143.8
	Mixed			mi^2	149	-	58	-	149	207
				%	1.0	-	1.1	-	43.2	113.2
	Soft			mi^2	13,244	142	4,869	-	13,102	17,971
				%	92.1	99.7	92.6	-	102.6	385.2
	Unknown			mi^2	44	-	2	-	44	46
				%	0.3	-	0.0	-	80.4	111.7
Priority Habitats	Canyon			mi^2	784	24	105	-	760	865
				%	5.4	16.6	2.0	-	98.0	175.5
	OFS			mi^2	61	-	111	-	61	171
				%	0.4	-	2.1	-	6.4	176.2
	Habitat Forming Invertebrates	Presence	DSC	Count	369	4	282	-	365	647
				%					41.2	184.9
			Sponges	Count	959	2	441	-	957	1,398
				%					69.5	270.9
			SeaPens	Count	484	13	170	-	471	641
				%					53.5	145.4
		Bycatch	DSC	Count	5,436	6	693	-	5,430	6,123
				%					109.3	429.7
			Sponges	Count	4,975	1	1,528	-	4,974	6,502
				%					69.7	430.0
			SeaPens	Count	3,669	9	1,064	-	3,660	4,724
				%					63.7	424.4

Trawl Effort. The proposed closures would contain 3.0 percent of the 2011 to 2014 trawl effort, while the reopenings would contain 0.3 percent of the 1997 to 2001 effort.

4.2.1.3.1 Summary of habitat effects of Alternative 1.b, the Oceana et al. Alternative

Alternative 1.b, the Oceana et al. Alternative, would directly affect habitat along the West Coast by 1) protecting the habitat in the closures from further degradation by bottom trawls and 2) exposing the habitat in the reopenings that has been recovering since the areas were closed in 2006 to future degradation by commercial bottom trawls.

As described above, Alternative 1.b, the Oceana et al. Alternative, would increase overall EFH protections by 14,380 mi^2 through closing 100 times more habitat than it would reopen, with gains in EFH protections across all of the habitat metrics. The areas to be either closed or reopened would consist, primarily, of soft substrate (92 percent and 99.7 percent, respectively), the substrate type that is the least sensitive to bottom trawling and the fasted to recover. For all priority habitat types, the EFH protections would be more than doubled over current protections, with the largest percent increase among the HFI metrics (41 percent to 110 percent). The very low extent of the priority habitats that would be reopened by this alternative would mean that the recovery that has occurred in the EFHCAs would remain largely intact.

The increase in habitat protections would be spread across all latitudinal and most depth zones and most of the habitat types within those zones. The exception would be a small decrease (5 mi^2) in the CMPC greater than 700 fm depth zone (Appendix A).

The net increase in EFH protections across all habitat types in most of the latitudinal and depth zones would, in the long term, allow the recovery of those habitats and the restoration of ecosystem functions. As a result, biological production, including that of managed groundfish, would likely increase. Because most marine species have pelagic eggs and larvae, and many have mobile juveniles and adults, the benefits of increased biological production would not be confined to the closures, but they would be more broadly distributed as these life stages disperse into adjoining areas (Thompson et al., 2017).

While it is not possible to make a direct comparison of the trawl effort that would be displaced by the closures to the effort that may be restored by the reopenings, some general statements can be made about the effects of the Oceana et al. Alternative on trawl effort. First, the effort that would be displaced by the closures would represent a small percentage (3 percent) of the 2011 to 2014 effort. This effort occurred in 35 of the 60 proposed closures. The highest effort occurred in Samoa Reef closure (0.9 percent), with the remaining closures containing less than 0.6 percent each. If this relatively small amount of effort were to shift to other currently open areas or to areas that would be reopened, it would not significantly increase the pressures on benthic habitats, and the negative effects on benthic habitat from this shift in effort would likely be minimal.

Although it is not possible to predict the location or intensity of bottom trawling that would occur in the areas to be reopened, Oceana et al. identified them as important historical fishing grounds, and 0.3 percent of the 1997 to 2001 coastwide trawl effort occurred there. Therefore, it is reasonable to assume that those areas would be fished to some extent. However, because 99 percent of the area is soft substrate, which is the most resilient type of habitat, and fishermen generally avoid high-relief areas to protect their gear and reduce the bycatch of some limiting stocks, the negative effects of these reopenings on benthic habitat would likely be minimal.

Overall, Alternative 1.a, the Oceana et al. Alternative, would result in short- and long-term net benefits, compared to the No-action Alternative, for benthic habitat on the West Coast, as a whole, as well as all geographic breaks shoreward of 700 fm.

For a comparison of Alternative 1.b, the Oceana et al. Alternative, with the other action alternatives under Subject Area 1, see Section 4.2.1.7.

4.2.1.4 Alternative 1.c., the Midwater Trawlers Cooperative Alternative

As described in Section 2.2.3, this alternative would make a number of changes to the current suite of EFHCAs along the West Coast, and would consist of 13 polygons: 9 closures and 4 reopenings.

Change in BTCs (non-overlapping EFHCAs). The alternative-wide habitat metrics for Alternative 1.c, the MTC Alternative, are shown in Table 4-5. This alternative would increase the total area of BTCs by 102 mi^2, an increase of 0.7 percent over the No-action Alternative. These gains in protections from bottom trawling, relative to the No-action alternative, would be spread across most other habitat metrics, but to varying degrees.

The largest increase in substrate protections is for hard substrate (65 mi^2, plus 4.9 percent), followed by soft substrate (33 mi^2, plus 0.3 percent), and mixed substrate (4 mi^2, plus 1.3 percent).

Most priority habitats would see relative small gains in protections, compared to the No-action Alternative, ranging from a high of 4.9 percent for hard substrate to a low of 0 percent for canyons. OFS, on the other hand, would see a small reduction (minus 1 mi^2, minus 0.1 percent).

Change in EFHCAs. The MTC Alternative would increase coastwide EFHCA-specific protections by 100 mi^2 (plus 1.7 percent). Modest gains would be made across most habitat metrics.

Because of the small scope of this alternative, and the fact that the areas that overlap with other BTCs is relatively small compared to the areas that do not overlap, net changes to EFHCAs is similar, in spatial extent, to the change in coastwide BTCs.

Trawl Effort. The proposed closures would contain less than 0.1 percent of the 2011 to 2014 coastwide trawl effort, while the reopenings would contain less than 0.1 percent of the 1997 to 2001 coastwide effort.

Table 4-5. Habitat metrics for Alternative 1.c, the MTC Alternative. BTC = Bottom trawl closures. % Closed and % Reopened = percent of area closed or reopened by the alternative. Net mi2 = Closed minus Reopened. Net Change is relative to the No-action Alternative. "-" = true zero; 0 = <1 mi^2, 0.0=<0.1%. Negative values are in parentheses.

Metric					**No Overlap with Other BTCs**		**Overlap with Other BTCs**		**Net Change in Total BTC**	**Net Change in Total EFHCA**
					Closed	**Reopened**	**Closed**	**Reopened**		
Spatial extent (mi^2)					mi^2	115	13	6	8	102	100
					%					0.7	1.7
Substrate Type	Hard				mi^2	65	0	-	-	65	65
					%	56.6	2.1	-	-	4.9	7.3
	Mixed				mi^2	4	0	4	2	4	7
					%	3.9	0.0	68.3	24.3	1.3	3.6
	Soft				mi^2	46	13	2	6	33	29
					%	39.5	97.9	31.7	75.7	0.3	0.6
	Unknown				mi^2	-	-	-	-	-	-
					%	-	-	-	-	-	-
Priority Habitats	Canyon				mi^2	-	-	0	-	-	0
					%	-	-	1.3	-	-	0.0
	OFS				mi^2	-	1	1	-	(1)	(0)
					%	-	6.8	13.1	-	(0.1)	(0.1)
	Habitat Forming Invertebrates	Presence	DSC		Count	7	-	1	2	7	6
					%					0.8	1.7
			Sponges		Count	18	1	6	7	17	16
					%					1.2	3.1
			SeaPens		Count	6	-	-	-	6	6
					%					0.7	1.4
		Bycatch	DSC		Count	-	-	-	-	-	-
					%					-	-
			Sponges		Count	42	-	30	50	42	22
					%					0.6	1.5
			SeaPens		Count	25	-	42	46	25	21
					%					0.4	1.9

4.2.1.4.1 Summary of the Habitat Effects of Alternative 1.c, the MTC Alternative

The MTC Alternative would directly affect habitat along the West Coast by 1) protecting the habitat in the closures from further degradation by bottom trawls and 2) exposing the habitat in the reopenings that has been recovering since the areas were closed in 2006 to future degradation by bottom trawls.

As described above, this alternative, would increase overall EFH protections along the Oregon Coast by 102 mi^2 by closing five times more habitat than it would reopen, with gains across all of the habitat metrics, except for a very small decrease in OFS (-0.1 percent) and no change in canyons. The largest gains would be in hard substrate (65 mi^2), followed by soft substrate (33 mi^2). While the relative changes in coastwide protections would be small, this reflects the relatively small geographic scope of the alternative.

The net increase in EFH protections across most habitat types would, in the long term, allow the recovery of those habitats and the restoration of ecosystem functions along the Oregon Coast. As a result, biological production, including that of managed groundfish, would likely increase in this area. Because most marine species have pelagic eggs and larvae, and many have mobile juveniles and adults, the benefits of increased biological production would not be confined to the closures, but they would be more broadly distributed as these life stages disperse into adjoining areas (Thompson et al., 2017).

Although it is not possible to predict the location or intensity of bottom trawling that would occur in the areas to be reopened, the MTC identified them as being important to the local fishing communities. Although these areas would contain less than 0.1 percent of the 1997 to 2001 coastwide trawl effort, it is reasonable to assume that those areas would be fished to some extent. However, 98 percent of the area to be reopened is soft substrate, which is the most resilient type of habitat, and fishermen generally avoid high-relief areas to protect their gear and reduce the bycatch of some limiting stocks, the negative effects of these reopenings on benthic habitat would likely be minimal.

In summary, the MTC Alternative would result in short- and long-term net benefits, compared to the No-action Alternative, for benthic marine habitats along the Oregon Coast.

4.2.1.5 Alternative 1.d, the Garibaldi Reef South Alternative, Alternative 1.e, the Rittenburg Bank Alternative, and Alternative 1.f, the Potato Bank Correction Alternative

Alternative 1.d, the Garibaldi Reef South Alternative, Alternative 1.e, the Rittenburg Bank Alternative, and Alternative 1.f, the Potato Bank Correction Alternative would consist of either a single polygon (1.d and 1.e) or two polygons of equal size (1.f). As such, the alternative-wide and polygon analyses are combined, and no geographic break analysis is necessary. In addition, because of their small size, these alternatives are not compared to the No-action alternative. Should the Council select any of these alternatives, it is likely that they would be combined with other Subject Area 1 alternatives, and not as a stand-alone preferred alternative. Therefore, they are discussed as a group below.

Alternative 1.d., the Garibaldi Reef South Alternative: This alternative would close 8 mi^2 to bottom trawling (Table 4-6), and would not overlap with other BTCs. It consists primarily of soft substrate (7

mi^2, 91 percent), with small amounts of hard and mixed substrate (<1 mi^2 each). It has no canyon or OFS habitat, and it has very few cells with presence or exceeding the median bycatch of any HFI taxa.

No bottom trawling occurred in this area from 2011 to 2014.

Alternative 1.e., the Rittenburg Bank Alternative: This alternative would close 13 mi^2 to bottom trawling (Table 4-6), and would not overlap with other BTCs. It consists primarily of soft substrate (12 mi^2, 91 percent), but it has one mi^2 of hard substrate. It has no mixed substrate, canyon, or OFS habitat, and it has few cells with presence or exceeding the median bycatch of any HFI taxa.

No bottom trawling occurred in this area from 2011 to 2014.

Alternative 1.f., the Potato Bank Correction Alternative: This alternative would correct the coordinates of the existing Potato Bank EFHCA so that it would contain Potato Bank. Although the size of the corrected EFHCA would match the size of the existing EFHCA, the corrected location would overlap with the CCA, resulting in a net loss in coastwide BTCs of 49 mi^2 (0.3 percent) (Table 4-7). However, the area that would be reopened consists entirely of soft substrate, and contains very little, to none, of the priority habitats. Areas of hard and mixed substrate within the new closure overlap with the CCA, and would not increase the coastwide extent of protections for these substrate types. No bottom trawling occurred in this area from 2011 to 2014.

4.2.1.5.1 Summary of the Habitat Effects of Alternative 1.d, the Garibaldi Reef South Alternative, Alternative 1.e, the Rittenburg Bank Alternative, and Alternative 1.f, the Potato Bank Correction Alternative

Alternative 1.d, the Garibaldi Reef South Alternative, Alternative 1.e, the Rittenburg Bank Modifications in NMFS Report Alternative, and Alternative 1.f, the Potato Bank Correction Alternative, would each directly affect habitat along the West Coast by protecting the habitat in the closures from degradation by future bottom trawls. However, bottom trawl effort data indicate that there has been no bottom trawling in these polygons since at least 2002 (FRAM data warehouse), so the risk of damage to the habitat within them from bottom trawling would be minimal even without the EFHCA designations. The sole reopening in these alternatives would be for Alternative 1.f, the Potato Bank Correction Alternative, which would reopen 78 mi^2 of the existing Potato Bank EFHCA to bottom trawling. However, as noted above, there has been no bottom trawling in the Southern California Bight since at least 2002, so reopening this EFHCA to bottom trawling would likely present a minimal risk to the benthic habitats within.
In summary, these alternatives would likely result in beneficial, but localized and minimal, effects over the short and long term for benthic marine habitats along the West Coast.

Table 4-6. Habitat metrics for Alternatives 1.d, the Garibaldi Reef South Alternative and 1.e, the Rittenburg Bank Alternative. % Closed and % Reopened = percent of area closed or opened by the alternative.

Metric					**Alternative**	
					1.d Garibaldi Reef South	**1.e Rittenburg Bank**
Spatial extent (mi^2)				mi^2	8	13
				%	-	-
Substrate Type	Hard*			mi^2	0	1
				%	5.9	9.2
	Mixed			mi^2	0	0
				%	3.5	0.0
	Soft			mi^2	7	12
				%	90.6	90.8
	Unknown			mi^2	-	-
				%	-	-
Priority Habitats	Canyon			mi^2	-	-
				%	-	-
	OFS 80% Max PO			mi^2	-	-
				%	-	-
	Habitat Forming Invertebrates	Presence	DSC	Count	2	5
			Sponges	Count	2	6
			Sea Pens	Count	3	6
		Bycatch	DSC	Count	-	-
			Sponges	Count	11	-
			Sea Pens	Count	-	-
Trawl Effort (% of Coastwide Effort)					-	-

Table 4-7. Habitat metrics for Alternatives 1.f, the Potato Bank Correction Alternative. BTC = Bottom trawl closures. % Closed and % Reopened = percent of area closed or reopened by the alternative. Net mi2 = Closed minus Reopened. Net Change is relative to the No-action Alternative. Negative values are in parentheses.

Metric					**No Overlap with Other BTCs**		**Overlap with Other BTCs**		**Net Change in Total BTC**	**Net Change in Total EFHCA**
					Closed	**Reopened**	**Closed**	**Reopened**		
Spatial extent (mi^2)				mi^2	30	78	81	32	(49)	0
				%					(0.3)	0.0
Substrate Type	Hard			mi^2	-	-	1	-	-	1
				%	-	-	1.2	-	-	0.1
	Mixed			mi^2	-	-	9	-	-	9
				%	-	-	11.4	-	-	5.0
	Soft			mi^2	30	78	71	32	(49)	(10)
				%	100.0	100.0	87.4	100.0	(0.4)	(0.2)
	Unknown			mi^2	-	-	-	-	-	-
				%	-	-	-	-	-	-
Priority Habitats	Canyon			mi^2	-	-	-	-	-	-
				%	-	-	-	-	-	-
	OFS			mi^2	-	-	-	-	-	-
				%	-	-	-	-	-	-
	Habitat Forming Invertebrates	Presence	DSC	Count	2	-	9	1	2	10
				%					0.2	2.9
			Sponges	Count	4	3	23	4	1	20
				%					0.1	3.9
			Sea Pens	Count	-	2	2	-	(2)	-
				%					(0.2)	-
		Bycatch	DSC	Count	-	-	-	-	-	-
				%					-	-
			Sponges	Count	-	-	-	-	-	-
				%					-	-
			Sea Pens	Count	-	-	-	-	-	-
				%					-	-

4.2.1.6 Alternative 1.g, the New EFHCAs within the Trawl RCA off Washington Alternative

This alternative would create new EFHCAs within the trawl RCA off the Washington Coast, based on the presence of priority habitats, as described in section 2.2.7.

The analysis of Alternative 1.g, the New EFHCAs in Washington Alternative, does not propose a specific polygon for closure to bottom trawling, but instead, identifies the priority habitats within the trawl RCA off Washington (Table 4-8) from which the Council could select one or more EFHCAs. Should the

Council select this alternative as part of their FPA, the Project Team requests direction on drawing the polygons for the new EFHCAs. Habitat metrics would need to be generated for those specific polygons.

OFS makes up the largest area of priority habitats, at 73 mi^2 (90.4 percent of the area with priority habitats). However, this is based entirely on the probability of occurrence for two of the three overfished species that were analyzed (DBRF and POP), both of which have recently been declared rebuilt. The probability of occurrence of the third species, YRF, did not exceed the 80 percent of maximum threshold in any grid cells. Therefore, if DBRF and POP were not included when identifying OFS habitats, the total extent of priority habitats in the RCA would be greatly reduced.

Canyons covered 30 percent of the area covered by this alternative (24 mi^2), while there is less than 1 mi^2 of hard substrate. The HFI data show low numbers of cells with presence data, but higher numbers that exceeded the median bycatch of all three taxa.

4.2.1.6.1 Summary of habitat effects of Alternative 1.g, the New EFHCAs in Washington Alternative

Selecting all the priority habitats in the trawl RCA off Washington described here would directly increase overall EFH protections by 81 mi^2 of benthic habitat from bottom trawling compared to current EFH protections[21]. The area to be closed would consist almost exclusively of soft substrate. While 30 percent of the priority habitats are canyons, other priority habitats are relatively scarce, with less than one mi^2 of hard substrate. There are small areas with known presence of HFI, and larger areas that exceeded the median bycatch for HFI. However, because most of priority areas consist of OFS for species that have been declared rebuilt and are primarily soft substrate, which the least sensitive to, and fastest to recover from bottom trawling, the benefits to habitat of closing this area would be low positive and localized.

[21] This alternative is not compared to the No-action Alternative because it overlaps with the trawl RCA and would not provide any additional habitat protection as long as the trawl RCA remains in place. It would, however, expand EFH-specific protections.

Table 4-8. Habitat metrics for Alternative 1.g, Priority Habitats in the Trawl RCA off Washington. % = percent of the total area.

Metric					
Spatial extent (mi^2)				mi^2	81
Substrate Type	Hard			mi^2	0
				%	0.3
	Mixed			mi^2	-
				%	-
	Soft			mi^2	81
				%	99.7
	Unknown			mi^2	-
				%	-
Priority Habitats	Canyons			mi^2	24
				%	30.1
	OFS			mi^2	73
				%	90.4
	Habitat Forming Invertebrates	Presence	DSC	Count	4
			Sponge	Count	7
			Sea Pen	Count	3
		Bycatch	DSC	Count	214
			Sponge	Count	203
			Sea Pen	Count	414

4.2.1.7 Comparison of Subject Area 1 Alternatives: EFHCA Modifications

Six of the seven EFHCA alternatives would increase habitat protections across a range of habitat types relative to those provided by the No-action Alternative[22]. Of those six, only two of them are compared to each other here: Alternative 1.a, the Collaborative Alternative and Alternative 1.b, the Oceana, et al. Alternative. The other five are not considered stand-alone alternatives and, if selected by the Council, would be combined with one of these two. Therefore, they are not considered in this comparison.

The net metrics for the two alternatives shown in Table 4-9. Alternative 1.b, the Oceana, et al. Alternative, would close 19 times more area to bottom trawling than would Alternative 1.a, the

[22] Alternative 1.g, the new EFHCA in the Trawl RCA off Washington Alternative would not provide any additional habitat protection as long as the trawl RCA remains in place.

Collaborative Alternative. It would close 2.9 times more mixed substrate, 9.7 times more hard substrate, and 21.9 times more soft substrate than the Collaborative Alternative. Among priority habitats, it would close between 3.8 times and 9.7 times more than the Collaborative Alternative.

These differences are, in large part, due to the narrower geographic scope of the Collaborative Alternative compared to the Oceana, et al. Alternative because the Collaborative does not cover the Oregon Coast or the Southern California Bight.

From a strictly habitat point of view, the Oceana, et al. Alternative would provide substantially greater benefit to benthic habitats, across all metrics, than the Collaborative Alternative.

Table 4-9. Comparison of net habitat metrics for Alternatives 1.a and 1.b.

Habitat Metrics					**Net Change by Alternative**		**Relative Comparison (1.b/1.a)**
					1.a Collaborative	**1.b Oceana et al.**	
Spatial extent				mi^2	749	14,238	19.0
Substrate	Hard			mi^2	97	943	9.7
	Mixed			mi^2	51	149	2.9
	Soft			mi^2	600	13,102	21.8
Priority Habitats	Canyon			mi^2	209	760	3.6
	OFS			mi^2	9	61	7.0
	Habitat-Forming Invertebrates	Presence	DSC	count	96	366	3.8
			Sponge	count	99	958	9.7
			Sea Pen	count	71	471	6.6
		Bycatch	DSC	count	867	5,430	6.3
			Sponge	count	961	4,974	5.2
			Sea Pen	count	626	3,660	5.8

[1] Hard substrate is also a priority habitat.
[2] Count of 2 km grid cell count with presence data in NOAA's Deep Sea Coral Research and Technology Program coral database.
[3] Count of 0.5 km grid cells with greater than the median bycatch in kg/km trawled of habitat-forming invertebrates based on West Coast Groundfish Observer Program bycatch data. Median bycatch kg/km trawled: DSC 0.0978; Sponges 0.5582; sea pen 0.0101.

4.2.1.8 Alternative 2.a., the Remove the Trawl RCA Alternative

As described in Section 2.3.1, Alternative 2.a would eliminate the trawl RCA south of the combined tribal U&A. However, BTCs for other purposes (i.e., EFHCAs and CBGCA) that overlap with the trawl RCA would remain in place. Therefore, the habitat metrics for this alternative cover only those areas that do not overlap with other BTCs. Percents given here represent the percent change in coastwide BTCs.

Change in BTCs. The alternative-wide habitat metrics for Alternative 2.a, the Remove the Trawl RCA Alternative, are shown in Table 4-10. This alternative would reopen 2,835 mi^2 to bottom trawling along the West Coast, reducing coastwide BTCs by 19.6 percent compared to the No-action Alternative. The loss of protection from bottom trawling would be spread across all habitat metrics, but to varying degrees.

The largest reduction in substrate protections is for soft substrate (reopen 2,713 mi^2, minus 21.2 percent), followed by hard substrate (reopen 88 mi^2, minus 6.7 percent), and mixed substrate (reopen 32 mi^2, minus 9.3 percent).

Among priority habitats, reduction in protection would be greatest for OFS (reopen 807 mi^2, minus 85.1 percent). HFI metrics, across all taxonomic groups, would be reduced by 22.9 percent (DSC Presence, reopen 203 grid cells) to 75.6 percent (sea pen bycatch, reopen 4,341 grid cells).

Approximately 10.8 percent of the coastwide trawl effort occurred there between 1997 and 2001.

Table 4-10. Habitat metrics for Alternative 2.a, the Remove the trawl RCA Alternative. % Change = percent change from No-action Alternative in coastwide BTCs. Negative values are in parentheses.

Metric					Reopened to BT	% Change to Coastwide BTCs
Spatial extent				mi^2	(2,835)	(19.6)
Substrate Type	Hard*			mi^2	(88)	(6.7)
	Mixed			mi^2	(32)	(9.3)
	Soft			mi^2	(2,713)	(21.2)
	Unknown			mi^2	(2)	(4.0)
Priority Habitats	Canyon			mi^2	(132)	(17.0)
	OFS			mi^2	(807)	(85.1)
	Habitat-Forming Invertebrates	Presence	DSC	Count	(203)	(22.9)
			Sponges	Count	(421)	(30.6)
			Sea Pens	Count	(247)	(28.0)
		Bycatch	DSC	Count	(3,034)	(61.1)
			Sponges	Count	(5,030)	(70.4)
			Sea Pens	Count	(4,341)	(75.6)

[1] Hard substrate is also a priority habitat.
[2] Count of 2 km grid cell count with presence data in NOAA's Deep Sea Coral Research and Technology Program coral database.
[3] Count of 0.5 km grid cells with greater than the median bycatch in kg/km trawled of habitat-forming invertebrates based on West Coast Groundfish Observer Program bycatch data. Median bycatch kg/km trawled: DSC 0.0978; Sponges 0.5582; sea pen 0.0101.

4.2.1.8.1 Summary of the habitat effects of Alternative 2.a, the Remove the Trawl RCA Alternative

Alternative 2.a, the Remove the Trawl RCA Alternative (PPA for Oregon and California), would directly affect habitat along the West Coast by exposing 3,758 mi2 along the West Coast from Point Chehalis south to the border with Mexico to commercial groundfish bottom trawling. These areas have been closed to such trawling since 2002 and have had 15 years to recover. The priority habitats in this area would experience a significant reduction in protections from bottom trawling. The relative reduction in protection is especially large for HFI, which would experience a coastwide reduction from 22 percent to 76 percent.

Trawling in these areas would certainly degrade benthic habitats, but the extent is unknown. The location and intensity of bottom trawling depends on a variety of factors, including, but not limited to, changes to other fishery management measures (e.g., ACLs, IFQs), market demands for fish, the number of active vessels, and the effort by those vessels. Although neither the location nor the intensity of future bottom trawling can be predicted with any certainty, this alternative is specifically intended to reopen historically important fishing grounds, where more than 10 percent of coastwide effort occurred between 1997 and 2001, to provide additional opportunity to the fishing community. It is, therefore, reasonable to assume that bottom trawling would occur in the area that would be reopened. However, bottom trawling would likely be concentrated over soft substrates, which make up 96 percent of the trawl RCA and are the least sensitive to, and the fastest to recover from, bottom trawling compared to hard and mixed substrates. This would not rule out trawling occurring over the more sensitive hard and mixed substrates, canyons, or areas with HFI taxa; it would only mean that those areas would make up a relatively small proportion of the total trawl RCA. If those habitats were trawled, they would certainly be degraded, but to an unknown degree.

The loss of protections for these habitats may, in the long term, indirectly reduce the ecosystem function that they provide as habitat is degraded by bottom trawling. As described above, the extent to which ecosystem functions would be impacted would depend on the habitat type and location and intensity of bottom trawling in the reopened area. Although we cannot predict the location and intensity of bottom trawling, it is likely that most of it would occur over soft substrates, the least sensitive to, and fastest recover from, to bottom trawling. Bottom trawling over the more sensitive habitat types (e.g., hard substrate, HFI) would be expected to reduce habitat function over the long term. Because we cannot predict the location or intensity of trawling in the reopened area, we cannot predict the magnitude of any adverse effects on ecosystem function and biological productivity.

In summary, at both the alternative-wide and latitudinal and depth zones, eliminating the trawl RCA would likely result in more than minimal short- and long-term adverse effects for benthic marine habitats on the West Coast.

4.2.1.9 Alternative 2.b, the Remove the Trawl RCA, and, in Washington, Implement DACs Alternative

This alternative would eliminate the coastwide trawl RCA and establish DACs for overfished species off the coast of Washington. The Project Team identified five potential DACs (Figure 2-16). However, since this analysis began, two of the three species (DBRF and POP) have been declared rebuilt. The third species, YRF, remains overfished.

The metrics for evaluating the elimination of the trawl RCA are provided above under Alternative 2.a above and will not be discussed here. The metrics are provided for each DAC in Table 4-11, but they are not summarized across the alternative as a whole. This is because the effects of the alternative would depend on which DACs were implemented, when they were implemented, and for how long. If they were not implemented on a long-term basis, they would provide minimal, if any, benefits to habitat. Due their relatively small size, percent changes to the coastwide BTCs are not included here.

The five DACs would range in size from 9 mi^2 (Yelloweye 1) to 48 mi^2 (POP DBRK) and would close a maximum total of 148 mi^2 to bottom trawling. Soft substrate covers 142 mi^2 (96 percent) and hard substrate covers only 6 mi^2 (4.3 percent) of the area in the DACs combined. Canyon habitat covers 43 mi^2 (29 percent), and OFS habitat covers 40 mi^2 (27 percent) of the combined DACs.

Four of the five DACs consist of greater than 95 percent soft substrate with very little (less than 1 mi^2) to no hard substrate and no mixed substrate. The remaining DAC, Yelloweye 1, has 55 percent (5 mi^2) soft substrate and 45 percent hard substrate.

Two of the DACs, POP 2 and POP DBRK, have canyon habitat (7 mi^2 and 35 mi^2, respectively). While all five DACS contain OFS habitat, Yelloweye 1 and Yelloweye 2 each have less than 1 mi^2 of it. The other three DACs, POP 1, POP 2, and POP DBRK have more OFS habitat (3 mi^2, 17 mi^2, and 20 mi^2, respectively).

Four of the five DACs contain cells with HFI, and one, Yelloweye 2, has none. In those four DACs, cells with DSC and sponge presence or bycatch are generally low or zero, except sponges in POP DBRK, which has 340 cells that exceeded the median bycatch for sponges. Cells with sea pen presence and bycatch are more common across three of the five DACs. Cells with presence or exceeding the median bycatch of sea pens are generally higher than for DSC or sponges in all DACs except POP DBRK.

4.2.1.9.1 Summary of habitat effects of Alternative 2.a, the Remove the Trawl RCA, and, in Washington, Implement DACs Alternative.

Eliminating the trawl RCA and implementing the five DACs would directly affect habitat along the West Coast by exposing between 2,687 mi^2 and 2,835 mi2 of benthic habitat to bottom trawling, depending on how the DACs were implemented. If the DACs were all immediately implemented on a full-time, permanent basis, they would provide benefits to the habitat of the coast of Washington and would offset a small portion of the adverse habitat effects of eliminating the trawl RCA. However, if they were implemented on an as-needed basis over short periods, they would provide minimal protection to the benthic habitat and would not offset any of the adverse habitat effects of eliminating the trawl RCA. The shorter the time they are implemented, the lower the benefits to habitat.

Based on the uncertainty regarding how the DACs would be implemented and the small spatial extent of the DACs relative to the RCA, it is not possible to differentiate the effects of this alternative from the effects of eliminating the RCA without the DACs, as described under Alternative 2.a, above.

Table 4-11 Habitat metrics for Alternative 2.b, the Remove the Trawl RCA, and, in Washington, Implement DACs for Overfished Species Alternative. The metrics represent the areas that would be closed to bottom trawling if the Council were to implement the DACs in this alternative. % = percent of the total area closed by the DAC. Net Change = closures minus openings for all DACs combined. 0 = true zero. DBRK=darkblotched rockfish. YRF=yelloweye rockfish.

				Discrete Area Closures					
Habitat Metrics				**POP 1**	**POP 2**	**POP DBRK**	**YRF 1**	**YRF 2**	**DAC total**
Spatial extent (mi^2)				14	31	48	9	46	148
Substrate Type	Hard[23]		mi^2	<1	<1	0	4	1	6
			%	4.4	0.4	0	45.5	3.2	4.3
	Mixed		mi^2	0	0	0	0	0	0
			%	0	0	0	0	0	0.0
	Soft		mi^2	13	31	48	5	45	142
			%	95.6	99.6	100.0	54.5	96.8	95.7
	Unknown		mi^2	0	0	0	0	0	0
			%	0	0	0	0	0	0
Priority Habitats	Canyon		mi^2	0	7	35	0	0	43
			%	0	23.9	73.4	0	0	28.8
	OFS		mi^2	3	17	20	<1	<1	40
			%	22.2	55.9	41.6	<1	<1	27.2
	Habitat-Forming Invertebrates	Presence[24]	DSC	2	1	0	0	0	3
			Sponge	1	5	3	0	0	9
			Sea Pen	109	0	47	32	0	188
		Bycatch[25]	DSC	1	2	1	2	0	6
			Sponge	2	0	340	0	0	342
			Sea Pen	15	140	57	53	480	745

[23] Hard substrate is also a priority habitat.

[24] Count of 2 km grid cell count with presence data in NOAA's Deep Sea Coral Research and Technology Program coral database.

[25] Count of 0.5 km grid cells with greater than the median bycatch in kg/km trawled of habitat-forming invertebrates based on West Coast Groundfish Observer Program bycatch data. Median bycatch in kg/km trawled: DSC: 0.0978; Sponges 0.5582; sea pen 0.0101.

4.2.1.10 Alternative 2.c. Remove Trawl RCA and Implement BACs Alternative

This alternative would eliminate the trawl RCA and establish BACs that could be implemented pre-season or in-season to reduce catch of a particular species or species complex. We did not combine the habitat metrics for the elimination of the trawl RCA and the BACs into an alternative wide summary for two reasons: (1) we cannot predict when any of the BACs would be implemented and (2) combining them would represent the entire area shoreward of the 700 fm contour. Instead, this section relies on the description of the trawl RCA habitat metrics found in Section 4.2.1.8, Table 4-10, and will concentrate on the BAC metrics (Table 4-12).

The latitudinal breaks, and the depth zones within them, are discussed separately. In general, the relative extent of each depth zone is similar across all latitudinal zones, with the 150 fm to 700 fm depth zone having the largest extent, followed by the 30 fm to 100 fm, 100 fm to 150 fm, and 0 fm to 30 fm depth zones.

The spatial extent of the BACs range in size from less than 1 mi^2 (three BACs in CFPC) to 17,225 mi^2 (150 fm to 700 fm, PCUSMB). Three BACs have less than 1 mi^2, all in CFPC, due to the exclusion of the combined tribal U&A. The spatial extent of the other BACs is determined largely by the depth range and slope of the seafloor. Larger depth ranges and shallower slopes result in larger spatial extents.

The amount of each substrate type varies among the BACs, but the general pattern for each type follows the same pattern as seen for spatial extent, with the highest amounts in 150 fm to 700 fm, followed by 30 fm to 100 fm, 100 fm to 150 fm, and 0 fm to 30 fm. Canyon habitat, on the other hand, is most common in the deepest depths, becoming less abundant at shallower depths. OFS habitat is most abundant in depths below 30 fm in all depth zones of PCCB and CBCM. It is minimal in all other BACs.

Cells with presence of, and those that exceed the median bycatch of, all HFI taxa are generally, with a few exceptions, most abundant in the BACs at 150 fm to 700 fm, becoming progressively less abundant in the shallower BACs. The clear exception to this pattern is the BACs in the PCUSMB zone, where no cells exceeding the median bycatch of any HFI taxa occurred. This is likely due to the low bottom-trawl effort in these waters.

Table 4-12. Habitat metrics for Alternative 2.c, Remove Trawl RCA and Implement BACs for Groundfish Species and Protected Species, Particularly Salmon. The metrics represent the areas that would be closed to bottom trawling by implementing any of the BACs in this alternative. "-" = true zero; 0 = <1 mi^2.

							Priority Habitats							
									Habitat-forming Invertebrates					
			Substrate Type (mi^2)						**Presence**			**Bycatch**		
Latitudinal Zone	**Depth Zone**	**Spatial extent (mi2)**	**Hard**	**Mixed**	**Soft**	**Unknown**	**Canyons**	**OFS**	**Coral**	**Sponge**	**Sea Pens**	**DSC**	**Sponge**	**Sea Pens**
Cape Flattery to Pt Chehalis	0-30fm	-	-	-	-	-	-	-	-	-	-	-	-	-
	30-100fm	-	-	-	-	-	-	-	-	-	1	-	-	-
	100-150fm	0	-	-	0	-	0	0	1	3	3	-	-	-
	150-700fm	281	-	-	281	-	182	7	7	20	10	354	419	173
	Total	282	-	-	282	-	182	7	8	23	14	354	419	173
Pt Chehalis to Cape Blanco	0-30fm	410	2	1	406	0	-	-	1	1	2	-	-	311
	30-100fm	5,217	466	181	4,570	0	9	423	55	191	311	1,195	1,689	17,563
	100-150fm	928	19	9	900	-	39	596	22	64	32	1,119	1,767	2,171
	150-700fm	5,442	22	322	5,097	0	662	168	213	562	463	30,886	38,624	26,220
	Total	11,997	509	513	10,975	0	710	1,187	291	818	808	33,200	42,080	46,265
Cape Blanco to Cape Mendocino	0-30fm	199	0	-	199	-	-	-	1	-	1	-	41	11
	30-100fm	1,281	12	0	1,269	-	15	109	9	9	79	734	368	1,928
	100-150fm	204	1	-	203	-	27	148	7	15	8	410	163	19
	150-700fm	3,162	9	-	3,153	0	867	65	132	211	149	17,343	16,654	6,041
	Total	4,847	23	0	4,824	0	908	322	149	235	237	18,487	17,226	7,999
Cape Mendocino to Pt Conception	0-30fm	458	5	0	453	-	-	-	-	1	7	-	-	99
	30-100fm	3,169	84	1	3,084	-	15	1	95	159	434	151	113	1,426
	100-150fm	665	25	9	631	-	21	1	101	103	100	201	118	69
	150-700fm	8,641	1,002	7	7,583	50	899	11	265	332	600	1,793	2,288	10,310
	Total	12,934	1,116	17	11,751	50	934	14	461	595	1,141	2,145	2,519	11,904
Pt Conception to US/Mexico Border	0-30fm	167	12	0	155	0	0	-	5	4	5	-	-	-
	30-100fm	839	59	2	775	3	33	-	129	210	127	-	-	-
	100-150fm	447	28	-	417	1	24	-	52	123	45	-	-	-
	150-700fm	17,225	870	93	16,230	31	340	-	385	942	281	-	-	-
	Total	18,678	968	96	17,578	36	398	-	571	1,279	458	-	-	-
Grand Total		48,738	2,617	626	45,409	86	3,132	1,529	1,480	2,950	2,658	54,186	62,244	66,341

4.2.1.10.1 Summary of the habitat effects of Alternative 2.c, the Remove the Trawl RCA and Implement BACs Alternative

The habitat effects of Alternative 2.c, the Remove Trawl RCA and Implement Block Area Closures Alternative, would affect habitat along the West Coast by exposing 2,835 mi^2 of benthic habitat to bottom trawling that would result from eliminating the trawl RCA. If the BACs were implemented on a multi-year or permanent basis, they would provide benefits to the habitat and would offset some of the adverse habitat effects of eliminating the trawl RCA. The extent of this offset would depend on how soon, how many, and which, BACs were closed. The offset could range from minimal to complete and could even produce gains in habitat protection. However, if they were implemented on an as-needed basis over short periods, they would provide minimal to no meaningful habitat protection and would not offset any of the adverse habitat effects of eliminating the trawl RCA.

This alternative does not provide a schedule or plan for implementing the BACs, but they would be implemented using the process described in Section 2.3.3. Therefore, based on this uncertainty, it is not possible to differentiate the effects of this alternative from the habitat effects of Alternative 2.a., as described in Section 4.2.1.8.

4.2.1.11 Comparison of Subject Area 2 Alternatives, Adjustments to the Trawl RCA

All three trawl RCA action alternatives would eliminate the trawl RCA, thereby reducing habitat protections relative to the No-action Alternative. The degree to which the habitat effects of the three trawl RCA action alternatives would differ would depend on how the DACs or BACs were implemented. If they were implemented on a short-term basis only, the habitat in those closures would not fully recover from the effects of commercial groundfish bottom trawling, and there would be little, if any, difference in the effects of the three alternatives. However, if the DACs or BACs were implemented on a long-term basis, benefits to habitat would accrue as the habitat recovered, and some of the adverse effects of eliminating the RCA would be offset. The degree to which they would be offset would depend on what closures were implemented, and how long they remained in effect. At this time, however, it is not possible to predict how the Council would implement the DACs and BACs; it is, therefore, not possible to predict how the three alternatives would differ from each other at this time.

4.2.1.12 Alternative 3. Use MSA discretionary authorities to close waters deeper than 3,500 m to bottom contact fishing gear.

Alternative 3, the Use MSA discretionary authorities to close waters deeper than 3,500 m to bottom contact gear Alternative, would close the waters seaward of groundfish EFH out to the full extent of the EEZ to all bottom contact gear unless the vessel obtained an EFP. This area is off the coast of California,

south of the Mendocino Ridge, and covers 123,487 mi^2. Deep sea benthic habitats are sensitive to disturbance and are slow to recover. Very little is known about the types and distributions of benthic habitats in this area, although limited surveys west of Monterey Bay have found sponges and sea pens at depths up to 4,000 m (NOAA Deep-Sea Coral database). This area has never been commercially fished with bottom contact gear, and is, therefore, likely to be in pristine condition.

The lack of commercial bottom fishing is due to several factors, including the relatively low biomass of fishes, the lack of a market for the fishes that live there, and the depth limitations of the current fishing gear. Given these limitations, it is unlikely that a fishery would develop in the foreseeable future. Thus the benefits to habitat would be minimal. However, if a bottom fishery became feasible, this alternative's requirement for an EFP would result in significant benefits to the benthic habitats. The EFP requirement would prevent a commercial fishery from developing before the Council could develop management measures that would conserve the deep-sea habitats upon which the ecosystem depends. These measures could protect sensitive, pristine, deep-sea habitats through measures that put restrictions on the location, timing, or gear used by the fishery.

4.2.2 Fish Resources

This section describes impacts on fish resources for the No-action Alternative and each of the alternatives in the three Subject Areas. Fish resources fall within multiple categories that include all those finfish and shellfish resources that occur in the Action Area that may be affected by the proposed action. Most of the impacts on fish resources are due to harvest from or interaction with bottom trawl gear within the Action Area. Impacts on non-groundfish fish resources are also considered. For the action alternatives, discussion of the impacts on fish resources are divided into two parts: impacts of proposed reopening of areas to bottom trawl gear and impacts of proposed closures of areas on bottom trawl gear. For each alternative there is a qualitative, alternative-wide summary presented, comparing the impacts of the alternative to the No-action Alternative.

In general, the effects on fish resources would be a change in location of where harvest is occurring (i.e., displacement and redistribution of bottom trawl effort) and habitat effects in newly closed or newly opened areas. Generally, displacement of bottom trawl effort would neutrally affect fish resources if harvest levels remained similar to those considered under the No-action Alternative. Habitat protection and recovery would have positive effects on fish resources, especially for groundfish stocks for which the areas would be closed for long periods. However, as described in Section 4.1.2, habitat and harvest characteristics may change the relative importance of these areas regarding harvest and habitat.

Harvest by vessels using bottom trawl gear would continue to be limited by groundfish management measures like limited entry permits, IFQ, harvest specifications, etc., as described in Section 4.2.1.1, the No-action Alternative. Redistribution of fishing activities under any of the action alternatives, even if landings increase from the levels seen from 2011 to 2014, would not likely result in overfishing. Reopened trawlable areas may have localized negative effects on fish resources susceptible to harvest with bottom trawl gear, but catch controls in the IFQ management scheme would mitigate risks of overfishing.

The general effects described in this section would also apply to most non-groundfish species and ecosystem component species (ECS). Commercial harvest of these species in the bottom trawl fishery is monitored, and an increase in the catch of a non-groundfish stocks or ECS could trigger additional management measures, under a separate action, if necessary to reduce the risk of overfishing.

State-managed fisheries (California halibut, ridgeback prawn, sea cucumber, and pink shrimp) may be impacted by EFH alternatives; however, impacts on these resources would be relatively neutral. We discuss these fishery impacts separately from the bottom trawl fishery analysis.

4.2.2.1 No-action Alternative

The No-action Alternative would 1) retain the current suite of EFHCAs intended to minimize the adverse effects of fishing on groundfish EFH (Subject Area 1), 2) retain the groundfish trawl RCA closures in place to control the catch of overfished species (Subject Area 2), and 3) continue to allow the use of bottom-contact gear in waters deeper than 3,500 m (Subject Area 3). The No-action Alternative also assumes that allowable harvest (e.g., annual catch limits, Shorebased IFQ Program allocations, etc.), trawl gear restrictions, and the overall management scheme for the groundfish bottom trawl fishery would remain similar to recent years, as described in Section 4.1.2.

EFHCAs under the No-action Alternative are designed to provide habitat protections for Pacific coast groundfish species by restricting certain types of fishing activities. Though the purposes of the trawl RCA and other GCAs are not habitat protection, some recovery of habitats has likely occurred in the areas closed for years to bottom trawling by these measures to reduce harvest of overfished groundfish species.

As described in Section 4.2.2.1, the No-action Alternative would maintain the current habitat protections provided by the combined BTCs across 14,485 mi^2, preserving habitats that are currently protected from the degrading effects of bottom trawl gear. This action would continue protections for fish and fish habitat, although fishing that is allowed under the No-action Alternative would continue, subject to ACLs and other harvest control measures that prevent overfishing. Protections from BTCs are limited in scope because other fishing activities are permitted in those areas, such as longlining, trolling, setting pot/traps,

and using trawl gears to harvest species like pink shrimp. Fishing activities that occur in the action area, both inside and outside BTCs, would continue under the No-action Alternative, as described in Section 4.2.2.1. Under the No-action Alternative, bottom trawling does not occur in depths greater than 3,500 m, so there would be no effect on fish resources.

4.2.2.1.1 Summary of the effects of the No-Action Alternative

Under the No-action Alternative, bottom trawl participants would continue to be limited to areas that allow the use of bottom trawl gear, and areas that prohibit the use of bottom trawl gear would continue to provide some protections for habitat and the fish resources that utilize those habitats. Groundfish species would continue to be harvested with bottom trawl gear, subject to ACLs and other measures to prevent overfishing. It is unlikely that fishers would begin bottom trawling in depths greater than 3,500 m because it is impractical. State-managed fisheries would continue to be limited to areas that allow the use of bottom trawl gear to target non-groundfish species, and areas that prohibit the use of bottom trawl gear would continue to provide some protections for habitat and the fish resources that utilize those habitats. We do not expect that these fisheries or their target resources would be impacted by the No-action Alternative.

4.2.2.2 Alternative 1.a, the Collaborative Alternative

This alternative would make a number of changes to the EFHCAs described in the No-action Alternative. Changes would include 42 closures and 26 reopenings. Under this alternative, there would be a net increase of 749 mi^2 (plus 5.2 percent) in the spatial extent of coastwide BTCs compared to the No-action Alternative.[26]

There is not a quantifiable measure of how much habitat is required for a population of fish to attain a stable, productive age structure. However, healthy functioning habitat is important for sustaining populations of fish, and there is a level at which adverse effects to habitat will negatively affect fish populations. This alternative would increase the total area of BTCs, protecting more habitat compared to the No-action Alternative. Therefore, the Collaborative Alternative would have an overall positive effect on habitats. Protecting fish habitat benefits fish resources by increasing overall productivity of fish populations. Fish populations would respond positively to improvements in the quality and quantity of habitat, which could result in fish populations supporting increased harvest (e.g., ACLs would go up while the stock[s] would remain healthy).

[26] The analysis of this alternative assumes that the trawl RCA would remain in place.

Areas that would be closed under the Collaborative Alternative would displace any bottom trawl fishing effort that was occurring there into areas that would remain open. Based on the estimated economic impacts of the closures under the Collaborative Alternative, a low proportion of groundfish harvest from 2011 to 2014 occurred in these areas that would be closed. However, fish resources harvested with bottom trawl gear and occurring in the areas that would be protected by the new BTCs under Alternative 1.a would experience immediate positive effects.

Areas that would be reopened under the Collaborative Alternative would no longer be closed to bottom trawling. However, this does not necessarily mean that bottom trawl fishermen would concentrate efforts in these newly reopened areas. Localized increases in harvest of fish resources would occur in these areas compared to the No-action Alternative. However, fish resources managed under MSA would continue to be subject to a suite of regulations intended to promote healthy fish populations and prevent overfishing, the same as the No-action Alternative.

Below is a more detailed description of the fish resources most likely to be affected by EFHCA closures and reopenings under Alternative 1.a, the Collaborative Alternative; groundfish species that are susceptible to bottom trawl gear. Specifically discussed are two groupings: 1) economically important stocks and 2) overfished species.

4.2.2.2.1 Effects on groundfish stocks from proposed closures

The Collaborative Alternative would close 959 mi^2 over a variety of depths and substrate types. Areas proposed to be closed would have displaced bottom trawl effort. While a very small proportion of groundfish[27] species landings come from the areas that would be closed (less than 1 percent of coastwide landings), available landings data overlaid with habitat characteristics can give some inference as to which species may benefit most from the proposed closures under the Collaborative Alternative.

Economically Important Species: The proportion of coastwide landings of economically important species coming from areas proposed for closure under the Collaborative Alternative is less than 1 percent for any species (Table 4-13). Soft substrates proposed for closure under the Collaborative Alternative would be mostly within the 150 fm to 700 fm depth contours (Table 4-3). This area could encompass suitable habitat for arrowtooth flounder, Dover sole, petrale sole, longspine thornyheads, shortspine thornyheads, and sablefish. This alternative would also include areas south of 40° N. latitude within the 30 fm to 100 fm zone with mixed substrate that could provide habitat for bocaccio or canary rockfish.

[27] Groundfish in this context means any species listed in the Pacific Coast Groundfish FMP, including ecosystem component species.

Table 4-13. Landings of economically important species in areas proposed to be closed under Alternative 1.a.

Latitudinal Zone	Depth Zone	Species Common Name	Round Pounds	Percentage of coastwide total
1 Cape Flattery to Pt Chehalis	**150fm-700fm**	Arrowtooth Flounder	10	0.00%
		Dover Sole	375	0.00%
		Pacific Cod	1	0.00%
		Sablefish	4,909	0.04%
		Thornyhead	19,482	0.14%
		Yellowtail Rockfish	9	0.00%
		Darkblotched Rockfish	7	0.00%
		POP	21	0.01%
2 Pt Chehalis to Cape Blanco	**150fm-700fm**	Arrowtooth Flounder	6,259	0.04%
		Dover Sole	4,559	0.01%
		Lingcod	3	0.00%
		Longnose Skate	1,999	0.03%
		Pacific Cod	7	0.00%
		Petrale Sole	17	0.00%
		Sablefish	1,446	0.01%
		Thornyhead	811	0.01%
		Yellowtail Rockfish	4	0.00%
		Darkblotched Rockfish	37	0.00%
		POP	25	0.01%
	30fm-100fm	Arrowtooth Flounder	2,836	0.02%
		Dover Sole	19,476	0.03%
		Lingcod	158	0.01%
		Longnose Skate	1,579	0.03%
		Pacific Cod	31	0.00%
		Petrale Sole	1,443	0.01%
		Sablefish	3,593	0.03%
		Thornyhead	1,297	0.01%
		Yellowtail Rockfish	1	0.00%
		Darkblotched Rockfish	1	0.00%
		POP	1	0.00%
3 Cape Blanco to Cape Mendocino	**150fm-700fm**	Arrowtooth Flounder	16,074	0.10%
		Dover Sole	54,275	0.09%
		Lingcod	219	0.01%
		Longnose Skate	4,740	0.08%

Table 4-13. Landings of economically important species in areas proposed to be closed under Alternative 1.a. (continued)

Latitudinal Zone	Depth Zone	Species Common Name	Round Pounds	Percentage of coastwide total
		Petrale Sole	35,913	0.26%
		Sablefish	14,310	0.11%
		Thornyhead	22,175	0.16%
		Darkblotched Rockfish	339	0.01%
		POP	6	0.00%
4 Cape Mendocino to Pt Conception	**150fm-700fm**	Dover Sole	10,842	0.02%
		Lingcod	6	0.00%
		Longnose Skate	78	0.00%
		Petrale Sole	1,456	0.01%
		Sablefish	1,267	0.01%
		Thornyhead	966	0.01%
		Bocaccio Rockfish	59	0.08%
	30fm-100fm	Arrowtooth Flounder	199	0.00%
		Dover Sole	9	0.00%
		Lingcod	94	0.00%
		Longnose Skate	278	0.00%
		Petrale Sole	4,930	0.04%
		Sablefish	90	0.00%
		Yellowtail Rockfish	1	0.00%
		Bocaccio Rockfish	296	0.42%

Overfished Species: From 2011 to 2014, a very small amount (8 pounds, less than 1 percent of the coastwide total) of cowcod were caught in areas proposed to be closed under Alternative 1.a, the Collaborative Alternative. The cowcod were caught in the 150 fm to 700 fm depth range between Cape Mendocino and Point Conception. No yelloweye rockfish were caught from 2011 to 2014 in areas proposed for closure. Some of the areas proposed for closure may include habitat preferable to cowcod and yelloweye rockfish.

4.2.2.2.2 Effects on groundfish stocks from proposed reopenings

The Collaborative Alternative would reopen 211 mi^2 to bottom trawling over a variety of depths and mostly soft substrates. Areas proposed to be reopened may experience bottom trawling to some degree, resulting in negative effects to groundfish[28] species that are susceptible to bottom trawl gear.

[28] Groundfish in this context means any species listed in the Pacific Coast Groundfish FMP, including ecosystem component species.

Additionally, fish resources associated with the habitat types opened by Alterative 1.a. may be negatively impacted due to the negative effects that bottom trawl gear can have on benthic habitats. While a very small proportion of landings come from the areas that would be reopened (less than 1 percent of coastwide landings for most species; less than 2 percent for bocaccio), available landings data overlaid with habitat characteristics can give some inference to which species may be subject to additional habitat impacts or fishing pressure from the proposed reopenings under the Collaborative Alternative.

Economically Important Species: A very small amount of coastwide catch of economically important species would occur within areas proposed for reopening under Alternative 1.a. (less than 1 percent for all species and depths bins combined) (Table 4-14). This alternative would reopen 210 mi^2 of soft substrate habitat, primarily between 150 fm and 700 fm, although it would also open an area shoreward of 100 fm. Therefore, fish resources that are most likely to be negatively affected by fishing activities that could occur in reopened areas are groundfish species associated with soft substrate habitat. These areas could be good habitat for thornyheads, sablefish, and longnose skate.

Table 4-14. Landings of economically important species in areas proposed to be reopened under Alternative 1.a.

Latitudinal Zone	Depth Zone	Species Common Name	Round Pounds	Percentage of coastwide total
2 Pt Chehalis to Cape Blanco	**100fm-150fm**	Arrowtooth Flounder	141	0.00%
		Dover Sole	10,383	0.01%
		Longnose Skate	888	0.01%
		Petrale Sole	11,658	0.07%
		Sablefish	3,765	0.01%
		Thornyhead	315	0.00%
		Yellowtail Rockfish	6	0.00%
		Darkblotched Rockfish	1,492	0.03%
		POP	49	0.00%
	150fm-700fm	Arrowtooth Flounder	10,545	0.03%
		Dover Sole	165,764	0.21%
		Lingcod	551	0.02%
		Longnose Skate	1,687	0.01%
		Pacific Cod	108	0.00%
		Petrale Sole	2,624	0.02%
		Sablefish	24,648	0.09%
		Thornyhead	12,164	0.04%
		Yellowtail Rockfish	2,648	0.03%

Table 4-14 Landings of economically important species in areas proposed to be reopened under Alternative 1.a. (continued)

Latitudinal Zone	Depth Zone	Species Common Name	Round Pounds	Percentage of coastwide total
		Darkblotched Rockfish	1,812	0.04%
		POP	5,130	0.13%
	30fm-100fm	Arrowtooth Flounder	232	0.00%
		Dover Sole	704	0.00%
		Lingcod	1,047	0.03%
		Longnose Skate	1,658	0.01%
		Pacific Cod	14	0.00%
		Petrale Sole	5,760	0.04%
		Sablefish	126	0.00%
		Thornyhead	1	0.00%
		Yellowtail Rockfish	0	0.00%
		Darkblotched Rockfish	177	0.00%
		POP	42	0.00%
3 Cape Blanco to Cape Mendocino	**150fm-700fm**	Arrowtooth Flounder	49	0.00%
		Dover Sole	6,744	0.01%
		Longnose Skate	103	0.00%
		Petrale Sole	192	0.00%
		Sablefish	2,180	0.01%
		Thornyhead	2,567	0.01%
		Yellowtail Rockfish	273	0.00%
		Darkblotched Rockfish	530	0.01%
		POP	58	0.00%
	30fm-100fm	Dover Sole	2,052	0.00%
		Lingcod	85	0.00%
		Longnose Skate	1,815	0.01%
		Petrale Sole	2,268	0.01%
		Sablefish	884	0.00%
		Yellowtail Rockfish	4	0.00%
		Darkblotched Rockfish	0	0.00%
		POP	0	0.00%
4 Cape Mendocino to Pt Conception	**150fm-700fm**	Arrowtooth Flounder	2	0.00%
		Dover Sole	448,858	0.56%
		Lingcod	14,352	0.46%

Table 4-14 Landings of economically important species in areas proposed to be reopened under Alternative 1.a. (continued)

Latitudinal Zone	Depth Zone	Species Common Name	Round Pounds	Percentage of coastwide total
		Longnose Skate	6,657	0.05%
		Petrale Sole	13,028	0.08%
		Sablefish	57,042	0.22%
		Thornyhead	169,356	0.61%
		Yellowtail Rockfish	5,541	0.06%
		Bocaccio Rockfish	5,493	0.87%
		Darkblotched Rockfish	5,534	0.12%
		POP	40	0.00%
	30fm-100fm	Arrowtooth Flounder	27	0.00%
		Dover Sole	9,242	0.01%
		Lingcod	3,307	0.11%
		Longnose Skate	8,561	0.07%
		Petrale Sole	9,572	0.06%
		Sablefish	4,558	0.02%
		Thornyhead	2,531	0.01%
		Yellowtail Rockfish	2,665	0.03%
		Bocaccio Rockfish	7,330	1.16%
		Darkblotched Rockfish	4,073	0.09%
		POP	70	0.00%
	greater than 700fm	Dover Sole	55,892	0.07%
		Petrale Sole	617	0.00%
		Sablefish	8,628	0.03%
		Thornyhead	36,519	0.13%

Overfished Species: The Collaborative Alternative would reopen areas where cowcod (738 pounds, 0.12 percent of the total coastwide catch) and yelloweye rockfish (311 pounds, 0.34 percent of the total coastwide catch) were caught from 1997 to 2001. The cowcod catch was all from the area between Cape Mendocino and Point Conception, predominantly between 150 fm and 700 fm. The yelloweye rockfish catch came from a variety of latitude and depth areas, but the largest concentration was caught in the 150 fm to 700 fm depth range between Point Chehalis and Cape Blanco (Section 4.2.2.2.3). Reopening these areas would allow fishing with bottom trawl gear, and cowcod and yelloweye rockfish catch could occur, resulting in negative effects on overfished stocks. Overall, the areas proposed for reopening would be mostly soft substrate, which is not the preferred habitat of cowcod or yelloweye and, therefore, would be

unlikely to provide good habitat for overfished stocks. Opening soft substrates rather than hard or mixed substrates would mitigate negative impacts on cowcod and yelloweye rockfish because bottom trawling on soft substrates would not negatively impact their associated habitat.

4.2.2.2.3 Summary of effects for Alternative 1.a, the Collaborative Alternative

Overall, Alternative 1.a would increase the areas closed to bottom trawl gear compared to the No-action Alternative. A net increase in areas closed would facilitate habitat recovery in those areas, as described in Section 4.2.1.2. Improvements in the quality and quantity of habitats would benefit all fish resources due to ecosystem-wide benefits of habitat recovery. Specifically, areas that would be closed include a variety of habitats suitable for arrowtooth flounder, Dover sole, petrale sole, longspine thornyheads, shortspine thornyheads, sablefish and yelloweye rockfish. The areas that would be opened are predominantly soft substrates.

Table 4-15. Landings of overfished species in areas proposed to be reopened under Alternative 1.a.

Latitudinal Zone	Depth Zone	Species common Name	Landings (lbs)	Percentage of coastwide total
2 Pt Chehalis to Cape Blanco	**100fm-150fm**	Yelloweye Rockfish	7	0.00%
	150fm-700fm	Yelloweye Rockfish	63	0.02%
	30fm-100fm	Yelloweye Rockfish	38	0.01%
3 Cape Blanco to Cape Mendocino	**150fm-700fm**	Yelloweye Rockfish	20	0.01%
	30fm-100fm	Yelloweye Rockfish	0	0.00%
4 Cape Mendocino to Pt Conception	**150fm-700fm**	Cowcod Rockfish	559	0.62%
		Yelloweye Rockfish	105	0.04%
	30fm-100fm	Cowcod Rockfish	179	0.20%
		Yelloweye Rockfish	78	0.03%
	greater than 700fm	Cowcod Rockfish	0	0.00%

As stated in 4.2.2, one effect of all of the alternatives would be bottom trawl effort displacement, however impacts on fish resources would be limited by a variety of fishery management measures, as described in Section 4.1.2. It is not possible to predict how fishing behavior would change, but the proposed reopenings under Alternative 1.a, would not likely result in overfishing, because overfishing would be unlikely to occur in the IFQ management scheme.

The net effects of this alternative would be positive compared to the No-action Alternative. This is because benefits to habitats would provide benefits to fish resources.

4.2.2.2.4 Effects on state-managed non-groundfish fishery stocks

The California Department of Fish and Wildlife (CDFW) provided recent fishing activity for three state-managed fisheries. These fisheries generally operate shoreward of the non-groundfish trawl and trawl RCAs and into state waters. State-managed fisheries may operate near Alternative 1a. Figure 4-4 through 4-11 provide a general view of the potential overlap and where these fisheries operate relative to Alternative 1a. Based on mapping of trawl tracks of the California halibut fishery, this fishery would not overlap with Alternative 1a. Therefore, we do not expect the fishery to be impacted by its implementation. Alternative 1.a could benefit California halibut that may reside in the proposed area.

The ridgeback prawn fishery generally operates in the southern California bight and concentrates its effort along state waters and shoreward of the trawl RCA. However, it has operated in a portion of one polygon of Alternative 1a. Figure 4-7 provides a view of the area of operation for this fishery and the catch rates over seven years. Since this fishery generally has not operated in the Alternative 1.a area, we expect impacts to be neutral. Alternative 1.a could benefit California halibut that may reside in the proposed area.

The sea cucumber fishery generally operates in the southern California bight, and its effort concentrates along state waters and shoreward of the trawl RCA. However, it has operated in a portion of one polygon of Alternative 1a. Figure 4-8 provides a view of the area of operation for this fishery and the catch rates over seven years. Since this generally has not operated Alternative 1.a area, we expect impacts on this fishery would be neutral. Alternative 1.a could benefit sea cucumbers that may reside in the proposed area.

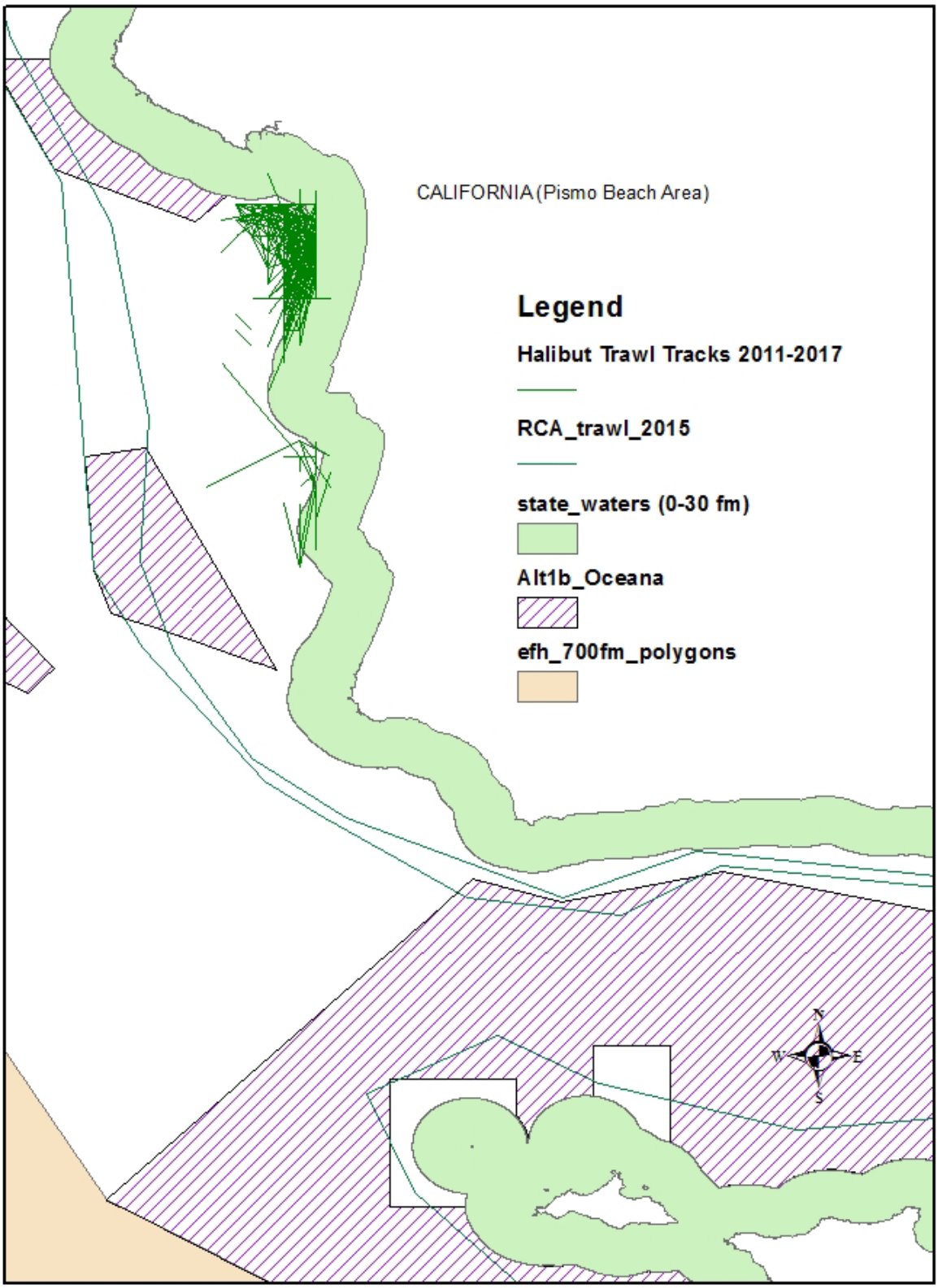

Figure 4-4 Summary of aggregate state-managed trawl logbook data (trawl track lines) in the southern California bight for California halibut from 2011 to 2017.

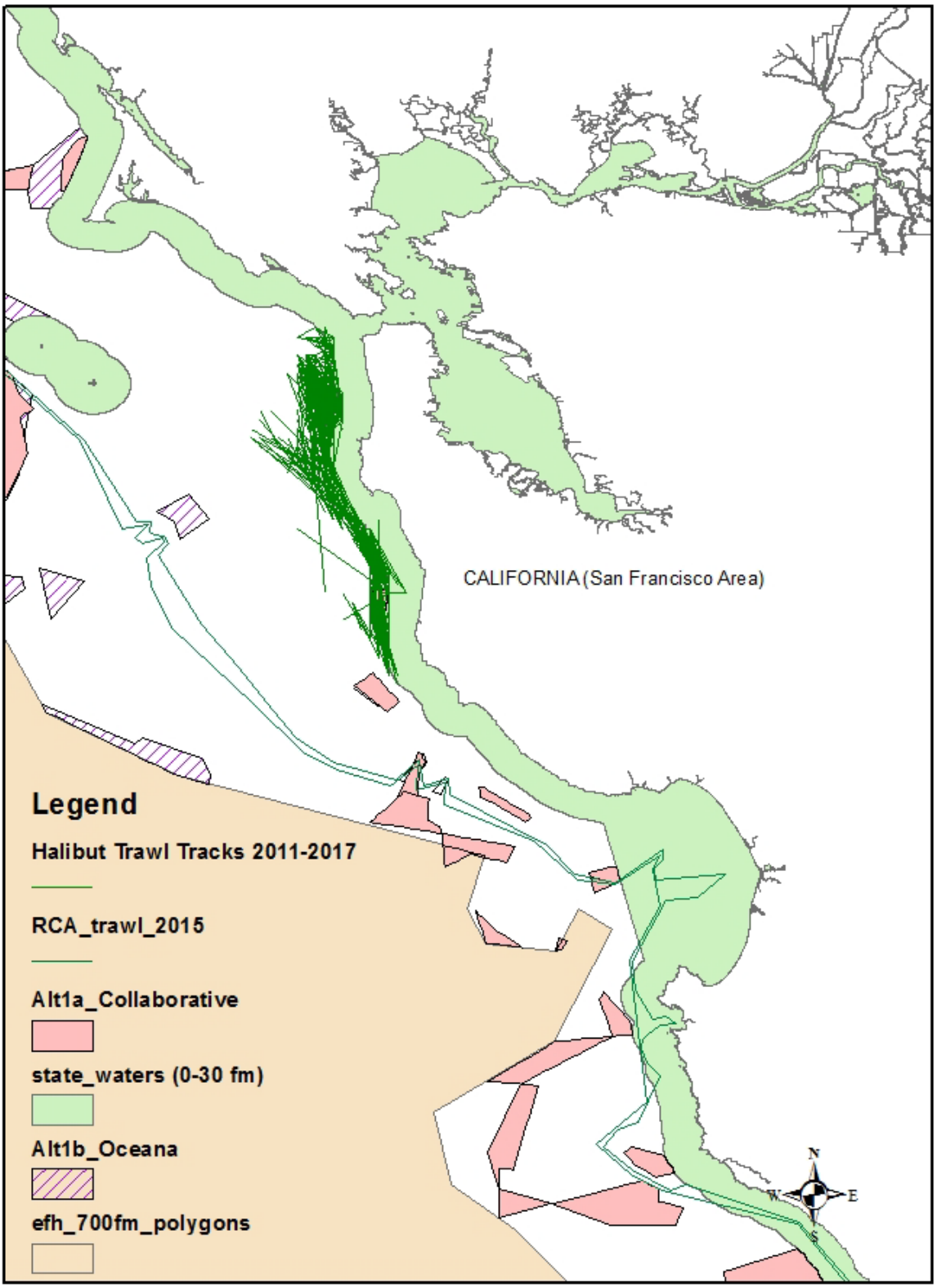

Figure 4-5. Summary of aggregate state-managed trawl logbook data (trawl track lines) in Central California for California halibut from 2011 to 2017.

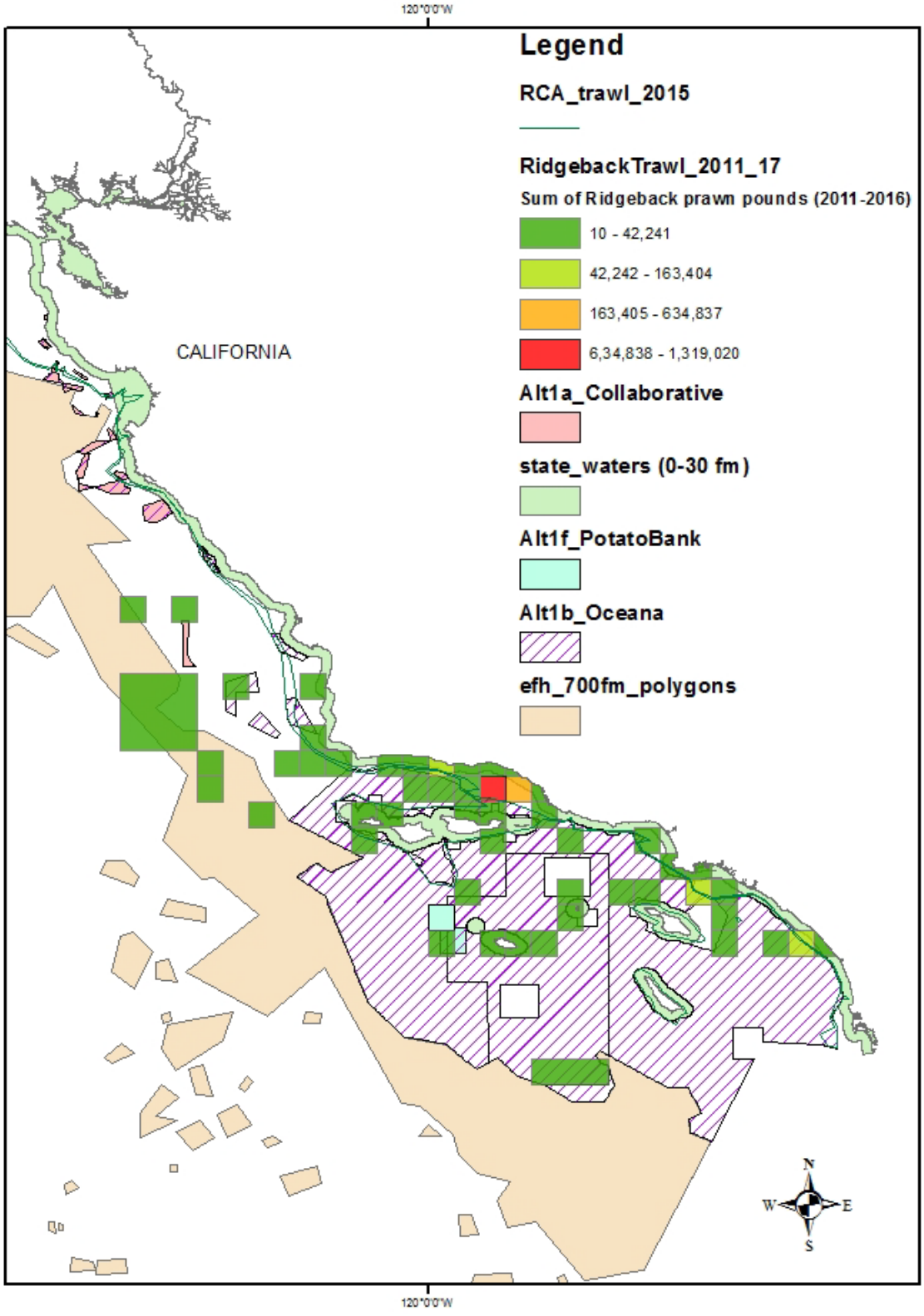

Figure 4-6. Ridgeback prawn landings by CDFW block as reported on state fish tickets from 2011 through 2017. Note: EFH proposals are shown for reference to fishing activity.

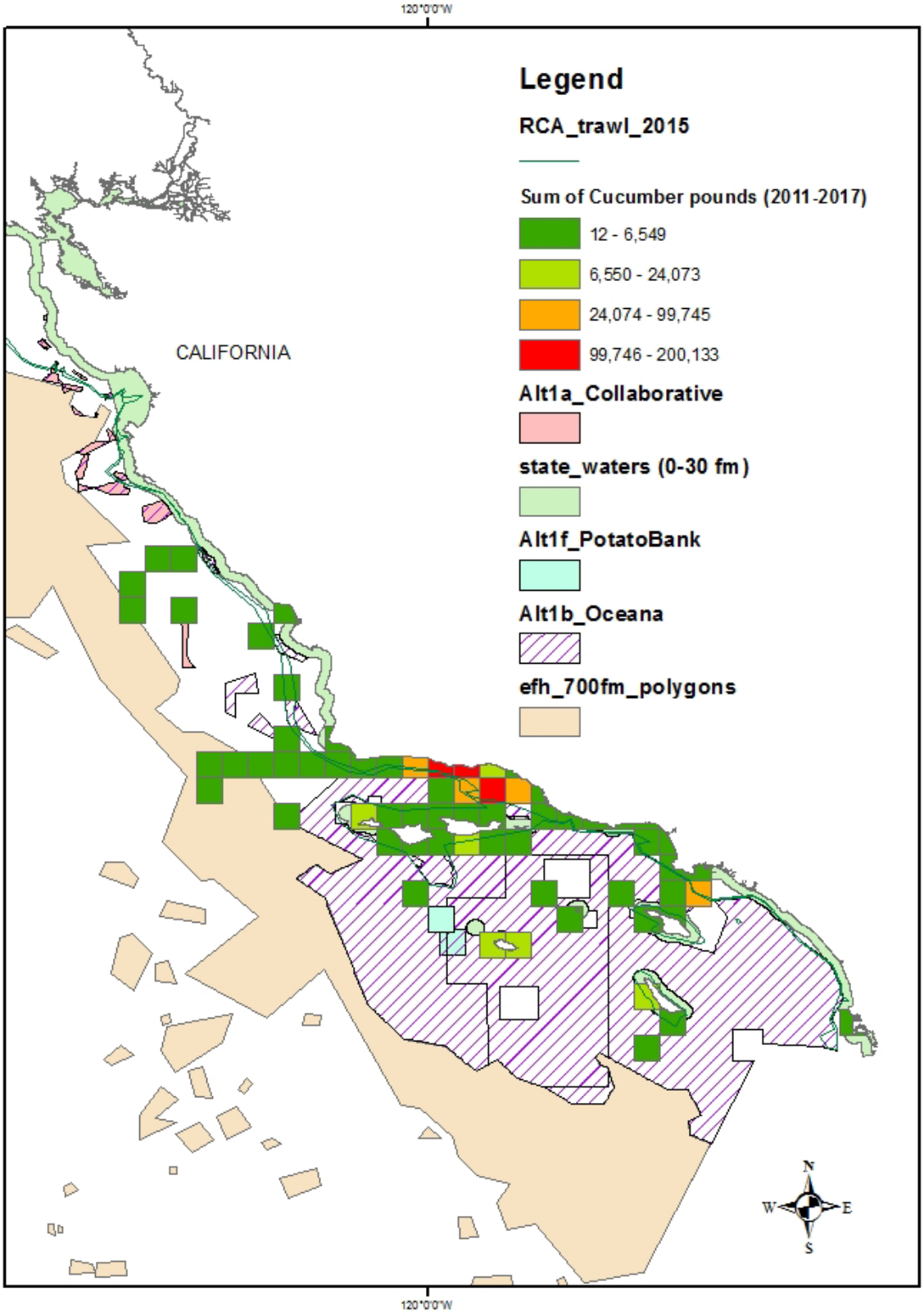

Figure 4-7. Sea cucumber landings by CDFW block as reported on state fish tickets for 2011 through 2017. Note that EFH proposals are shown for reference to fishing activity.

Since the pink shrimp fishery is prohibited from fishing in EFHCAs, adding or removing EFHCAs would affect fishable areas for the fishery. We cannot quantify the catch or revenue for the pink shrimp fishery that may be gained or lost should EFH proposals be implemented because we cannot assign a value to the footprint that overlaps each proposal. In addition, the fishery moves continuously and may not return to an area each year. Therefore, it is difficult to predict changes in catch or revenue for areas that are proposed to be opened or closed. Instead, we provide a summary of where the fishery operates and how it may be affected by EFH proposals.

To evaluate the spatial distribution of the pink shrimp fishery (footprint), NMFS West Coast Region prepared an analysis of VMS data to help inform future trawl RCA decisions. We mapped the proposed EFH closures with the footprint of the pink shrimp fishery. We then calculated the proportion of the closed areas that would overlap the alternatives and divided the figure by the total coastwide area of the shrimp trawl footprint (Table 4-15). Based on this information, Alternative 1.a could impact the area of operation for the pink shrimp fishery; however, the magnitude would be low (1.8 percent) compared to the available areas in which the fishery could operate. Fishing occurs during daylight hours. This reflects the behavior of ocean pink shrimp, which exhibit a vertical diurnal migration, moving to the bottom during daylight hours and ascending to feed at night. Oregon studies of trawl fishing effects on the overall stocks of pink shrimp show that the environment drives juvenile fish recruitment. There is little evidence that harvest reduces recruitment. Based on this information, implementation of Alternative 1.a would not impact pink shrimp stocks.

Table 4-16. Percent of pink shrimp fishing area overlap with proposed closures and openings in each alternative.

Alternative	Percent Overlap of Proposed EFH closures	Percent Overlap of Proposed EFH openings
1.a Collaborative	1.8%	0.0%
1.b Oceana et al.	5.2%	0.0%
1.c MTC	0.3%	0.0%
1.d Potato Bank	0.0%	0.0%
1.e Garibaldi Reef South	0.1%	NA%
1.f Rittenburg Bank	0.0%	NA
1.g Priority Habitats in Trawl RCA - WA	0.3%	NA

Note: NA = not applicable because there are no proposed openings as part of Alternative 1.a.

The pink shrimp fishery operates coastwide. Figure 4-8, Figure 4-9, Figure 4-10, and Figure 4-11 provide views of the overlap and the alternative. Observer data suggest that the observed pink shrimp fishery footprint might be largely limited in depth to approximately 100 fm. However, Washington and Oregon State commercial pink shrimp logbook data suggest that some level of effort is distributed deeper, between 100 fm and 150 fm, with virtually no effort deeper than 150 fm.

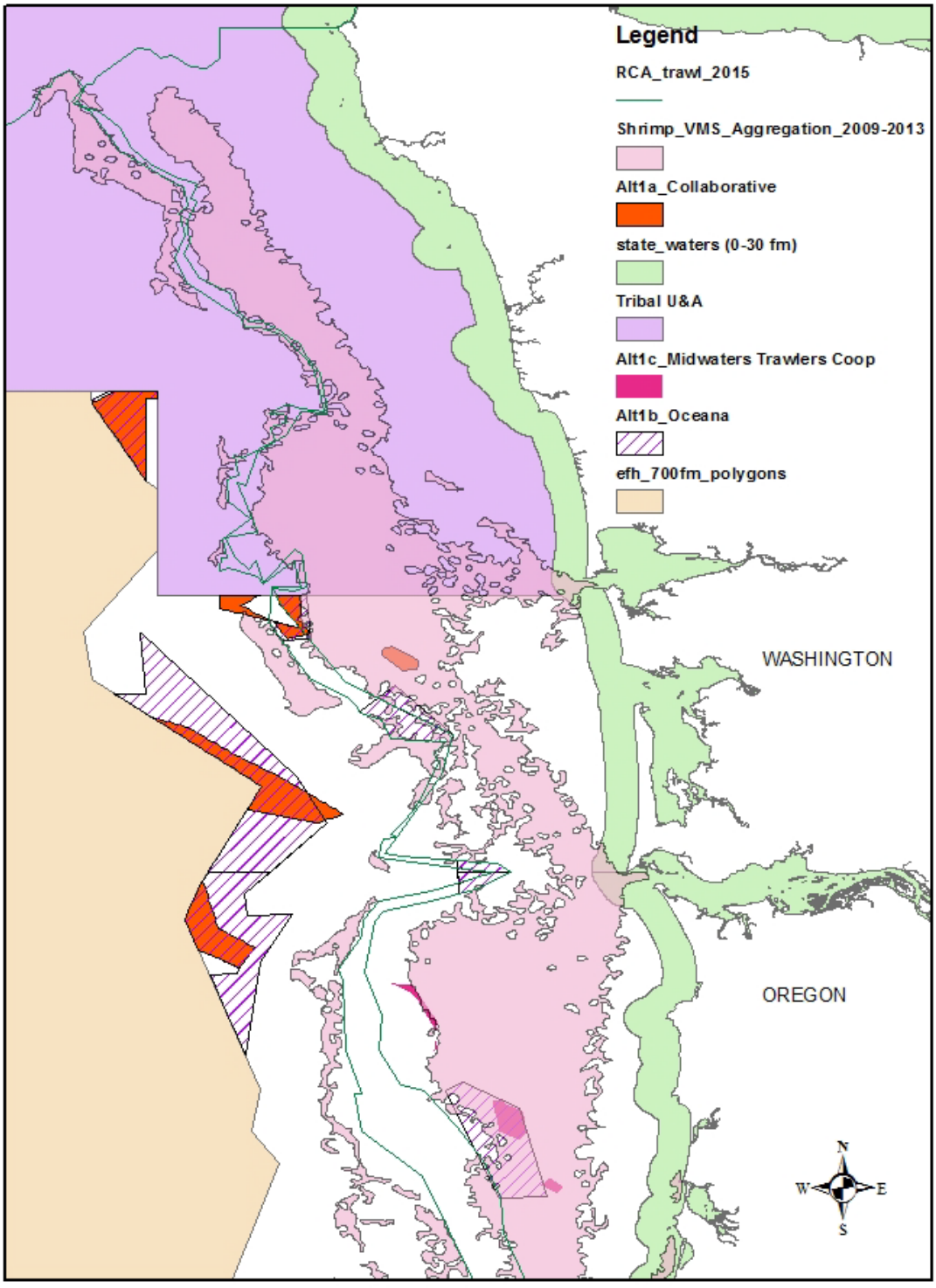

Figure 4-8. Map of pink shrimp trawl fishery off Washington showing the general area of overlap with EFH alternatives. This figure shows the footprint of fishery operations we developed using vessel monitoring system (VMS) data from 2009 to 2013.

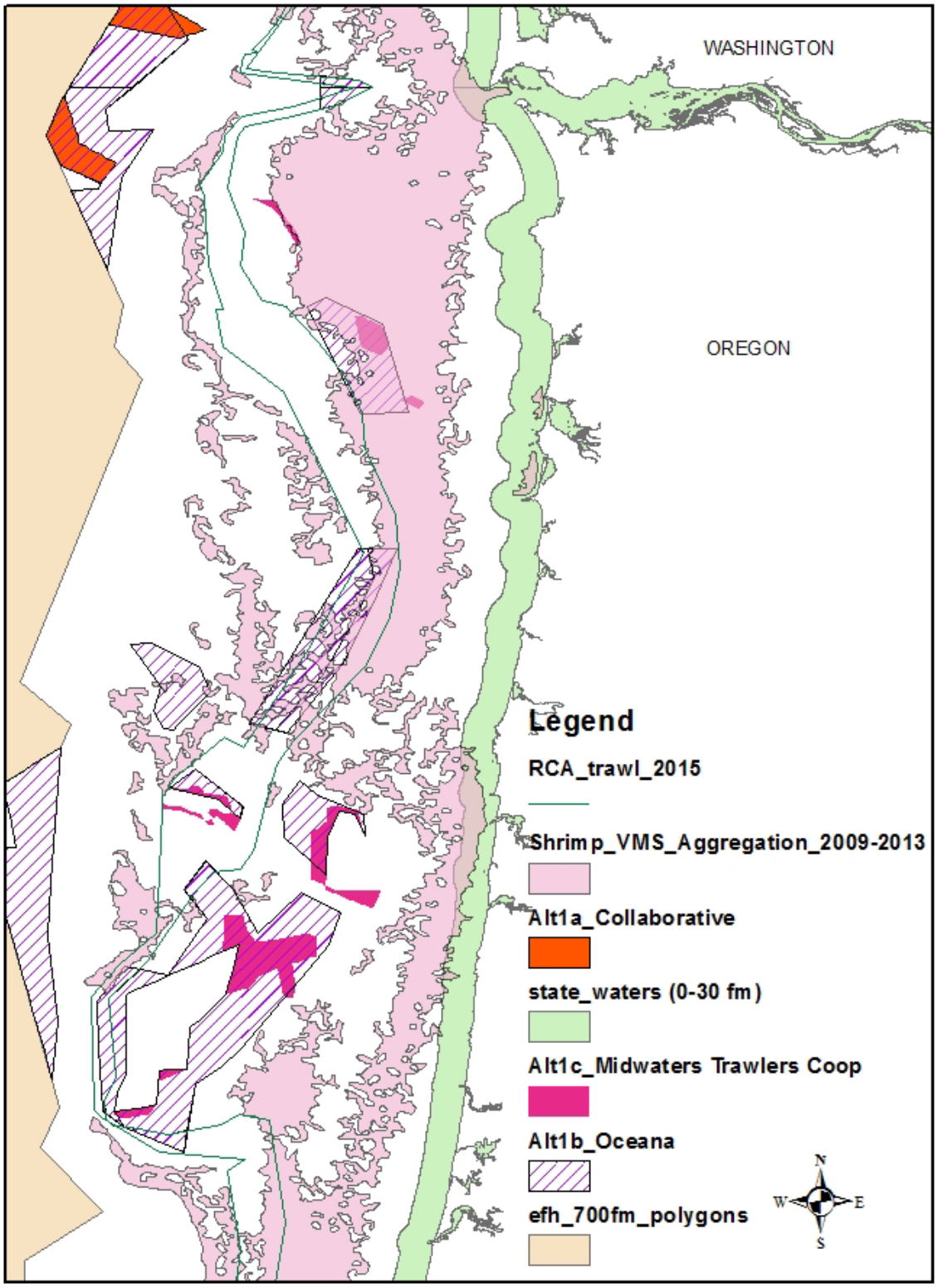

Figure 4-9. Map of pink shrimp trawl fishery off central and northern Oregon showing the general area of overlap with EFH alternatives. This figure shows the footprint of fishery operations we developed using VMS data from 2009 to 2013.

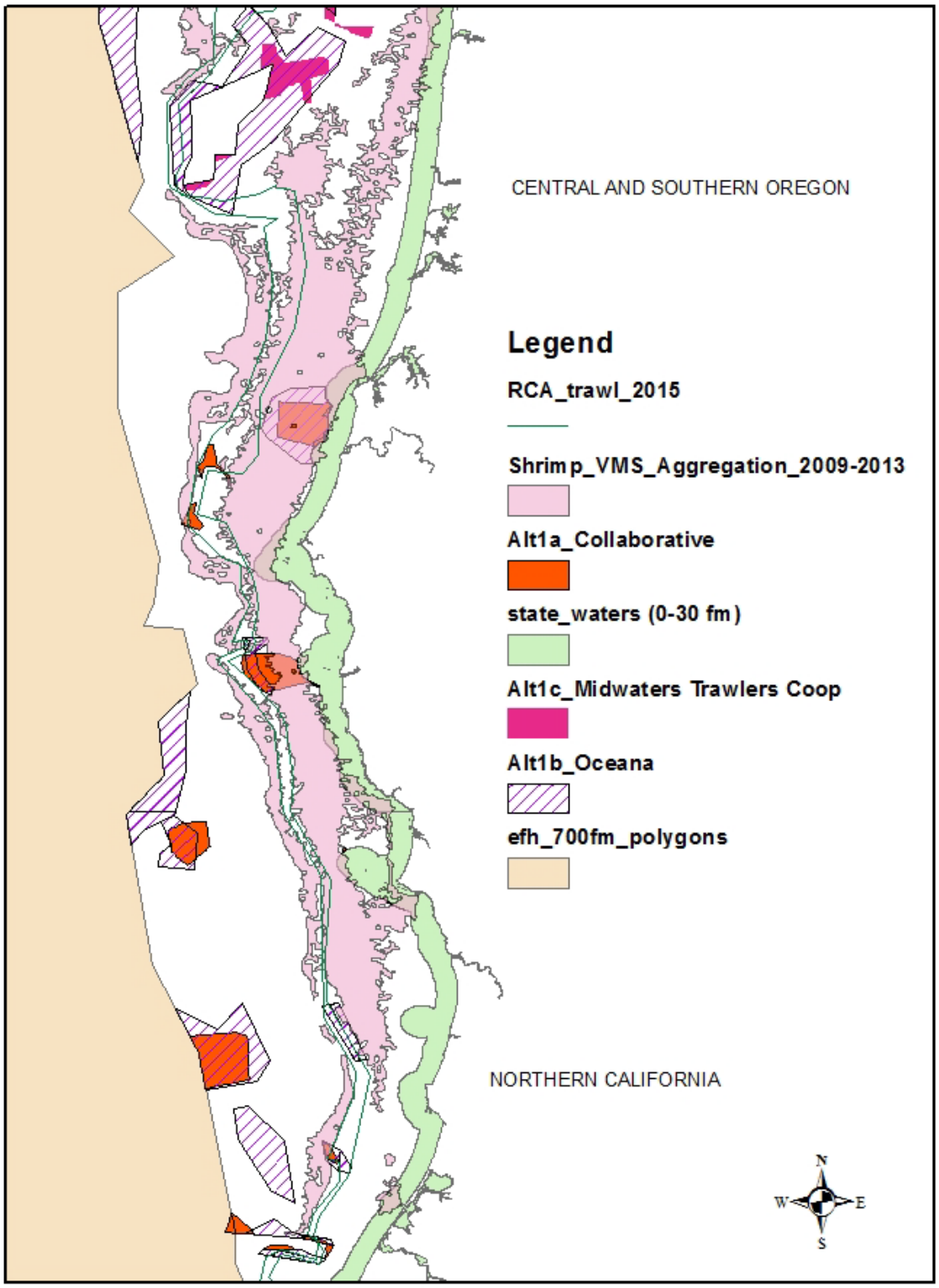

Figure 4-10. Map of pink shrimp trawl fishery off central and southern Oregon and northern California showing the general area of overlap with EFH alternatives. This figure shows the footprint of fishery operations we developed using VMS data from 2009 to 2013.

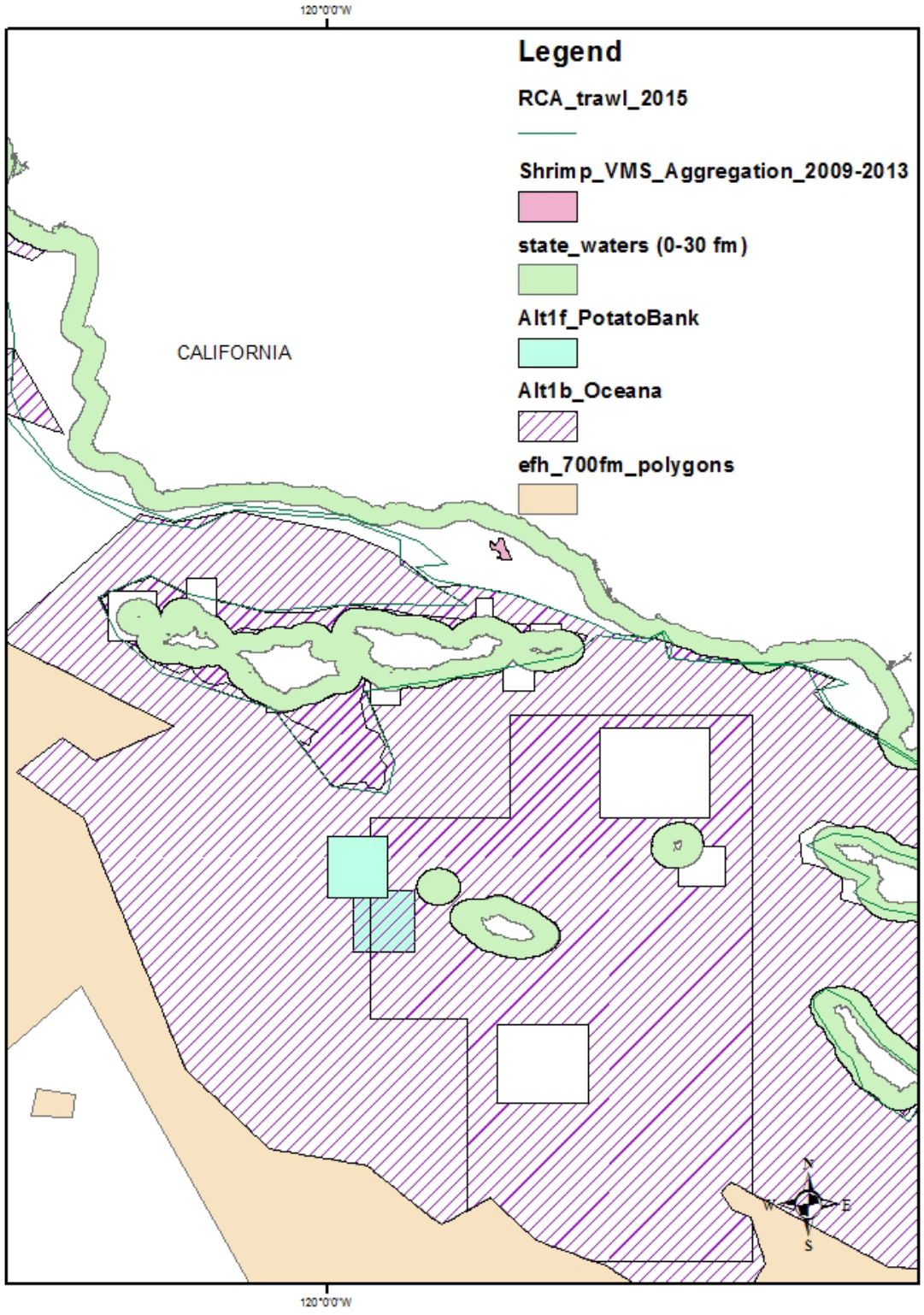

Figure 4-11. Map of pink shrimp trawl fishery off southern California with showing the general area of overlap with EFH alternatives. This figure shows the footprint of fishery operations we developed using VMS data from 2009 to 2013.

4.2.2.3 Alternative 1.b, the Oceana et al. Alternative

This alternative would make a number of changes to the EFHCAs described in the No-action Alternative. Changes would include 61 closures and 7 reopenings. Under this alternative, there would be a net increase of approximately 14,000 mi^2 (plus 98 percent; almost a doubling) in the spatial extent of coastwide BTCs compared to the No-action Alternative.[29]

As described in Section 4.2.2.2 under Alternative 1.a, the Collaborative Alternative would have the following effects. A net increase in habitat protections would benefit fish resources, closures would have an immediate effect on protection of fish resources in those areas, bottom trawl effort that occurred in the newly closed areas would be displaced to areas that would remain open to bottom trawling, and openings would allow bottom trawl fishing to occur in a manner similar to areas open to bottom trawling in the No-action Alternative.

Below is a more detailed description of the fish resources most likely to be affected by EFHCA closures and reopenings under Alternative 1.b, the Oceana et al. Alternative; groundfish species that are susceptible to bottom trawl gear. Two groupings are specifically discussed: 1) economically important stocks and 2) overfished species.

4.2.2.3.1 Effects on groundfish stocks from proposed closures

Alternative 1.b, the Oceana et al. Alternative, would close approximately 14,000 mi^2 over a variety of depths and substrate types. Areas proposed to be closed would have displaced bottom trawl effort. While a small proportion of groundfish[30] species landings come from the areas that would be closed (less than 3 percent of coastwide landings), available landings data overlaid with habitat characteristics can give some inference to which species may benefit most from the proposed closures under the Oceana et al. Alternative.

Economically Important Species: The proportion of coastwide landings of economically important species coming from areas proposed for closure under the Oceana et al. Alternative would be less than 1 percent for many species. The hard substrate area between Point Chehalis and Cape Blanco in the 30 fm to 100 fm depth range could provide suitable habitat for bocaccio or canary rockfish (Table 4-15). The proposed closure of 15,870 mi^2 of soft substrate area in the 150 fm to 700 fm depth range could provide suitable habitat for arrowtooth flounder, Dover sole, petrale sole, thornyheads, and sablefish.

[29] The analysis of this alternative assumes that the trawl RCA would remain in place.
[30] Groundfish in this context means any species listed in the Pacific Coast Groundfish FMP, including ecosystem component species.

Table 4-17. Landings of economically important species in areas proposed to be closed under Alternative 1.b.

Latitudinal Zone	Depth Zone	Species Common Name	Landings (lbs)	% of coastwide total
1 Cape Flattery to Pt Chehalis	**150fm-700fm**	Arrowtooth Flounder	20,586	0.12%
		Dover Sole	22,529	0.04%
		Longnose Skate	2,025	0.03%
		Pacific Cod	1	0.00%
		Petrale Sole	99	0.00%
		Sablefish	10,244	0.08%
		Thornyhead	30,943	0.22%
		Yellowtail Rockfish	9	0.00%
		Darkblotched Rockfish	21	0.00%
		POP	33	0.01%
2 Pt Chehalis to Cape Blanco	**150fm-700fm**	Arrowtooth Flounder	25,101	0.15%
		Dover Sole	118,599	0.19%
		Lingcod	517	0.02%
		Longnose Skate	15,127	0.25%
		Pacific Cod	848	0.02%
		Petrale Sole	20,096	0.14%
		Sablefish	125,940	1.01%
		Thornyhead	117,444	0.83%
		Yellowtail Rockfish	65	0.00%
		Darkblotched Rockfish	6,469	0.86%
		POP	1,295	0.38%
	30fm-100fm	Arrowtooth Flounder	5,173	0.03%
		Dover Sole	63,988	0.10%
		Lingcod	65	0.00%
		Longnose Skate	3,314	0.05%
		Pacific Cod	0	0.00%
		Petrale Sole	2,209	0.02%
		Sablefish	8,475	0.07%
		Thornyhead	4,078	0.03%
		Yellowtail Rockfish	1	0.00%
		Darkblotched Rockfish	4,141	0.55%
		POP	1,260	0.37%
3 Cape Blanco to Cape Mendocino	**150fm-700fm**	Arrowtooth Flounder	63,580	0.38%
		Dover Sole	1,618,219	2.56%
		Lingcod	461	0.02%
		Longnose Skate	67,915	1.10%
		Petrale Sole	123,185	0.88%

Table 4-17. Landings of economically important species in areas proposed to be closed under Alternative 1.b. (continued)

Latitudinal Zone	Depth Zone	Species Common Name	Landings (lbs)	% of coastwide total
		Sablefish	326,547	2.62%
		Thornyhead	485,853	3.45%
		Darkblotched Rockfish	1,611	0.21%
		POP	30	0.01%
	30fm-100fm	Arrowtooth Flounder	14	0.00%
		Dover Sole	3,226	0.01%
		Lingcod	1,352	0.05%
		Longnose Skate	617	0.01%
		Petrale Sole	10,368	0.07%
		Sablefish	1,230	0.01%
		Thornyhead	14	0.00%
		Yellowtail Rockfish	33	0.00%
		Darkblotched Rockfish	62	0.01%
4 Cape Mendocino to Pt Conception	**150fm-700fm**	Arrowtooth Flounder	1,062	0.01%
		Dover Sole	285,897	0.45%
		Lingcod	4	0.00%
		Longnose Skate	12,939	0.21%
		Petrale Sole	1,168	0.01%
		Sablefish	158,388	1.27%
		Thornyhead	207,018	1.47%
		Bocaccio Rockfish	432	0.61%
		Darkblotched Rockfish	41	0.01%
		POP	3	0.00%
	30fm-100fm	Arrowtooth Flounder	542	0.00%
		Dover Sole	1,255	0.00%
		Lingcod	4,654	0.18%
		Longnose Skate	1,240	0.02%
		Petrale Sole	17,049	0.12%
		Sablefish	2,796	0.02%
		Thornyhead	0	0.00%
		Yellowtail Rockfish	23	0.00%
		Bocaccio Rockfish	3,631	5.12%
		Darkblotched Rockfish	0	0.00%
		POP	0	0.00%

Overfished Species: From 2011 to 2014, only 1 pound of cowcod (0.09 percent of coastwide landings) and 12 pounds of yelloweye rockfish (2.97 percent of coastwide landings) were landed, primarily in the 150 fm to
700 fm depth zone between Point Chehalis and Cape Blanco (Table 4-18). The areas proposed for closure under Alternative 1.b would include areas with mixed and hard substrate in the 30 fm to 100 fm depth range between Point Chehalis to Cape Blanco. This zone could be suitable habitat for yelloweye, and potentially cowcod. An additional proposed closure of mostly hard substrate between Cape Mendocino and Point Conception in the 100 fm to 150 fm depth range could provide habitat for cowcod and yelloweye rockfish.

Table 4-18. Landings of overfished species in areas proposed to be closed under Alternative 1.b.

Latitudinal Zone	Depth Zone	Species Common Name	Landings (pounds)	% of coastwide total
1 Cape Flattery to Pt Chehalis	**150fm-700fm**	Yelloweye Rockfish	0	0.02%
2 Pt Chehalis to Cape Blanco	**150fm-700fm**	Yelloweye Rockfish	11	2.69%
4 Cape Mendocino to Pt Conception	**150fm-700fm**	Cowcod Rockfish	1	0.09%
	30fm-100fm	Yelloweye Rockfish	1	0.26%

4.2.2.3.2 Effects on groundfish stocks from proposed reopenings

The Oceana et al. Alternative would reopen approximately 150 mi^2 to bottom trawling over a variety of depths and mostly soft substrates. As described under Section 4.2.2.2.2 may experience bottom trawling, and fish resources may be negatively affected. While a very small proportion of groundfish landings came from the areas that would be reopened (based on 1997 to 2001 fishing data; less than 1 percent of coastwide landings, Table 4-19), available landings data overlaid with habitat characteristics can give some inference as to which species may be subject to additional habitat impacts or fishing pressure from the proposed reopenings under the Oceana et al. Alternative.

Economically important stocks: A very small amount of coastwide catch of economically important species would occur within areas proposed for reopening under Alternative 1.b (less than 1 percent each for all species and depths bins) (Table 4-20). The highest landings were for bocaccio between Cape Mendocino and Point Conception, in depths ranging from 150 fm to 700 fm. The depth and substrate characteristics of the areas proposed for reopening may be suitable for Dover sole, petrale sole, longnose skate, sablefish, and thornyheads.

Table 4-19. Landings of economically important species in areas proposed to be reopened under Alternative 1.b.

Latitudinal Zone	Depth Zone	Species Common Name	Round Pounds	% of coastwide total
4 Cape Mendocino to Pt Conception	**150fm-700fm**	Dover Sole	400,086	0.50%
		Lingcod	192	0.01%
		Longnose Skate	2,828	0.02%
		Petrale Sole	10,556	0.07%
		Sablefish	47,375	0.18%
		Thornyhead	163,322	0.59%
		Yellowtail Rockfish	311	0.00%
		Bocaccio Rockfish	3,442	0.54%
		Darkblotched Rockfish	593	0.01%
		POP	0	0.00%
	30fm-100fm	Arrowtooth Flounder	10	0.00%
		Dover Sole	6,428	0.01%
		Lingcod	1,009	0.03%
		Longnose Skate	5,738	0.05%
		Petrale Sole	2,657	0.02%
		Sablefish	3,751	0.01%
		Thornyhead	2,430	0.01%
		Yellowtail Rockfish	1,001	0.01%
		Bocaccio Rockfish	1,086	0.17%
		Darkblotched Rockfish	1,210	0.03%
		POP	33	0.00%
	greater than 700fm	Dover Sole	54,568	0.07%
		Petrale Sole	125	0.00%
		Sablefish	7,747	0.03%
		Thornyhead	34,305	0.12%

Overfished Species: All of the areas proposed for reopening under the Oceana et al. Alternative are in the Cape Mendocino to Point Conception area. This alternative would reopen areas where cowcod (299 pounds, 0.33 percent of the total coastwide catch) and yelloweye rockfish (97 pounds, 0.03 percent of the total coastwide catch) were caught from 1997 to 2001. Both cowcod and yelloweye rockfish prefer areas with rocky or otherwise hard substrates; therefore, none of the areas of soft substrate proposed for reopening would likely provide suitable habitat for these stocks.

Table 4-20. Landings of overfished species in areas proposed to be reopened under Alternative 1.b.

Latitudinal Zone	Depth Zone	Species Common Name	Landings (lbs)	% of coastwide total
4 Cape Mendocino to Pt Conception	**150fm-700fm**	Cowcod Rockfish	246	0.27%
		Yelloweye Rockfish	76	0.03%
	30fm-100fm	Cowcod Rockfish	53	0.06%
		Yelloweye Rockfish	22	0.01%
	greater than 700fm	Cowcod Rockfish	0	0.00%

4.2.2.3.3 Summary of effects of Alternative 1.b, the Oceana et al. Alternative

Similar to the effects described in the summary of effects of Alternative 1.a., Alternative 1.b would increase the areas closed to bottom trawl gear compared to the No-action Alternative. Alternative 1.b would close more areas compared to the No-Action Alternative than would Alternative 1.a. A net increase in areas closed would facilitate habitat recovery in those areas, as described in Section 4.2.3.4.1, Alternative 1.b. Improvements in the quality and quantity of habitats would benefit all fish resources due to ecosystem-wide habitat recovery. Specifically, areas that would be closed include a variety of habitats suitable for Dover sole, petrale sole, and thornyheads. The areas that would be opened are predominantly soft substrates.

As stated in Section 4.2.2, one effect of all of the alternatives would be bottom trawl effort displacement; however, impacts on fish resources are limited by a variety of fishery management measures, as described in Section 4.1.2. It is not possible to predict how fishing behavior would change, but the proposed changes under Alternative 1.a would not likely result in overfishing because overfishing is unlikely to occur in the IFQ management scheme.

The net effects of this alternative would be positive compared to the No-action Alternative. This is because benefits to habitats would enhance fish resources.

4.2.2.3.4 Effects on state-managed non-groundfish fishery stocks

As shown in Figures 4-4 through 4-11 in Section 4.2.2.2.4, all four fisheries operate in the area of Alternative 1b; therefore, this alternative may impact California halibut, ridgeback prawn, sea cucumber and pink shrimp fisheries. California halibut, ridgeback prawn, sea cucumber stocks could benefit from closures of the alternative. Since Alternative 1b may close a large area in the southern California bight where sea cucumber fishery operates, this stock may benefit the most from a closure. Openings could negatively influence California halibut, ridgeback prawn, sea cucumber stocks but the extent is unknown. The pink shrimp fishery overlaps with Alternative 1.b as noted in Table 4-16 (5.2% overlap with closures and 0.0% for openings). Therefore, the pink shrimp fishery may lose some grounds due to closures but

would not be affected by openings. However, Alternative 1.b would not influence stock recruitment or stock size since environment drives recruitment in the fishery.

4.2.2.4 Alternative 1.c, the MTC Alternative

This alternative would make a number of changes to the EFHCAs described in the No-action Alternative. Changes would include several dozen closures and several reopenings, as described in Section 4.1.2. Under this alternative, there would be a net increase of 102 mi^2 (0.7 percent) in the spatial extent of coastwide BTCs compared to the No-action Alternative.[31]

As described in Section 4.2.2.2 under Alternative 1.a, the Collaborative Alternative, there would be a series of improvements. A net increase in habitat protections would result in a benefit to fish resources, closures would have an immediate effect of protecting fish resources in those areas, bottom trawl effort that occurred in the newly closed areas would be displaced to areas that would remain open to bottom trawling, and openings would allow bottom trawl fishing to occur in a manner similar to areas open to bottom trawling in the No-action Alternative.

Below is a more detailed description of the fish resources most likely to be affected by EFHCA closures and reopenings under Alternative 1.c, the MTC Alternative; groundfish species that are susceptible to bottom trawl gear. Two groupings are specifically discussed: 1) economically important stocks and 2) overfished species.

4.2.2.4.1 Effects on groundfish stocks from proposed closures

Alternative 1.c, the MTC Alternative, would close 115 mi^2 over a variety of depths and substrate types. Areas proposed to be closed would have displaced bottom trawl effort. While a very small proportion of groundfish[32] species landings come from the areas that would be closed (0.1 percent of coastwide landings Table 4-20), available landings data overlaid with habitat characteristics enables some inference as to which species may benefit most from the proposed closures under the MTC Alternative.

Economically Important Species: In the areas proposed for closure under Alternative 1.c, negligible amounts of economically important stocks were landed between 2011 and 2014 (less than 0.02 percent of coastwide landings for any species) (Table 4-21). The highest landings from this area were of Dover sole (over 6,000 pounds). The areas proposed for closure under this alternative would include habitat for arrowtooth flounder, Dover sole, and thornyheads.

[31] The analysis of this alternative assumes that the trawl RCA would remain in place.
[32] Groundfish in this context means any species listed in the Pacific Coast Groundfish FMP, including ecosystem component species.

Table 4-21 Landings of economically important species in areas proposed to be closed under Alternative 1.c.

Latitudinal Zone	Depth Zone	Species Common Name	Round Weight (lbs)	% of coastwide total
2 Pt Chehalis to Cape Blanco	30fm-100fm	Arrowtooth Flounder	302	0.00%
		Dover Sole	6,255	0.01%
		Longnose Skate	650	0.01%
		Petrale Sole	2	0.00%
		Sablefish	988	0.01%
		Thornyhead	1,067	0.01%
		Darkblotched Rockfish	2	0.00%
		POP	1	0.00%

Overfished Species: In the areas proposed for closure under Alternative 1.c, no cowcod or yelloweye were landed between 2011 and 2014. However, based on the latitude, depth, and substrate of this area, there may be suitable yelloweye habitat. Since this alternative would only close a small latitudinal range north of 40° N. latitude, the area would not likely not likely include suitable habitat for cowcod.

4.2.2.4.2 Effects on groundfish stocks from proposed reopenings

The MTC Alternative would reopen 13 mi^2 to bottom trawling over mostly soft substrates. As described under 4.2.2.2.2, opened areas may experience bottom trawling, and fish resources may be negatively affected. While a very small proportion of groundfish landings would come from the areas that would be reopened (less than 0.01 percent of coastwide landings), available landings data overlaid with habitat characteristics could enable some inference as to which species may be subject to additional habitat impacts or fishing pressure from the proposed reopenings under the MTC Alternative.

Economically Important Species: In the areas proposed for openings under Alternative 1.c, negligible amounts of economically important stocks were landed between 1997 and 2011 (Table 4-22). The soft substrate area proposed for reopening in the 30 fm to 100 fm depth range may provide habitat for arrowtooth flounder, Dover sole, longnose skate, yellowtail rockfish and darkblotched rockfish.

Table 4-22. Landings of economically important species in areas proposed to be reopened under Alternative 1.c.

Latitudinal Zone	Depth Zone	Species Common Name	Round Weight (lbs)	% of coastwide total
2 Pt Chehalis to Cape Blanco	30fm-100fm	Arrowtooth Flounder	836	0.00%
		Dover Sole	12,532	0.02%
		Lingcod	84	0.00%
		Longnose Skate	1,178	0.01%
		Pacific Cod	135	0.00%
		Petrale Sole	101	0.00%
		Sablefish	806	0.00%
		Thornyhead	114	0.00%
		Yellowtail Rockfish	1,251	0.01%
		Darkblotched Rockfish	1,089	0.02%
		POP	32	0.00%

Overfished Species: In the areas proposed for openings under Alternative 1.c, no cowcod and a negligible amount of yelloweye rockfish (14 pounds, 0 percent of the coastwide landings) were landed between 1997 and 2001. The alternative would reopen only a small area of hard substrate, so it would not have any effect on yelloweye rockfish or cowcod habitat.

4.2.2.4.3 Summary of effects of Alternative 1.c, the MTC Alternative

Overall, Alternative 1.c would increase the areas closed to bottom trawl gear compared to the No-action Alternative. A net increase in areas closed would facilitate habitat recovery in those areas, as described in Section 4.2.1.4. Improvements in the quality and quantity of habitats would benefit all fish resources due to ecosystem-wide habitat recovery. Additionally, the areas that would be closed under Alternative 1.c did not have much bottom trawl fishing effort, so closing them would not reduce harvest compared to the No-action alternative. The areas that would be opened are predominantly soft substrates.

Because there was not much fishing effort in the areas that would be closed, there would not likely be much effort displaced by Alternative 1.c. The proposed reopenings under Alternative 1.c, would not likely result in overfishing because overfishing would not likely occur in the IFQ management scheme.

The net effects of this alternative would be positive compared to the No-action Alternative. Benefits to habitats would positively impact fish resources.

4.2.2.4.4 Effects on state-managed non-groundfish fishery stocks

As shown in Figures 4-8 through 4-11 Section 4.2.2.2.4 only the pink shrimp fishery operatea in the area of Alternative 1.c; therefore, this alternative may affect pink shrimp fisheries whereby the fishery may have less grounds to fish under closures (Table 4-16, 0.3% overlap with closures and 0.0% overlap with openings). However, implementation of Alternative 1.c would not influence stock recruitment or stock size since environment drives recruitment in the fishery.

4.2.2.5 Alternative 1.d, the Garibaldi Reef South Alternative, Alternative 1.e, the Rittenburg Bank Alternative, and Alternative 1.f, the Potato Bank Correction Alternative

Alternative 1.d, the Garibaldi Reef South Alternative, Alternative 1.e, the Rittenburg Bank Alternative, and Alternative 1.f, the Potato Bank Correction Alternative would consist of either a single polygon (Alternatives 1.d and 1.e) or two polygons of equal size (Alternative 1.f). As such, the alternative-wide and polygon analyses are combined, and no geographic break analysis is necessary. In addition, because of their small size, these alternatives are not compared to the No-action Alternative. Should the Council select any of these alternatives, it is likely that they would be combined with other Subject Area 1 alternatives, and they would not be a stand-alone preferred alternative. Therefore, they are discussed as a group below.

Alternative 1.d, the Garibaldi Reef South Alternative: Alternative 1.d would close 7 mi^2 of soft substrate. This alternative would not reopen any areas. There were no bottom trawl tows made from 2011 to 2014 in the proposed closure area; therefore, there are no landings to report for economically important stocks or overfished stocks. This alternative would close a small area of soft substrate between 30 and 100 fm. Based on the latitude and depth, this area could include potential habitat for arrowtooth flounder, petrale sole, bocaccio, canary rockfish, and Pacific cod. This alternative would close a small area of soft substrate, which is not the preferred habitat type of either yelloweye or cowcod.

Alternative 1.e, the Rittenburg Bank Alternative: Alternative 1.e, would close 1 mi^2 of hard substrate and 12 mi^2 of soft substrate. This alternative would not reopen any areas. There were no bottom trawl tows made during 2011 to 2014 in the proposed closure area; therefore, there are no landings to report for economically important stocks overfished stocks. This alternative would close a small area of hard substrate and a medium area of soft substrate in the 30 to 100 fm range. In the area between Cape Mendocino and Point Conception, this could include habitat for cowcod.

Alternative 1.f. Potato Bank Correction Alternative: Alternative 1.f, would have a net decrease of 49 mi^2. There were no bottom trawl tows made during 2011 to 2014 in the proposed closure area; therefore, there are no landings to report for economically important stocks or overfished stocks. Due to the far south

latitude area of this proposed closure, potential habitat exists for only a few economically important species. For soft substrate habitat in the 150 fm to 700 fm depth range, these species may include petrale sole, thornyhead, and sablefish. Due to the latitudinal, depth, and substrate characteristics, the area proposed for closure under this alternative would not likely have habitat preferred by yelloweye rockfish.

4.2.2.5.1 Summary of effects of Alternative 1.d, the Garibaldi Reef Alternative, Alternative 1.e, the Rittenburg Bank Modification Alternative, and Alternative 1.f, the Potato Bank Correction

Impacts of these single polygon restrictions on fish resources would be minimal. They may be considered in combination with other Subject Area 1 alternatives.

4.2.2.5.2 Effects on state-managed non-groundfish fishery stocks

As shown in Table 4-16 pink shrimp fishery operates in the area of Alternative 1.e (0.1% overlap with closure); therefore, this alternative may affect pink shrimp fisheries whereby the fishery may have less grounds to fish under the proposed closure. However, implementation of Alternative 1e would not influenced stock recruitment or stock size since environment drives recruitment in the fishery.

The ridgeback prawn and sea cucumber fishery only operates in the area of Alternative 1.f; however, compared to other areas a relatively low volume of harvest has come from the Potato Bank area (less than 7,000 pounds of sea cucumber and less than 43,000 pounds of ridgeback prawn over a 7-year period, see Figure 4-6 and 4-7). Vessels may be restricted by the new closure; however, other areas will be available for harvest. Sea cucumber and ridgeback prawn stocks that reside in the area could be negatively affected by the new opening but also receive benefits of the closure that is adjacent to it. The extent of these impacts to the stocks (positive or negative) is unknown. The California halibut fishery does not operate in the area of Alternatives 1.d through 1.f; however, if Pacific halibut reside in these areas the stock may benefit from the closure due to a reduction in bycatch in other fisheries.

4.2.2.6 Alternative 1.g, New EFHCAs within the Trawl RCA Alternative

Alternative 1.g, New EFHCAs within the Trawl RCA Alternative. Would close 81 mi^2 of soft substrate in the 100 to 150 fm depth range off the coast of Washington. Overall, from 1997 to 2001, 1,416,333 pounds of species managed under the FMP were landed from areas proposed for closure under this alternative (0.48 percent of the coastwide average).

Economically Important Species: Under this alternative, 327,577 pounds of arrowtooth flounder, 423,719 pounds of Dover sole, 23,776 pounds of lingcod, 86,091 pounds of sablefish, 82,088 pounds of yellowtail rockfish, and 54,736 pounds of POP were landed from 1997 to 2001 in areas proposed for

closure Table 4-23). The soft substrate area in the 100 fm to 150 fm depth range that would be closed under this alternative could provide habitat for arrowtooth flounder, Dover sole, petrale sole, Pacific cod, and sablefish.

Table 4-23. Landings of economically important species in areas proposed to be closed under Alternative 1.g.

	Retained Catch (lbs)	
Speciess	**% of Coastwide Pounds Landed**	**Pounds Landed**
Arrowtooth Flounder	0.99%	327,577
Darkblotched	0.32%	14,425
Dover Sole	0.53%	423,719
Lingcod	0.76%	23,776
Longnose Skate	0.29%	36,047
Pacific Cod	0.13%	4,781
POP	1.39%	54,736
Petrale Sole	0.37%	59,122
Sablefish	0.33%	86,091
Thornyhead	0.15%	40,866
Yellowtail Rockfish	0.95%	82,088

Overfished Stocks: Under this alternative, 1,433 pounds of yelloweye rockfish were landed from 1997 to 2001 from areas proposed for closure. As these closed areas are primarily soft substrate, they may provide little preferred habitat for yelloweye rockfish, though yelloweye rockfish may be present in that area. No cowcod were landed from this northern area, and the area would not likely include suitable habitat for cowcod.

4.2.2.6.1 Summary of effects of Alternative 1.g, the New EFHAs in Washington

The areas proposed for closure under Alternative 1.g overlap entirely with the trawl RCA and would have no impact on fish resources compared to the No-action Alternative. Impacts of combinations of alternatives from the three subject areas are discussed in Chapter 5.

4.2.2.6.2 Effects on state-managed non-groundfish fishery stocks

As shown in Table 4-16 pink shrimp fishery operates in the area of Alternative 1g (0.3% overlap with closure); therefore, this alternative may affect pink shrimp fisheries whereby the fishery may have less

grounds to fish under a closure. However, implementation of Alternative 1g would not influenced stock recruitment or stock size since environment drives recruitment in the fishery.

Other state-managed fisheries (Pacific halibut, seas cucumber, and ridgeback prawn) do not operate in the area of Alternative 1g. The target stocks of these state-managed fisheries do not reside in the area, therefore they would not benefit from the closure.

4.2.2.7 Comparison of Subject Area 1 Alternatives

Alternative 1.b, the Oceana et al. Alternative, would be the most protective and would have the greatest potential for positive effects on fish resources, primarily due to benefits to fish populations that would occur from habitat protections. Alternative 1.a, the Collaborative Alternative, would also benefit fish resources, similar to Alternative 1.b, but to a lesser degree. The other five are not considered stand-alone alternatives and, if selected by the Council, would be combined with one of these two. Therefore, they are not considered in this comparison.

As stated in Section 4.2.2, an effect of all of the alternatives would be bottom trawl effort displacement; however, impacts on fish resources are limited by a variety of fishery management measures, as described in Section 4.1.2. Proposed reopenings and redistribution of fishing activities, even if landings increased from the levels seen from 2011 to 2014, would not likely result in overfishing.

Reopened trawlable areas may have localized negative effects on fish resources susceptible to harvest with bottom trawl gear. This could include higher risk of unpredictable, large, tows of species commonly occurring in these areas. However, it is not possible to predict how fishing behavior would change. It is unlikely that such tows would result in overfishing because of catch controls in the IFQ management scheme. Both alternatives would close areas and reopen areas. Alternative 1.a, the Collaborative Alternative, would reopen a larger amount of area compared to Alternative 1.b, Oceana et al. Alternative. Thus, Alternative 1.a may have a higher potential for localized impacts to fish resources.

4.2.2.8 Alternative 2.a, Remove the Trawl RCA (PPA for Oregon and California)

Alternative 2.a would eliminate the entire trawl RCA outside of the tribal U&As, allowing access to vessels fishing with groundfish bottom trawl gear. This alternative would open areas extending from Point Chehalis, Washington, to the United States/Mexico border. This area would be primarily in the 100 fm to 150 fm depth range, but it would include some sections that were modified out to the 200 fm line (mostly in Oregon and northern California). Under this alternative, there would be a net decrease in BTCs of 25.6 percent compared to the No-action Alternative.

There is no quantifiable measure of how much habitat is required for a population of fish to attain a stable, productive age structure. However, healthy functioning habitat is important for sustaining fish populations, and there is a level at which adverse effects on habitat will negatively affect fish populations. This alternative would decrease the total area of BTCs, exposing more habitat to bottom trawl gear compared to the No-action Alternative. Therefore, overall, the Remove the Trawl RCA Alternative could have an overall negative effect on habitats if opening these areas would reduce the quality and quantity of habitats used by fish resources. Fish populations may have lower productivity due to habitat loss, which could result in lower ACLs.

Areas that would be reopened under Alternative 2.a would no longer be closed to bottom trawling. Reopening areas would have a negative effect on fish resources if fishing occurs there that was prohibited under the No-action Alternative. However, fish resources managed under MSA would continue to be subject to a suite of regulations intended to promote healthy fish populations and prevent overfishing, the same as under the No-action Alternative.

Below is a more detailed description of the fish resources most likely to be affected by trawl RCA reopenings under Alternative 2.a; groundfish species that are susceptible to bottom trawl gear. Two groupings are s0pecifically discussed: 1) economically important stocks and 2) overfished species.

Economically important stocks: Extensive landings of a number of economically important stocks took place from 1997 to 2001 in the areas of the trawl RCA proposed for opening under Alternative 2.a. The proportion of coastwide landings was highest for darkblotched rockfish, lingcod, and longnose skate (greater than 20 percent of coastwide landings (Table 4-24). These three stocks were most commonly caught in the areas that are proposed to reopen under Alternative 2.a.

Table 4-24. Landings of economically important species in areas proposed to be reopened under Alternative 2.a.

	Retained Catch (lbs)	
Species	**% of Coastwide Pounds Landed**	**Pounds Landed**
Arrowtooth Flounder	6.16%	2,029,582
Bocaccio	14.24%	90,379
Darkblotched	25.17%	1,146,208
Dover Sole	9.99%	7,969,671
Lingcod	26.78%	840,724
Longnose Skate	20.62%	2,559,883
Pacific Cod	0.63%	23,441
POP	9.28%	365,570
Petrale Sole	12.60%	1,994,774
Sablefish	9.34%	2,461,399
Thornyhead	2.36%	657,343
Yellowtail rockfish	11.88%	1,024,433

Overfished stocks: In the areas of the trawl RCA proposed for opening under Alternative 2.a, 11,503 pounds of cowcod were landed from 1997 to 2001, which amounted to 12.74 percent of the coastwide total. Additionally, 59,328 pounds of yelloweye rockfish were landed (19.89 percent of the coastwide total).

4.2.2.8.1 Summary of effects of Alternative 2.a, Remove the Trawl RCA (PPA for Oregon and California)

This alternative would open the trawl RCA and a large amount of area to the use of bottom-trawl gear compared to the No-action Alternative. Some areas that have been closed for more than 15 years will reopen. This would have a negative effect on habitat and on fish resources that use those habitats. Areas that would be opened include a variety of habitats suitable for flatfish, yelloweye rockfish, and other groundfish species. The areas that would be opened are predominantly soft substrates, as described in Section 4.1.2.

As stated in Section 4.2.2, an effect of all of the alternatives would be bottom trawl effort displacement; however, impacts on fish resources would be limited by a variety of fishery management measures, as described in Section 4.1.2. Therefore, the proposed reopenings under Alternative 2.a., as well as the

redistribution of fishing activities, even if landings were to increase from the levels seen in 2011 to 2014, would not likely result in overfishing.

Reopened trawlable areas may have localized negative effects on fish resources susceptible to harvest with bottom trawl gear. This could include higher risk of unpredictable, large tows of species commonly occurring in these areas, particularly the rockfishes that these areas were designed to protect. However, it is not possible to predict how fishing behavior would change. It is unlikely that such tows would result in overfishing because of catch controls in the IFQ management scheme. The effects of this alternative on fish resources would be negative compared to the No-action Alternative, particularly if the quantity and the quality of habitats were reduced.

4.2.2.9 Alternative 2.b, the Remove the Trawl RCA, and, in Washington, Implement DACs for Overfished Species

Alternative 2.b, would reopen all of the area defined as the trawl RCA between Cape Flattery and the United States/Mexico border except for areas closed for other purposes (e.g., EFHCAs and GCAs). It would establish DAC boundaries that could be closed to protect overfished species off the coast of Washington. The area to be reopened would be the same as Alternative 2.a. and it would also have a net decrease in BTCs of 25.6 percent compared to the No-action Alternative. Alternative 2.b would include five discrete areas straddling the area that was the trawl RCA that could be closed, if needed: two for POP, one for POP and darkblotched rockfish, and two for yelloweye rockfish. In 2017, POP and darkblotched rockfish were declared rebuilt.

As described under Alternative 2.a, we cannot quantify how much habitat is enough, but we do know that heathy habitat has positive effects on fish resources. This alternative would decrease the total area of BTCs, exposing more fish resources and habitat to bottom trawl gear compared to the No-action Alternative. Therefore, like Alternative 2.a, Alternative 2.b could have an overall negative effect on habitat and fish resources. The impacts to fish resources of the areas to be reopened under Alternative 2.b would be the same as those described under Alternative 2.a.

Below is a more detailed description of the fish resources most likely to be affected by the DACs that could be closed under Alternative 2.b. Two fish groups are specifically discussed: 1) economically important stocks and 2) overfished species.

Economically important species: From within the portion of the DAC polygons that overlap with the trawl RCA, less than 1 percent of the coastwide landings occurred for any species from 1997 to 2001. Dover sole had the highest number of pounds landed (more than 78,000 pounds), and yellowtail rockfish had the highest proportion of landings (0.34 percent of coastwide total) (Table 4-25). From within the

portion of the DAC polygons that did not overlap with the trawl RCA, up to 7 percent of coastwide landings occurred for some species between 2011 and 2014. Arrowtooth flounder had the highest number of pounds landed (more than 700,000 pounds), and lingcod and Pacific cod had the highest proportion of landings (approximately 7 percent of the coastwide total each) (Table 4-26).

Table 4-25. Landings of economically important species in areas proposed as DACs overlapping the trawl RCA under Alternative 2.b.

	Retained Catch (lbs)	
Species	**% of Coastwide Pounds Landed**	**Pounds Landed**
Arrowtooth Flounder	0.08%	27,853
Darkblotched	0.03%	1,540
Dover Sole	0.10%	78,391
Lingcod	0.16%	4,898
Longnose Skate	0.05%	5,789
Pacific Cod	0.02%	704
POP	0.10%	3,992
Petrale Sole	0.23%	35,950
Sablefish	0.03%	7,884
Thornyhead	0.02%	5,546
Yellowtail Rockfish	0.34%	28,929

Table 4-26. Landings of economically important species in areas proposed as DACs outside trawl RCA under Alternative 2.b., 2011- 2014

	Retained Catch (lbs)	
Species	**% of Coastwide Pounds Landed**	**Pounds Landed**
Arrowtooth Flounder	2.26%	743,944
Dover Sole	1.23%	978,691
Lingcod	7.46%	234,170
Longnose Skate	0.93%	115,429
Pacific Cod	6.56%	242,125
Petrale Sole	3.16%	499,952
Sablefish	0.59%	154,600
Thornyhead	0.44%	122,576
Yellowtail rockfish	5.50%	474,507
Darkblotched	1.32%	59,965
POP	0.59%	23,308

Overfished Species: The discreet areas were identified based on the probability of occurrence of suitable habitat for POP, darkblotched rockfish, and yelloweye rockfish. However, since POP and darkblotched rockfish are rebuilt, they are considered above in economically important species. In the areas of the DACs that overlap the trawl RCA under
Alternative 2.b, 496 pounds of yelloweye rockfish were landed from 1997 to 2001. For areas of the DACs outside of the trawl RCA, 42 pounds of yelloweye rockfish were landed from 2011 to 2014. The location of these DACs is too far north to be suitable habitat for cowcod.

4.2.2.9.1 Summary of effects of Alternative 2.b, Remove the trawl RCA, and, in Washington, Implement DACs for Overfished Species

The impacts to fish resources of the areas to be reopened under Alternative 2.b are the same as those described under Alternative 2.a. Like Alternative 2.a, Alternative 2.b could have an overall negative effect on habitat and fish resources.

The impacts on fish resources of the DACs that could be closed preseason or inseason under this alternative could reduce harvest of species such as yelloweye rockfish, POP, darkblotched rockfish, flatfish, and yellowtail rockfish. During times when DACs are closed, fish resources such as these would be positively affected. However, as described in Section 4.2.1.10, we would be unlikely to see habitat recovery benefits for fish resources if they were closed on an as-needed basis over short periods. Short-term closures of this spatial extent would be unlikely to offset the negative impacts described under Alternative 2.a.

The net effects of this alternative on fish resources would be negative compared to the No-action Alternative, particularly if quantity and quality of habitats are reduced.

4.2.2.10 Alternative 2.c, Remove Trawl RCA, and Implement BACs (PPA for Oregon and California)

Alternative 2.c would reopen all of the area defined as the trawl RCA between Cape Flattery and the United States/Mexico border except for areas closed for other purposes (e.g., EFHCAs and GCAs). It would also establish BAC boundaries that could be closed to reduce harvest of target or non-target stocks, including salmon. The area reopened would be the same as Alternative 2.a. and would also have a net decrease in BTCs of 25.6 percent compared to the No-action Alternative. Under this alternative, the EEZ out to the 700 fm contour would be divided into 20 separate BACs designated by depth contours and latitude. Closure of any of these areas could be implemented alone or in concert. Areas that make up the BACs include a variety of substrate types, the majority being soft bottom (Table 4-12 Habitat metrics for Alternative 2.c, Remove the Trawl RCA and Implement BACs [PPA for Oregon and California])

As described und Alternative 2.a, we cannot quantify how much habitat is enough, but we do know that heathy habitat has positive effects on fish resources. This alternative would decrease the total area of BTCs, exposing more fish resources and habitat to bottom trawl gear compared to the No-action Alternative. Therefore, like Alternative 2.a, Alternative 2.c could have an overall negative effect on habitat and fish resources. The impacts on fish resources of the areas to be reopened under Alternative 2.c would be the same as those described under Alternative 2.a. in Section 4.2.2.8.

The remainder of this section explores the impacts on fish resources from areas that could be closed by BACs. The BACs overlap with many BTC areas associated with the No-action Alternative. Therefore, the impacts on fish resources of closing BACs that would overlap with existing BTCs, including the trawl RCA, would be the same as those under the No-action Alternative. They are described in Section 4.2.2.1. Alternative 2.c would differ from the No-action Alternative in newly closed BAC areas, and they are the focus of the description that follows.

Because the BACs under this alternative could be located at any depth and latitude combinations between 700 fm and state waters, coastwide summary data do not provide applicable information. Therefore, only data specific to depth and latitude (e.g., BACs) are presented.

Economically Important Species

Between Cape Flattery and Point Chehalis: Only small amounts of economically important species were landed between 2011 and 2014 (i.e., less than 1 percent of the coastwide total for any species) from areas outside the tribal U&A fishing area.

Between Point Chehalis and Cape Blanco: A variety of economically important species were landed from various depths between 2011 and 2014. Shoreward of 30 fms, most of the landings were flatfish and longnose skate (ranging from 13 to 26 thousand pounds), though the lands were less than 1 percent of any species' coastwide catch. Between 30 fm and 100 fm, Dover sole, Petrale sole, Pacific cod, and yellowtail rockfish had the highest number of landings (ranging from 1 to 3 million pounds), and between 25 percent and 50 percent of the coastwide harvest for lingcod, Pacific cod, and yellowtail rockfish occurred in these depths. From 100 fm to 150 fm, the impacts of the BAC on fish resources in this area would be similar to the No-action Alternative. From 150 fm to 700 fm, a large amount of catch occurred, both in pounds and in percent of the coastwide total. Several species had more than 4 million pounds landed, including Dover sole (more than 22 million pounds), arrowtooth flounder, sablefish, and thornyheads. Several species also had more than 30 percent of the coastwide catch come from this depth-latitude: darkblotched rockfish (67 percent), as well as sablefish, arrowtooth flounder, longnose skate, thornyheads, and POP (Table 4-27).

Between Cape Blanco and Cape Mendocino: From 2011 to 2014, across all depths, only Dover sole had more than 4 million pounds landed. From 150 fm to 700 fm, a large amount of catch occurred, both in pounds and in percent of the coastwide total. In the 150 fm to 700 fm depth range, some species had a proportion of coastwide landings above 20 percent, but the highest was sablefish with 30 percent of the coastwide landings. (Table 4-27).

Between Cape Mendocino and Point Conception: From 2011 to 2014 landings, across all depths, only two species had more than 4 million pounds landed: Dover sole and thornyheads. The 30 to 100 fm depth zone had highest proportion of bocaccio landed (73 percent of the coastwide total). From 150 fm to 700 fm, a large amount of catch occurred, both in pounds and in percent of the coastwide total. The area between 150 fm and 700 fm was the source for most of the remaining bocaccio landings (27 percent of the coastwide total), and sablefish also had a high proportion in this area (36 percent of the coastwide total. (Table 4-27).

Table 4-27. Landings of economically important species in areas proposed to be closed under Alternative 2.c.

Latitudinal Zone	Depth Zone	Species Common Name	Landings (pounds)	% of coastwide total
1 Cape Flattery to Pt Chehalis	**150fm-700fm**	Arrowtooth Flounder	99,597	0.60%
		Dover Sole	104,080	0.16%
		Lingcod	371	0.01%
		Longnose Skate	3,630	0.06%
		Pacific Cod	51	0.00%
		Petrale Sole	413	0.00%
		Sablefish	59,698	0.48%
		Thornyhead	70,513	0.50%
		Yellowtail Rockfish	94	0.00%
		Darkblotched Rockfish	411	0.05%
		POP	820	0.24%
2 Pt Chehalis to Cape Blanco	**0fm-30fm**	Arrowtooth Flounder	1,194	0.01%
		Dover Sole	18,797	0.03%
		Lingcod	2,645	0.10%
		Longnose Skate	13,868	0.23%
		Pacific Cod	6,732	0.15%
		Petrale Sole	26,165	0.19%
		Sablefish	324	0.00%
		Thornyhead	442	0.00%
		Yellowtail Rockfish	247	0.01%
		Darkblotched Rockfish	234	0.03%

Table 4-27. Landings of economically important species in areas proposed to be closed under Alternative 2.c. (continued)

Latitudinal Zone	Depth Zone	Species Common Name	Landings (pounds)	% of coastwide total
		POP	53	0.02%
	30fm-100fm	Arrowtooth Flounder	770,315	4.62%
		Dover Sole	3,161,290	5.01%
		Lingcod	699,930	26.40%
		Longnose Skate	612,085	9.95%
		Pacific Cod	1,279,892	28.64%
		Petrale Sole	2,463,411	17.50%
		Sablefish	183,784	1.48%
		Thornyhead	60,418	0.43%
		Yellowtail Rockfish	1,725,036	54.92%
		Darkblotched Rockfish	19,728	2.63%
		POP	4,757	1.41%
	150fm-700fm	Arrowtooth Flounder	7,377,683	44.24%
		Dover Sole	22,298,484	35.33%
		Lingcod	36,071	1.36%
		Longnose Skate	2,332,867	37.92%
		Pacific Cod	8,059	0.18%
		Petrale Sole	3,959,201	28.12%
		Sablefish	5,197,668	41.74%
		Thornyhead	4,661,579	33.09%
		Yellowtail Rockfish	37,523	1.19%
		Darkblotched Rockfish	503,702	67.13%
		POP	193,369	57.27%
3 Cape Blanco to Cape Mendocino	**0fm-30fm**	Dover Sole	1	0.00%
		Lingcod	46	0.00%
		Longnose Skate	538	0.01%
		Petrale Sole	8,538	0.06%
		Thornyhead	10	0.00%
	30fm-100fm	Arrowtooth Flounder	15,271	0.09%
		Dover Sole	286,557	0.45%
		Lingcod	90,870	3.43%
		Longnose Skate	32,175	0.52%
		Pacific Cod	7	0.00%
		Petrale Sole	582,562	4.14%
		Sablefish	20,622	0.17%
		Thornyhead	5,355	0.04%
		Yellowtail Rockfish	496	0.02%

Table 4-27. Landings of economically important species in areas proposed to be closed under Alternative 2.c. (continued)

Latitudinal Zone	Depth Zone	Species Common Name	Landings (pounds)	% of coastwide total
		Darkblotched Rockfish	637	0.08%
	150fm-700fm	Arrowtooth Flounder	1,019,597	6.11%
		Dover Sole	16,037,977	25.41%
		Lingcod	13,837	0.52%
		Longnose Skate	1,041,332	16.93%
		Petrale Sole	2,009,629	22.70%
		Sablefish	3,196,278	30.41%
		Thornyhead	3,787,088	26.88%
		Yellowtail Rockfish	33	0.00%
4 Cape Mendocino to Pt Conception	**0fm-30fm**	Longnose Skate	70	0.00%
		Petrale Sole	1,734	0.00%
		Sablefish	10	0.26%
	30fm-100fm	Arrowtooth Flounder	32,587	0.20%
		Dover Sole	48,838	0.08%
		Lingcod	50,937	1.92%
		Longnose Skate	75,506	1.23%
		Petrale Sole	823,622	0.73%
		Sablefish	103,127	0.04%
		Thornyhead	5,088	0.04%
		Yellowtail Rockfish	950	0.03%
		Bocaccio Rockfish	51,655	72.83%
		Darkblotched Rockfish	858	0.11%
		POP	4	0.00%
	150fm-700fm	Arrowtooth Flounder	195,126	1.17%
		Dover Sole	9,649,640	15.29%
		Lingcod	35,285	1.33%
		Longnose Skate	458,276	7.45%
		Petrale Sole	948,350	16.75%
		Sablefish	2,357,826	36.22%
		Thornyhead	4,510,524	0.14%
		Bocaccio Rockfish	19,270	27.17%
		Darkblotched Rockfish	15,033	2.00%
		POP	385	0.11%

Overfished species: For the areas that could be closed as BACs under this alternative that are not already closed under the No-action Alternative, only a few depth/latitude zones had landings of cowcod or

yelloweye rockfish between 2011 and 2014. yelloweye rockfish were caught, in trace amounts in all four latitudinal zones, mostly in the area between Point Chehalis and Cape Blanco primarily from the 30 and 100 fm depth zone (92 pounds) (Table 4-28).

Table 4-28. Landings of overfished species in areas proposed to be closed under Alternative 2.c.

Latitudinal Zone	Depth Zone	Species Common Name	Landings (pounds)	% of coastwide total
1 Cape Flattery to Pt Chehalis	150fm-700fm	Yelloweye Rockfish	0	0.02%
2 Pt Chehalis to Cape Blanco	30fm-100fm	Yelloweye Rockfish	92	23.63%
Pt Chehalis to Cape Blanco	150fm-700fm	Yelloweye Rockfish	30	7.81%
3 Cape Blanco to Cape Mendocino	30fm-100fm	Yelloweye Rockfish	3	0.77%
4 Cape Mendocino to Pt Conception	30fm-100fm	Yelloweye Rockfish	29	7.44%
Cape Mendocino to Pt Conception	30fm-100fm	Cowcod Rockfish	681	71.53%
Cape Mendocino to Pt Conception	150fm-700fm	Cowcod Rockfish	271	28.47%

4.2.2.10.1 Summary of effects of Alternative 2.c, the Remove the trawl RCA and Implement BACs (PPA for Oregon and California)

The impacts to fish resources of the areas to be reopened under Alternative 2.c are the same as those described under Alternative 2.a. Like Alternative 2.a, Alternative 2.c could have an overall negative effect on habitat and fish resources.

It is not possible to predict the impacts to fish resources of the BACs that could be closed in any combination, either preseason or inseason under this alternative. BACs could reduce harvest of many groundfish species and species groups, including yelloweye rockfish, POP, darkblotched rockfish, flatfish, skates, and other rockfish. During times when one or more DACs are closed, fish resources within those areas would not be subject to harvest with bottom trawl gear. However, as described in Section 4.1.2, we would be unlikely to see habitat recovery benefits for fish resources if BACs were closed on an as-needed basis over short periods. It is unlikely that short-term closures of this spatial extent would offset the negative impacts described under Alternative 2.a. The net effects of this alternative on fish resources would be negative compared to the No-action Alternative, particularly if quantity and quality of habitats were reduced.

4.2.2.11 Comparison of Subject Area 2 Alternatives

All three alternatives in Subject Area 2 would remove the trawl RCA, which would reopen areas that have been closed for more than 15 years. The impacts to fish resources would be negative compared to the No-action Alternative. Alternatives 2.b and 2.c would include options to implement area closures, as needed,

after removal of the trawl RCA. Unless DACs or BACs were implemented, the impact of Alternatives 2.b and 2.c would be the same as those for Alternative 2.a (described in Section 4.2.2.8.1) .

DACs are only considered off the Washington C; therefore, they would have less potential to provide protections for fish resources than BACs, which could be implemented in a variety of depths and latitudes. Because the entire EEZ shoreward of the 700 fm depth contour could be closed (unlikely, but not impossible) Alternative 2.c would have the highest potential to benefit fish resources by closing areas to harvest.

4.2.2.12 Alternative 3.a: Use MSA discretionary authorities to close waters deeper than 3,500 m to bottom contact fishing gear.

As noted in Section 4.2.2.12, Alternative 3.a would close waters deeper than 3,500 m to bottom contact gear, at approximately 1,914 fm. This would have very little effect on fish resources, because many of the species that may be affected by the action alternatives in Subject Areas 1 and 2 do not occur in the deep waters impacted under this alternative. Fish resources in this area are generally not harvested with bottom trawl or bottom contact gear, are not overfished, and are not economically important to bottom trawl fisheries. Prohibiting bottom contact gear under this alternative could have a low positive effect on fish resources that live in deep water that would be closed under Alternative 3.a because it would eliminate potential exploratory fishing activities with bottom contacting gear. However, it is unlikely that bottom contact gear fisheries would develop in this area due to the impracticality of fishing with such gears in such deep water. Overall, no effects to fish resources are anticipated under Alternative 3.a.

4.2.3 Economic Resources

This section describes impacts on economic resources associated with the alternatives under consideration. Economic impacts are measured in terms of landings (round pounds), revenues (inflation-adjusted 2015 United States dollars), and effort (tow duration). The impacts are presented in tables, both as absolute numbers and percentages. For the No-action Alternative, the port group values are presented as a percentage of coastwide values. For the action alternatives, the port group values are presented as a percentage of the total groundfish bottom trawl landings for that particular port group. This is to present the data in terms of relevance to each individual port group.

4.2.3.1 No-action Alternative

The No-action Alternative provides a basis for comparison to analyze the effects of the action alternatives. The No-action Alternative is described in Chapter 2, and the description includes data from the United States West Coast EEZ, excluding waters deeper than 700 fm, and state waters. Although no changes are proposed for areas inside the tribal U&A, fisheries data are included from those areas because

they are part of the coastwide bottom trawl fishery landings, revenues, and effort. Hence, they are used for a comparison to the action alternatives.

The shorebased trawl fishery has significantly under-attained its allocations for most species managed with IFQ, with the exception of sablefish, Petrale sole, and Pacific whiting. This under-attainment has been attributed to a number of possible causes, including market limits, constraining species (limited ability to harvest complexes in which sablefish is caught because of the limits amounts of sablefish quota available), and regulatory constraints related to pre-catch share regulations that may no longer be needed (e.g., a number gear regulations and area restrictions such as RCAs).

Economic impacts flow from the groundfish fishery in the form of personal income to owners of harvester operations, captains and crew, owners of buyers and processors, their employees, and the community as a whole (as these individuals spend and take part in the social lives of their local communities). Suppliers, financers, and other related support industries are also impacted by groundfish fishery activity. Additionally, the products generated by the fishery flow into the fish and protein markets, generating jobs in the marketing chains and nutrition for domestic users. Some product also flows into the export market, affecting the balance of trade and foreign consumers. As with other natural resource-based jobs such as farming and wood products, declines in personal income and changing job conditions within fisheries affect quality of life and relationships, including individual and family well-being and health (Smith et al. 2003). Numerous studies have shown connections between regulations in fisheries, participant working conditions, and personal relations (e.g., Gien 2000; Polnac and Poggie 2008; Polnac et al. 2015, and Smith et al. 2003).[33]

In the following sections, the geographic distribution of recent landings and effort provides an indicator of the level and initial distribution of this activity, assuming that activity under the No-action Alternative would be similar to that which has occurred in the recent past. The fishery continues to evolve as the natural and human system fluctuates. Stocks become rebuilt, changing fishery constraints; landings shift geographic locations as the fishery continues to adjust to the catch share program; changes in global market conditions alter demands for particular species creating or alleviating market constraints to which the fishery responds. The cumulative effects section provides a discussion of expected changes, including regulatory changes, which may alter these conditions in the future, even if no action is taken.

Under the No-action Alternative, existing closed areas would primarily affect the nonwhiting shoreside groundfish bottom trawl fishery, since this midwater whiting fishery is not constrained by EFH/RCA closed areas, except in the area south of 40º 10’ N. latitude (for which the trawl RCA is closed to

midwater trawling). Individual fishing quotas are the main management tool used to limit harvest in the shorebased fishery.

When the IFQ program was implemented in 2011, as part of the Amendment 20 trawl catch share program, important changes in the incentive system affected individual vessels. This, in turn, altered the impacts of the EFH/RCA closed areas. Prior to IFQs, vessels delivering shoreside were held to landing limits for nonwhiting species in the form of bimonthly cumulative limits. When a vessel reached a landing limit for one species, it could continue to fish for other species, discarding those species for which it had reached its limit. Under the IFQ program, vessels are held to catch limits based on their amount of quota. This means they are responsible for each fish they catch, and they can no longer continue fishing once they have reached a limit. They have to acquire additional quota to continue fishing. Under such a system, the ability to control the mix of catch became more important, and it is one of the factors that can be used to alter catch mix is the fishing area. Therefore, when the catch share program was implemented, the limit that EFH/RCA closed areas imposed on the fishery became more important due to the need for control over the mix of catch.

Further, the economic advantages provided by the EFH/RCA closures changed when the catch share program was implemented. Under trip limit management, without RCAs and the ability to monitor and control catch, trip limit management would have had to become much more restrictive to ensure that the practice of discarding to comply with landing limits was not resulting in mortality exceeding management limits, particularly for overfished species under rebuilding plans. Without RCAs, landing limits would have been much more restrictive. Once the IFQ system went into place with catch-based limits, at-sea catch monitoring, and individual vessel responsibility, RCAs no longer provided this economic advantage. Instead, they acted as risk control mechanism for the fleet by reducing the chances that a vessel might take excessive risk in the shelf area and catch the entire trawl quota of an overfished species, such as yelloweye rockfish, resulting in severe constraints for the entire fleet.

Finally, with implementation of the catch share program, there has been a redistribution of landings, with more effort occurring in association with landings in Oregon ports (see tables in the following sections). With this redistribution of effort, the relative effect of the EFH/RCA closures on different areas also shifted.

Existing EFH/RCA closures have also likely impacted intrinsic and ecosystem services values associated with habitat and fish resources. These are discussed further in the general analysis of the action alternatives (Section 4.2.3.2), where the impacts of changing those closures are discussed.

Enforcement and compliance costs are also aspects of the current RCA and EFH closures. Current RCA and EFH boundaries have been designed in consultation with enforcement experts to improve enforceability. Compliance with the closed areas not only includes avoiding fishing within them, but also maintaining continuous transit. RCA incursions and disputes over continuous transit provisions have resulted in court cases and led to a recent vessel movement monitoring rule designed to improve monitoring so that closed areas can be better enforced.

In the following section, quantitative indicators of economic activity associated with the groundfish fishery are provided for recent (2011 to 2014) along with historic (1997 to 2001) periods. Data on the earlier period are included because they are used for the indicators that inform the analysis of the action alternatives.

4.2.3.1.1 Coastwide and State Analysis

4.2.3.1.1.1 Landings

Table 4-29 shows landings (pounds round weight) of aggregated bottom trawl groundfish coastwide and by state during the No-action Alternative reference period, 2011 to 2014. During this period, 153,792,000 pounds were landed for an average of 38,448,000 pounds per year. Oregon had the highest percentage (61.8 percent) of landings, followed by California (25.7 percent) and Washington (12.5 percent).

4.2.3.1.1.2 Revenues

Table 4-33 shows that inflation-adjusted, ex-vessel revenues of aggregated bottom trawl groundfish coastwide were $98,861,000, for an average of $24,715,000 per year. Oregon had the highest percentage of coastwide revenues (58.4 percent), followed by California (29.6 percent) and Washington (12.1 percent).

4.2.3.1.1.3 Effort

During the 2011 to 2014 period, 77 non-tribal vessels participated in the fishery coastwide. Oregon had the most vessels (54), followed by California (35) and Washington (28). Many vessels participate in bottom trawl fisheries off more than one state. Coastwide, there were 146,601 hours of effort for that period, or an annual average of 39,150 hours. Appendix XX summarizes bottom trawl effort (hours) during the 2011 to 2014 period by state, latitude zone, and depth zone.

4.2.3.1.2 Port Group Analysis

Table 4-29 shows total landings and inflation-adjusted ex-vessel revenues of bottom trawl groundfish by port group during the No-action Alternative reference period, 2011 to 2014.

Table 4-29. No-action Alternative: Aggregated bottom trawl groundfish species landings and revenue coastwide, by state, and by port group; totals from 2011 to 2014.

Port Group	Landings (Thousand pounds)	Percent of Coastwide Non-whiting Groundfish Landings	Infl-adj. Ex-vessel Revenue ($000, 2015)	Percent of Coastwide Non-whiting Groundfish Revenue
North WA coast	6,971	4.5%	4,223	4.3%
Puget Sound	3,506	2.3%	2,020	2.0%
South and Central WA coast	8,763	5.7%	5,673	5.7%
Washington Total	**19,240**	**12.5%**	**11,916**	**12.1%**
Astoria	58,422	38.0%	32,811	33.2%
Newport	10,920	7.1%	7,755	7.8%
Coos Bay	15,516	10.1%	10,186	10.3%
Brookings	10,173	6.6%	6,963	7.0%
Oregon Total	**95,032**	**61.8%**	**57,715**	**58.4%**
Crescent City	1,125	0.7%	720	0.7%
Eureka	18,238	11.9%	12,988	13.1%
Fort Bragg	11,666	7.6%	8,963	9.1%
San Francisco	2,638	1.7%	1,953	2.0%
Monterey	3,213	2.1%	2,406	2.4%
Morro Bay	2,641	1.7%	2,200	2.2%
California Total	**39,520**	**25.7%**	**29,230**	**29.6%**
Coastwide Total	**153,792**	**100%**	**98,861**	**100%**

4.2.3.1.2.1 Landings

Table 4-29 shows that the Astoria port group landed the largest portion of coastwide aggregated groundfish bottom trawl landings (round weight) from 2011 to 2014, followed by Eureka, Coos Bay, Fort Bragg, Newport, and Brookings. All other port groups received less than 6 percent (10 million pounds) of landings during the period.

4.2.3.1.2.2 Revenue

Table 4-29 shows the largest portion of inflation-adjusted ex-vessel value from aggregated groundfish landings was also in the Astoria port group from 2011 to 2014, followed by Eureka, Coos Bay, Fort Bragg, Newport, and Brookings. All other port groups received less than 5 percent ($4 million) of coastwide ex-vessel revenue during the period.

4.2.3.1.3 Alternative-Wide Net Effects

Selection of the No-action Alternative would result in a status quo configuration of open and closed areas. The general patterns and the nature of impacts resulting from bottom trawl fishing would be expected to

stay generally similar in terms of landings, ex-vessel revenues, and effort. However, fishing behavior such as target strategies and timing is largely driven by external forces such as market demand, regulatory changes, and weather. These factors could result in changes to landings, revenues, and effort, but those changes and any resulting impacts would not result from selecting the No-action Alternative.

4.2.3.2 Action Alternatives: General Qualitative Analysis

All of the action alternatives would involve some combination of opening areas currently closed and/or closing areas currently open. Most of these would likely result in some spatial shift or change in level of fishing effort using bottom trawl gear, except Alternative 3.a, which would close deep areas in which there currently is no active fishing. Additionally, in the area south of 40º 10' N. latitude, the use of midwater trawl within the area of the trawl RCA may also be impacted (midwater trawl is currently prohibited within the trawl RCA but is allowed seaward of the trawl RCA year-round).

A general qualitative analysis of the action alternatives is provided below. The following sections on each action alternative contain summaries of the qualitative analysis. They also provide a description of quantitative indicators that further inform the qualitative analysis and help distinguish likely impacts among the alternatives.

Economic impacts flow from the groundfish fishery in the form of personal income and changes in working conditions (as discussed for the no-action alternative). Affected groups include suppliers, financers, participants in marketing channels, and domestic and foreign consumers. The income and characteristics of jobs in the groundfish fishery also affect the quality of lives and relations among these individuals and groups. Additionally, intrinsic and ecosystem service values may also be impacted by the action alternatives. The effects of the action alternatives on these aspects of the human environment will depend on incremental changes in fishermen's behaviors in response to changes in fishing opportunities posed by each to the alternatives.

When fishing areas are opened or closed, economic conditions may be impacted through a number of mechanisms. Net harvesting revenue is a function of a number of interrelated factors including effort, quantities caught, fishing costs, and ex-vessel prices. As areas open and close, the amount and location of effort will be determined by how the factors in this array vary by area and by fishermen's preferences for the mix offered by different fishing areas. Quantities caught are affected by CPUE and the mix of species, both of which also may vary by fishing area. Fishing costs vary with CPUE, quantities caught, and time and distance traveled to the fishing area. Similarly, ex-vessel prices may be impacted by the size and quality of fish as well as the species mixes, all of which may vary by fishing area. The degree of economic impacts depends on the adjustments that vessels make in response to openings and closures, as

well as the net differences between the array of factors for the previous fishing grounds and the array of factors for the new fishing areas.

Direct impacts of the action alternatives, e.g., changes in distance to and location of grounds and vessel net revenue, in turn, impact economic factors such as personal income, job conditions, social relations, and safety. If the action alternatives were to result in increases in personal income, social stress in families may be alleviated while reductions in income may increase such stresses (Gien 2000; Polnac and Poggie 2008; Polnac et al. 2015 and, Smith et al. 2003). While increased travel time to fishing grounds affects vessel net revenue through factors such as additional payments required for fuel and observers, it affects crew members due to lost opportunities to use their time in other pursuits, and it affects friends and families from whom they are apart. Greater distances to fishing grounds also impact safety, providing more opportunity for unexpected weather and sea conditions to arise during transit. Additionally, closed areas might increase the time a vessel spends searching for fishable aggregations of fish.

Extensive closed areas also require vessels to act to comply, including dealing with other regulatory complexities such as continuous transit rules. These rules impinge on vessel operations, including creating uncertainty about thresholds for altering courses when weather and sea conditions arise that might justify such changes for safety reasons. Enforcement of closed areas and continuous transit rules are also a burden on enforcement resources that may be impacted by changes to the extent and shape of the closed area boundaries. In general, the boundaries included in the alternatives have been developed in consultation with enforcement expertise to optimize enforceability.

With respect to time and distances to the fishing ground, opening or closing areas might increase or decrease the times for some trips, depending on the particular situations and vessel choices. For example, in response to RCA closures, some trips might be made closer to shore (shoreward of the trawl RCA) rather than farther out over the shelf. Alternatively, a vessel might make a trip seaward of the trawl RCA instead of shoreward or travel greater latitudinal distances to reach preferred fishing grounds. Similarly, in response to a closed EFH area, a vessel might travel further to access grounds likely to have a more desirable CPUE and species mix or decide that it is better to spend less time in transit and fish at a higher probability of encountering a lower CPUE or a less desirable species mix.

The foregoing paragraphs list a large number of factors that fishermen running vessels may take into account when deciding where and how hard to fish in response to the changed array of opportunities posed by the new set of open and/or closed areas that would be created by the action alternatives. Increasing open areas will likely increase the array and allow vessels to better achieve their economic objectives, while closing areas will reduce the array. Thus, whatever choices a vessel makes, reducing

closed areas provides more optimization opportunities among many considerations, and closing open areas will incrementally reduce some of these opportunities.

While the adjustment that fishermen make is uncertain, the original closures of the trawl RCA were intended to reduce harvest of shelf species, and they have been effective. It is reasonable to expect that reopening these areas will increase the harvest of at least some shelf species. Whether that increase will be offset by a decline in the harvest of nearshore and slope species likely depends on available markets and the degree to which species such as sablefish constrain harvest and are required to prosecute fisheries in newly opened areas. The impacts of EFH closures on amount harvested are less certain, since they were not necessarily originally intended to restrict the amounts harvested of any particular species but, rather, just to protect certain habitats.

While individual vessels, the broader industry, and communities may well benefit from reducing the extent of closed areas, there is also some risk that may be entailed with opening the trawl RCAs. As discussed under the No-action Alternative, RCAs originally provided managers with a way to control fishing mortality for overfished species, while allowing as much fishing activity as possible, prior to there being a way to regulate and account for catch on each vessel (when only a vessel's landings could be monitored and controlled[34]).

Without RCAs, the landings limits used prior to catch shares would have had to be much more restrictive. Once the catch share program went into place (with its catch-based control and at-sea monitoring on every vessel), the trawl RCAs no longer provided that benefit, but they may have been providing some risk mitigation for the fleet. Under catch shares, if a vessel has an overage of its quota that is sufficient to cause the fleet to exceed its allocation or an ACL to be exceeded, it may become necessary to close or restrict the fishery before many participants have had a chance to use their quota. This has been a particular concern for overfished species for which rebuilding plans are in place and allocations are more limited. The RCAs are places where these species are more likely to be encountered. Because amounts of quota for these species have been so small, single large bycatch events exceeding a vessel's quota can potentially put the fleet over its allocation. Therefore, while leaving the trawl RCAs in place has constrained fleet harvest, it may have also provided some protection for the fleet as a whole against an accidental high bycatch event. The degree to which that protection might be useful is uncertain, given the individual incentives the catch share program provides to avoid overfished species. Further, most of the rockfish species that received some protection due to the trawl RCAs have been rebuilt. Now there are

[34] Scientific observers were sometimes present, but their role was not to monitor a vessel's catch for compliance with regulations.

only two overfished species of concern, cowcod in the south (for which there are special conservation areas) and yelloweye rockfish coastwide.

Reduction of areas protected from bottom trawling may also impact intrinsic values such as existence values (the values that members of a society place on knowing, for example, that particular areas have been preserved from certain types of human disturbance or that certain species will continue to exist), as well as ecosystem services provided by these areas. On one hand, while existence values for habitat and sensitive organisms within that habitat may be obscure for most consumers, they should not be ruled out for consideration simply because most members of society have relatively little information (Bishop and Welsh 1992) about it. On the other hand, there is a high degree of substitutability in the existence values for environmental goods (Bishop and Welsh 1992[35]), though perhaps not for individual species. Further, quantification of existence value is not provided here for the following reasons:

- There is uncertainty around existence value methodologies.
- Values placed on different marine habitat types and relatively unknown organisms would be difficult to assess.
- The habitats to be opened or closed are generally not pristine but have been subject to numerous other fishing and nonfishing human activities.
- The habitats will not be irreparably destroyed by the proposed fishing activity.
- It has not been proposed that the existence of any species in these areas would be endangered by these actions.
- Portions of each habitat type will continue to be protected by some closed areas.
- This analysis is primarily qualitative such that the absence of quantitative information on existence values will not bias the results.

At the same time, it is likely that there are existence values for the habitats and sensitive organisms within these habitats and a balanced impact evaluation and decision process requires their consideration as part of the trade-offs in decisions to open and close areas.

Another economic consideration is the valuation of ecosystem services. “Ecosystem services are those processes and functions that benefit people, consciously or un-consciously, directly or indirectly. They only exist if they contribute to human wellbeing and cannot be defined independently” (Costanza et al. 2017, p. 3[36]). In their recent review of the history of theory on ecosystem services, Constanza et al. note the following:

> Even without any subsequent valuation, the very process of listing all the services derived from an ecosystem can help ensure their recognition in public policy. This makes the analysis of ecological systems more transparent and can help inform decision makers of the relative merits of different options. (Costanza et al. 2017, p. 7)

Where valuations can be made, they are useful for decision processes. The following are the categories ecosystem services likely most relevant to this proposed action: disturbance regulation, biological control, refugia, food production, recreation and cultural services.[37] Among the ecosystem services provided by the habitat protected by closed areas are the commercial and recreational fisheries that must be prosecuted to benefit from those services. This situation illustrates that sometimes a balance must be struck between preserving ecosystem services and the human activities necessary to benefit from them. Part of the balance depends on the degree to which the human activity, in this case fishing, actually diminishes the ecosystem services. One of the concerns for food production and recreational-fishing-related ecosystem services would be whether any diminishment of ecosystem resulting from gear impacts on habitat would affect stock productivity or the resilience of the ecosystem in the face of other disturbances.

The impacts of the alternatives on habitat and other species are provided in Sections 4.2.1 and Section 4.2.2 In those sections, the first steps toward quantification of the impacts on these services are taken. Information is not available to convert those effects into dollar amounts that could be balanced with other economic effects. However, as noted with respect to existence values, that is not expected to lead to a biased analytical result because it has not been possible to quantify other economic effects. While some indicators give a sense of the relative magnitudes of the impacts (including indicators expressed in dollar values), those indicators are not converted to impact estimates and given dollar values.

While the analysis to this point has been qualitative, as mentioned, some quantitative indicators have been developed to help inform the decisions by differentiating the alternatives. The total areas to be opened and closed and the different associated habitat types are relevant to understanding something about the magnitude of the action alternative impacts on vessel choice arrays, existence values, and ecosystem services.

The following sections on each alternative focus on recent and historic indicators of the relative importance of various fishing grounds that would be subject to opening or closing under the various alternatives. Due to changing conditions in the fishery, these indicators, expressed mainly as percentages

[37] The complete list developed by Constanza et al, also includes gas regulation (e.g., CO_2), climate regulation, water regulation, water supply erosion control, and sediment retention; soil formation; nutrient cycling; waste treatment; pollination; raw materials, and genetic resources.

for the action alternatives, only provide a general feel for the potential importance of the fishing area. They should not be taken as predictions of the size of the impacts. The indicators of past importance (recent or historic) of the grounds also do not consider opportunities to adjust by shifting effort elsewhere, nor the many potential impacts of shifting effort and catch that have been discussed in this section. This is particularly true for the pre-catch share indicators (1997 to 2001), given the large number of factors that have changed, including the incentive system under which vessels operate. In the late 1990s, for example, a vessel might fish in an area because of a high CPUE and, without penalty, discard any incidental catch that could not be landed due to regulatory restrictions. Under the catch share system, that bycatch counts against the individual's quota, and catching it could constrain future fishing. Conversely, an area that historically was not fished because of lower CPUE might become a more important fishing ground than indicated by historical data if there is a low frequency of occurrence of a constraining species.

State-managed fisheries (pink shrimp, California halibut, ridgeback prawn, and sea cucumber) may experience some impacts associated with closing or reopening areas, but only associated with proposed changes to EFHCAs. State-managed bottom trawl fisheries will not be impacted by any RCA alternative, because the non-groundfish RCA would restrict them from fishing in the trawl RCA footprint. EFH alternatives may have limited impacts on the pink shrimp, ridgeback prawn, and sea cucumber fisheries, because those fisheries are restricted from fishing inside an EFHCA, and they would, therefore, be able to fish in any EFHCA that is reduced or eliminated. The California halibut bottom trawl fishery will not be impacted by any EFH alternatives and are not discussed further. See Section 4.1.5 for a description and maps on state-managed fisheries.

4.2.3.3 Alternative 1.a, the Collaborative Alternative

The section provides a general qualitative analysis of the action alternatives (Section 4.2.3.2). Quantitative indicators related to the bottom trawl fishery are also presented here to help distinguish the alternatives in terms of the likely size of the impact. For the reasons described in Section 4.1, Description of Analytical Approach and Methods, and Section 4.2.3.2, Action Alternatives: General Qualitative Analysis, these values should not be treated as predictions or estimates but simply as measures of the past importance of particular fishing grounds within the context of the conditions of the time. Nonetheless, these values may serve as qualitative indicators of where fishermen may focus future effort. Impacts on state-managed bottom trawl fisheries are discussed in the alternative-wide net effects section.

Alternative 1.a includes a combination of proposed new closures and reopenings. It does not include area off the central Oregon coast, or areas in the California Bight.

4.2.3.3.1 Coastwide and State Analysis

4.2.3.3.1.1 Proposed Closures

Table 4-30 shows landings and revenues coastwide, by state and by port group. Data cover the years from 2011 to 2014 in areas proposed for closure under Alternative 1.a.

Landings

Areas proposed for closure under this alternative account for less than 0.2 percent of the coastwide landings by weight from 2011 to 2014. Although California has relatively more landings affected than the other two states, the areas proposed for closure under this alternative accounted for less than 0.5 percent of California's landing weight from 2011 to 2014. Washington and Oregon landings were each less than one-tenth of 1 percent of coastwide, in areas proposed for closure under this alternative.

Revenues

Revenues followed the same pattern as landings, with less than 0.2 percent of coastwide revenues represented by proposed closures under this alternative. California shows the greatest amount of revenues coming from proposed closures, but that was under 0.5 percent of state totals. Washington and Oregon had less than or equal to 0.1 percent of state totals, for proposed closures.

Effort

The areas proposed for closure under Alternative 1.a accounted for 290 trawl hours, or 0.2 percent of coastwide effort. Data used covered 2011 to 2014.

4.2.3.3.1.2 Proposed Reopenings

Landings

Areas proposed for reopening under this alternative accounted for less than 0.5 percent of coastwide landing weight from 1997 to 2001. California had relatively more areas affected by the proposed reopenings than the other two states, although the areas proposed for reopening under this alternative accounted for approximately 1 percent of California's landing weight from 1997 to 2001. Oregon had 0.2 percent of its revenues, and Washington had 0.02 percent coming from proposed closures under this alternative.

Revenues

Revenues followed the same pattern as landings, with 0.5 percent of coastwide revenues represented by proposed reopenings under this alternative. California showed the greatest amount of revenues coming

from proposed reopenings, but that was under 1 percent of state totals. Oregon had 0.2 percent, and Washington had less than 0.1 percent of state totals, for proposed reopenings.

Effort

The areas proposed for reopening under Alternative 1.a were associated with 2,650 trawl hours, or 0.4 percent of coastwide effort.. Data used covered 1997 to 2001.

4.2.3.3.2 Port Group Analysis

4.2.3.3.2.1 Proposed Closures

Table 4-30 shows landings (round weight) and inflation-adjusted ex-vessel revenues for bottom trawl groundfish by coastwide, by state, and by port group, from 2011 to 2014, in areas proposed for closure.

Table 4-30. Landings and revenues coastwide, by state, and by port group from 2011 to 2014 in areas proposed for closure under Alternative 1.a.

Port Group	Landings (Thousand pounds)	Percent of Port Group Non-whiting Groundfish Landings	Infl-adj. Ex-vessel Revenue ($000, 2015)	Percent of Port Group Non-whiting Groundfish Revenue
North WA coast	-	-	-	-
Puget Sound	-	-	-	-
South and Central WA coast	16	0.18%	12	0.20%
Washington Total	**16**	**0.08%**	**12**	**0.10%**
Astoria	60	0.10%	34	0.10%
Newport	-	-	-	-
Coos Bay	-	-	-	-
Brookings	8	0.08%	6	0.09%
Oregon Total	**68**	**0.07%**	**40**	**0.07%**
Crescent City	2	0.20%	2	0.25%
Eureka	141	0.77%	103	0.79%
Fort Bragg	3	0.03%	3	0.03%
San Francisco	12	0.44%	16	0.84%
Monterey	4	0.13%	4	0.18%
Morro Bay	11	0.43%	5	0.22%
California Total	**173**	**0.44%**	**133**	**0.46%**
Coastwide Total	**257**	**0.17%**	**185**	**0.19%**

Landings

Table 4-30 shows landings coastwide, by state and port group, for areas proposed for closure under Alternative 1.a. The data from 2011 to 2014 show that there could be displacement of landings. The Eureka port group would be the most affected by this alternative. However, the displaced landings as a percentage of that port group's groundfish landings would be less than 1 percent. All other port groups would have less than 0.5 percent of landings affected by the proposed closures. It is possible that fishing effort would shift to other areas, including those proposed for reopening, thereby mitigating the impacts of displaced landings from the proposed closed areas.

Revenue

Table 4-30 also shows revenues coastwide, by state, and by port group, for areas proposed for closure under Alternative 1.a. The Eureka port group shows the largest amount of revenue from the proposed closures, but the amount of revenue represents less than 1 percent of the total bottom trawl groundfish landings revenue in this port group from 2011 to 2014. San Francisco shows a higher percentage of affected revenues (0.89 percent), but a smaller absolute amount. All other port groups show less than 0.5 percent of estimated revenues from the proposed closures. It is possible that fishing effort would shift to other areas, including those proposed for reopening, thereby mitigating the impacts of displaced revenues from the proposed closed areas.

4.2.3.3.2.2 Proposed Reopenings

Table 4-31 shows landings and inflation-adjusted ex-vessel revenues of non-whiting trawl groundfish by port group that were caught from 1997 to 2001 in areas proposed for reopening.

Table 4-31. Collaborative Alternative 1.a: Aggregated total bottom trawl groundfish species landings and revenue coastwide, by state, and by port group from 1997 to 2001 in areas proposed for reopening.

Port Group	Landings (Thousand pounds)	Percent of Port Group Non-whiting Groundfish Landings	Infl-adj. Ex-vessel Revenue ($000, 2015)	Percent of Port Group Non-whiting Groundfish Revenue
North WA coast	-	-	-	-
Puget Sound	-	-	-	-
South and Central WA coast	11	0.08%	6	0.07%
Washington Total	**11**	**0.02%**	**6**	**0.02%**
Astoria	231	0.41%	135	0.40%
Newport	-	-	-	-
Coos Bay	38	0.12%	35	0.16%
Brookings	4	0.04%	3	0.04%
Oregon Total	**273**	**0.22%**	**172**	**0.21%**
Crescent City	2	0.01%	1	0.01%
Eureka	51	0.16%	32	0.15%
Fort Bragg	192	0.81%	113	0.72%
San Francisco	178	0.97%	104	0.90%
Monterey	685	4.90%	436	5.23%
Morro Bay	60	0.66%	40	0.66%
California Total	**1,167**	**1.02%**	**727**	**0.95%**
Coastwide Total	**1,451**	**0.50%**	**905**	**0.50%**

Landings

Table 4-31 shows historical landings by port group from areas proposed for reopening under Alternative 1.a. Based on landings from 1997 to 2001, The Monterey port group had the highest proportion (4.9 percent) of its total landings coming from areas proposed to be reopened under this alternative. No other port group had as much as 1 percent of its total landings from areas proposed to be reopened under this alternative.

Revenues

Table 4-31 also shows inflation-adjusted ex-vessel revenues by port group for bottom trawl groundfish that were caught from 1997 to 2001 in areas proposed for reopening. In terms of revenue, the Monterey port group also had the highest proportion (5.2 percent) of its total bottom trawl groundfish ex-vessel revenues coming from areas proposed to be reopened under this alternative. This could mean that the Monterey port group would see increased revenues under this alternative, compared to other port groups, depending on other factors which have changed since the 1997 to 2001 period. No other port group had as much as 1 percent of its total landings revenue from areas proposed to be reopened under this alternative.

Alternative-wide Net Effects

Closings and openings affect the array of fishing choices available to vessels. This, in turn, impacts business incomes, personal income, quality of life, relations within communities, safety, domestic and foreign consumers, export balances, existence values, and ecosystem service value. Because it is not possible to develop useful predictions of the response that vessels will have to new choice arrays, we cannot produce quantitative estimates of economic impacts. Hence indicators are presented of the past economic importance of fishing grounds to be opened and closed. Caveats for interpreting this information are presented in the methods section and the section on general qualitative analysis of the action alternatives.

The areas proposed for closure contributed less than 1 percent of port group landings and revenues for every individual port group, less than 0.5 percent of every state's statewide landings and revenues, and less than 0.2 percent of coastwide landings and revenues during the 2011 to 2014 reference period. The areas proposed for reopening accounted for more than 1 percent of port group landings and revenues for only one California port (Monterey), but only 0.5 percent of coastwide landings and revenues during the 1997 to 2001 reference period.

There may be limited impacts on the state-managed pink shrimp, ridgeback prawn, and sea cucumber fisheries, because those fisheries are restricted from fishing inside EFHCAs. This alternative includes a mix of proposed closures and proposed reopenings. New closures that are currently open to these fisheries would preclude fishing in those areas. However, available data (Section 4.1.5) indicate low levels of fishing activity associated with EFHCAs proposed for modification. Proposed reopenings, if they are in areas not otherwise closed to state-managed bottom trawling, may allow increased access into new fishing grounds. Again, the available data show a low amount of this fishing in areas being considered for modification.

4.2.3.4 Action Alternative 1.b, the Oceana et al. Alternative

The section on general qualitative analysis of the action alternatives (Section 4.2.3.2) provides a general qualitative analysis of the action alternatives. Quantitative indicators related to the bottom trawl fishery are presented here to help distinguish the alternatives in terms of the likely size of the impact. For the reasons described in Section 4.1, Analysis of Alternatives by Resources, and Section 4.2.3.2, Action Alternatives: General Qualitative Analysis, these values should not be treated as predictions or estimates, but simply as indicators of the past importance of particular fishing grounds within the context of the conditions at the time. Nonetheless, these values may serve as qualitative indicators of where fishermen

may focus future effort. Impacts on state-managed bottom trawl fisheries are discussed in the alternative-wide net effects section.

4.2.3.4.1 Coastwide and State Analysis

4.2.3.4.1.1 Proposed Closures

Landings

Table 4-32 shows landings by weight and inflation-adjusted ex-vessel revenues by port group for bottom trawl groundfish caught from 2011 to 2014 in areas proposed for closure. Areas proposed for closure under this alternative accounted for 2.8 percent of coastwide landings by weight from 2011 to 2014. California could be more affected by the proposed closures than the other two states. The areas proposed for closure under this alternative accounted for 8.8 percent of California's landings from 2011 to 2014. The other two states received no more than 1 percent of statewide landings from areas proposed for closure under this alternative. However, it is unknown whether catch from other areas would compensate for a port's displaced landings associated with the proposed closures.

Revenues

Table 4-32 shows that areas proposed for closure under this alternative accounted for 2.8 percent of coastwide ex-vessel revenue from 2011 to 2014. California could be more affected by the proposed closures than the other two states. The areas proposed for closure under this alternative accounted for 9 percent of statewide ex-vessel revenue from 2011 to 2014. The other two states received no more than 1 percent of statewide ex-vessel revenue from areas proposed for closure under this alternative. However, it is unknown whether catch from other areas would compensate for a port's displaced revenues associated with the proposed closures.

Effort

Areas proposed for closure under Alternative 1.b had 4,366 trawl hours. This represents 3 percent of coastwide effort recorded from 2011 to 2014.

4.2.3.4.1.2 Proposed Reopenings

Landings

Table 4-37 shows landings by weight and inflation-adjusted ex-vessel revenues by port group for bottom trawl groundfish caught from 1997 to 2001 in areas proposed for reopening under this alternative. Areas proposed for reopening under this alternative accounted for 0.3 percent of coastwide landings and ex-vessel revenue from 1997 to 2001. The areas proposed for reopening under this alternative accounted for

less than 1 percent of California's statewide landings and ex-vessel revenue from 1997 to 2001, and there are no proposed reopenings off Oregon or Washington.

Revenues

Table 4-30 shows inflation-adjusted ex-vessel revenues by port group, state, and coastwide, for bottom trawl groundfish caught from 1997 to 2001 in areas proposed for reopening under this alternative. Areas proposed for reopening under this alternative accounted for 0.3 percent of coastwide ex-vessel revenue from 1997 to 2001. The areas proposed for reopening under this alternative accounted for less than 1 percent of California's statewide ex-vessel revenue from 1997 to 2001, and there are no proposed reopenings off Oregon or Washington.

Effort

Areas proposed for reopening under this alternative represent 1,506 trawl hours. This represents 0.25 percent of coastwide effort from 1997 to 2001.

4.2.3.4.2 Port Group Analysis

4.2.3.4.2.1 Proposed Closures

Table 4-32 shows landings by weight and inflation-adjusted ex-vessel revenues by port group for bottom trawl groundfish caught from 2011 to 2014 in areas proposed for closure.

Table 4-32. Alternative 1.b, the Oceana et al. Alternative; Landings and Revenues coastwide, by state, and by Port Group from 2011 to 2014 from Catch in Areas Proposed for Closure.

Port Group	Landings (Thousand pounds)	Percent of Port Group Non-whiting Groundfish Landings	Infl-adj. Ex-vessel Revenue ($000, 2015)	Percent of Port Group Non-whiting Groundfish Revenue
North WA coast	-	-	-	-
Puget Sound	-	-	-	-
South and Central WA coast	106	1.21%	100	1.77%
Washington Total	**106**	**0.55%**	**100**	**0.84%**
Astoria	376	0.64%	278	0.85%
Newport	153	1.40%	149	1.92%
Coos Bay	19	0.12%	19	0.18%
Brookings	184	1.81%	133	1.91%
Oregon Total	**732**	**0.77%**	**579**	**1.00%**
Crescent City	3	0.26%	2	0.31%
Eureka	3,083	16.90%	2,338	18.00%
Fort Bragg	301	2.58%	213	2.38%
San Francisco	34	1.29%	38	1.94%
Monterey	2	0.06%	2	0.09%
Morro Bay	51	1.94%	46	2.10%
California Total	**3,474**	**8.79%**	**2,640**	**9.03%**
Coastwide Total	**4,312**	**2.80%**	**3,319**	**3.36%**

Landings

Table 4-32 indicates possible displaced catch by port group in which the catch was landed for areas proposed for closure under Alternative 1.b. The Eureka port group shows the largest amount of landings from the proposed closures, more than 3 million pounds (17 percent) of the total bottom trawl groundfish landings in this port group from 2011 from to 2014. This represents one-sixth of that port group's landings from the sector. Most of these impacts are from the Samoa Deepwater site, followed by North Eel River Canyon and Mendocino Ridge Expansion, as shown in (Appendix Table Reference here).

The Fort Bragg port group shows the second largest amount of landings from the proposed closures, approximately 300 thousand pounds across all four years, representing 2.6 percent of total non-whiting trawl groundfish landings in this port group from 2011 to 2014, with the bulk of impacts split between the Noyo Canyonhead and the South Delgada Canyonhead (Appendix Table Reference here). All other port groups have less than 2 percent of estimated port landings from the proposed closures. In terms of landings, Eureka and Fort Bragg are the port groups that would face the most displaced fishing from the proposed closures under this alternative. For the remaining port groups, areas proposed for closure would represent less than 2 percent of the total bottom trawl groundfish landings in each port group.

Revenues

also shows revenue by port group from catch in areas proposed for closure under Alternative 1.b. The Eureka port group could potentially experience the largest amount of revenue coming from the proposed closures. The amount of revenue landed from the areas proposed for closure ($2.33 million across all four years) represents 18 percent of total non-whiting trawl groundfish landings revenue in this port group from 2011 to 2014. This represents nearly one-fifth of that port group's revenues from the sector. The Fort Bragg port group could potentially lose have the second largest amount of revenue coming from the proposed closures, approximately $213 thousand, representing 2.4 percent of total bottom trawl groundfish landings in this port group from 2011 to 2014, depending on ability to increase effort and catch in open areas. All other port groups showed less than 2 percent of estimated port revenue coming from the proposed closures.

4.2.3.4.2.2 Proposed Reopenings

Landings

Table 4-33 shows historical landing weights by port group from areas proposed for reopening under Alternative 1.b. Only port groups in California would be affected by the reopenings, because this alternative does not contain any proposed reopenings north of California. The Monterey port group had the highest proportion (685 thousand pounds from 1997 to 2001, 4.9 percent) of its total landings coming

from areas proposed to be reopened under this alternative. No other port group had as much as 1 percent of its total historic landings for this period from areas proposed to be reopened under this alternative.

Revenues

Table 4-33 also shows inflation-adjusted ex-vessel revenues by port group for bottom trawl groundfish that were caught from 1997 to 2001 in areas proposed for reopening. In terms of revenue, the Monterey port group also had the highest proportion ($436 thousand from 1997 to 2001, 5.23 percent) of its total non-whiting trawl groundfish ex-vessel revenues coming from areas proposed to be reopened under this alternative. No other port group had as much as 1 percent of its total historic landings revenue for this period from areas proposed to reopen under this alternative.

Table 4-33. Alternative 1.b, the Oceana et al. Alternative; Aggregated Bottom Trawl Groundfish Species Landings and Revenues, coastwide, by state, and by Port Group from 1997 to 2001 from Catch in Areas Proposed for Reopening.

Port Group	Landings (Thousand pounds)	Percent of Port Group Non-whiting Groundfish Landings	Infl-adj. Ex-vessel Revenue ($000, 2015)	Percent of Port Group Non-whiting Groundfish Revenue
North WA coast	-	-	-	-
Puget Sound	-	-	-	-
South and Central WA coast	-	-	-	-
Washington Total	**-**	**-**	**-**	**-**
Astoria	-	-	-	-
Newport	-	-	-	-
Coos Bay	-	-	-	-
Brookings	-	-	-	-
Oregon Total	**-**	**-**	**-**	**-**
Crescent City	-	-	-	-
Eureka	1	0.00%	0	0.00%
Fort Bragg	48	0.20%	30	0.19%
San Francisco	85	0.46%	45	0.39%
Monterey	685	4.90%	436	5.23%
Morro Bay	60	0.66%	40	0.66%
California Total	**879**	**0.76%**	**551**	**0.72%**
Coastwide Total	**879**	**0.30%**	**551**	**0.30%**

4.2.3.4.3 Alternative-wide Net Effects

Closings and openings affect the array of fishing choices available to vessels; this, in turn, impacts business incomes, personal income, quality of life, relations within communities, safety, domestic and foreign consumers, export balances, existence values, and ecosystem service value. Because it is not possible to develop useful predictions of the response that vessels will have to new choice arrays, we cannot to develop quantitative estimates of economic impacts. Therefore, we present indicators of the past

economic importance of fishing grounds to be opened and closed. Caveats for interpreting this information are presented in the methods section and in the section on general qualitative analysis of the action alternatives.

New reopenings may not increase catch if effort simply moves from currently open areas into newly opened areas. On the other hand, new open areas may increase catch if the species mix in the area is such that there is less co-occurrence of constraining species in the catch. Additionally, new open areas may increase net vessel revenue without increasing catch if CPUE is higher (reducing fishing costs) or if travel costs to the area are lower than for other fishing areas. Increases in catch or net revenue are likely to increase personal income and local income impacts within communities.

Similarly, new closures may result in a decrease in catch or revenues. Depending on constraining species and the ability of the fleet to access equally productive fishing grounds, the changes could also be neutral.

The areas proposed for closure would likely affect every port group except the North Washington Coast group. Over the recent period these areas proposed for closure contributed, and could displace, more than 1 percent of port group landings, revenues, and effort in seven port groups. The largest contributions were to Eureka and Fort Bragg. Therefore, these ports would most likely experience the largest local negative impacts from area closures and subsequent displacement of effort. Statewide, more than 8 percent of California landings weight and revenues came from areas proposed for closure. Effects on Washington and Oregon port groups would be relatively minor by comparison, with coastwide landings and revenues from areas proposed for closure only 2.8 percent and 3.4 percent, respectively, of coastwide totals during the 2014 reference period. The areas proposed for reopening provided more than 1 percent of port group landings and revenues for only one California port (Monterey), but less than 1 percent of California statewide landings, and only 0.3 percent of coastwide landings and revenues during the 2001 reference period. This alternative might reduce opportunity somewhat in the active Eureka-Fort Bragg area, and it could provide somewhat increased opportunity associated with the relatively smaller Monterey port group.

This alternative may have limited impact on the state-managed pink shrimp, ridgeback prawn, and sea cucumber fisheries, because those fisheries are restricted from fishing inside EFHCAs. This alternative includes a mix of proposed closures and proposed reopenings. New closures that are currently open to these fisheries would preclude fishing in those areas. However, available data (see Section 4.1.5) indicate low levels of fishing activity associated with EFHCAs proposed for modification. Proposed reopenings in areas not otherwise closed to state-managed bottom trawling may allow increased access into new fishing grounds. Again, the available data show a low amount of this fishing in areas being considered for modification.

4.2.3.5 Alternative 1.c, MTC Alternative

Section 4.2.3.2, Action Alternatives: General Qualitative Analysis, provides information on methods of analyses applied to the action alternatives. Quantitative indicators related to the bottom trawl fishery are presented here to help distinguish the alternatives in terms of the likely size of the impact. For the reasons described in Section 4.1, Description of Analytical Approach and Methods, and Section 4.2.3.2, these values should not be treated as predictions or estimates, but as indicators of the past importance of particular fishing grounds within the context of the conditions of the time. Nonetheless, these values may serve as qualitative indicators of where fishermen may focus future effort. Impacts on state-managed bottom trawl fisheries are discussed in the alternative-wide net effects section.

This alternative would modify the configuration of EFHCAs in waters off the Oregon Coast. Because the geographic scope is limited, proposed closures and reopenings would only affect Oregon port groups and, to a negligible extent, South Washington Coast and Crescent City.

4.2.3.5.1 Coastwide and State Analysis

4.2.3.5.1.1 Proposed Closures

Landings

Table 4-34 shows landings (round pounds) in areas proposed for closure under this alternative. These areas accounted for less than 0.01 percent of coastwide landings from 2011 to 2014. Newport, Oregon, would be the only port affected by the proposed closures. From 2011 to 2014, landings from areas proposed to be closed under this alternative were only approximately 0.01 percent of Oregon statewide landings.

Revenues

Table 4-34 shows revenues (inflation-adjusted 2015 dollars) in areas proposed for closure under this alternative. Newport would be the only port group with revenues from the proposed closures, and those landings make up less than one tenth of percent of Newport's total groundfish bottom trawl revenues.

Effort

Effort in areas proposed for closure under Alternative 1.c total approximately 13 hours from 2011 to 2014. This was approximately 0.02 percent of coastwide effort during the reference period of 2011 to 2014.

4.2.3.5.1.2 Proposed Reopenings

Landings

Table 4-35 shows landings (round pounds) in areas proposed for reopening under this alternative. Washington and Oregon would be the only states affected by the proposed reopenings under this alternative, although the areas proposed for reopening accounted for only approximately 0.01 percent of statewide landings in each of those two states from 1997 to 2001.

Revenues

Table 4-35 shows revenues (inflation-adjusted 2015 dollars) in areas proposed for reopening under this alternative. Washington and Oregon would be the only states affected by the proposed reopenings under this alternative, although the areas proposed for reopening accounted for only approximately 0.01 percent of statewide landings and ex-vessel revenue in each of those two states from 1997 to 2001.

Effort

Effort in areas proposed for reopening under the alternative was approximately 51 hours; it was also only approximately 0.02 percent of coastwide effort from 1997 to 2001.

4.2.3.5.2 Port Group Analysis

Table 4-34 shows landings weight and inflation-adjusted ex-vessel revenues for non-whiting trawl groundfish by port group that were caught from 2011 to 2014 in areas proposed for closure.

Table 4-34. Alternative 1.c, the MTC Alternative; Aggregated Bottom Trawl Groundfish Species Landing Weights and Revenues coastwide, by state, and by Port Group from 2011 to 2014 from Catch in Areas Proposed for Closure.

Port Group	Landings (Thousand pounds)	Percent of Port Group Non-whiting Groundfish Landings	Infl-adj. Ex-vessel Revenue ($000, 2015)	Percent of Port Group Non-whiting Groundfish Revenue
North WA coast	-	-	-	-
Puget Sound	-	-	-	-
South and Central WA coast	-	-	-	-
Washington Total	**-**	**-**	**-**	**-**
Astoria	-	-	-	-
Newport	9	0.09%	6	0.08%
Coos Bay	-	-	-	-
Brookings	-	-	-	-
Oregon Total	**9**	**0.01%**	**6**	**0.01%**
Crescent City	-	-	-	-
Eureka	-	-	-	-
Fort Bragg	-	-	-	-
San Francisco	-	-	-	-
Monterey	-	-	-	-
Morro Bay	-	-	-	-
California Total	**-**	**-**	-	**-**
Coastwide Total	**9**	**0.01%**	**6**	**0.01%**

4.2.3.5.2.1 Proposed Closures

Landings

Table 4-34 indicates landing weights by port group from catch in areas proposed for closure under Alternative 1.c. Only the Newport port group would be affected by the proposed closures based on 2011 to 2014 landings data. However, landings from the proposed closure areas were only 0.09 percent of the Newport port group total groundfish bottom trawl landings from 2011 to 2014. The areas proposed for closure under this alternative show very little fishing activity.

Revenues

Table 4-35 also shows revenue by port group from catch in areas proposed for closure under Alternative 1.c. Only the Newport port group would be affected by the proposed closures, based on 2011 to 2014 landings data. Revenues from the proposed closure areas were 0.08 percent of the Newport port group total groundfish bottom trawl landings from 2011 to 2014. The areas proposed for closure accounted for only a small fraction of the total bottom trawl groundfish revenue in Newport, the only port group affected by the closures.

4.2.3.5.2.2 Proposed Reopenings

Landings

Based on landing weights in 1997 to 2001, only the South and Central Washington Coast port group in Washington and the Astoria and Newport port groups in Oregon would be affected by the proposed reopenings (Table 4-35). This alternative proposes changes only off the Oregon Coast. The South and Central Washington Coast port group had the highest proportion (8 thousand pounds, 0.05 percent) of its total landings coming from areas proposed to be reopened under this alternative. The Astoria and Newport port groups each received only 0.02 percent of total landings from areas proposed to be reopened under this alternative.

Table 4-35. Alternative 1.c, the MTC Alternative; Aggregated Bottom Trawl Groundfish Species Landing Weights and Revenues coastwide, by state, and by by Port Group from 1997 to 2001 from Catch in Areas Proposed for Reopening.

Port Group	Landings (Thousand pounds)	Percent of Port Group Non-whiting Groundfish Landings	Infl-adj. Ex-vessel Revenue ($000, 2015)	Percent of Port Group Non-whiting Groundfish Revenue
North WA coast	-	-	-	-
Puget Sound	-	-	-	-
South and Central WA coast	8	0.05%	3	0.04%
Washington Total	**8**	**0.01%**	**3**	**0.01%**
Astoria	12	0.02%	6	0.02%
Newport	4	0.02%	2	0.01%
Coos Bay	-	-	-	-
Brookings	-	-	-	-
Oregon Total	**16**	**0.01%**	**8**	**0.01%**
Crescent City	-	-	-	-
Eureka	-	-	-	-
Fort Bragg	-	-	-	-
San Francisco	-	-	-	-
Monterey	-	-	-	-
Morro Bay	-	-	-	-
California Total	**-**	**-**	**-**	**-**
Coastwide Total	**24**	**0.01%**	**12**	**0.01%**

Revenues

In terms of revenues, the South and Central Washington Coast port group also had the highest proportion ($3000, 0.04 percent) of its total bottom trawl groundfish ex-vessel revenues coming from areas proposed to be reopened under this alternative (Table 4-35). Historically, the Astoria and Newport port groups received only 0.02 percent and 0.01 percent, respectively, of total landings revenue from areas proposed to be reopened under this alternative.

4.2.3.5.3 Alternative-wide Net Effects

Closings and openings affect the array of fishing choices available to vessels. This, in turn, impacts business incomes, personal income, quality of life, relations within communities, safety, domestic and foreign consumers, export balances, existence values, and ecosystem service value. Because it is not possible to develop useful predictions of the response that vessels will have to new choice arrays, we cannot produce quantitative estimates of economic impacts. Hence, we present indicators of the past economic importance of fishing grounds to be opened and closed. Caveats for interpreting this information are presented in the methods section and the section on general qualitative analysis of the action alternatives.

The areas proposed for closure would affect only the Newport port group, and they contributed less than 0.1 percent of that port group's landing weights and revenues from the 2011 to 2014 reference period. The areas proposed for reopening would affect only three port groups (South and Central Washington Coast, Astoria, and Newport); these areas contributed less than 0.1 percent of each port group's landings and revenues from the 1997 to 2001 reference period. Therefore, it is not anticipated that this alternative would have substantial economic effects on any port group. This alternative would have no effect on California and only minimal effects on Washington and Oregon.

This alternative is limited to waters off the Oregon Coast, and it would not impact California halibut or ridgeback prawns. There could be limited impact on the state-managed pink shrimp and sea cucumber fisheries, because those fisheries are restricted from fishing inside EFHCAs. This alternative includes a mix of proposed closures and proposed reopenings. New closures that are currently open to these fisheries would preclude fishing in those areas. However, available data (see Section 4.1.5) indicate low levels of fishing activity associated with EFHCAs proposed for modification. Proposed reopenings, if they are in areas not otherwise closed to state-managed bottom trawling may allow increased access into new fishing grounds. Again, the available data show a low amount of this fishing in areas being considered for modification.

4.2.3.6 Alternative 1.d, the Garibaldi Reef South Alternative, Alternative 1.e, the Rittenburg Bank Alternative, and Alternative 1.f, the Potato Bank Correction Alternative

Section 4.2.3.2 provides a general qualitative analysis of the action alternatives. Areas encompassed by these alternatives do not have any quantitative data associated with them during the reference periods.

These alternatives are stand-alone polygons off Oregon, northern California, and central California. Alternative 1.d would close 8 square miles of currently open fishing grounds off the north Oregon coast and Alternative 1.e would close 13 square miles off the central California coast. Alternative 1.e would correct the Amendment 19 action, which placed the coordinates of the Potato bank closure incorrectly. After placing the closed polygon correctly, Alternative 1.e would close 111 square miles while reopening 111 square miles. Much of the new closure is within the current western CCA, and it is, therefore, already closed to bottom trawling.

The areas encompassed by these alternatives have no bottom trawl fishery quantitative data associated with them for the reference periods used in this analysis (1997 to 2001 for proposed reopenings and 2001 to 2014 for proposed closures). Therefore, they would be expected to experience no more than negligible effects.

Areas encompassed by these alternatives may experience limited impacts on state-managed pink shrimp, ridgeback prawn, and sea cucumber fisheries because those fisheries are restricted from fishing inside EFHCAs. These alternatives include a mix of proposed closures and proposed reopenings. New closures that are currently open to these fisheries would preclude fishing in those areas. However, no quantitative fisheries data are associated with any of the proposed changes under these alternatives. Although Garibaldi Reef South and Rittenburg Bank are technically open to state-managed bottom trawling, none currently takes place. Closure of these areas would likely have no more than a negligible effect on state-managed fisheries. Potato bank would technically become open to state-managed bottom trawl fisheries. However, fisheries data from the 1997 to 2001 reference period show no state-managed bottom trawling. It is unlikely that reopening the Potato Bank EFHCA would have more than negligible impacts on state-managed bottom trawl fisheries.

4.2.3.7 Alternative 1.g, the New EFHCAs within Trawl RCA Alternative

This alternative would establish EFHCA closures within the existing trawl RCA off the coast of Washington outside the tribal U&A. Because these areas have been closed since 2002, the only landings and revenue data available are from the 1997 to 2001 period. For both landings and revenues, the areas proposed to remain closed represent less than 0.5 percent of coastwide totals from that reference period.

Section 4.2.3.2, Action Alternatives: General Qualitative Analysis, also describes quantitative indicators used in this analysis. For the reasons described in Section 4.1 on analytical approaches and Section 4.2.3.2, these values should not be treated as predictions or estimates, but simply as indicators of the past importance of particular fishing grounds within the context of the conditions of the time.

4.2.3.7.1 Proposed Closures

Landings and Revenues

Closings and openings affect the array of fishing choices available to vessels. This, in turn, impacts business incomes, personal income, quality of life, relations within communities, safety, domestic and foreign consumers, export balances, existence values, and ecosystem service value. Because it is not possible to develop useful predictions of the response that vessels will have to new choice arrays, it is not possible to develop quantitative estimates of economic impacts. Hence indicators are presented of the past economic importance of fishing grounds to be opened and closed. Caveats for interpreting this information are presented in the methods section and the section on general qualitative analysis of the action alternatives.

Alternative-wide net effects and state-managed fisheries

This alternative would close areas that are already closed. Therefore, it would have no impact on landings or revenues relative to the groundfish bottom trawl fishery. The only state-managed fishery that could potentially experience impacts is the pink shrimp fishery, which can operate in the trawl RCA but is prohibited from fishing in EFHCAs. Other state-managed fisheries are not allowed to fish inside the trawl RCA. The pink shrimp fishery would be prohibited from fishing in those newly established EFHCAs within the trawl RCA. However, these impacts cannot be quantified based on available data.

4.2.3.8 Comparison of Subject Area 1 Alternatives: EFHCA Modifications

Three alternatives (1.a, 1.b, and 1.c) include multiple areas proposed for closure. In some cases, these alternatives would have more than negligible contributions to the landings and revenues in the context of recent fisheries (2011 to 2014). These three alternatives are described in more detail here. Three other alternatives (1.d, 1.e, and 1.f) each include a single polygon for proposed closure, and all show negligible (less than 1 percent) values for landings and revenues of coastwide and port group values, and are therefore not analyzed in detail here.

4.2.3.8.1 Proposed Closures

For Alternative 1.a, the Collaborative Alternative, the economic data on catch in areas proposed to be closed suggest that, overall, they make a negligible contribution to harvest from a coastwide and state-by-

state perspective. Table 4-28 below shows that statewide landings for Washington, Oregon, and California all had total landings and revenues at less than 1 percent of the total coastwide values for landings and revenues. Each state showed similar values. Based on landings and values data in areas proposed for closure under the three largest Subject Area 1 alternatives, all port groups show less than 1 percent of their aggregated annual landings come from areas proposed for closure within that port group. The indicators that these grounds have had a negligible contribution to harvest must be balanced with consideration of the benefits from ecosystem services that may be enhanced by these closing and any associated existence values (neither of which can be quantitatively estimated, but which may have some correlation to the total square miles of different habitat types closed (see Table 4-2). We can note that the closure of areas associated with negligible contributions to harvest would be at least partially offset by these benefits. Given the limited information available, it becomes a policy evaluation as to whether these positive benefits are sufficient to offset any negative impacts potentially producing a net positive result.

For Alternative 1.b, Oceana et. al, the landings and revenue data show mixed magnitudes of contributions for catch areas proposed to be closed, with Washington at less than 1 percent, Oregon at between 1percent and 5 percent, and California showing values in the 5 percent to 10 percent range, as compared to total coastwide groundfish bottom trawl landings and revenues. From a port group perspective, one port group, Eureka, would have areas closed that have made particularly noticeable contributions, with approximately 18 percent of its landings and revenues values coming from areas proposed for closure under this alternative. The Eureka area closures would account for approximately 80 percent of the reduction in contribution from areas to be closed under this alternative. As with Alternative 1.a, the indicators that these grounds have had a low contribution to harvest (but greater than negligible) must be balanced with consideration of the benefits from ecosystem services that may be enhanced by the closures and any associated existence values (see Table 4-3. Given the limited information available, it becomes a policy evaluation as to whether these positive benefits are sufficient to offset any negative impacts, potentially producing a net positive result. Also to be taken into account is whether the closure of these grounds reduces harvest, displaces existing effort to remaining open areas, or reduces efficiency or other opportunities to optimize fishing operations.

Alternative 1.c, the Midwater Trawlers Cooperative, would affect only Oregon, and only the Newport port group, with landings and revenue values from areas to be closed at less than 1 percent of that port group's total aggregated annual landings and revenues. The contributions from closures under this alternative are considered negligible at the port group, state, and coastwide levels. As with Alternative 1.a, the indicators that these grounds have had a negligible contribution to harvest must be balanced with

consideration of the benefits from ecosystem services that may be enhanced by the areas closing and any associated existence values (see Table 4-4). The relatively low contributions to harvest would be at least partially offset by these benefits. Because the areas to be protected are much smaller, however, the offsetting benefits are likely smaller. Given the limited information available, it becomes a policy evaluation as to whether these positive benefits are sufficient to offset any negative impacts, potentially producing a net positive result. Also to be taken into account is whether the closure of these grounds reduces harvest, displaces existing effort to remaining open areas, or reduces efficiency or other opportunities to optimize fishing operations.

In summary, while all Subject Area 1 alternatives propose closures, the harvest landings and revenue contributions from Alternative 1.b proposed closures would be a substantially higher percent, compared with proposed closures under Alternatives 1.a and 1.c, especially for the Eureka port group. Alternative 1.b would close areas that have contributed more to recent harvest, compared to the other action alternatives. Coastwide, however, this works out to about 2.8 percent and 3.36 percent of landings and values, respectively, in areas proposed for closure. As discussed above, these amounts are offset by benefits from ecosystem service and existence value benefits of closures, which are likely to vary in proportion with the amount of area closed. At the same time, however, one of the ecosystem services is the support of fisheries, and access to fish is required to accrue the benefit. Also to be taken into account is whether the closure of these grounds reduces harvest, displaces existing effort to remaining open areas, or reduces efficiency or other opportunities to optimize fishing operations. Table 4-36 provides a qualitative summary comparison of the economic impacts resulting from proposed closures under Alternatives 1.a, 1.b, and 1.c.

Table 4-36. Qualitative summary of recent contribution of landings in proposed closures under Subject Area 1 alternatives, net square miles proposed to be closed, and expected coastwide net economic impact.

	Subject Area 1 Proposed Closures (2011 to 2014 data)		
	Collaborative (1.a)	**Oceana (1.b)**	**MTC (1.c)**
	Relative Contribution* of Areas Proposed for the Following:		
Port Group	**Closure**	**Closure**	**Closure**
N. WA coast	No Data	No Data	No Data
Puget Sound	No Data	No Data	No Data
S. and Central WA coast	Negligible Contribution	Low Contribution	No Data
WA Total	**Negligible Contribution**	**Negligible Contribution**	**No Data**
Astoria	Negligible Contribution	Negligible Contribution	No Data
Newport	No Data	Low Contribution	Negligible Contribution
Coos Bay	No Data	Negligible Contribution	No Data
Brookings	Negligible Contribution	Low Contribution	No Data
OR Total	**Negligible Contribution**	**Low Contribution**	**Negligible Contribution**
Crescent City	Negligible Contribution	Negligible Contribution	No Data
Eureka	Negligible Contribution	High Contribution	No Data
Fort Bragg	Negligible Contribution	Low Contribution	No Data
San Francisco	Negligible Contribution	Low Contribution	No Data
Monterey	Negligible Contribution	Negligible Contribution	No Data
Morro Bay	Negligible Contribution	Low Contribution	No Data
CA Total	**Negligible Contribution**	**Medium Contribution**	**No Data**
Square Miles	**925 mi^2**	**14,380 mi^2**	**109 mi^2**
Summary	• Loss of areas of negligible contribution offset by gains in ecosystem services and existence values for areas proposed to be closed • Some reduction in the opportunity to optimize fishing activity	• Loss of areas of low contribution offset by gains in ecosystem services and existence values for closed areas that are greater than in Alt 1a (based on mi^2 proposed to be closed) • Some reduction in the opportunity to optimize fishing activity. (more reduction than 1.a)	• Loss of areas of negligible contribution offset by gains in ecosystem services and existence values for closed areas that are less than in either Alt 1a or 1b (based on mi^2 proposed to be closed) • Some reduction in the opportunity to optimize fishing activity, likely less than 1.a or 1.b

*Contribution to port group of landings in impacted areas relative to all bottom trawl landings in port group in that period.

No Data
Negligible Contribution 0-1%
Low Contribution 1-5%
Medium Contribution 5-10%
High Contribution >10%

4.2.3.8.2 Proposed Reopenings

Landings and revenues from areas proposed for reopenings under subject Area 1 alternatives are almost all less than 1 percent of the coastwide (or port group) values, using the reference period of 1997 to 2001. The only exception is Monterey Bay, which shows that 5 percent to 10 percent of landings and revenues for that port group came from areas proposed for reopening, under Alternative 1.a and 1.b for the reference period. Alternative 1.c showed no values over 1 percent for port areas, states, or coastwide. Alternatives 1.d and 1.e do not include any proposed reopenings. Alternative 1.f, Potato Bank, includes approximately 100 square miles of reopening, but there was essentially zero groundfish bottom trawl fishing activity in the reference time period.

The fact that historical landings in areas proposed for reopening among Subject Area 1 alternatives were almost all less than 1 percent of landings and revenues indicates the likelihood that the direct positive economic impacts on the fishing and related support industries and communities from these reopenings, with the exception of the Monterey port group, would be negligible. However, due to shifting distributions of harvest and changing management and market context, the historic importance of these grounds may not be a good indicator of the contribution these grounds would make if reopened. Also to be taken into account is whether the reopening of these grounds expands harvest, attracts existing effort from open areas, or changes the efficiency or creates other opportunities to optimize fishing operations. Further, there may be indirect negative impacts from any reduction in ecosystem services or existence values that are associated with these openings, as discussed in the summary on closures. Section 4.1.3 provides a qualitative summary comparison of the economic impacts resulting from proposed reopenings under Alternatives 1.a, 1.b, and 1.c.

Table 4-37. Qualitative summary of historic contributions of proposed reopenings and expected coastwide net economic impact under Subject Area 1 alternatives.

	Subject Area 1 Reopenings (1997 to 2001 data)		
	Collaborative (1a)	**Oceana (1.b)**	**MTC (1c)**
	Relative Historic Contribution* of Areas Proposed for the Following:		
Port Group	**Reopening**	**Reopening**	**Reopening**
N. WA coast	No Data	No Data	No Data
Puget Sound	No Data	No Data	No Data
S. and Cent. WA coast	Negligible Contribution	No Data	Negligible Contribution
WA Total	**Negligible Contribution**	**No Data**	**Negligible Contribution**
Astoria	Negligible Contribution	No Data	Negligible Contribution
Newport	No Data	No Data	Negligible Contribution
Coos Bay	Negligible Contribution	No Data	No Data
Brookings	Negligible Contribution	No Data	No Data
OR Total	**Negligible Contribution**	**No Data**	**Negligible Contribution**
Crescent City	Negligible Contribution	No Data	No Data
Eureka	Negligible Contribution	Negligible Contribution	No Data
Fort Bragg	Negligible Contribution	Negligible Contribution	No Data
San Francisco	Negligible Contribution	Negligible Contribution	No Data
Monterey	Medium Contribution	Medium Contribution	No Data
Morro Bay	Negligible Contribution	Negligible Contribution	No Data
CA Total	**Negligible Contribution**	**Negligible Contribution**	**No Data**
Square Miles	**176 mi^2**	**143 mi^2**	**5 mi^2**
Summary	• Gains of areas of negligible historic contribution offset by some losses in ecosystem services and existence values for reopened areas • Some increase in the opportunity to optimize fishing activity	• Gains of areas of negligible historic contribution offset by some losses in ecosystem services and existence values for reopened areas • Some increase in the opportunity to optimize fishing activity, possibly less than Option 1.a, based on square miles	• Gains of areas of negligible historic contribution offset by some losses in ecosystem services and existence values for reopened areas • Small increase in the opportunity to optimize fishing activity, likely less than either 1.a or 1.b, based on square miles

*Contribution to port group of landings in impacted areas relative to all bottom trawl landings in port group in that period.

No Data
Negligible Contribution 0-1%
Low Contribution 1-5%
Medium Contribution 5-10%
High Contribution >10%

4.2.3.9 Action Alternative 2.a: Remove the Trawl RCA

Section 4.2.3.2 provides a general qualitative analysis of the action alternatives. Quantitative indicators related to the bottom trawl fishery are presented here to help distinguish the alternatives in terms of the likely size of the impact. For the reasons described in Section 4.1 on analytical approaches and Section 4.2.3.2, these values should not be treated as predictions or estimates, but simply as indicators of the past importance of particular fishing grounds within the context of the conditions of the time. Nonetheless, these values may serve as qualitative indicators of where fishermen may focus future effort. Impacts on state-managed bottom trawl fisheries are discussed in the alternative-wide net effects section.

This alternative would remove the trawl RCA off California and Oregon, thereby allowing bottom trawl groundfish fishing where it has been prohibited since 2002. Some areas would remain closed due to other trawl closures such as EFHCAs or state water closures, but most of the trawl RCA would open to bottom trawl fishing. Under this alternative, the trawl RCA would remain in place in waters off Washington State.

There are no proposed closures under this alternative. Therefore, the only metrics analyzed are the proposed reopenings within the trawl RCA. This section analyzes landing weights and revenues alternative wide, by state, and by port group.

4.2.3.9.1 Coastwide and State Analysis

4.2.3.9.1.1 Proposed Reopenings

Landings

Areas proposed for reopening under this alternative accounted for 11.6 percent of coastwide landings from 1997 to 2001 (Table 4-30). Oregon would likely be most affected by the proposed reopenings since 14.2 percent of statewide landing weight was from this state. California would likely be close behind Oregon in terms of statewide effects, since 13.9 percent of statewide landings. Less than 1 percent of Washington statewide landings originated from areas proposed for reopening under this alternative, because much of the trawl RCA in waters off Washington are in the tribal U&A; they are, therefore, not being considered for reopening.

For Oregon and California, a substantial percent of coastwide landings came from the trawl RCA, from 1997 to 2001. The substantial landings from 1997 to 2001 in the area proposed for reopening indicate that this alternative would increase landing opportunities for these ports.

Revenues

Areas proposed for reopening under this alternative accounted for 10.8 percent of coastwide ex-vessel revenue from 1997 to 2001 (Table 4-38). Oregon would likely be most affected by the proposed reopenings with 12.9 percent of statewide revenues during the period originating from areas proposed for reopening, followed by California (11.7 percent), and Washington (less than 1 percent). In Washington, much of the trawl RCA is in the tribal U&A; it is, therefore, not being considered for reopening.

Effort

Estimated vessel participation and fishing effort for the limited entry bottom trawl fishery under Alternative 2.a are displayed in the following tables. These tables summarize metrics for the fishery from 1997 to 2001, the most recent period when bottom trawling was permitted between depths from 100 fm to 150 fm. Beginning in 2002, areas between 100 fm and 150 fm were designated as trawl RCAs, and they have since been closed to bottom trawling.

Table 4-38. Counts of non-tribal vessels participating in the West Coast bottom trawl fishery by state from 1997 to 2001.

State	Total	Number Fishing in 100-150 fm	Percent Fishing in 100-150 fm
Washington	81	75	92.6%
Oregon	153	137	89.5%
California	169	138	81.7%
Total (Unique counts)	**254**	242	**95.3%**

Table 4-38 shows that nearly all of the 254 vessels that participated in the non-tribal bottom trawl fishery from 1997 to 2001 (95 percent) fished at some point in the 100 fm to 150 fm depth areas that were later designated as RCAs. Washington State had the largest portion of trawl vessels fishing in the 100 fm to 150 fm range (92.6 percent), followed closely by Oregon (89.5 percent) and California (81.7 percent). Many vessels participated in bottom trawl fisheries off more than one state during the period.

Table 4-39. Trawl hours of fishing effort for non-tribal vessels participating in the bottom trawl fishery by state from 1997 to 2001.

	Area Total Trawl Hours	**Trawl Hours in 100-150fm**	**Percent Coastwide**
Washington	130,687	3041	2.3%
Oregon	203,809	37,241	18.3%
California	272,649	25,536	9.4%
Total	607,145	65,818	10.8%

Table 4-39 summarizes bottom trawl effort (trawl hours) from 1997 to 2001 by state, highlighting effort that occurred between 100 fm and 150 fm in areas later designated as trawl RCAs. Areas proposed for reopening under Alternative 2.a accounted for 65,818 trawl hours, or 10.8 percent of the coastwide trawl effort from 1997 to 2001. For vessels fishing off Washington, most of the effort occurred north of Point Chehalis, which is outside of the action area and, therefore, is not included in the Washington total. For vessels fishing off Oregon, 18.3 percent of overall effort occurred in areas between 100 fm and 150 fm, and 9.4 percent of bottom trawl effort for vessels fishing off California occurred between 100 fm and 150 fm, mostly between Cape Mendocino and Point Conception.

4.2.3.9.2 Port Group Analysis

Proposed Reopenings

Table 4-40 shows landing weights and inflation-adjusted ex-vessel revenues of non-whiting trawl groundfish by port group. The non-whiting trawl groundfish were caught from 1997 to 2001 in areas proposed for reopening.

Table 4-40. Alternative 2.a, the Remove the Trawl RCA Alternative for Oregon and California; Aggregated Bottom Trawl Groundfish Species Landings and Revenues coastwide, by state, and by Port Group from 1997 to 2001 from catch in areas proposed for reopening.

Port Group	Landings (Thousand pounds)	Percent of Port Group Non-whiting Groundfish Landings	Infl-adj. Ex-vessel Revenue ($000, 2015)	Percent of Port Group Non-whiting Groundfish Revenue
North WA coast	-	-	-	-
Puget Sound	33	0.11%	35	0.32%
South and Central WA coast	364	2.57%	190	2.41%
Washington Total	**396**	**0.75%**	**225**	**0.91%**
Astoria	3,152	5.60%	1,779	5.34%
Newport	6,626	25.74%	4,091	22.89%
Coos Bay	6,704	20.59%	3,754	17.42%
Brookings	1,230	11.77%	766	10.13%
Oregon Total	**17,713**	**14.16%**	**10,390**	**12.94%**
Crescent City	2,807	15.04%	1,522	11.75%
Eureka	5,298	17.01%	2,689	12.39%
Fort Bragg	2,978	12.53%	1,622	10.31%
San Francisco	2,750	14.98%	1,804	15.63%
Monterey	1,612	11.55%	904	10.83%
Morro Bay	543	6.00%	397	6.59%
California Total	**15,988**	**13.91%**	**8,939**	**11.72%**
Coastwide Total	**34,097**	**11.64%**	**19,554**	**10.78%**

Landings

Eight of twelve port groups had at least 10 percent of port group landings from 1997 to 2001 originating from areas proposed for reopening (Table 4-40). These include Newport (25.7 percent), Coos Bay (20.6 percent), Eureka (17 percent), Crescent City (15 percent), San Francisco (15 percent), Fort Bragg (12.5 percent), Brookings (11.8 percent), and Monterey (11.6 percent). Of the remaining four port groups, three, Morro Bay (6 percent), Astoria (5.6 percent), and South and Central Washington coast (2.6 percent), received at least 2 percent of port group landings from areas proposed for reopening. In the Puget Sound port group, only 0.1 percent of port group landings from 1997 to 2001 originated from areas proposed for reopening under this alternative.

Landings for the Astoria and the South and Central Washington Coast port groups would only be affected under this alternative when vessels from those port groups caught fish in the trawl RCA off Oregon and delivered to those port groups. Hence, the impacts appear lower for those port groups. The Morro Bay

port group also shows lower values than most others. The RCA reopening would also apply in waters off Morro Bay; thus, it is unclear why that port group would not be similarly affected.

These data show that a substantial percent of coastwide landings for most port groups came from the trawl RCA from 1997 to 2001. The substantial landings from 1997 to 2001 from the area to be reopened indicate that this alternative, would provide an opportunity to increase landings in these ports.

Revenue

With respect to revenue, 8 of 12 port groups had at least 10 percent of port group ex-vessel revenue from 1997 to 2001 originating from areas proposed for reopening, although the ranking order is somewhat different than with respect to landed weight (Table 4-40). The eight port groups include Newport (22.9 percent), Coos Bay (17.4 percent), San Francisco (15.6 percent), Eureka (12.4 percent), Crescent City (11.8 percent), Monterey (10.8 percent), Fort Bragg (10.3 percent), and Brookings (10.1 percent). Of the remaining four port groups, three, Morro Bay (6.6 percent), Astoria (5.3 percent), and South and Central Washington Coast (2.4 percent), each received at least 2 percent of port group landings revenue from areas proposed for reopening. In the Puget Sound port group, only 0.3 percent of port group landings revenue from 1997 to 2001 originated from areas proposed for reopening under this alternative.

4.2.3.9.3 Alternative-wide Net Effects

Closings and openings affect the array of fishing choices available to vessels. This, in turn, impacts business incomes, personal income, quality of life, relations within communities, safety, domestic and foreign consumers, export balances, existence values, and ecosystem service value. Because it is not possible to develop useful predictions of the response that vessels will have to new choice arrays, we cannot to develop quantitative estimates of economic impacts. Therefore, we present indicators of the past economic importance of fishing grounds to be opened and closed. Caveats for interpreting this information are presented in the methods section and the section on general qualitative analysis of the action alternatives.

Reopening RCA areas that have been closed to bottom trawling since 2002 would likely increase economic opportunities coastwide due to increased access to economically important trawl groundfish species. During the 1997 to 2001 reference period, 10.8 percent of the coastwide bottom trawl effort occurred in areas in the 100 fm to 150 fm range that would be reopened under this alternative. These areas were later designated as RCAs. While the greatest beneficiaries, based on 1997 to 2001 fishing data, appear to be port groups in the central Oregon coast (Newport and Coos Bay), and northern California (Crescent City to San Francisco), all port groups would potentially experience enhanced economic opportunities derived from increased access to bottom trawl groundfish species, at least in the short term.

4.2.3.10 Action Alternative 2.b, the Remove the Trawl RCA and, in Washington, implement DACs Alternative

Section 4.2.3.2 provides a general qualitative analysis of the action alternatives. Quantitative indicators related to the bottom trawl fishery are presented here to help distinguish the alternatives in terms of the likely size of the impact. For the reasons described in Section 4.1 on analytical approaches and Section 4.2.3.2, these values should not be treated as predictions or estimates, but simply as indicators of the past importance of particular fishing grounds within the context of the conditions of the time.

This alternative would remove the trawl RCA and would implement DACs. DACs would be applied only off the Washington coast, outside the tribal U&A. The impacts of this alternative would be identical to those described under Alternative 2.a, except for those port groups with landings from the DACs. These are South and Central Washington, Astoria, and, to a lesser degree, Newport. DACs could be applied as needed, prior to the fishing season onset. In the absence of such action to close those areas, the impacts would be identical to those of Alternative 2.a.

4.2.3.10.1 Proposed closures outside the trawl RCA

4.2.3.10.1.1 Port groups and statewide

Table 4-41 shows landings and revenues from 2011 to 2014 for areas proposed as DACs that would be outside the trawl RCA. Nearly 7 percent of the South and Central Washington port group's groundfish bottom trawl landings occurred in DACs. The Astoria port group showed
5.7 percent of landings coming from DACs proposed under this alternative. In both cases, this alternative could have an economic impact, particularly if the port fleets could not replace those landings with catch from areas that would remain open. However, with the simultaneous reopening of the trawl RCA not covered by DACs, the fleet could likely replace at least some of those landings with catch from adjacent open areas. The same pattern would hold true for statewide impacts, with just over 3 percent of landings coming from DACs for both Washington and Oregon.

Table 4-41. Alternative 2.b, the Remove the Trawl RCA and, in Washington, implement DACs; Aggregated Bottom Trawl Groundfish Species Landing Weights and Revenues coastwide, by state, and Port Group from Catch in proposed DACs located outside the trawl RCA, 2011 to 2014.

Port Group	Landings (Thousand pounds)	Percent of Port Group Non-whiting Groundfish Landings	Infl-adj. Ex-vessel Revenue ($000, 2015)	Percent of Port Group Non-whiting Groundfish Revenue
North WA coast	-	-	-	-
Puget Sound	-	-	-	-
South and Central WA coast	604	6.89%	452	7.97%
Washington Total	**604**	**3.14%**	**452**	**3.79%**
Astoria	3,327	5.70%	1,901	5.79%
Newport	15	0.14%	4	0.05%
Coos Bay	-	-	-	-
Brookings	-	-	-	-
Oregon Total	**3,343**	**3.52%**	**1,905**	**3.30%**
Crescent City	-	-	-	-
Eureka	-	-	-	-
Fort Bragg	-	-	-	-
San Francisco	-	-	-	-
Monterey	-	-	-	-
Morro Bay	-	-	-	-
California Total	**-**	**-**	**-**	**-**
Coastwide Total	**3,947**	**2.57%**	**2,357**	**2.38%**

4.2.3.10.2 Proposed closures inside the trawl RCA

4.2.3.10.2.1 Port groups and statewide

Table 4-42 shows 1997 to 2001 landings and revenues for proposed DACs that fall within the trawl RCA. The affected port groups and states would experience negligible negative impacts resulting from closure of these DCAs: less than half of 1 percent of landings. Further, the DACs are presumed to apply only if the Council and NMFS agree that spatial control mechanisms are necessary to constrain catch. If the DACs were to remain open, then the effects would equal those described under Alternative 2.a, Remove the Trawl RCA.

Table 4-42. Alternative 2.b, the Remove the Trawl RCA and, in Washington, implement DACs Alternative; aggregated Bottom trawl groundfish species landings and Revenues coastwide, by state, and port group from catch in proposed DACs located inside the trawl RCA, 1997 to 2001.

Port Group	Landings (Thousand pounds)	Percent of Port Group Non-whiting Groundfish Landings	Infl-adj. Ex-vessel Revenue ($000, 2015)	Percent of Port Group Non-whiting Groundfish Revenue
North WA coast	-	-	-	-
Puget Sound	-	-	-	-
South and Central WA coast	13	0.09%	9	0.12%
Washington Total	**13**	**0.03%**	**9**	**0.04%**
Astoria	209	0.37%	134	0.40%
Newport	4	0.02%	2	0.01%
Coos Bay	-	-	-	-
Brookings	-	-	-	-
Oregon Total	**213**	**0.17%**	**136**	**0.17%**
Crescent City	-	-	-	-
Eureka	-	-	-	-
Fort Bragg	-	-	-	-
San Francisco	-	-	-	-
Monterey	-	-	-	-
Morro Bay	-	-	-	-
California Total	**-**	**-**	**-**	**-**
Coastwide Total	**226**	**0.08%**	**145**	**0.08%**

4.2.3.11 Alternative 2.c, Remove the Trawl RCA and implement BACs (PPA for Oregon and California)

Section 4.2.3.2 provides a general qualitative analysis of the action alternatives. Quantitative indicators related to the bottom trawl fishery are presented here to help distinguish the alternatives in terms of the likely size of the impact. For the reasons described in Section 4.1 on analytical approaches and Section 4.2.3.2, these values should not be treated as predictions or estimates, but simply as indicators of the past importance of particular fishing grounds within the context of the conditions of the time.

This alternative would remove the trawl RCA, thereby allowing groundfish bottom trawling in areas closed since 2002. However, the BACs could be turned on if the Council and NMFS agreed that spatial closures were necessary to curtail catch or bycatch.

Table 4-43 shows and revenues from 1997 to 2001 for those areas within the trawl RCA, but outside the tribal U&A, that are proposed for BACs under this alternative. Table 4-44 shows landings and revenues from 2011 to 2014 for those areas outside the trawl RCA proposed for BCAs under this alternative. The

totals in both cases would show the landings and revenue associated with all the BACs that might, in the extreme case, be closed to groundfish bottom trawling at the same time. A more likely scenario is that closures would be implemented selectively, on a temporary basis, prior to the onset of the fishing season.

Table 4-43. Alternative 2.c, the Remove Trawl RCA and implement BACs in the newly opened areas.

Port Group	Landings (Thousand pounds)	Percent of Port Group Non-whiting Groundfish Landings	Infl-adj. Ex-vessel Revenue ($000, 2015)	Percent of Port Group Non-whiting Groundfish Revenue
North WA coast	-	-	-	-
Puget Sound	1	0.00%	1	0.01%
South and Central WA coast	360	2.54%	186	2.36%
Washington Total	**361**	**0.68%**	**186**	**0.75%**
Astoria	3,001	5.33%	1,673	5.02%
Newport	4,298	16.69%	2,510	14.05%
Coos Bay	4,279	13.14%	2,305	10.69%
Brookings	730	6.99%	428	5.67%
Oregon Total	**12,309**	**9.84%**	**6,916**	**8.61%**
Crescent City	1,938	10.38%	1,080	8.34%
Eureka	3,880	12.45%	1,912	8.81%
Fort Bragg	2,911	12.25%	1,582	10.05%
San Francisco	2,750	14.98%	1,804	15.63%
Monterey	1,612	11.55%	904	10.83%
Morro Bay	535	5.92%	392	6.50%
California Total	**13,625**	**11.85%**	**7,675**	**10.06%**
Coastwide Total	**26,295**	**8.97%**	**14,778**	**8.15%**

Table 4-44. Aggregated Bottom Trawl Groundfish Species Landings and Revenue coastwide, by state, and by Port Group from Catch in proposed BACs located outside the trawl RCA, 2011 to 2014.

Port Group	Landings (Thousand pounds)	Percent of Port Group Non-whiting Groundfish Landings	Infl-adj. Ex-vessel Revenue ($000, 2015)	Percent of Port Group Non-whiting Groundfish Revenue
North WA coast	-	-	-	-
Puget Sound	212	6.05%	191	9.43%
South and Central WA coast	3,620	41.31%	2,826	49.82%
Washington Total	**3,832**	**19.92%**	**3,017**	**25.32%**
Astoria	37,396	64.01%	21,752	66.30%
Newport	10,797	98.87%	7,664	98.83%
Coos Bay	15,486	99.80%	10,167	99.81%
Brookings	10,166	99.93%	6,957	99.90%
Oregon Total	**73,845**	**77.71%**	**46,540**	**80.64%**
Crescent City	1,125	100%	720	100%
Eureka	18,232	99.97%	12,983	99.96%
Fort Bragg	11,666	100%	8,963	100%
San Francisco	2,638	100%	1,953	100%
Monterey	3,213	100%	2,406	100%
Morro Bay	2,641	100%	2,200	100%
California Total	**39,515**	**99.99%**	**29,225**	**99.98%**
Coastwide Total	**117,192**	**76.20%**	**78,782**	**79.69%**

4.2.3.12 Comparison of Subject Area 2 Alternatives, Adjustments to the Trawl RCA

All three Subject Area 2 alternatives involve reopening the trawl RCA coastwide (excluding the tribal U&A off Washington). All the alternatives in Subject Area 2 represent some degree of reopening; therefore, they represent potential positive direct economic impacts on industry, supply chains, and communities through increased flexibility in harvest operations, access to the resource, and potential for increased harvest of allocations. Alternative 2.a includes complete removal coastwide, and areas reopened are associated with the highest values of historic landings and revenues, as a percent of coastwide landings, from the reference period 1997 to 2001. Table 4-30 shows aggregated bottom trawl groundfish landings for the reference period 1997 to 2001, by port group, state, and coastwide. Several port groups had a substantial portion of landings and revenues came from the RCA in the 1997 to 2001 period: Newport, Coos Bay, Brookings, Crescent City, Eureka, Fort Bragg, San Francisco, and Monterey all show between 10 percent and 26 percent of landings and revenues as coming from the areas enclosed by the trawl RCA.

The trawl RCA contributes to indirect economic benefits through ecosystem services and existence values. To the degree that there are some adverse impacts on habitat, reopening the trawl RCA may diminish those values. However, fishery-related ecosystem services require fishing activities; therefore, a balance must be drawn between those particular ecosystem services and fishing activities. In drawing this balance, a consideration is that these areas will continue to provide ecosystem services, though perhaps at a somewhat diminished rate. As discussed earlier in Chapter 4, existence values tend to be substitutable and, therefore, do not likely increase in proportion to the amount of something protected. In national policy, they are exemplified by the ESA, which only comes into play at extremely low levels. Therefore, while there may be some impact on existence values, it seems less likely that there would be noticeable effects at the levels of protection being considered here.

Under both the No-action Alternative and Alternative 2.a, NMFS can implement area closures as needed to ensure that conservation objectives are met (including complete closure of the EEZ). Impacts of Alternative 2.b would fall between the impacts of the No-action Alternative and Alternative 2.a, in that they would provide the agency with some additional flexibility that may allow it to implement closures more precisely targeted on conservation needs such that there would be a less direct economic impact on the industry. The potential impacts of Alternative 2.c could range between the impacts of Alternative 2.a (remove the trawl RCA), and complete closure of waters shoreward of 700 fm to groundfish bottom trawling. NMFS currently has the authority to close all groundfish bottom trawling, and this alternative would provide the ability to close only certain depth and latitude segments shoreward of 700 fm (i.e., BACs) rather than the entire EEZ. The economic impacts associated with a complete closure would equal losing the landings and revenues associated with the No-action Alternative, minus those associated with the tribal U&A off Washington (see Table 4-27).

Alternatives 2.b and 2.c start with complete RCA removal, but include the possibility of then reclosing certain areas based on conservation or socioeconomic concerns. The closures could be enacted preseason or inseason, but excluding these closures, the entire trawl RCA would be considered open to groundfish bottom trawling, except in areas such as EFHCAs that are closed under other mechanisms. Alternative 2.c has the potential to close more areas of the trawl RCA than Alternatives 2.b and 2.a, and, thus, the potential for lower economic benefits compared to complete reopening (Alternative 2.a) or fewer closures (Alternative 2.b). However, if the flexibility provided under Alternative 2.c. allows NMFS to avoid a closure that is even more constraining, its eventual direct benefits might be considered positive.

The closures that might be implemented under Alternatives 2.b and 2.c would not likely provide the same habitat-related ecosystem services as those associated with permanent closures because they likely would not be in place for long enough periods to allow a habitat response. They would, however, likely provide

at least some economic benefit related to the conservation of the fish resources the closures would be intended to protect.

Oregon and California would both experience more immediate direct economic benefits to the fishing industry than Washington. Coastwide, the most direct economic benefits would be associated with Alternative 2.a, followed by Alternative 2.b and Alternative 2.c, from a coastwide perspective. Historic data indicate that the port groups that would derive the most positive economic benefit from the Subject Area 2 restoration of formerly important trawl RCA fishing grounds would be Newport, Coos Bay, Crescent City, Eureka, and San Francisco, with 11.75 percent to 25.7 percent of each port group's landings and revenues coming from areas proposed for reopening. Reopening the trawl RCA would likely benefit remaining bottom trawl vessels in those ports. However, consolidation of the fleet since this historic period may redistribute and locally depress some of these potential benefits compared to what is observed in the historic period, with fleet size drastically smaller in Coos Bay and the California ports, in particular. The action may encourage renewed participation of bottom trawlers in these areas; however, port infrastructure and processing capabilities may have to be rebuilt over time to accommodate this, which would slow realization of potential benefits. It is unlikely that this change would lead to a renewal of effort on the scale observed in the historic period; thus, actual benefits to communities impacted by consolidation would likely be lower than indicated by data from the pre-buyback era. Thus, for particular ports, the potential direct benefits from the reopenings may not accrue immediately.

4.2.3.13 Alternative 3.a, Use MSA Discretionary Authorities to Close Waters Deeper than 3,500 m to Bottom Contact Gear

This alternative would close areas of the United States West Coast EEZ to groundfish bottom trawling in waters deeper than 3,500 m. These areas are limited to south of the Mendocino Ridge, in waters off California. No current or historic bottom trawl fishing has taken place or currently occurs there, and there is no indication that this type of fishing activity would take place. Therefore, this alternative would not be expected to have any impact on landings, revenues, effort, or state-managed fisheries.

4.2.4 Social

[Currently being developed]

4.2.5 Protected Resources

As described in Chapter 3, protected resources are species protected under MMPA, Migratory Bird Treaty Act (MBTA), and ESA, including marine mammals, sea turtles, and sea birds. This section summarizes expected impacts of the No-action Alternative and implementation of the action alternatives on these resources.

Implementation of an alternative, including the No-action Alternative, may change fishing behavior and areas fished. Therefore, we expect some level of impact to protected species. We discuss the potential for impact under each alternative qualitatively based on observed interactions. State-managed fisheries (pink shrimp, California halibut, ridgeback prawn, and sea cucumber) would not be impacted by any RCA alternative; therefore, protected resources would not be impacted and are not discussed further. EFH alternatives may have limited impact on California halibut, ridgeback prawn, sea cucumber, and pink shrimp fisheries, and, therefore, qualitative impacts on protected resources. Impacts on resources are noted in the appropriate sections.

4.2.5.1 No-action Alternative

This section summarizes impacts of the No-action Alternative. We provide numbers of interactions by species for all areas that are open to fishing inside the EEZ, including the tribal U&A. These data come from the WCGOP when 100 percent of all trips were observed (2011 to 2014). By providing a comprehensive look at the entire coast, we establish a baseline of total interactions for the fishery to evaluate the effects of the action alternatives. Under the No-action Alternative, the fishery would continue to operate with the current set of closures (EFHCA and RCA) in place. Under the No-action Alternative, we expect that the fishery would operate in a similar way as 2011 to 2014. The No-action Alternative assumes that harvest levels (e.g., annual catch limits), trawl gear restrictions, and the overall management scheme for the groundfish bottom trawl fishery would remain similar to recent years. The area of operations for the fishery would not be expected to change, and effort might slowly increase as available annual catch limits increased. We expect some gear changes to occur in the future (allowing the use short footrope roller gear and changes in mesh size); however, these changes are considered under the cumulative effects section.

State-managed fisheries for California halibut and pink shrimp impact green salmon and eulachon, respectively. We expect impacts on these species under the No-action Alternative would be similar to those recently observed. Other state-managed fisheries do not impact protected species.

4.2.5.2 ESA-Listed Species

4.2.5.2.1 Salmon

Figure 1 in Chapter 3 provides the status of and designated habitat for ESA-listed salmon and steelhead. Although all these species could be encountered in the bottom trawl fishery, based on the 2017 Biological Opinion (NMFS2017b) and Table 4-48, Chinook and coho are most likely to be encountered as bycatch under the No-action Alternative. Only those species that the fishery interacts with are presented. Steelhead have not been observed in the fishery; therefore, they are not discussed.

Fleetwide salmon bycatch estimates for the fishery are derived from the WCGOP observer database (2011 to 2015). The WCGOP takes genetic samples of nearly all salmon encountered and may subsample if a haul has an extremely high salmon bycatch. Not all samples are analyzed, however, so we do not have data on the percentage of salmon mortality for ESA-listed salmon versus non-listed salmon. Therefore, we report catch of all salmon species in the bottom trawl fishery in this section to indicate the total impact of the fishery for each species of salmon and where these fish have been observed along the West Coast. We also provide projected impacts of the bottom trawl fishery on salmon from the 2017 Biological Opinion.

From 2011 to 2015, 2,782 Chinook and 116 coho were caught with bottom trawl gear (Table 4-38). The annual average for this period was 556 Chinook and 23 coho.

Table 4-45. Observed salmon mortality (number of fish) by species in the bottom trawl fishery, 2011 to 2015.

Species	2011	2012	2013	2014	2015	Total	Average
Chinook	175	304	323	984	996	**2,782**	**556.4**
Coho	19	27	49	18	3	**116**	**23.2**
Chum	0	0	0	0	0	**0**	**0**
Pink	0	2	0	2	0	**4**	**0.8**
Sockeye	1	0	0	0	0	**1**	**0.2**
Total	**195**	**333**	**372**	**1,004**	**999**	**2,903**	**580.6**

Source: WCGOP observer database, July 5, 2017, and "Observed and estimated total bycatch of salmon in the 2002-2015 U.S. west coast fisheries" downloaded on February 2, 2018.

Based on the ESA Section 7(a)(2) Biological Opinion, Reinitiation of Section 7 Consultation Regarding the Pacific Fisheries Management Council's Groundfish FMP (NMFS 2017d), NMFS expects the bottom trawl fishery to continue to interact with Chinook and coho salmon. Section 2.5.2 of the 2017 Opinion describes the projected distributions of take in the fishery based on total groundfish catch. The projections provide a minimum take of 73 Chinook per year up to 3,290 per year and a mean of 960 per year. The maximum number of coho projected to be caught per year is 66.

Based the Biological Opinion (NMFS 2017d), bycatch rates are expected to remain similar to those recently estimated by WCGOP because incentives and improved efficiencies associated with the catch shares program, along with real time, 100 percent monitoring and near-real-time data reporting, mean that IFQ fishermen can selectively choose where, when, and how to fish to increase catch of target species, while minimizing bycatch. Also, the catch share program and the vessel buyback program have resulted in significant fleet consolidation. These programs, combined with improved efficiencies, have resulted in increased catch per unit of effort of groundfish species with fewer trips and tows that may encounter salmon.

The fishery continues to target dover sole, sablefish, and Thornyhead from 150 to 700 fathoms and flatfish between 30 and 100 fm. We expect fisherman to continue to return to these familiar grounds in those depth ranges to harvest these species. We also expect fishing activity in these areas to continue under the No-action Alternative since no new bottom trawl fisheries have developed in the past four years. Under the No-action Alternative, we expect that the number of observed interactions and the species of salmon caught will remain similar to what has been observed from 2011 through 2015 (Table 4-48) since fishing operations will likely not change.

The bottom trawl fishery will be managed under new non-whiting fisheries incidental take statement (ITS) limits of 9,000 Chinook salmon. This includes an annual guideline amount of 5,500 Chinook, plus a potential use of the reserve of 3,500 Chinook salmon if that bycatch increased unexpectedly. A separate ITS was created to limit coho take to 560 per year. Based on the projected numbers of the 2017 Biological Opinion (NMFS 2017d) that largely assume fishing operations would remain similar to the current fishery, we expect that the number of interactions in the bottom trawl fishery would not exceed the ITS limits under the No-action Alternative.

The fishery does not operate in designated critical habitat for salmon or steelhead. Therefore, it would not be impacted under the No-action Alternative.

4.2.5.2.2 Eulachon

A new biological opinion for the southern distinct population segment (DPS) of eulachon is being developed for the bottom trawl fishery. Information from that analysis will be incorporated into this analysis as it becomes available. The 2012 biological opinion (USFWS 2012) specified that catch of eulachon in the bottom trawl and at-sea whiting fishery must be kept below the ITS value of 1,004 fish per year. That number was exceeded in 2011, 2013, and 2014, which prompted NMFS to reinitiate consultation. The ITS level of 1,004 fish was based on bycatch estimates from 2002 to 2010, a time when eulachon abundance was severely depressed; abundance subsequently increased. This may be one reason

that the ITS level was exceeded in subsequent years. Beginning in September 2016, a new biological opinion is being developed for the groundfish fishery to evaluate effects of the bottom trawl fishery on eulachon.

Historically, eulachon were caught in the bottom trawl fishery (Table 4-49). Bycatch of eulachon in Washington and Oregon increased from 2011 to 2014; in 2015, however, the number of interactions decreased. The increase may be due to species recovery because recent estimations of spawning biomass show a similar trend increasing trend. In 2015, however, catch declined, along with a decrease in biomass estimates. This indicates that eulachon catch may be directly related to biomass. However, eulachon bycatch/take is small relative to the estimated population size.

Table 4-46. Observed bycatch of eulachon from bottom and midwater trawl catch share fishery (2011 to 2014). Acronyms are state names: WA = Washington, OR = Oregon, and CA = California.

State	Year	Fleet total bycatch (Expanded No. of eulachon)	No. of vessels	No. of trips	No. of tows	Eulachon observed per MT of groundfish	Observed groundfish landings (mt)	Fleet total groundfish landings (mt)	% groundfish landings sampled
WA	2011	12	10	82	941	0.0059	1,849	1,860	99.5
	2012	1	6	81	905	0.0005	2,190	2,221	98.6
	2013	137	6	64	901	0.087	1,552	1,554	99.9
	2014	292	4	39	439	0.3148	883	886	99.7
	2015	0	NA	NA	NA	0	409	409	100
OR	2011	127	49	632	5976	0.0113	10,810	10,894	99.2
	2012	167	52	618	5607	0.0153	10,669	10,735	99.4
	2013	521	46	693	6432	0.0408	12,438	12,473	99.7
	2014	2,516	46	590	5190	0.221	11,190	11,217	99.8
	2015	641	NA	NA	NA	0.057	11,036	11,086	99.6
CA	2011	0	28	429	2,282	0	4,597	4,602	99.9
	2012	0	29	420	2,493	0	4,443	4,451	99.8
	2013	0	26	464	2,764	0	5,030	5,044	99.7
	2014	0	26	443	2843	0	4,853	4,878	99.5
	2015	2	NA	NA	NA	0	4,096	4,099	99.9
Total	2011-2015	4,416	NA	NA	NA	NA	86,045	86,409	99.6

Source: WCGOP NWFSC 2016 mortality tables at https://www.nwfsc.noaa.gov/research/divisions/fram/observation/data_products/protected_species.cfm and WCGOP updates.
Table Note: Midwater trawl trips were added to protect the confidentiality of bottom trawl data. NA = data not available.

Bycatch of eulachon is estimated either by subsampling a haul and expanding the catch rate, or by counting and weighing all catch in a haul. Observed counts and weights for 2011 to 2014 are provided in Table 4-50 by depth and area to show where these species are typically caught in the bottom trawl fishery.

Effort in the fishery is made in all depth bins; however, most of the catch occurs in the 30 to 100 fm depth range. Vessels that fish in the 30 to 100 fm depth range usually target flatfish and catch eulachon as bycatch.

Table 4-47. Observed bycatch of eulachon by latitudinal zone and depth bin, 2011 to 2014.

Latitudinal Zone and Depth Bin	Count of Eulachon	Sum of Eulachon (lb)
Total Cape Flattery to Pt Chehalis	2,084	216
0fm-30fm	4	-
30fm-100fm	2,047	212
150fm-700fm	33	4
Total Pt Chehalis to Cape Blanco	1,598	174
0fm-30fm	156	7
30fm-100fm	1,418	165
100fm-150fm	2	-
150fm-700fm	22	2
Total Cape Blanco to Cape Mendocino	6	-
30fm-100fm	2	-
150fm-700fm	4	-
Grand Total	3,689	392

Source: WCGOP observer database. Numbers are not expanded to fleet total. Data from 2015 was not available at the time of analysis.

In 2015, Ward et al. applied spatiotemporal models to both fishery-dependent observations of eulachon bycatch and eulachon fisheries-independent survey data to identify persistent bycatch hotspots. They used pink shrimp fishery data and West Coast Bottom Trawl Survey data. Ward et al. stated that "increases in bycatch [are] not due to an increase in incidental targeting of eulachon by fishing vessels, but likely occur because of an increasing population size of eulachon."

Ward et al. (2015) found that the coastal areas just south of Coos Bay, Oregon, between the Columbia River and Grays Harbor, Washington, and just south of La Push, Washington were consistent hotspots of eulachon bycatch across years. This information is consistent with areas where bottom trawls have encountered eulachon.

Under the No-action Alternative, we expect the number of eulachon bycatch to be similar to recent years from 2011 to 2015, since we do not expect the fishery to change its area of operations or dramatically increase the amount of groundfish it catches, particularly flatfish. However, the Council is considering changes in the allowable mesh size and the use of small footropes in areas less than 100 fm. These potential changes may impact eulachon. This potential change is discussed in the cumulative effects section of this document.

If flatfish catch is related to catch of eulachon, then we could expect a lower number of eulachon interaction if catch for flatfish decreases because fishermen prefer to target deep water species in the 150 fm to 700 fm depth range. The opposite could happen as well, whereby an increase in flatfish targeting could increase the bycatch of eulachon. If catch of eulachon is related to the population trends, then we would expect increasing and decreasing trends over time, along with increasing and decreasing bycatch relative to groundfish catch.

Currently, there is no designated critical habitat for eulachon. Eulachon spawn in the Columbia River, which is outside the area of fishing operations. Therefore, the fishery would not impact the spawning biomass or the area in which it spawns.

4.2.5.2.3 Green Sturgeon

Historically green sturgeon were observed as bycatch in the bottom trawl fishery. Annual catches of green sturgeon and catch per metric ton are provided in Table 4-51. There does not seem to be a bycatch pattern in the fishery, and the interaction rate is rather stable between 2011 and 2015.

Table 4-48. Observed numbers of green sturgeon bycatch from bottom trawl catch shares fishery (2011 to 2015). Acronyms are state names: WA = Washington, OR = Oregon, and CA = California.

State	Year	Fleet total bycatch (Expanded No. of sturgeon)	No. of vessels	No. of trips	No. of tows	Sturgeon catch per mt of Observed groundfish landings (mt)	Observed groundfish landings (mt)	Fleet total groundfish landings (mt)	% groundfish landings sampled
WA	2011	0	9	81	935	0	1,849	1860	99.4
	2012	0	5	74	877	0	2,035	2066	98.5
	2013	0	6	61	886	0	1,487	1489	99.9
	2014	0	4	35	423	0	737	740	99.6
	2015	0	NA	NA	NA	0	409	409	100
OR	2011	38.4	46	612	5,883	0.0034	10,793	10877	99.2
	2012	21.5	44	594	5,537	0.002	10,625	10692	99.4
	2013	10.3	43	664	6,298	0.0008	12,098	12134	99.7
	2014	39.7	43	546	5,017	0.0037	10,410	10438	99.7
	2015	5.1	NA	NA	NA	0.0005	11,036	11,086	99.6
CA	2011	0	23	414	2,256	0	4596	4601	99.9
	2012	0	24	403	2,474	0	4,443	4451	99.8
	2013	0	24	454	2,746	0	5029	5043	99.7
	2014	0	23	432	2,815	0	4855	4880	99.5
	2015	1	NA	NA	NA	0.00024	4096.1	4098.8	99.9
Total	2011-2015	116	NA	NA	NA	NA	84,498.1	84,864.5	NA

Source: WCGOP NWFSC 2016 mortality tables at the following website address: https://www.nwfsc.noaa.gov/research/divisions/fram/observation/data_products/protected_species.cfm and WCGOP updates. NA = data not available.

Bycatch of green sturgeon as observed (estimated count and weights) in the bottom trawl fishery by latitudinal zone and depth bin is shown in Table 4-52 (the table excludes 2015 data since they were not available at the time of its creation). Most of the catch occurs in the 0 fm to 30 fm depth bin off Oregon

(Table 4-52). Figure 4-12 shows where green sturgeon consistently have been caught in the bottom trawl fishery since 2002.

Table 4-49. Observed bycatch of green sturgeon in the bottom trawl fishery by latitudinal zone and depth bin, 2011 to 2014.

Latitudinal Zone and Depth Bin	Count of Green Sturgeon	Sum of Green Sturgeon (lb)
1 Cape Flattery to Point Chehalis	4	84
0fm-30fm	1	20
30fm-100fm	3	62
2 Point Chehalis to Cape Blanco	103	3,389
0fm-30fm	81	2,584
30fm-100fm	22	805
Grand Total	107	3,472

Designated critical habitat for southern DPS green sturgeon includes coastal marine waters within 60 fathoms in depth from Monterey Bay, California, to the United States/Canada border, including the Strait of Juan de Fuca (Figure 4-12). The operation of bottom trawl and state-managed non groundfish trawl fisheries overlaps with and impacts designated critical habitat for southern DPS green sturgeon. Fishing with bottom trawl gear alters or disturb benthic habitats, as well as prey resources for green sturgeon in coastal marine waters. The table and figure information show that the fishery operates and catches green sturgeon in its critical habitat. Under the No-action Alternative, we expect that fishing activity would continue in the critical habitat of green sturgeon and that the number of green sturgeon interactions would be similar to observed numbers in Table 4-53.

Selective flatfish trawl gear (gear modified to allow rockfish to escape) is required shoreward of the trawl RCA (shallower than 100 fm). Since all sturgeon were caught shoreward of the trawl RCA, we know that the sturgeon were caught with selective flatfish trawl gear. This gear would still be used shoreward of the trawl RCA under the No-action Alternative; therefore, this level of catch would likely continue. However, the Council is considering allowing any small footrope gear to be used, including the selective flatfish trawl gear; large footrope gear would still be prohibited. This potential change will be examined under the cumulative effects section of this document. We do not anticipate that catch would change (increase or decrease) under the No-action Alternative, because current trends in catch do not indicate an upward or downward trend since 2011 and fishing operations would remain unchanged.

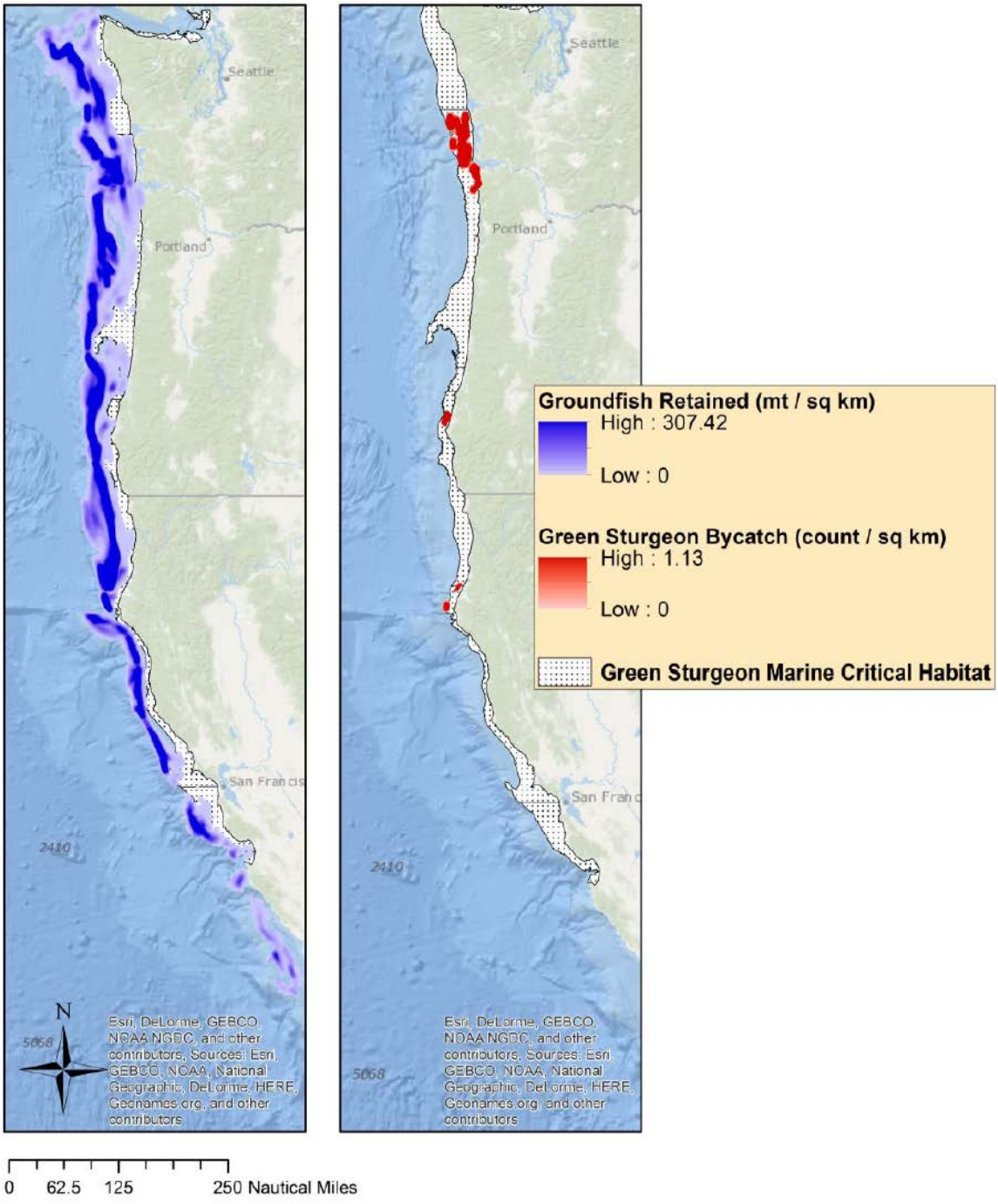

Figure 4-12. Map of observed fishing locations (left panel) and observed green sturgeon bycatch locations (right panel) in the bottom trawl fishery, based on observer data during 2002 to 2015. Observer data are aggregated to 1-square-kilometer cells. Fishing locations are weighted by fishing effort, which is the landed amount of FMP-listed groundfish species, except hake. Green sturgeon bycatch locations are weighted by the number of green sturgeons in the defined spatial cells. Cells containing fewer than three vessels are not shown to maintain confidentiality.

4.2.5.2.4 Marine Mammals

In the 2012 Biological Opinion (USFWS 2012), NMFS determined that the fishery is not likely to adversely affect these species: Sei whales (*Balaenoptera borealis*); North Pacific right whales (*Eubalaena japonica*); Blue whales (*Balaenoptera musculus*); Fin whales (*Balaenoptera physalus*); Sperm whales (*Physter macrocephalus*); Southern Resident killer whales (*Orcinus orca*); Guadalupe fur seals (*Arctocephalus townsendi*). Under the No-action Alternative, the fishery likely would continue not to impact these species since they have not been observed in the fishery; therefore, these species will not be discussed further. In addition, critical habitat of Steller sea lions has been designated; however, NMFS determined that the fishery would not likely adversely affect their critical habitat. Under the No-action Alternative, we expect that the fishery would not operate in the area of Steller sea lion critical habitat, so it would not be impacted.

As noted in Chapter 3, marine mammals may be injured or drowned by trawl gear. Most interactions are feeding on catch near vessels, and observers sight many marine mammals during fishery operations. Interaction types are summarized by the following descriptors: boarded vessel, deterrence used, entangled in gear - not trailing gear, entangled in gear - trailing gear, feeding on catch, killed by gear, lethal removal - not trailing gear, and lethal removal - trailing gear. Sightings are not summarized in this analysis.

Marine mammal interactions that have occurred in the bottom trawl fishery are shown in Table 4-53 and Table 4-54. From 2011-2014, 54 marine mammals were killed by bottom trawl gear (Table 4-54). Steller sea lion, California sea lion, and unidentified and Pacific white-sided dolphins comprise the most interactions (Table 4-53 and Table 14-44). Large cetaceans, such as whales, have not been observed directly interacting with the gear in groundfish trawl fisheries.

The bottom trawl fishery harvest rate (metric tons of groundfish landed) has remained similar from year to year throughout the 2011 to 2014 period, yet the number interactions varies greatly from year to year. More recent information is not yet available to analyze trends since 2014.

There is no clear correlation between the level fishing effort or areas fished and the number of marine mammal interactions observed in the bottom trawl fishery, so it is difficult to predict interactions. However, marine mammals may follow vessels to feed on discarded catch. As noted in Table 4-54, 1,486 feeding interactions were observed. The number of Pacific white-sided dolphins, Steller sea lion and California sea lion interactions has fluctuated, even though populations are noted to be increasing. We expect this type of feeding behavior to continue as well as observed vessel boardings, gear entanglement, and crews using deterrence measures. We expect that the type and number of marine mammal interactions

noted in Table 4-54 would continue under the No-action Alternative because fishing operations (area fished and effort) would remain largely unchanged.

Table 4-50. Total number of observed interactions with marine mammal species for the bottom trawl fishery, 2011 to 2014.

Species	**2011**	**2012**	**2013**	**2014**	**Grand Total**
California Sea Lion	90	117	31	30	268
Common Unidentified Dolphin	22	0	0	0	22
Dalls Porpoise	0	0	0	0	0
Dolphin, Unidentified	200	0	0	1	201
Harbor Porpoise	0	0	0	0	0
Harbor Seal	0	0	0	3	3
Marine mammal, Unidentified	0	0	0	0	0
Northern Elephant Seal	1	0	1	0	2
Pacific White-sided Dolphin	20	1	100	1	122
Pinniped, Unidentified	0	0	0	0	0
Porpoise, Unidentified	0	1	0	0	1
Rissos Dolphin	0	0	0	0	0
Sea Lion, Unidentified	0	0	1	5	6
Seal, Unidentified	1	0	0	0	1
Short-beaked Com Dolphin	0	0	0	1	1
Steller Sea Lion	326	288	383	289	1,286
Grand Total	660	407	516	330	1,913

Source: WCGOP NWFSC 2016 mortality tables at
https://www.nwfsc.noaa.gov/research/divisions/fram/observation/data_products/protected_species.cfm

Table 4-51. Interaction type for each marine mammal species observed in the bottom trawl fishery, 2011 to 2014.

Species	Boarded vessel	Deterrence used	Entangled in gear - NTG	Entangled in gear - TG	Feeding on catch	Killed by gear	Lethal removal - NTG	Lethal removal - TG	Other	Previously Dead	Unknown	Grand Total
California Sea Lion	2	3	18	3	214	26		1		1		268
Common Unid Dolphin					22							22
Dolphin Unid									200	1		201
Harbor Seal					3							3
Northern Elephant Seal						1					1	2
Pacific White-sided Dolphin					120	1				1		122
Porpoise Unid										1		1
Sea Lion Unid			1		5							6
Seal Unid			1									1
Short-beaked Common Dolphin										1		1
Steller Sea Lion	2	41	62		1,148	26	1		5	1		1,286
Grand Total	**4**	**44**	**82**	**3**	**1,512**	**54**	**1**	**1**	**205**	**6**	**1**	**1,913**

4.2.5.2.5 Sea Birds (ESA-listed and MBTA species)

Seabirds are federally protected under ESA or MBTA or both. The bottom trawl fishery is restricted to an ITS under the 2017 Biological Opinion for seabirds (NMFS 2017b). Section 6.1.2 and 6.2 of the Opinion discusses take in the trawl fishery. The 2017 Biological Opinion concurred with NMFS' determination that the fishery is not likely to have an adverse effect on the marbled murrelets or the California least tern. USFWS anticipates take of no more than one short-tailed albatross in two years, or an average estimated take of no more than five birds per two-year period. The incidental take is expected to be in the form of injury and mortality due to birds injured or drowned as a result of encounters with hook and line groundfish gear or taken by collision with trawl gear, including the third wire and warp cables.

Incidental take of seabirds in the bottom trawl fishery has occurred in the form of injury and mortality due to bird entanglement in nets. Strikes with third wire and warp cables are possible; however, they have not been observed. Most interactions with bottom trawl fishery are seabirds feeding on catch, and most bird interactions are with black-footed albatross (Table 4-55).

Table 4-52. Observed seabird interactions in the bottom trawl fishery, 2011 to 2014.

Species	Number of Birds
Black-footed Albatross	635
Brown Booby	1
Brown Pelican	1
California Gull	1
Cassins Auklet	2
Herring Gull	1
Leachs Storm-Petrel	1
Murre Unidentified	1
Northern Fulmar	33
Short-tailed Albatross	12
Sooty Shearwater	2
Storm-Petrel Unidentified	2
Grand Total	**692**

Note: The table includes interaction types of boarded vessel, deterrence used, entangled in gear – not trailing gear, entangled in gear – trailing gear, feeding on catch, killed by gear.

The bottom trawl fishery had six interactions that resulted in mortalities from 2011 to 2014 and no injury or mortalities with short-tailed albatross (Table 4-56). Twelve short-tailed albatross were observed feeding on catch however, this is not considered a take under the ITS.

Table 4-53. Number of seabird interactions observed in the bottom trawl fishery across all years by species and interaction type, 2011 to 2014.

Species	Boarded vessel	Deterrence used	Entangled in gear – NTG	Feeding on catch	Killed by gear	Grand Total
Black-footed Albatross	48	36		551		635
Brown Booby	1					1
Brown Pelican	1					1
California Gull					1	1
Cassins Auklet	2					2
Herring Gull					1	1
Leachs Storm-Petrel	1					1
Murre Unidentified					1	1
Northern Fulmar	32				1	33
Short-tailed Albatross				12		12
Sooty Shearwater					2	2
Storm-Petrel Unidentified			2			2
Grand Total	85	36	2	563	6	692

There are no clear trends between interactions resulting in death of seabirds and the bottom trawl fishery. The number of interactions that result in seabird death is low compared their population size, and the level of interaction is not expected to change the populations. In addition, the bottom trawl fishery has never had a take of short-tailed albatross or any other ESA-listed seabird.

Seabirds tend to follow vessels to feed on fish discards, or they may land on the deck or wires to rest. We expect that the type and number of seabird interactions noted in Table 4-43 would continue under the No-action Alternative because fishing operations (area fished and effort) would remain largely unchanged. Since we have found no clear correlation between areas fished and the type or number of interactions observed in the fishery, we do not anticipate changes in type and number of protected species to exceed what has already been observed under the No-action Alternative.

4.2.5.3 Alternative 1.a, the Collaborative Alternative

This section presents the impacts of Alternative 1.a. The Collaborative Alternative would close 959 mi^2 and would reopen 211 mi^2 to bottom trawling. We provide observed interactions with protected species in EFH proposed closures outside the trawl RCA for Alternative 1.a. We do not have observer data for areas that are proposed to be opened, so we cannot quantify interactions that have occurred in the past for these areas. Instead we compare the No-action Alternative to the type and number of interactions observed in the proposed closures to examine if these changes would modify the number and type of interactions observed should they be implemented. We then suppose that openings would likely result in similar numbers of interactions as those seen in the proposed closures, but proportional to the size of the area. For example, if 10 animals are found in a 10-square-mile closed area, we assume that 2 animals may be found in 2-square-mile openings.

4.2.5.3.1 ESA-listed Fish (salmon, eulachon, green sturgeon)

From 2011 to 2014, 24 Chinook salmon were caught with bottom trawl gear in the proposed closures under Alternative 1.a. No other salmon or steelhead species were observed in the proposed closed areas. It's unlikely that these proposed closures would noticeably decrease the total number of salmon encountered in the fishery on an annual basis. The proposed opening would provide exposure to salmon if they are in the area at the time of fishing; however it is difficult to speculate on the frequency of interactions under a permanent opening of the area. If we were to apply a proportional amount to the openings based on the number of interactions and size of proposed closures, then we could assume that less than four to five Chinook salmon may be caught in the proposed openings over a 4-year period. This amount of take could increase the total number of salmon taken in the fishery, but it would not likely cause and exceedance of the ITS. Therefore, based on these assumptions, we expect that the fishery

would continue to interact with Chinook and coho salmon. We expect that the number of salmon interactions would be similar to or lower than those observed under Alternative 1.a, the No-action Alternative.

Eulachon and green sturgeon were not observed in the bottom trawl fishery in the proposed closed areas from 2011 to 2014; therefore, implementation of the proposed area clousres would not likely change the population sizes or exceed the current ITS for these species. Proposed openings may result in fewer impacts. Since none of the polygons under Alterative 1.a falls within the critical habitat of the green sturgeon, we do not anticipate impacts on it.

The pink shrimp fishery has impacted eulachon in the past. It operates in the Alternative 1.a areas; therefore, implementation of proposed closures under Alternative 1.a could benefits these species by lowering exposure to the pink shrimp fishery. However, proposed openings could expose eulachon to the pink shrimp fishery. We cannot quantify the extent the benefits or negative impacts on eulachon; however, we provide the percent overlap of the fishery with Alternative 1.a (1.8 percent) in Section 4.2.2, Fish Resources.

The California halibut fishery impacts green sturgeon; therefore, implementation of closures under Alternative 1.a may benefit the species through less exposure to California halibut trawling. The fishery generally has not operated in the areas proposed to be closed under this alternative; therefore, there may only be indirect benefits to green sturgeon through the closures. Again, we cannot quantify the extent of the benefits or the negative impacts on green sturgeon.

4.2.5.3.2 Marine Mammals

WCGOP data from 2011 to 2014 were used for protected species interactions analysis. We can only summarize information for proposed closures and must infer potential interactions for proposed openings. In the closures under Alternative 1.a, observers documented interactions with 20 Steller sea lions; 19 were seen feeding on catch in deeper water (150 fm to 700 fm), and one was observed entangled in gear. These closures could prevent interactions with marine mammals that reside or travel though that area. However, the magnitude of interaction is unknown. If we assume that the observed totals are what may be realized under the closure, then we would assume that five Steller sea lions may not interact with the fishery each year. Similarly, if the proposed openings expose these animals to fishing gear, then some additional interactions might be observed. If we assume that the number of animal interactions is proportional to the size of the area, and that interactions in proposed closures may be similar to those that could be observed in proposed openings, then we might expect one additional Steller sea lion interaction annually as a result of the openings.

Under Alternative 1.a, vessel would likely move to other areas (shift effort) to harvest. This could push vessels to unfamiliar or old fishing grounds. As noted under the No-action Alternative, there are no clear correlations between areas fished and marine mammal interactions. Therefore, changes in fishing patterns or areas fished may or may not increase or decrease impacts on marine mammals.

The proposed closed and opened areas would not be placed in areas designated as critical habitat for Steller sea lions; therefore, Alternative 1.a would not impact or change these designations.

Based on this information, the number of interactions and type of species under Alternative 1.a would likely be similar to or lower than those observed under the No-action Alternative. Overall, the number of interactions that might result under Alternative 1.a may not noticeably change marine mammal populations.

4.2.5.3.3 Sea birds

ESA-listed or MBTA-listed seabirds were not observed interacting with the fishery in the proposed closed areas from 2011 to 2014. In addition, we have not found clear correlations between areas fished and the type or number of interactions observed in the fishery. Therefore, we do not anticipate the type and total number of protected species interactions to change beyond what has already been observed under the No-Action Alternative.

4.2.5.4 Alternative 1.b, the Oceana et al. Alternative

This section provides observed interactions with protected species in EFH proposed closures outside the trawl RCA for Alternative 1.b, the Oceana et al. Alternative. Alternative 1.b would close 14,380 mi^2 and would reopen 143 mi^2 to bottom trawling. Again, we do not have observer data for areas that are proposed to be opened so we cannot quantify interactions that have occurred in the past for these areas. Instead we compare the No-action Alternative to the type and number of interactions observed in the proposed closures to examine whether these changes would alter the number and type of interactions observed if they were implemented. We then suppose that openings would likely result in similar rates of interactions as seen in the proposed closures. Since we have not found clear correlations between areas fished and the type or number of interactions observed in the fishery, we do not anticipate that proposed openings or closings, either separate or combined, would result in substantial changes to the type and total number of interactions over what has been observed under the No-action Alternative. The proposed closure area under Alternative 1.b is significantly larger than that under Alternative 1.a and the No-action Alternative EFH closures, however much of the additional closure is in Southern California where bottom trawling does not occur.

4.2.5.4.1 ESA-Listed Fish (salmon, eulachon, and green sturgeon)

From 2011 to 2014, 38 Chinook salmon and one coho salmon were caught with bottom trawl gear in the closure areas proposed under Alternative 1.b (Table 4-57). These interactions mostly occurred from Cape Blanco, Oregon, to Cape Mendocino, California, between 150 fm and 700 fm.

Table 4-54. Observed eulachon and salmon interactions (number of fish) by species in the bottom trawl fishery in proposed closures under Alternative 1.b, 2011 to 2014.

Latitudinal Zone and Depth Bin	Eulachon	Chinook Salmon	Coho Salmon	Grand Total
2 Point Chehalis to Cape Blanco	2	0	1	3
100fm-150fm	1			1
150fm-700fm	1	0	1	2
3 Cape Blanco to Cape Mendocino		37		37
150fm-700fm		37		37
4 Cape Mendocino to Point Conception		1		1
150fm-700fm		0		0
30fm-100fm		1		1
Grand Total	2	38	1	41

If we assume that the number of interactions observed would be the number of fish conserved by these proposed closures, then we could expect that approximately 10 salmon per year would be conserved. If proposed openings exposed salmon to fishing gear and we assumed that some portion of interactions in the proposed closures would reflect what could occur in proposed openings (the area to be opened is smaller than the area proposed to be closed), then we could expect less than 10 fish per year to be negatively impacted by the proposed openings. Neither the proposed opening nor the closures would noticeably decrease or increase the total number of salmon encountered in the fishery on an annual basis if conservation would offset exposure. If we assume that that the size of the proposed closed areas is directly related to the magnitude of preventing interactions, then Alternative 1.b may provide the most conservation for salmon. However more than half the areas proposed for closure is not trawled; therefore, the conservation value may be lower overall, but greater than Alternative 1.a and the No-action Alternative EFH closures.

From 2011 to 2014, two eulachon were caught between Point Chehalis, Washington, and Cape Blanco, Oregon. Green sturgeon were not observed in the proposed closed areas. The polygons in Alternative 1.b would not fall within the critical habitat of green sturgeon or eulachon; therefore, they would not be impacted.

The pink shrimp fishery has impacted eulachon in the past, and it operates in the areas of Alternative 1.a. Therefore, implementation of proposed closures under Alternative 1.a could benefit these species by

lessoning exposure to the pink shrimp fishery. However, proposed openings could expose eulachon to the pink shrimp fishery. While we cannot quantify the extent the of the benefits or negative impacts on eulachon, we provide the percent overlap of the fishery with Alternative 1.b (5.2 percent) in Section 4.2.2, Fish Resources.

The California halibut fishery impacts green sturgeon; therefore, implementation of closures under Alternative 1.a may benefit the species through less exposure to California halibut trawling. The fishery generally does not operate in the proposed closure of Alternative 1.a; therefore, there may only be indirect benefits for green sturgeon through the closures. Again, we cannot quantify the extent of the benefits for or negative impacts on green sturgeon.

Based on this information, the number of interactions and the types of species of salmon, eulachon, and green sturgeon under Alternative 1.a would likely be similar to or lower than those observed under the No-action Alternative. Overall, the number of interactions that might result under Alternative 1.b may not noticeably change salmon, eulachon, or green sturgeon populations.

4.2.5.4.2 Marine Mammals

Under Alternative 1.b closed areas, observers documented interactions with 120 Steller sea lions; 117 of those were seen feeding on catch from Cape Blanco, Oregon, to Cape Mendocino, California, and 3 were observed entangled in gear (Table 4-58). Deterrence was used on five animals. Observers also documented interactions with 34 California sea lions, 33 of those were seen feeding on catch from Cape Blanco, Oregon, to Cape Mendocino, California, and 1 was observed killed by gear.

Table 4-55. Interaction type for each marine mammal species observed in the bottom trawl fishery for proposed closed areas under Alterative 1b, 2011 to 2014.

Species	Deterrence used	Entangled in gear - NTG	Feeding on catch	Killed by gear	Grand Total
California Sea Lion			33	1	34
Steller Sea Lion	5	3	112		120
Grand Total	5	3	145	1	154

Note: Table only includes interactions of boarded vessel, deterrence used, entangled in gear - not trailing gear, entangled in gear - trailing gear, feeding on catch, killed by gear, lethal removal - not trailing gear, and lethal removal - trailing gear.

The proposed closures could reduce marine mammal encounters with all species known to interact with the fishery; however, it is unclear how much additional savings could be realized since not all areas are trawled or trawlable. If we assume that the number of observed Steller or California sea lions that were

observed in the proposed closed areas reflects a savings, then we could assume that the number of annual mortalities would be lower than that observed under the No-action Alternative.

We can assume that the proposed openings would expose marine mammals to fishing activity. If we assume that the number of interactions in the proposed opening is proportional to that observed in the proposed closures, then we may expect some interactions to occur, but they would likely be fewer than the 154 observed in Table 4-48. Under this assumption, and because the openings are relatively small in size (143 mi^2) compared to total square miles of the EEZ or the No-action Alternative EFH areas, the proposed openings may not noticeably increase the total number of marine mammal interactions or change population sizes, especially for Steller or California sea lions.

Under Alternative 1.b, vessels would likely move to other areas (shift effort) to harvest. This could push vessels to unfamiliar or old fishing grounds. As noted under the No-action Alternative, there are no clear correlations between areas fished and marine mammal interactions. Therefore, changes in fishing patterns or areas fished may not increase or decrease exposure of the fishery to marine mammals.

Based on this information, the number of interactions and type of species under Alternative 1.b would likely be similar to or lower than those observed under the No-action Alternative.

4.2.5.4.3 Sea birds

Eight black-footed albatross were observed boarding vessels in the proposed closures under Alternative 1.b. No other ESA-listed or MBTA seabirds were observed interacting with the fishery in the proposed closure areas from 2011 to 2014. If proposed closure interaction numbers are used to estimate interaction numbers for proposed openings, and those interactions are proportional to the size of the area, then we would expect that fewer than eight black-footed albatross may board vessels as a result of the proposed openings. In addition, we do not anticipate that movement of the fishery would increase or decrease exposure to seabirds or result in an increase in interactions because seabirds follow fishing vessels, regardless of where they fish. Based on this information, the number of interactions and type of species under Alternative 1.b would likely be similar to or less than those observed under the No-action Alternative.

4.2.5.5 Alternative 1.c, the MTC Alternative, Alternative 1.d, the Garibaldi Reef South Alternative, 1.e, the Rittenburg Bank Modifications in NMFs report Alternative, and Alternative 1.f, the Potato Bank Correction Alternative, Alternative 1.g, the New EFHCAs within trawl RCA, based on Presence of Priority Habitats (Washington only)

Alternative 1.c contains 13 polygons: 9 closures, and 8 reopenings. Alternative 1.d, Alternative 1.e, and Alternative 1.f are single polygons that are considered stand-alone alternatives. Garibaldi Reef is located

off Oregon's North Coast, Rittenburg Bank is located within California's Greater Farallones NMS, and Potato Bank is in the Southern California Bight. Alternative 1.g, is located off Washington and inside the Trawl RCA. The impacts are described in one section here.

Alternatives 1.c though 1.f do not contain trawl effort; therefore, there are no WCGOP observations to summarize. In addition, there are very few interactions around these areas to infer impacts. All alternatives contain proposed closures and could prevent interactions with all protected species; however, the magnitude is unknown. Alternative 1.c contains proposed reopenings; therefore, this alternative could impact protected species negatively. Since the areas under Alternative 1.c would be small compared to the No-action Alternative EFH and EEZ, we anticipate that the impact would be negligible. Alternative 1.g is within the trawl RCA; therefore, we do not have observer data to examine the impacts. Alternative 1.g could prevent interactions, but the magnitude is unknown. The pink shrimp fishery operates in the areas of Alternative 1.g; therefore, this alternative could benefit eulachon if they reside in the area. Based on this information, the number of interactions and type of species under Alternative 1.g would likely be similar to or lower than those observed under the No-action Alternative.

4.2.5.6 Alternative 2.a, Remove the trawl RCA (PPA for Oregon and California)

Alternative 2.a would remove the 2015 trawl RCA outside the tribal U&A. Bottom trawling would be permitted in the trawl RCA; however, all other bottom trawl closures would remain in place (EFHCAs, CCAs, and GCAs). As noted, we do not have WCGOP observation data inside the trawl RCA to summarize impacts and speculate on potential impacts to protected species. As discussed under the No-action Alternative, protected species interactions occur coastwide shoreward and seaward of the trawl RCA. Therefore, removal of the trawl RCA would increase the potential for interactions with protected species. We anticipate interactions would occur, but the magnitude of change (decrease or increase) cannot be estimated. We expect the fishery would shift some effort into this area; therefore, the number of interactions may not increase or decrease, and they may simply be transferred to other areas of the ocean. Interactions may simply be a function of effort and not area-based, so interactions may occur in other areas, rather than increase or decrease because of trawl RCA removal.

If the trawl RCA were removed, large footrope gear would be allowed seaward of the 100 fm line, and selective flatfish trawl would be required shoreward of the 100 fm line. We assume that other small footrope gear may be used shoreward of the trawl RCA in the future (see Chapter 6., Cumulative Effects, for discussion of these potential management actions and impacts).

4.2.5.7 Salmon

Under the ESA Section 7(a)(2) Biological Opinion, (NMFS 2017d), NMFS estimated the effects of the proposed action and concluded that the current IFQ management system, management tools, bycatch avoidance incentives, and near-real time catch data would likely result in larger groundfish catches, but lower salmon bycatch rates, than occurred historically.38 The 2017 Biological Opinion assumed that the trawl RCA would be removed off California and Oregon and that bycatch rates would remain similar to those recently estimated by WCGOP regardless of whether the trawl RCA off Oregon and California would stay in place or be removed. The 2017 Biological Opinion reasoned that incentives and improved efficiencies associated with the catch share program, along with real-time, 100 percent monitoring and near-real-time data reporting would mean that IFQ fishermen could selectively choose where, when, and how to fish to increase catch of target species yet minimize bycatch. These tools were not available to managers or fishermen in the 1980s and 1990s. Also, the catch share program and the vessel buyback program have resulted in significant fleet consolidation. These programs, combined with improved efficiencies, have resulted in increased catch per unit of effort of groundfish species with fewer trips and tows that may encounter salmon.

The trawl industry has the additional incentive of reducing bycatch of all species to remain certified by the Marine Stewardship Council (NMFS and PFMC 2017). The Marine Stewardship Council certified the West Coast LE groundfish trawl fishery as sustainable in 2014 (MSC.org). It is unlikely that fishing strategies will change dramatically throughout the EEZ, due to reasons described above, and any changes in distribution of effort and gear type could be strategic (i.e., to improve efficiency and maintain or reduce bycatch; NMFS and PFMC 2017; Agenda Item G.8 Attachment, March 2016; Matson and Erickson 2017). The availability of these measures and the increased incentives to avoid bycatch, combined with advancements in management, monitoring, and technology, would result in Chinook salmon bycatch rates similar to those of recent years. The analysis assumed that large roller gear would be used seaward of the 100 fm line and that the selective flatfish trawl (SFFT) would continue to be required shoreward of the trawl RCA. Based on this information, the number of interactions and salmon species under Alternative 2.a would likely be similar to those observed under the No-action Alternative and would remain within the confines of the salmon ITS.

[38] See Chapter 3 for a description of the 2017 ESA Section 7(a)(2) Biological Opinion and assumptions made for that analysis.

4.2.5.7.1 Eulachon and Green Sturgeon

We do not have observer data for these species inside the trawl RCA. Therefore, we cannot quantify the potential impacts. The fishery would return to some of these areas to fish for flatfish; therefore, we would expect some level of interaction with eulachon and green sturgeon. However, based on observed depth-based bycatch, green surgeon are typically not caught deeper than 100 fm. Therefore, catch under Alternative 2.a may be significantly lower than what has been observed under the No-action Alternative. Eulachon has been observed in the 100 fm to 150 fm and the 150 fm to 700 fathom depth ranges, however in lower numbers than those caught in 0 fm to 30 fm depth range. Therefore, we expect some level of eulachon catch from the trawl RCA. and we anticipate that catch of eulachon under Alternative 2.a may be higher than what has been observed under the No-action Alternative. We cannot provide estimates of the anticipated increase.

4.2.5.7.2 Marine Mammals

Marine mammals may be more exposed to the fishery based on the amount of area available to be fished, but we should not assume that an increase in interactions would occur. We do not anticipate that the opening of the trawl RCA would dramatically increase overall fishery effort or add vessels to the fleet. The fleet would likely shift some of its effort to inside the trawl RCA, and we anticipate that interactions would occur with marine mammals, but it is not possible to predict annual occurrences. We assume that interactions outside the trawl RCA would reflect the type of interaction (entanglement, feeding on catch, etc.) and the type of species that has been observed under the No-action Alternative. We expect that some portion of the observed interactions outside the trawl RCA would then be observed inside it. Based on these assumptions, we expect that the annual number of interactions and species observed under Alternative 2.a would be similar to those observed under the No-action Alternative.

4.2.5.7.3 Seabirds (ESA-listed and MBTA)

Seabirds follow fishing vessels; therefore, we anticipate that new fishing areas would not increase or decrease exposure to seabirds. We expect that the annual number of interactions and species observed under Alternative 2.a would be similar to those observed under the No-action Alternative.

4.2.5.8 Alternative 2.b, the Remove the Trawl RCA, and, in Washington, Implement DACs for Overfished Species Alternative

Alternative 2.b would open the 2015 trawl RCA outside the tribal U&A, and it would provide the Council with an management tool to close one or all five discrete area closures off Washington. These closures could be inseason or preseason (short or long term) based on the Council's need to conserve darkblotched

rockfish, POP, and yelloweye rockfish. While bottom trawling would be permitted in the trawl RCA, the current bottom trawl closures would remain in place.

If the trawl RCA were removed, large footrope gear could be used seaward of the 100 fm line, and the selective flatfish trawl would be required to operate shoreward of the 100 fm line. We assume that other small footrope gear could be used shoreward of the trawl RCA in the future. See Chapter 6, Cumulative Effects, for a discussion of impacts.

Impacts of opening of the trawl RCA are discussed under Alternative 2.a., the Remove the Trawl RCA Alternative. Under Alterative 2.b, we anticipate that impacts on protected species would be similar to those under Alternative 2.a.

Some of the DACs overlap with portions of the trawl RCA; therefore, the data available for an impacts analysis are limited. Using WCGOP data from 2011 to 2014, we can summarize impacts only for those areas that lie outside the trawl RCA.

The WCGOP observed one California Sea lion (killed by gear) in the proposed DACs outside the trawl RCA; no other marine mammal interactions were observed in the DACs from 2011 to 2014. In addition, one short-tailed albatross was sighted in the DACs area, and no other ESA or MBTA seabirds were sighted or interacted with the fishery. No green sturgeon were observed in the DACs area. Two coho, nineteen Chinook, and forty-five eulachon were observed in the DACs.

Implementation of one or all DACs year-round, for a short period, or during certain times of the year, would lower exposure of the fishery to protected species. While we cannot accurately predict a reduction in the number of interactions due to DAC implementation, we could assume that a reduction in observed takes may be similar to those observed in the DACs. The fleet would likely shift some of its effort to other areas inside and outside the trawl RCA if closures were implemented. We anticipate that interactions would continue to occur if DACs were implemented, but it is not possible to predict how many would occur on an annual basis. Based on this information and bycatch observed under the No-action Alternative, this alternative would not likely increase or decrease the number of interactions with all protected species beyond what we have observed under the No-action Alternative.

4.2.5.9 Alternative 2.c, the Remove the Trawl RCA and Implement BACs for Groundfish Species and Protected Species, Particularly Salmon, Alternative

Alternative 2.c would remove the 2015 trawl RCA outside the tribal U&A. This alternative would also provide NMFS and the Council with the option to use BACs to address a species management concern. The closures would be based on depth and latitude, and they could be implemented in any combination. Since, we are not certain when or where these closures would be implemented, it is difficult to assess the

overall benefits for protected species. Benefits may be localized through implementation of one BAC or applied coastwide using all BACs. To assess the impacts of these depth-based and latitude-based area closures, we present the observed interactions data for those depth and latitudinal breaks that contained observed protected species.

Even though an area is currently open to fishing, some BACs had no protected species observations. In addition, we cannot provide protected species observations for the BACS within the trawl RCA since none occurred. Therefore, we infer that BACs for these areas would have some benefit to protected species, but we do not know to what extent (i.e., the number of interactions that may not occur due to a closure).

Bottom trawling would be permitted in the current trawl RCA area under Alternative 2.c, however, gear restrictions may change. If the trawl RCA were removed, we assume that large footrope gear may be used seaward of the 100 fm line (currently it is required seaward of the 150 fm line). We assume that other small footrope gear may be used shoreward of the trawl RCA in the future because vessels are using EFPs to be exempt from the use of SFFT gear, and they use other small footrope gear. The use of these different gear types in various depth bins could impact eulachon or green sturgeon, but we are uncertain to what extent. See Chapter 6, Cumulative Effects, for a discussion of impacts.

The effectiveness of BACs to reduce impacts of the fishery on protected resources may be limited. Since this alternative may be implemented inseason or before the start of the fishing year, near real-time data would be necessary for the Council and NMFS to determine the need for action inseason to determine its effectiveness (i.e., preventing exceedance of ITS or for some other conservation and management need).

The WCGOP provides updates and annual reports each year. This information is crosschecked, and some are numbers are expanded to fleetwide totals to monitor mortality real time (salmon) or for an annual mortality report at the end of the fishing year. Any new information provided could be used to close a BAC before the start of the next fishing season or under an inseason action as needed. The ESA Section 7(a)(2) Biological Opinion (NMFS 20173) requires at-sea and dockside monitoring so that NMFS can monitor the salmon ITS in the non-whiting sector, including bottom trawl. Therefore, NMFS and the Council may have enough information to consider BAC closures inseason for salmon for a short time or for the remainder of the season. If catch of eulachon or green sturgeon were to increase, the Council could consider closing certain depth and latitudinal bins where these species typically reside or where catch occurs.

BAC closures may not be effective due to the lag of information and the general movement of some species. Although WCGOP gets real-time interaction information for short-tailed albatross and marine

mammals such as whales, a closure may not be effective for these species since they are rare, and these animals move great distances.

Under Alterative 2.b, the trawl RCA would be removed. Therefore, we refer to Alternative 2.a for a discussion of impacts to protected species.

The Council may implement BACs as needed for an extended time (all year) or for a short time (two-month period). The implementation of these closures may benefit species that happen to be in the area during the closure; however, the magnitude of the benefit is unknown. Even though a closure may occur, protected species move frequently, and they may be impacted in areas that are still open to fishing.

If we continue to assume that implementation of BACs could reduce the number of interactions, then BAC implementation could lower impacts to protected species on an annual basis. Table 4-59 Table 4-60 and Table 4-61 provide potential reductions if certain BACs were implemented. The numbers in each table are four-year totals for each area and should not be used as a true number for reduction. Rather, the numbers may indicate some level of reduction from the No-action Alternative. Data presented in Table 4-59, Table 4-60 Table 4-61, Table 4-62, and Table 4-63 are observations outside both the trawl RCA and the tribal U&A. Fishing activity south of Point Conception is not occurring; therefore, no data are presented.

Table 4-56. Number of salmon interactions observed in the bottom trawl fishery by species and by latitude/depth bin, 2011 to 2014.

Latitudinal Zone and Depth Bin	Chinook Salmon	Pink Salmon	Salmon Unid	Coho Salmon	Grand Total
2 Point Chehalis to Cape Blanco	559	3	1	66	629
0fm-30fm	10				10
100fm-150fm	0				0
150fm-700fm	292	3	1	28	324
30fm-100fm	257			38	295
3 Cape Blanco to Cape Mendocino	663	1	2	25	691
100fm-150fm	6				6
150fm-700fm	643	1	2	25	671
30fm-100fm	14				14
4 Cape Mendocino to Point Conception	148			11	159
150fm-700fm	9				9
30fm-100fm	139			11	150
Grand Total	1,370	4	3	1,02	1,480

Note: Data are observations outside both the trawl RCA and tribal U&A. Fishing activity south of Point Conception is not occurring therefore no data is presented.

Table 4-57. Number and weight of eulachon observed in the bottom trawl fishery by latitudinal zone and depth bin, 2011 to 2014.

Latitudinal Zone and Depth Bin	Count of Eulachon	Sum of Eulachon (lb)
2 Point Chehalis to Cape Blanco	1,589	173
0fm-30fm	149	6
150fm-700fm	22	3
30fm-100fm	1,418	165
3 Cape Blanco to Cape Mendocino	2	0
30fm-100fm	2	0
Grand Total	1,591	173

Table 4-58. Number of green sturgeon observed in the bottom trawl fishery by latitudinal zone and depth bin, 2011 to 2014.

Latitudinal Zone and Depth Bin	Count of Green Sturgeon	Sum of Green Sturgeon (lb)
2 Point Chehalis to Cape Blanco	87	3,017
0fm-30fm	65	2,212
30fm-100fm	22	805
Grand Total	87	3,017

Table 4-59. Number of marine mammal interactions by latitudinal zone and depth bin, 2011 to 2014.

Latitudinal Zone and Depth Bin	California Sea Lion	Common Unid Dolphin	Harbor Seal	Northern Elephant Seal	Pacific White-sided Dolphin	Sea Lion Unid	Seal Unid	Steller Sea Lion	Grand Total
2 Pt Chehalis to Cape Blanco	45	22	3	1				265	336
150fm-700fm	37	22						195	254
30fm-100fm	8		3	1				70	82
3 Cape Blanco to Cape Mendocino	134				100	1	1	936	1172
150fm-700fm	133				100	1	1	918	1153
30fm-100fm	1							18	19
4 Cape Mendocino to Pt Conception	88				21	5		48	162
0fm-30fm	1								1
150fm-700fm	75				21			43	139
30fm-100fm	12					5		5	22
Grand Total	267	22	3	1	121	6	1	1,249	1670

Table 4-60. Number of seabird interactions observed in the bottom trawl fishery by latitudinal zone and depth bin, 2011 to 2014.

Row Labels	Number of interactions
2 Point Chehalis to Cape Blanco	132
0fm-30fm	1
150fm-700fm	129
30fm-100fm	2
3 Cape Blanco to Cape Mendocino	45
150fm-700fm	45
4 Cape Mendocino to Point Conception	510
150fm-700fm	394
30fm-100fm	116
Grand Total	687

Based on this information and bycatch observed, BACs may decrease the number of interactions with all protected species from what has been observed under the No-action Alternative.

4.2.5.10 Alternative 3.a, the Use MSA Sec. 303(b)(2)(A), 303(b)(2)(B), or 303(b)(2) to close waters deeper than 3,500 m Alternative

This alternative would close waters deeper than 3,500 m to bottom contact gear. There are no known groundfish or non-groundfish trawl trips beyond 3,500 m, and there are no protected species observations to analyze. A closure of the area would prevent interactions and may benefit all protected species that reside or travel through the area. We do not expect that implementation of this alternative would negatively affect protected species.

5 SYNTHESIS COMBINATIONS

This chapter describes and compares the net effects of a range of combinations of Subject Area 1 (EFHCAs) and Subject Area 2 (Trawl RCA) alternatives, as well as the No-action Alternative, on habitat, fish resources, protected resources, and economics. It is intended to inform the Council as it selects its FPA, which will likely include elements from both Subject Area 1 and Subject Area 2. This synthesis is limited to alternatives under Subject Areas 1 and 2. The Subject Area 3 alternative (closing areas deeper than 3,500 m to all bottom contact gear) was not included because it would not affect the bottom trawl fishery for the foreseeable future, and it does not overlap with either Subject Areas 1 or 2.

There are too many possible combinations of alternatives to analyze all of them here, and we do not know the exact combination that the Council will select as their FPA. Instead, the Project Team identified a subset of combinations that cover the range of possible combinations, from the most protective of habitat to the least protective of habitat. We expect that one of these combinations will serve as a starting point for the Council as it develops its FPA. Those combinations are shown in Table 5-1, and Figures 5-1 through 5-4.

Table 5-1. Combinations of alternatives that were compared to the No-action Alternative and to each other.

		Combination of Alternatives			
Alternative	**No-action Alternative**	**Combination 1**	**Combination 2**	**Combination 3**	**Combination 4**
No-action Alternative	**X**				
Retain the trawl RCA (No-action on Subject Area 2)				**X**	
1.a, the Collaborative Alternative		**X**	**X**		
1.b, the Oceana et al. Alternative				**X**	**X**
1.c, the MTC Alternative			**X**		
1.d, the Garibaldi Reef South Alternative			**X**		
1.e, the Rittenburg Bank Alternative			**X**		
1.f, the Potato Bank Correction Alternative			**X**		
2.a, the Eliminate RCA Alternative		**X**	**X**		**X**

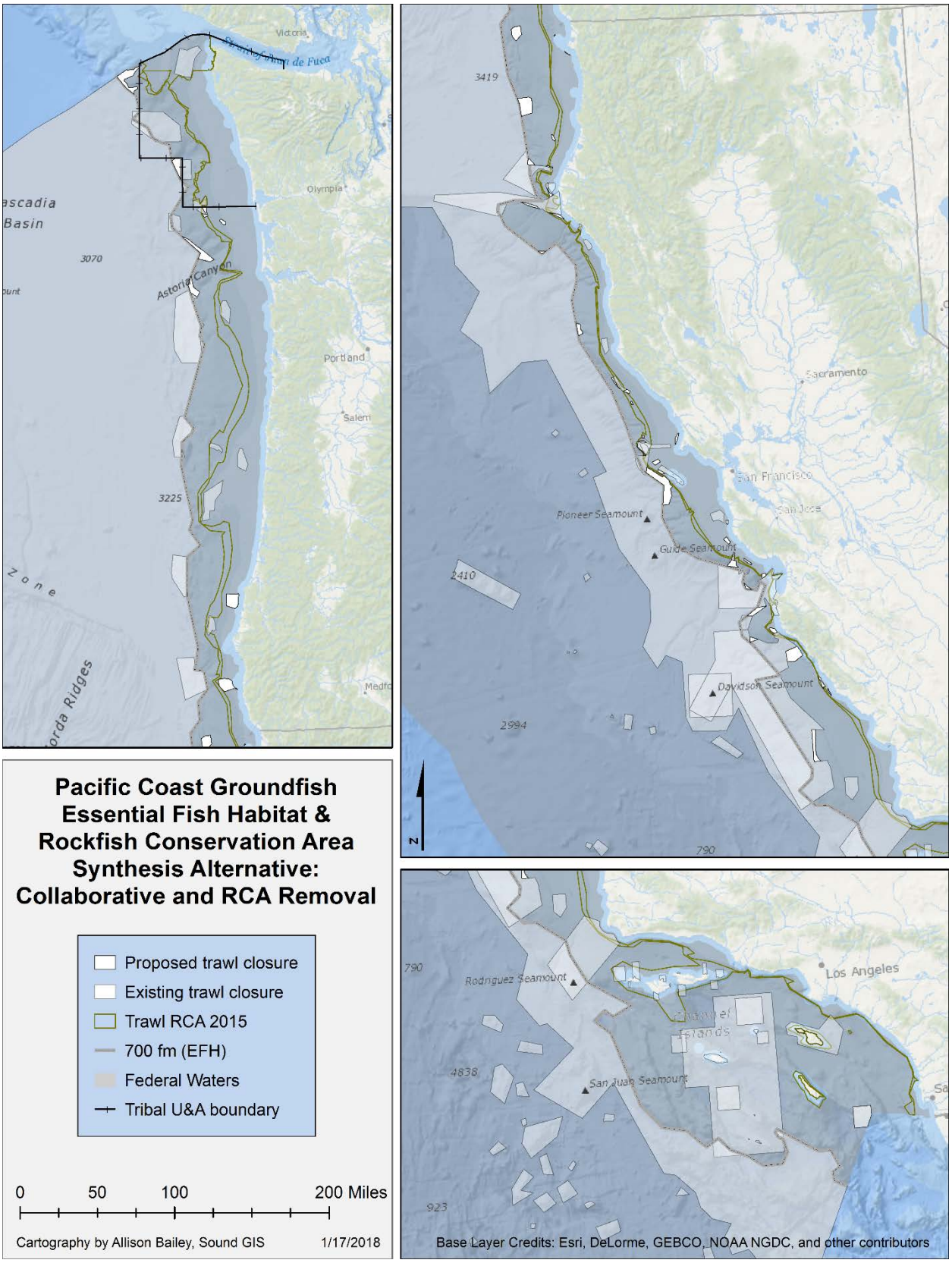

Figure 5-1. Coastwide bottom trawl closures resulting from Combination 1

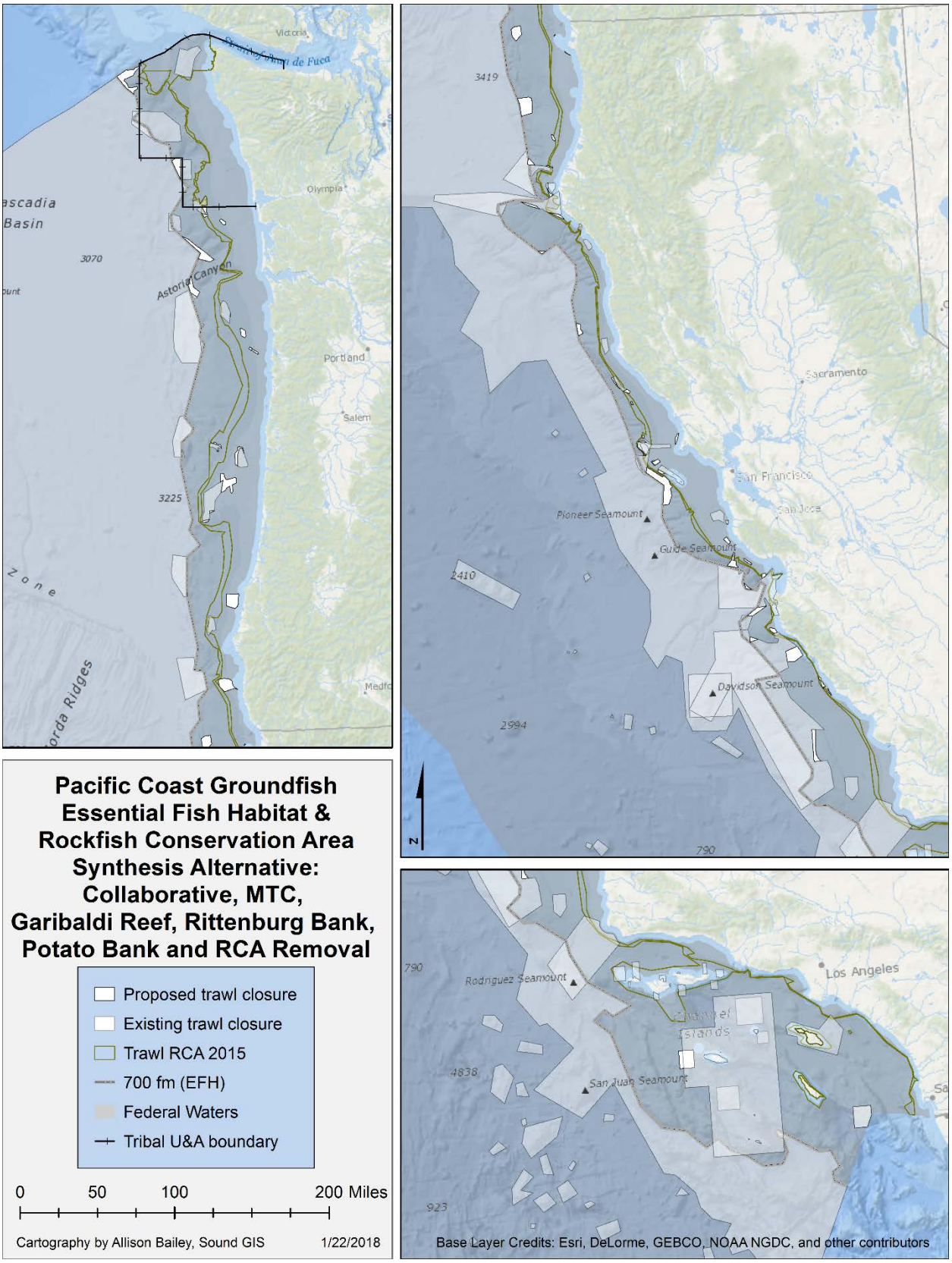

Figure 5-2. Coastwide bottom trawl closures resulting from Combination 2

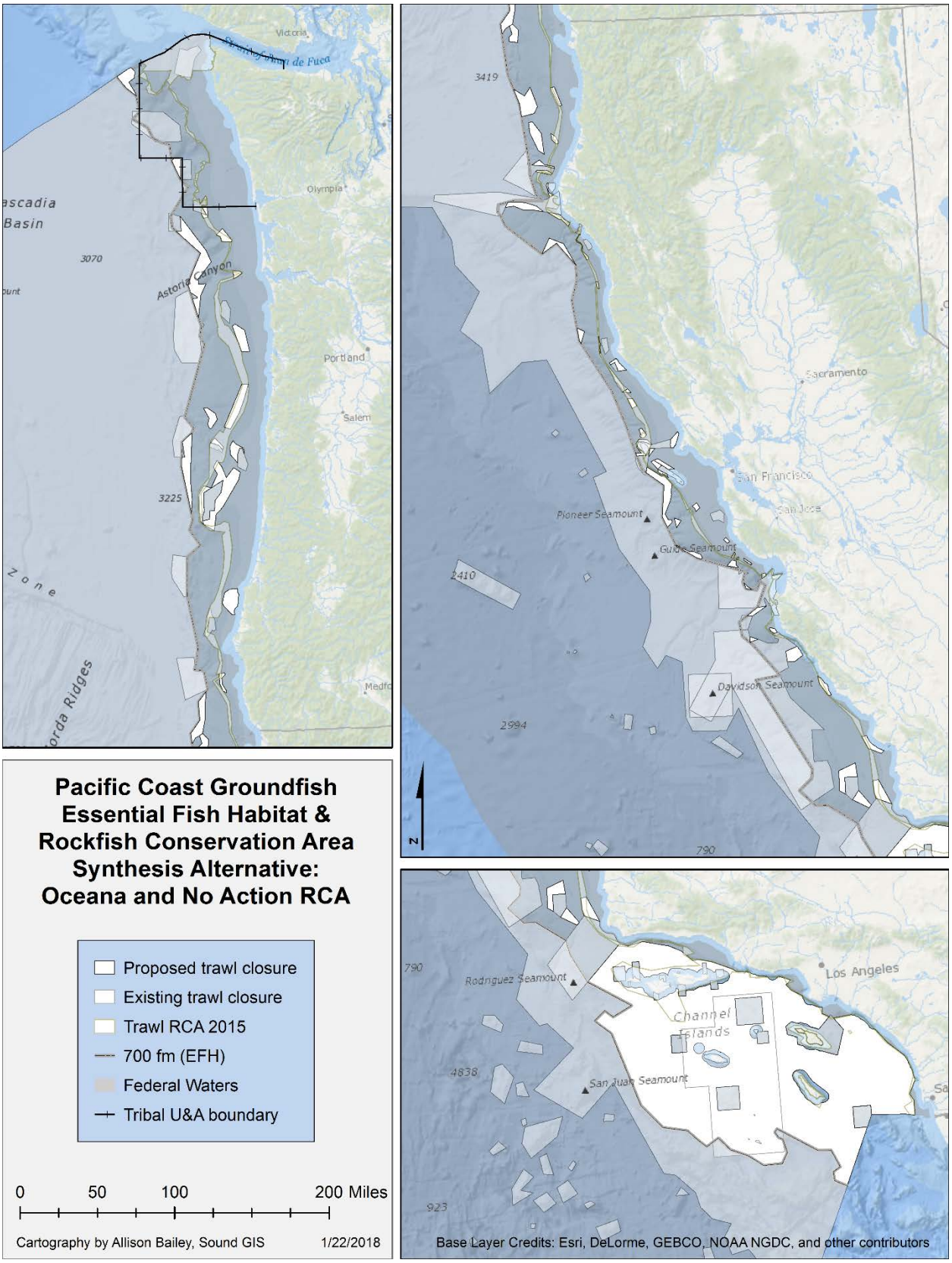

Figure 5-3. Coastwide bottom trawl closures resulting from Combination 3.

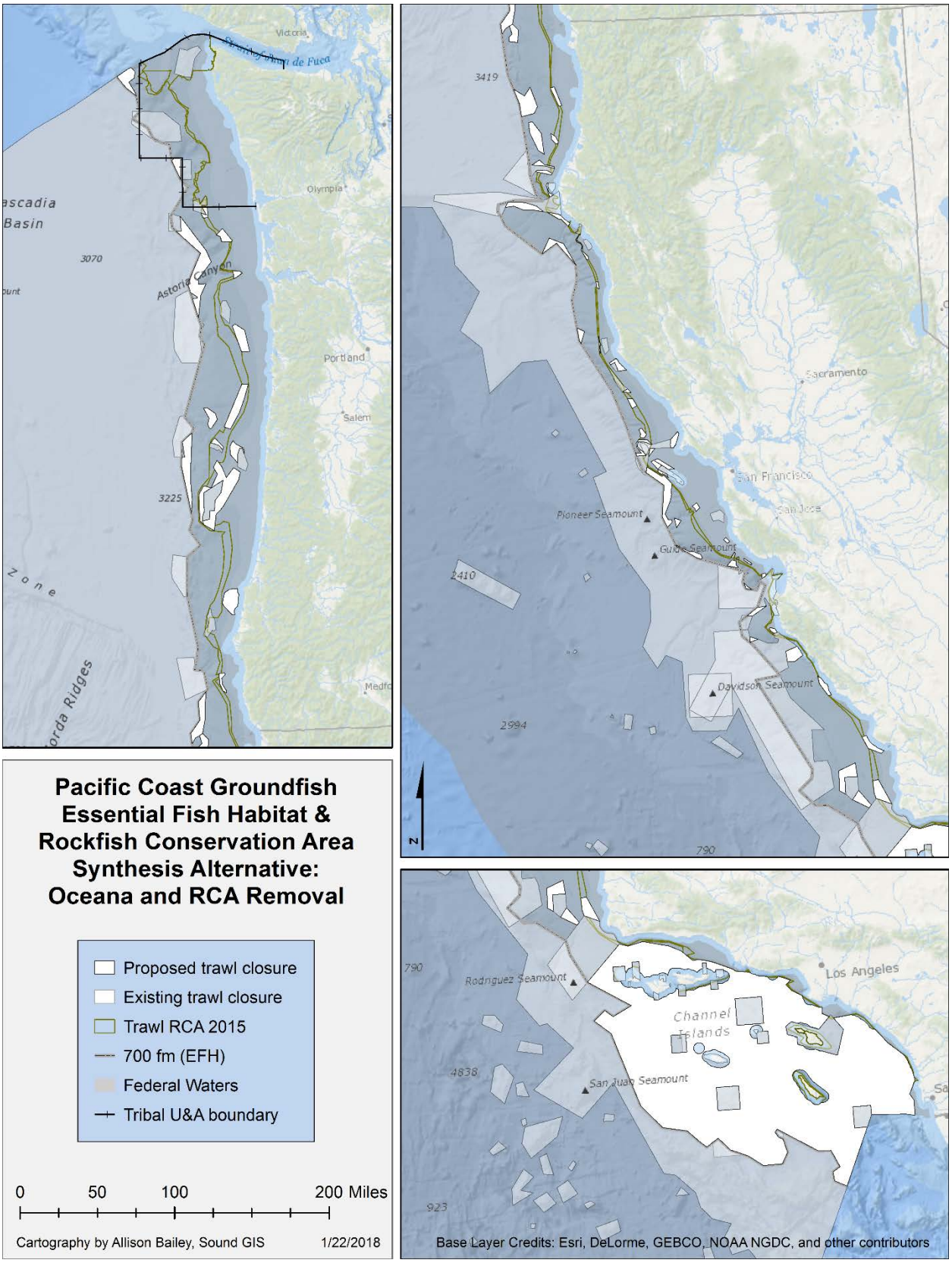

Figure 5-4. Coastwide bottom trawl closures resulting from Combination 4.

This analysis compares, for each combination of alternatives, the metrics in the total area closed to commercial bottom trawling along the West Coast to current closures under the No-action Alternative. These net changes for Combination 3 are the same as the metrics under Alternative 1.b, the Oceana et al. Alternative shown in Chapter 4, Section 4.2.1.3. However, the metrics for the remaining combinations are unique to this synthesis, because they account for areas where the EFHCA alternatives would overlap with the area to be reopened if the trawl RCA were eliminated (Figure 5-5).

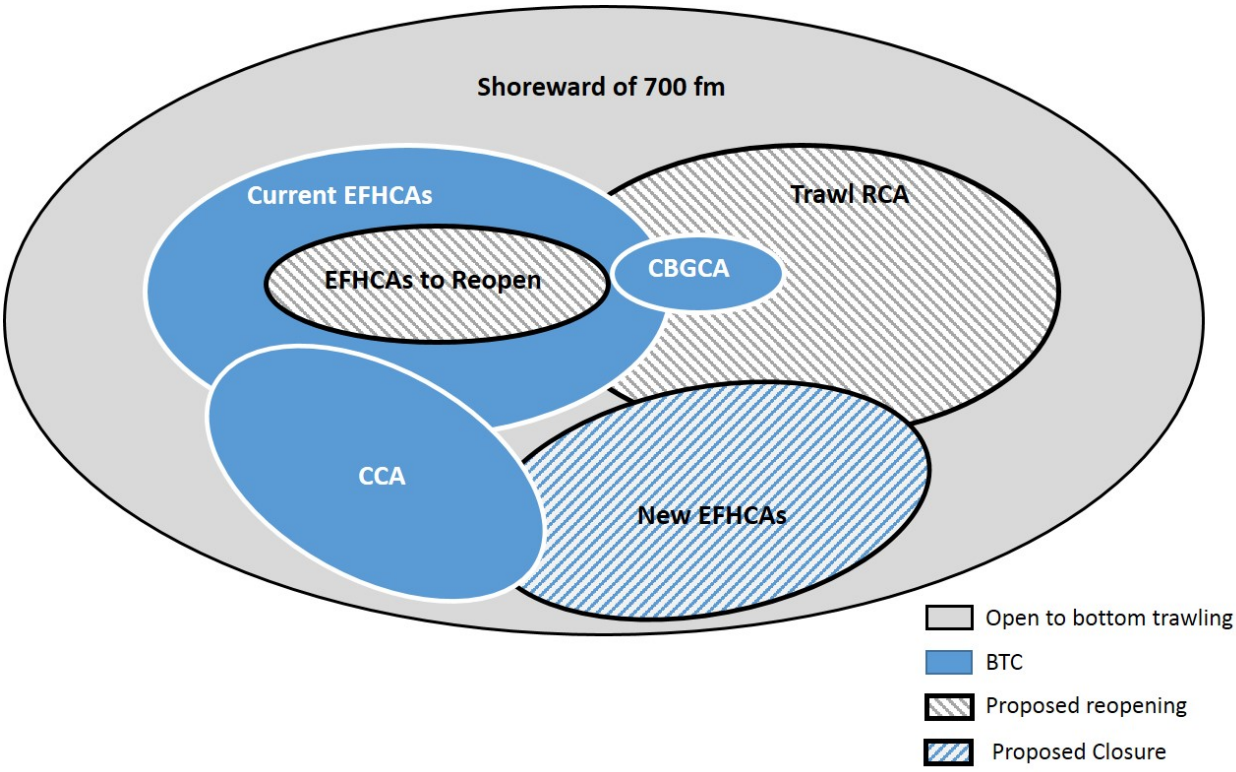

Figure 5-5. Conceptual Venn diagram of the relationship between the EFHCA changes, elimination of the trawl RCA, and areas to remain closed. Cross-hatched areas indicate changes to coastwide BTCs. Note: This figure is not to scale, and it is not intended to evaluate relative impacts.

5.1 Habitat Impacts

The net changes in spatial extent and habitat types of each combination are compared to the No-action Alternative in Table 5-2, ordered from highest to lowest net change in spatial extent from left to right. Table 5-2 ranks the alternative combinations, including the No-action Alternative, relative to the total area that would be closed to bottom trawling for each habitat metric (1 = highest, 5= lowest).

Combination 1: Combination 1 would have the greatest reduction in habitat protected from bottom trawling (minus 2,094 mi^2, minus 14 percent) (Table 5-2), which would be only slightly more than the loss in Combination 2. These losses would be spread across most habitat types, and they would range

from a low of minus 9 percent in coastwide cells with DSC presence data to a high of minus 84 percent in coastwide OFS habitat. Again, this large loss of OFS habitat would not be unexpected with removal of the trawl RCA. Despite these losses, there would be modest gains in protections for hard and mixed substrate and canyon habitat, (plus 11 mi^2, plus 21 mi^2, and plus 78 mi^2, respectively). Combination 1 would rank fourth or fifth in total protections across all habitat metrics, providing the least habitat protection among the combinations and the No-action Alternative (Table 5-2).

Combination 2: Combination 2 would result in a net reduction in the spatial extent of the area closed to bottom trawling (minus 2,012 mi^2, minus 14 percent) (Table 5-2 and Table 5-3). These losses would be spread across most habitat types and would range from a low of minus 8 percent loss of cells with DSC presence data to a high of minus 84 percent loss of OFS habitat (Table 5-2). Again, this large loss of OFS habitat would not be unexpected with removal of the trawl RCA. Despite these losses, there would be modest gains in protections for hard and mixed substrate and canyon habitat, (plus 78 mi^2, plus 28 mi^2, and plus 78 mi^2, respectively). Combination 2 would rank third or fourth in total protections across all habitat metrics (Table 5-2).

Combination 3: Combination 3 would provide the greatest overall protection to habitat, relative to the No-action Alternative and the other combinations. This combination would almost double the total spatial extent of the area closed to bottom trawling under the No-action Alternative (plus 14,484 mi^2, plus 98 percent).). Combination 3 would rank the highest for protection of all habitat metrics (Table 5-3), and relative increases in protections for each habitat type would range from a low of plus 6 percent for OFS to a high of plus 109 percent for the DSC bycatch (Table 5-2).

Combination 4: Combination 4 would have the second largest increase in total spatial extent (plus 86 percent) and would rank second highest in protections across all habitat types except OFS, which would rank third behind Combination 3 and the No-action Alternative (Table 5-2). This is not surprising because the trawl RCA was established to control the bycatch of overfished species, and it contains a large amount of OFS habitat. Increases in protection would range from a low of plus 7 percent (cells exceeding median sea pen bycatch) to a high of plus 89 percent (soft substrate). While Combination 4 would rank lower than Combination 3 on all metrics, they are more similar to one another than to other combinations.

Table 5-2. Net change from No-action Alternative to total area closed to bottom trawling, by all management measures combined (EFHCAs, trawl RCA, and West CCA) under a range of combinations of EFHCA and trawl RCA alternatives. Combinations are ordered from left to right, based on the magnitude of net change from No-action Alternative. (%) = percent change from No-action Alternative. Positive values = gains in habitat protection, negative values = reduction in habitat protection.

Metric				**No-action Alternative**	**Net Changes to area closed to bottom trawling**			
					Combination 3	**Combination 4**	**Combination 2**	**Combination 1**
Spatial extent (mi^2)				14,484	14,238 (+98%)	12,462 (+86%)	-2,021(-14%)	-2,094 (-14%)
Substrate Type	Hard (mi^2)			1,315	943 (+72%)	936 (+71%)	78 (+6%)	11 (+1%)
	Mixed (mi^2)			345	149(+43%)	137 (+40%)	28 (+8%)	21 (+6%)
	Soft (mi^2)			12,770	13,102 (+103%)	11,346 (+89%)	-2,125(-17%)	-2,124 (-17%)
	Unknown (mi^2)			54	44 (+80%)	44(+80%)	-2(-4%)	-2 (-4%)
Priority Habitats	Canyons (mi^2)			775	760 (+98%)	686 (+88%)	78 (+10%)	78 (+10%)
	OFS (mi^2)			948	61 (+6%)	-636 (-67%)	-799 (-84%)	-799 (-84%)
	Habitat-Forming Invertebrates	Grid Cell Count						
		Presence	DSC	885	365 (+41%)	317 (+36%)	-69 (-8%)	-84 (-9%)
			Sponges	1,377	957 (+69%)	814 (+59%)	-275 (-20%)	-300 (-22%)
			Sea Pens	881	471 (+53%)	362 (-41%)	-148 (-17%)	-161 (-18%)
		Bycatch	DSC	4,966	5,430 (+109%)	3,089 (+62%)	-2,174 (-44%)	-2,174 (-44%)
			Sponges	7,140	4,974 (+70%)	1,472 (-21%)	-4,017 (-56%)	-4,050 (-57%)
			Sea Pens	5,745	3,660 (+64%)	383 (+7%)	-3,673 (-64%)	-3,694 (-64%)

Table 5-3. Ranking of habitat metrics for total area closed to bottom trawling by each combination of alternatives. Combinations and No-action Alternative are ordered left to right based on rank of total spatial extent. 1 = highest, 5 = lowest.

Metric				**Combination 3**	**Combination 4**	**No-action Alternative**	**Combination 2**	**Combination 1**
Spatial extent			mi^2	**1**	**2**	**3**	**4**	**5**
Substrate Type	Hard		mi^2	**1**	**2**	**5**	**3**	**4**
	Mixed		mi^2	**1**	**2**	**5**	**3**	**4**
	Soft		mi^2	**1**	**2**	**3**	**5**	**4**
	Unknown		mi^2	**1**	**2**	**3**	**5**	**5**
Priority Habitats	Canyons		mi^2	**1**	**2**	**5**	**3**	**4**
	OFS		mi^2	**1**	**3**	**2**	**5**	**4**
	Habitat-Forming Invertebrates	Grid Cell Count						
		Presence	DSC	**1**	**2**	**3**	**4**	**5**
			Sponges	**1**	**2**	**3**	**4**	**5**
			Sea Pens	**1**	**2**	**3**	**4**	**5**
		Bycatch	DSC	**1**	**2**	**3**	**5**	**5**
			Sponges	**1**	**2**	**3**	**4**	**5**
			Sea Pens	**1**	**2**	**3**	**4**	**5**

Habitat protections benefit fish resources; therefore, the impacts of the combinations on fish resources due to habitat closures would be similar to those discussed in Section 5.1, Habitat, and they are shown in Table 5-1. Regardless of how alternatives are combined, the biggest potential for impacts on fish resources would be from Subject Area 2 alternatives. As described in Section 4.2.2.8, Alternative 2.a, removing the trawl RCA may increase landings of groundfish stocks compared to the 2011 to 2014 period, but negative impacts on fish resources from harvest are controlled by regulations that prevent overfishing. Therefore, any combination that includes removal of the trawl RCA would have impacts similar to those described in Chapter 4.

5.2 Economic Impacts

Table 5-4 displays the indices related to net economic impacts of four combinations of Subject Area 1 (EFHCA changes) and Subject Area 2 (RCA changes) alternatives, as well as the No-action Alternative relative to RCA changes. Alternatives 2.b, the Remove the Trawl RCA and, in Washington, Implement DACs, and Alternative 2.c, Remove the Trawl RCA and Implement BACs (PPA for Oregon and California), include discretionary actions that the Council and NMFS may take prior to or during a fishing season to close areas to bottom trawling. We do not explicitly address the impacts of those alternatives, which would fall within the range of impacts described here. The likely impacts of Alternative 2.b (areas of discretionary closures) would fall somewhere between Alternative 2.a, the Remove the Trawl RCA (PPA for Oregon and California), which would provide the most increase in area for groundfish bottom trawling and, likely, the largest possible immediate direct benefit to the fishing industry and supply chains, and the No-action Alternative. Under both the No-action Alternative and Alternative 2.a, NMFS could implement area closures as needed to ensure that conservation objectives were met (including complete closure of the EEZ).

Table 5-4. Summary of synthesis combination impacts. Values are percent of coastwide values, for the reference period (2011 to 2014 for proposed closures; 1997 to 2001 for proposed reopenings).

	Proposed Closures			**Proposed Reopenings**		
	As a percent of 2011 to 2014 values			**As a percent of 1997 to 2001 values**		
Combination	**Landings (1000s lbs)**	**Revenues (2015 dollars, 1000s $)**	**Square Miles**	**Landings (1000s lbs)**	**Revenues (2015 dollars, 1000s $)**	**Square Miles**
Comb #1 (Alt 1a + Alt 2a)	0.17%	0.19%	959	12.14%	11.28%	3,053
Comb #2 (Alt 1a + 1c-f) + 2a	0.01%	0.01%	1,125	11.65%	10.79%	3,146
Comb #3 Alt 1b + No Action for RCA	2.8%	3.36%	14,380	0.3%	0.3%	143
Comb #4 (Alt 1b + Alt 2a)	2.8%	3.36%	14,380	11.94%	11.08%	1,918

Note: The percent values for proposed closures and proposed reopenings cannot be directly compared, and they should not be summed in an effort to calculate net impacts. Rather, this table shows the percent values only relative to the individual reference period (either 1997 to 2001 for reopenings, or 2011 to 2014 for closures).

The potential impacts of Alternative 2.c could range between the impacts of Alternative 2.a (remove the trawl RCA), and complete closure of waters shoreward of 700 fm to groundfish bottom trawling. NMFS currently has the authority to close all groundfish bottom trawling, and this alternative would provide the ability to close only certain depth and latitude segments shoreward of 700 fm (i.e., BACs), rather than the entire EEZ. The economic impacts associated with a complete closure would be equal to losing the landings and revenues associated with the No-action Alternative, minus those associated with the tribal U&A off Washington (see Table 4-29).

Alternatives 2.b and 2.c would provide the agency with some additional flexibility that may allow them to implement closures more precisely targeted on conservation needs such that there would be a lesser direct economic impact on the industry. The closures that might be implemented under Alternatives 2.b and 2.c would not likely provide the same habitat-related ecosystem services as those associated with permanent closures because they would likely not be in place for long enough periods to allow a habitat response. They would likely provide at least some economic benefit related to the conservation of the fish resources the closures would be intended to protect.

We also do not include Alternative 3.a, the Close Waters Deeper than 3,500 m to Bottom Contact Gear, because there has been no bottom trawl fishing in those areas, for either reference period (1997 to 2001 or 2011 to 2014). Closing these waters would, therefore, not displace any past known groundfish bottom trawl fishing. While this action may potentially restrict flexibility in the fishery to access these areas in the future, the lack of historic participation indicates that these areas are not profitable for vessels under recent management, technology, and market conditions; thus, impacts are expected to be negligible or zero.

The combinations are shown here to present a range of options, with varying degrees of economic impact, as indicated by the indices and summaries of qualitative factors. Four of the five combinations show varying degrees of positive economic impacts coastwide, while one (Combination 3: Alternative 1.b and no EFHCA changes) shows a modest negative coastwide economic impact.

Combination 1

Combination 1 merges Alternative 1.a (Collaborative) with Alternative 2.a (Remove trawl RCA). It would close areas contributing less than 0.2 percent of coastwide landings (pounds) and revenues in recent years (2011 to 2014), and it would reopen areas contributing 12.14 percent and 11.28 percent, respectively, for landings (pounds) and revenues in the historic period (1997 to 2001). The proposed closures would restrict access to fishing grounds that are currently open, which may result in a negative impact since fishermen would see some reduction in their ability to optimize their fishing activity (including operational efficiency). Fishermen might increase their effort to find alternative areas to compensate for the newly closed areas, such that harvest and revenue are maintained to at least some degree, but with less optimal trip characteristics (costs, travel time, etc.).

The proposed reopenings would allow access to fishing grounds that have been closed between 12 and 16 years. Although groundfish bottom landings are limited by ACLs, opening new fishing areas would give the fleet flexibility to optimize its fishing effort, including potentially increasing ACL attainment for some species. Flexibility for operations and access to more fishing area with the potential for increased

attainment in those areas over the attainment in the No-action Alternative would provide economic benefits to the fleet, supply chains, and associated coastal communities.

Areas closed would contribute to ecosystem services and existence values, while areas reopened areas may detract from those indirect economic benefits. Fishery-related ecosystem services require fishing activities' therefore, a balance has to be drawn between those particular ecosystem services and fishing activities. As discussed in Chapter 4, existence values tend to be substitutable and, therefore, do not likely increase in proportion to the amount of something protected. In national policy, they are exemplified by the ESA, which only comes into play at extremely low levels. Therefore, while there may be some impact on existence values, it seems less likely that there would be noticeable affects at the levels of protection that are being considered here.

Combination 2

Combination 2 merges Alternative 1.a (Collaborative), 1.c (MTC), 1.d (Garibaldi Reef South), 1.e (Rittenburg Bank), 1.f (Potato Bank), and 2.a (Remove the Trawl RCA). It would close areas contributing 0.01 percent of coastwide landings (pounds) and revenues in recent years (2011 to 2014), and it would reopen areas contributing 11.65 percent and 10.79 percent (1997 to 2001), respectively, of coastwide landings (pounds) and revenues. See the first two paragraphs under Combination 1 for a discussion of the immediate direct impacts of closures and openings on the fishing industry, supply chain, and communities.

The proposed reopenings would allow access to fishing grounds that have been closed between 12 and 16 years. Although groundfish bottom landings are limited by ACLs, opening new fishing areas would give flexibility to the fleet to optimize its fishing effort, including potentially increasing ACL attainment for some species. Flexibility for operations and access to more fishing area with the potential for increased attainment in those areas over the attainment in the No-action Alternative would provide economic benefits to the fleet, supply chains, and associated coastal communities.

Areas closed would contribute to ecosystem services and existence values, while areas opened may detract from those indirect economic benefits. See the last paragraph under Combination 1 for further discussion of the dynamics of these costs and benefits.

Combination 3

Combination 3 merges Alternative 1.b (Oceana et al.) with no changes to the trawl RCA. The metrics are identical to a stand-alone Alternative 1.b. It would result in closing areas contributing 2.8 percent and 3.36 percent of coastwide landings (pounds) and revenues, respectively, in the recent period (2011 to 2014), and would reopen areas representing 0.3 percent of both coastwide landings (pounds) and revenues

in the historic period (1997 to 2001). See the first two paragraphs under Combination 1 for a discussion of the immediate direct impacts of closures and openings on the fishing industry, supply chain, and communities. The proposed reopenings may result in some localized compensatory benefit to surrounding communities, with access to areas that have been closed since 2002. These reopened areas would not likely provide enough new opportunity to offset the loss of the closures under this combination, resulting in likely negative immediate direct economic impacts for vessels, processors, and communities, particularly those in ports near the largest closures.

Areas closed would contribute to ecosystem services and existence values, while areas open may detract from those indirect economic benefits. See the last paragraph under Combination 1 for further discussion of the dynamics of these costs and benefits.

Combination 4

Combination 4 merges Alternative 1.b (Oceana et al.) with Alternative 2.a (remove trawl RCA). It would result in closing areas contributing 2.8 percent and 3.36 percent of coastwide landings (pounds) and revenues, respectively, in the recent period (2011 to 2014), and would reopen areas contributing 11.94 percent and 11.08 percent of coastwide landings (pounds) and revenues, respectively, in the historic period (1997 to 2001). The proposed closures could be considered a negative economic impact because fishermen must find alternative areas to fish to compensate for the lack of access to those newly closed areas. However, the newly reopened areas, represented primarily by the trawl RCA, would likely compensate to some degree for the closed areas by giving fishermen additional flexibility and the opportunity to fish more selectively. Most of these areas have been closed for 16 years, and reopening them could result in higher achievement of ACLs, which would be a positive economic impact to the fleet and to fishing-dependent coastal communities.

Areas closed would contribute to ecosystem services and existence values, while areas opened may detract from those indirect economic benefits. See the last paragraph under Combination 1 for further discussion of the dynamics of these costs and benefits.

5.3 Protected Species

None of the synthesis combinations would change the impacts on protected resources considered and discussed in Chapter 4. We do not expect that additional areas being closed or opened in combination with one another would change observation rates under the WCGOP (100 percent monitoring with EM or human observers) or change the observed number of interactions beyond what has been observed under the No-action Alternative.

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Appendix A.
Habitat metrics, by geographic breaks and polygon

Appendix A - Habitat metrics, by geographic break and polygon L1

This Appendix contains the habitat metrics, by geographic break and polygon, for Alternatives 1.a, 1.b, and 1.c. The information is presented in tables and figures.

Methodology L2

The metrics for the priority habitats in the polygon tables are color coded to help the reader compare one polygon with another. The bins for hard substrate, canyons, and overfished species (OFS) habitat are based on the spatial extent (mi^2), while the bins for habitat-forming invertebrates (HFI) presence and bycatch are based on the number of grid cells. The HFI bins were chosen to approximate the spatial extent of the mi^2 bins. For example, 1 mi^2 is equivalent to 2.6 of the 1 km grid cells used in the HFI presence, and 10.2 of the 0.5 km grid cells. The same bins and color codes are used for all alternatives, as shown in Table A-1.

Table A-1. Color codes for extent of priority habitats in each polygon.

Closures			Reopenings		
mi^2	Presence	Bycatch	mi^2	Presence	Bycatch
0	0	0	0	0	0
<1	<3	<10	<1	<3	<10
1-5	4-13	10-52	1-5	4-13	10-52
5-10	14-26	53-104	5-10	14-26	52-104
10-20	27-52	105-207	10-20	27-52	105-207
>20	<52	>207	>20	>52	>207

No-action Alternative L2

Geographic Break Analysis L3

Tables A-2 and Table A-3 show the habitat metrics summarized by latitudinal zone and depth zone. Table A-4 shows the habitat metrics for each geographic break.

Table A-2. No-action Alternative habitat metrics, summarized by latitudinal zone. Values in underlined italics are lowest for that metric and values in bold italics are highest for that metric, among the latitudinal zones. "-"= true zero. 0 = <1mi^2.

Latitudinal Zone	METRICS												
	Spatial extent (mi2)	Substrate Type (mi^2)				Priority Habitats							
						Canyon	OFS	Habitat-Forming Invertebrates					
								Presence			Bycatch		
		Hard	Mixed	Soft	Unknown			DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
Cape Flattery to Pt Chehalis	1,496	23	122	1,348	4	217	64	79	217	85	1,318	886	761
Pt Chehalis to Cape Blanco	1,796	206	99	1,491	-	54	710	57	190	90	2,855	5,381	4,803
Cape Blanco to Cape Mendocino	350	2	-	348	-	114	170	17	22	12	549	604	18
Cape Mendocino to Pt Conception	3,316	607	10	2,660	40	271	4	310	345	470	310	355	205
Pt Conception to US/Mexico Border	7,527	477	115	6,924	11	119	-	504	729	280	-	-	-
Grand Total	14,485	1,315	345	12,770	54	775	948	967	1,503	937	5,032	7,226	5,787

Table A-3. No-action Alternative habitat metrics, summarized by depth zone. Unkn = unknown. "-"= true zero.

Latitudinal Zone	METRICS												
	Spatial extent (mi2)	Substrate Type (mi^2)				Priority Habitats							
						Canyon	OFS	Habitat-Forming Invertebrates					
								Presence			Bycatch		
		Hard	Mixed	Soft	Unknown			DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
0fm - 30fm	430	29	10	384	8	-	-	35	21	8	-	-	-
30fm - 100 fm	1,903	335	112	1,453	5	12	55	198	318	200	182	616	354
100 fm - 150 fm	2,830	90	94	2,645	1	210	793	350	544	320	2,066	2,252	2,472
150 fm - 700 fm	9,321	861	130	8,289	41	553	100	384	620	409	2,784	4,358	2,961
Total	14,485	1,315	345	12,770	54	775	948	967	1,503	937	5,032	7,226	5,787

Table A-4. No-action Alternative habitat metrics by latitudinal and depth zones. Unkn = unknown. "-"= true zero. 0 mi2 = <1mi2; 0.0% = <0.1%.

Latitudinal Zone	Depth Zone	METRICS													
		Spatial extent (mi^2))	Substrate Type (mi^2)				Priority Habitats								
							Canyon (mi^2)	OFS (mi^2)	Habitat-Forming Invertebrates						
									Presence			Bycatch			
			Hard	Mixed	Soft	Unknown			DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
Cape Flattery to Pt Chehalis	0fm-30fm	106	12	-	93	1	-	-	-	-	-	-	-	-
	30fm-100fm	435	8	45	379	3	2	1	14	39	5	29	272	177
	100fm-150fm	432	2	77	354	-	57	53	51	103	27	345	82	215
	150fm-700fm	523	0	-	523	-	158	10	14	75	53	944	532	369
	Total	1,496	23	122	1,348	4	217	64	79	217	85	1,318	886	761
Pt Chehalis to Cape Blanco	0fm-30fm	-	-	-	-	-	-	-	-	-	-	-	-	-
	30fm-100fm	335	186	54	96	-	-	53	9	36	4	145	300	140
	100fm-150fm	924	19	8	896	-	39	594	25	66	33	1,123	1,881	2,156
	150fm-700fm	537	1	37	499	-	15	62	23	88	53	1,587	3,200	2,507
	Total	1,796	206	99	1,491	-	54	710	57	190	90	2,855	5,381	4,803
Cape Blanco to Cape Mendocino	0fm-30fm	1	0	-	1	-	-	-	-	-	-	-	-	-
	30fm-100fm	5	0	-	5	-	4	0	-	-	1	-	44	-
	100fm-150fm	199	1	-	198	-	26	143	7	15	8	392	167	15
	150fm-700fm	145	0	-	145	-	85	26	10	7	3	157	393	3
	Total	350	2	-	348	-	114	170	17	22	12	549	604	18
Cape Mendocino to Pt Conception	0fm-30fm	18	3	-	15	-	-	-	-	-	-	-	-	-
	30fm-100fm	317	46	0	271	-	4	1	19	31	79	8	-	37
	100fm-150fm	716	33	9	673	-	45	2	188	194	191	206	122	86
	150fm-700fm	2,265	525	-	1,701	40	222	1	103	120	200	96	233	82
	Total	3,316	607	10	2,660	40	271	4	310	345	470	310	355	205
Pt Conception to US/Mexico Border	0fm-30fm	305	13	10	275	7	-	-	35	21	8	-	-	-
	30fm-100fm	812	95	12	703	2	2	-	156	212	111	-	-	-
	100fm-150fm	559	34	0	524	1	43	-	79	166	61	-	-	-
	150fm-700fm	5,851	334	93	5,422	2	73	-	234	330	100	-	-	-
	Total	7,527	477	115	6,924	11	119	-	504	729	280	-	-	-
Grand Total		14,485	1,315	345	12,770	54	775	948	967	1,503	937	5,032	7,226	5,787

Alternative 1.a, the Collaborative Alternative L2

Geographic Break Analysis L3

Tables A-5 and A-6 show the habitat metrics summarized by latitudinal zone and depth zone. Table A-7 shows the habitat metrics for each geographic break.

Polygon analysis. L3

The habitat metrics for each polygon in the Collaborative Alternative are found in Table A-8. They will not be discussed in detail, but they are provided here as additional information.

This alternative contains 43 proposed closures and 16 proposed reopenings. The closures would range in size from 1 mi^2 (Saint George Reef) to 126 mi^2 (Farallon Escarpment). Of the remaining 41 closures, 21 closures would be smaller than 10 mi^2, 14 would be between 10 and 50 mi^2, and 6 would be between 50 and 100 mi^2. The Saint George Reef closure, as originally proposed, would have been much larger, but it would have been mostly in state waters (Figure A-1). When the state waters were removed, all that remained were two small polygons that, when summed, would total 0.9 mi^2.

The 16 reopenings would range in size from 1 mi^2 (Point Arena South Modification 4 and Monterey Bay NMS South of Mars Cable) to 74 mi^2 (Point Arena South Modification 1).

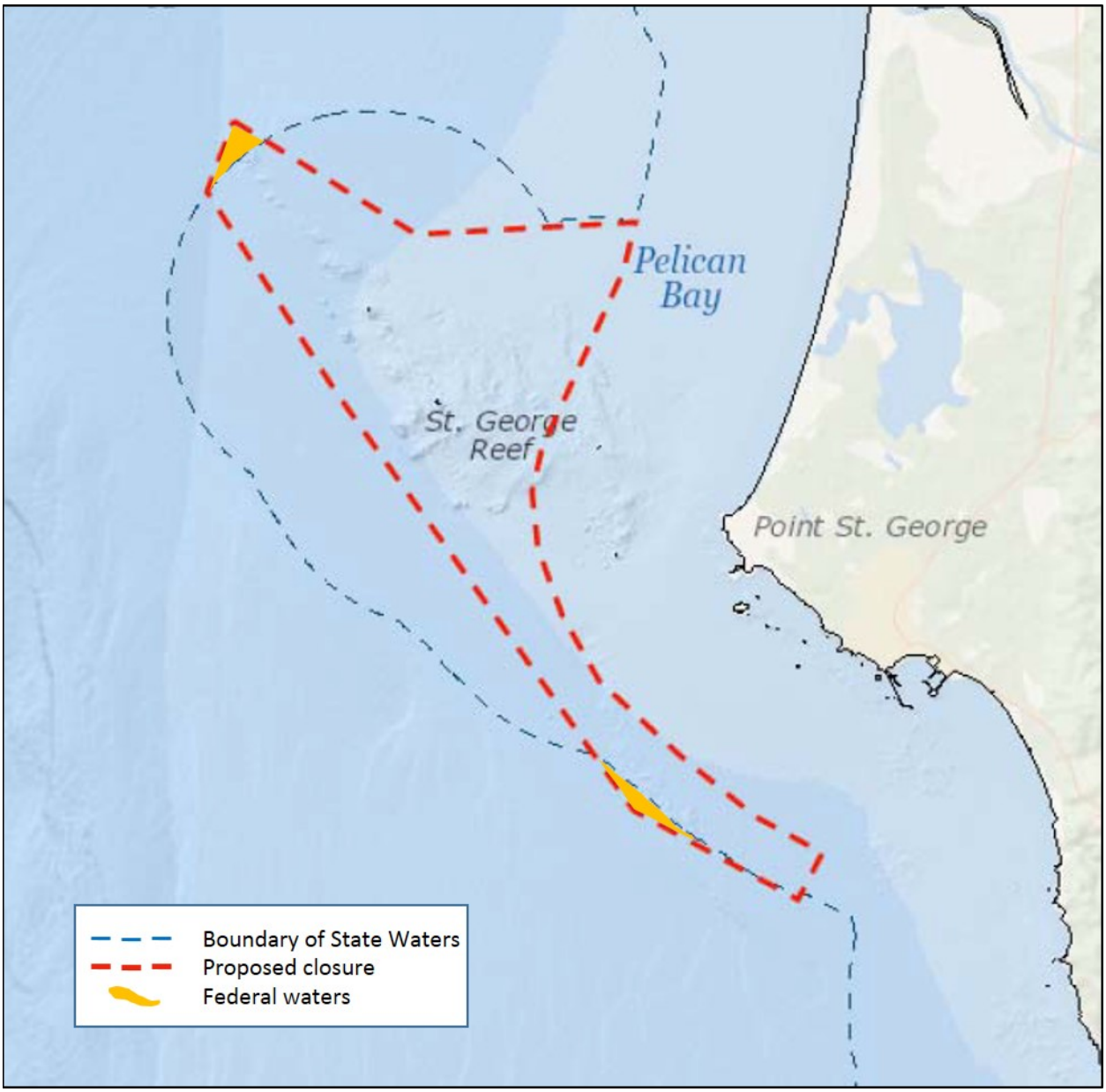

Figure A-6-1. The Saint George Reef in Alternative 1.a, the Collaborative Alternative, showing small polygons remaining when portions in state waters are eliminated.

Table A-5. Alternative 1.a, the Collaborative Alternative, net habitat metrics (closures minus reopenings), summarized by latitudinal zone. Values in underlined italics are lowest for that metric, and values in bold italics are highest for that metric, among the latitudinal zones. Δ% = net change from No-action Alternative. "-"= true zero. 0 mi2 = <1mi2; 0.0% = <0.1%. ** = 0 in No-action Alternative. Values in parentheses are negative.

Latitudinal Zone		METRICS													
		Spatial extent (mi2)	Substrate Type (mi^2)				Priority Habitats								
							Canyon	OFS	Habitat-Forming Invertebrates						
									Presence			Bycatch			
			Hard	Mixed	Soft	Unknown			DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
Cape Flattery to Pt Chehalis	mi^2	*126*	-	-	126	-	***96***	*0*	*2*	*3*	2	94	208	63
	Δ%	8.4	-	-	9.4	-	44.2	0.0	2.5	1.4	2.4	7.1	23.5	8.3
Pt Chehalis to Cape Blanco	mi^2	174	*11*	***50***	*112*	-	67	3	6	4	*1*	253	*(10)*	151
	Δ%	10	5	51	8	**	123	0	11	2	1	9	(0)	3
Cape Blanco to Cape Mendocino	mi^2	209	12	-	***197***	-	24	0	22	23	23	***529***	***661***	***447***
	Δ%	60	665	**	57	**	21	0	129	105	192	96	109	2,483
Cape Mendocino to Pt Conception	mi^2	***240***	***75***	0	165	-	*23*	***6***	***70***	***74***	***49***	*(9)*	102	*(35)*
	Δ%	7	12	4	6	-	8	134	23	21	10	(3)	29	(17)
Pt Conception to US/Mexico Border	mi^2	-	-	-	-	-	-	-	-	-	-	-	-	-
	Δ%	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total	mi^2	749	97	51	600	0	209	9	100	104	75	867	961	626
	Δ%	5.2	7.4	14.7	4.7	0.0	27.0	0.9	10.3	6.9	8.0	17.2	13.3	10.8

Table A- 6. Alternative 1.a, the Collaborative Alternative, net habitat metrics (closures minus reopenings), summarized by depth zone. Values in underlined italics are lowest for that metric, and values in bold italics are highest for that metric, among the latitudinal zones. Δ% = net change from No-action Alternative. "-"= true zero. 0 mi2 = <1mi2; 0.0% = <0.1%. ** = 0 in No-action Alternative. Values in parentheses are negative.

Depth Zone		METRICS												
		Spatial extent (mi2)	Substrate Type (mi^2)				Priority Habitats							
							Canyon	OFS	Habitat-Forming Invertebrates					
									Presence			Bycatch		
			Hard	Mixed	Soft	Unknown			DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
0-30 fm	mi^2	7	3	1	3	-	-	-	1	1	-	-	-	4
	Δ%	1.6	9.0	9.5	0.8	-	**	**	2.9	4.8	-	**	**	**
30-100fm	mi^2	143	***48***	***50***	45	-	0	3	***54***	***66***	19	94	57	42
	Δ%	7	14	45	3	-	1	5	27	21	10	52	9	12
100-150fm	mi^2	*(2)*	*(0)*	-	*(2)*	-	0	0	-	-	-	*(26)*	-	-
	Δ%	(0)	(0)	-	(0)	-	0	0	-	-	-	(1)	-	-
150-700fm	mi^2	***608***	47	-	***561***	-	***214***	***5***	45	37	***55***	***799***	***904***	***580***
	Δ%	7	6	-	7	-	39	5	12	6	13	29	21	20
>700fm	mi^2	(7)	(0)	-	(7)	-	(5)	-	-	-	1	-	-	-
	Δ%	**	**	**	**	**	**	**	**	**	**	**	**	**
Grand Total	mi^2	749	97	51	600	0	209	9	100	104	75	867	961	626
	Δ%	5.2	7.4	14.7	4.7	0.0	27.0	0.9	10.3	6.9	8.0	17.2	13.3	10.8

Table A-7. Alternative 1.a, the Collaborative Alternative, net habitat metrics (closed minus reopen) by geographic break. Δ% = net change from No-action Alternative. "-"= true zero. 0 mi2 = <1mi2; 0.0% = <0.1%. Values in parentheses are negative.

Latitudinal Zone	Depth Zone	METRICS													
		Spatial extent (mi2)	Substrate Type (mi^2)				Priority Habitats								
							Canyon	OFS	Habitat-Forming Invertebrates						
									Presence			Bycatch			
			Hard	Mixed	Soft	Unknown			DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
Cape Flattery to Pt Chehalis	0fm-30fm	-	-	-	-	-	-	-	-	-	-	-	-	-
	30fm-100fm	0	-	-	0	-	-	0	-	-	-	-	-	-
	100fm-150fm	-	-	-	-	-	-	-	-	-	-	-	-	-
	150fm-700fm	126	-	-	126	-	96	-	2	3	2	94	208	63
	Total	126	-	-	126	-	96	0	2	3	2	94	208	63
	Δ%	8.4	-	-	9.4	-	44.2	0.0	2.5	1.4	2.4	7.1	23.5	8.3
Pt Chehalis to Cape Blanco	0fm-30fm	3	1	1	1	-	-	-	1	1	-	-	-	-
	30fm-100fm	80	10	49	20	-	-	3	6	6	1	93	-	75
	100fm-150fm	(3)	(0)	-	(2)	-	-	-	-	-	-	(26)	-	-
	150fm-700fm	93	-	-	93	-	67	(1)	(1)	(3)	-	186	(10)	76
	Total	174	11	50	112	-	67	3	6	4	1	253	(10)	151
	Δ%	9.7	5.3	51.1	7.5	-	123.0	0.4	10.5	2.1	1.1	8.9	(0.2)	3.1
Cape Blanco to Cape Mendocino	0fm-30fm	1	0	-	0	-	-	-	-	-	-	-	-	-
	30fm-100fm	63	11	-	52	-	(1)	(0)	-	5	4	8	29	-
	100fm-150fm	0	-	-	0	-	0	0	-	-	-	-	-	-
	150fm-700fm	142	1	-	141	-	23	0	22	18	18	521	632	447
	>700fm	3	-	-	3	-	2	-	-	-	1	-	-	-
	Total	209	12	-	197	-	24	0	22	23	23	529	661	447
	Δ%	59.7	664.7	-	56.6	-	20.8	0.1	129.4	104.5	191.7	96.4	109.4	2483.3
Cape Mendocino to Pt Conception	0fm-30fm	3	1	-	2	-	-	-	-	-	-	-	-	4
	30fm-100fm	0	27	0	(27)	-	1	-	48	55	14	(7)	28	(33)
	100fm-150fm	-	-	-	-	-	-	-	-	-	-	-	-	-
	150fm-700fm	247	47	-	200	-	29	6	22	19	35	(2)	74	(6)
	>700fm	(10)	(0)	-	(10)	-	(7)	-	-	-	-	-	-	-
	Total	240	75	0	165	-	23	6	70	74	49	(9)	102	(35)

Latitudinal Zone	Depth Zone	METRICS												
		Spatial extent (mi2)	Substrate Type (mi^2)				Priority Habitats							
							Canyon	OFS	Habitat-Forming Invertebrates					
									Presence			Bycatch		
			Hard	Mixed	Soft	Unknown			DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
	Δ%	7.2	12.3	4.2	6.2	-	8.4	133.8	22.6	21.4	10.4	(2.9)	28.7	(17.1)
Pt Conception to US/Mexico Border	0fm-30fm	-	-	-	-	-	-	-	-	-	-	-	-	-
	30fm-100fm	-	-	-	-	-	-	-	-	-	-	-	-	-
	100fm-150fm	-	-	-	-	-	-	-	-	-	-	-	-	-
	150fm-700fm	-	-	-	-	-	-	-	-	-	-	-	-	-
	>700fm	-	-	-	-	-	-	-	-	-	-	-	-	-
	Δ%	-	-	-	-	-	-	-	-	-	-	-	-	-
Grand Total		749	97	51	600	-	209	9	100	104	75	867	961	626
Coastwide Δ%		5.2	7.4	14.7	4.7	-	27.0	0.9	10.3	6.9	8.0	17.2	13.3	10.8

Table A-8. Alternative 1.a, the Collaborative Alternative, habitat metrics for polygons. Color codes indicate extent of priority habitat in each polygon (see Section 1). "-" = true zero. 0 = <1 mi^2.

Polygon Name	Spatial Extent (mi^2)	Sediment				Priority Habitats							
						Canyon	OFS	Habitat-Forming Invertebrates					
								Presence			Bycatch		
		Hard	Mixed	Soft	Unknown			DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
Proposed Closures													
Arago Reef	67	11	50	6	-	-	-	5	6	-	-	-	-
Ascension Canyonhead	6	0	-	6	-	4	-	5	5	5	-	1	1
Astoria Deep	39	-	-	39	-	14	-	-	-	-	6	10	6
Big Sur Coast Modification	45	28	-	17	-	-	-	-	-	3	-	19	-
Biogenic 2 Northern Modification	44	-	-	44	-	23	-	-	1	-	88	96	63
Blunts Reef Modification	9	3	-	6	-	2	-	1	1	-	-	-	-
Brush Patch	46	-	-	46	-	0	-	11	11	4	470	471	346
Cordell Bank Modification 1	4	0	0	3	-	-	-	2	-	-	-	-	-
Cordell Bank Modification 2	4	1	-	3	-	-	-	7	-	5	-	-	-
Eel River Canyon Modification 2	2	-	-	2	-	2	0	2	1	2	-	18	-
Eel River Canyon Modification 4	11	-	-	11	-	7	-	1	-	1	-	-	-
Farallon Escarpment	126	-	-	126	-	10	-	2	2	-	-	-	-
Farallon Islands Modification	6	3	-	3	-	-	-	3	5	2	-	-	-
Gobbler's Knob	2	-	2	0	-	-	-	-	-	-	-	-	-
Grays Canyon Southern Modification	13	0	-	12	-	-	7	2	3	1	106	9	36
Mad River Rough Patch	5	1	-	4	-	1	0	5	3	3	-	3	-
MBNMS Ascension and Ano Nuevo Canyon Complex	20	5	-	14	-	14	-	6	5	6	-	47	-
MBNMS Between Partington Point and Lopez Point	74	-	-	74	-	20	-	2	2	11	-	-	-
MBNMS La Cruz Canyon	9	7	-	2	-	-	-	1	2	-	-	-	-
MBNMS Outer Soquel Canyon	6	2	-	4	-	1	-	16	19	17	-	-	-

Polygon Name	Spatial Extent (mi^2)	Sediment				Priority Habitats							
						Canyon	OFS	Habitat-Forming Invertebrates					
								Presence			Bycatch		
		Hard	Mixed	Soft	Unknown			DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
MBNMS Point Sur Platform	11	8	-	3	-	-	-	9	10	4	-	28	4
MBNMS South of Davenport	6	3	-	3	-	-	-	16	20	14	-	-	-
MBNMS Southwest of Smooth Ridge	6	-	-	6	-	-	-	1	-	4	-	-	-
MBNMS Triangle South of Surveyors Knoll	9	1	-	9	-	-	-	1	-	3	-	-	-
MBNMS West of Piedras Blancas SMCA	3	0	-	3	-	-	-	-	-	1	-	-	-
MBNMS West of Sobranes Point	24	-	-	24	-	5	-	-	-	1	-	18	1
Mendocino Ridge Modification 1	12	12	-	0	-	-	6	-	-	-	-	15	-
Mendocino Ridge Modification 3	10	0	-	10	-	-	-	1	1	1	-	16	-
Navarro Canyon	18	-	-	18	-	-	-	-	-	2	-	-	-
Nitinat Canyon	82	-	-	82	-	73	-	2	2	2	6	112	-
Pescadero Reef	3	1	-	2	-	-	-	-	-	-	-	-	4
Pigeon Point Reef	10	1	-	8	-	-	-	-	-	-	-	-	-
Point Arena South Modification 2	6	-	-	6	-	-	-	1	-	1	-	-	-
Point Arena South Modification 3	6	0	-	6	-	-	-	-	1	-	-	-	-
Point Reyes Reef	8	3	0	5	-	-	-	-	-	-	-	-	-
Rittenburg Bank	10	1	-	9	-	-	-	5	6	6	-	-	-
Rogue River Reef	63	10	-	53	-	-	0	-	5	5	8	46	-
Saint George Reef	1	0	-	1	-	-	-	-	-	-	-	-	-
Spanish Canyon Line Adjustment 2	5	-	-	5	-	-	-	-	-	-	-	-	-
The Football	2	-	-	2	-	-	-	3	5	1	15	-	-
Trinidad Canyon	88	-	-	88	-	20	-	3	3	8	51	147	101
Willapa Deep	63	-	-	63	-	59	-	-	-	-	180	-	99

Polygon Name	Spatial Extent (mi^2)	Sediment				Priority Habitats							
						Canyon	OFS	Habitat-Forming Invertebrates					
								Presence			Bycatch		
		Hard	Mixed	Soft	Unknown			DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
WIllapa Shelf	8	0	-	8	-	-	-	-	-	1	24	-	59
Proposed Reopenings													
Bandon High Spot Northern Modification	12	1	-	10	-	-	3	3	3	2	39	7	-
Bandon High Spot Southern Modification	9	3	-	7	-	-	2	1	1	2	40	-	-
Cordell Bank Modification 3	20	-	-	20	-	-	-	-	-	23	-	-	37
Delgada Canyon	8	0	-	8	-	5	-	-	-	-	15	-	-
Eel River Canyon Modification 1	2	-	-	2	-	2	0	-	-	1	-	23	-
Eel River Canyon Modification 3	4	-	-	4	-	4	-	-	-	-	-	-	-
Grays Canyon Western Modification	9	-	-	9	-	6	1	1	3	-	-	20	29
MBNMS East of Sur Ridge	27	-	-	27	-	1	-	1	-	4	-	-	-
MBNMS Lower Portion of Cabrillo Canyon	17	0	-	17	-	14	-	1	-	1	-	-	-
MBNMS South of Mars Cable	1	-	-	1	-	0	-	1	-	1	-	-	-
MBNMS Sur Canyon Slot Canyons	45	0	-	44	-	9	-	-	-	2	-	-	1
MBNMS West of Carmel Canyon	9	-	-	9	-	-	-	1	1	1	-	-	5
Mendocino Ridge Modification 2	3	0	-	3	-	-	-	2	2	1	-	26	1
Point Arena South Modification 1	74	-	-	74	-	-	-	-	3	4	-	-	-
Point Arena South Modification 4	1	-	-	1	-	-	-	-	1	-	-	-	-
Spanish Canyon Line Adjustment 1	5	-	-	5	-	4	-	-	-	-	-	-	-

6.1 Alternative 1.b, the Oceana et al. Alternative L2

6.1.1 Geographic Break Analysis L3

Table A-9 and Table A-10 show the habitat metrics summarized by latitudinal zone and depth zone. Table A-11 shows the habitat metrics for each geographic break

6.1.2 Polygon analysis. L3

The habitat metrics for each polygon in Alternative 1.b, the Oceana et al. Alternative are found in Table A-12. They will not be discussed in detail, but they are provided here as additional information.

This alternative would contain 61 proposed closures and 7 proposed reopenings. The closures would range in size from 2 mi^2 (MBNMS south of Mars Cable) to 16,184 mi^2 (Southern California Bight). Of the other closures, 12 would be less than 10 mi^2, 26 would be between 10 mi^2 and 50 mi^2, 11 would be between 50 mi^2 and 100 mi^2, and 1, Farallon Escarpment, would be more than 100 mi^2.

The seven reopenings would range from 1 mi^2 (MBNMS south of Mars Cable) to 45 mi^2 (MBNMS Sur Canyon Slot canyons).

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Table A-9. Alternative 1.b, the Oceana et al. Alternative, net habitat metrics (closures minus reopenings), summarized by latitudinal zone. Values in underlined italics are lowest for that metric, and values in bold italics are highest for that metric, among the latitudinal zones. Δ% = net change from No-action Alternative. "-"= true zero. 0 mi2 = <1 mi^2; 0.0% = <0.1%. ** = 0 in No-action Alternative. Values in parentheses are negative.

Latitud+A17:O33inal Zone		METRICS													
		Spatial extent (mi2)	Substrate Type (mi^2)				Priority Habitats								
							Canyon	OFS	Habitat-Forming Invertebrates						
									Presence			Bycatch			
			Hard	Mixed	Soft	Unknown			DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
Cape Flattery to Pt Chehalis	mi^2	*143*	-	-	*143*	-	105	0	*3*	*7*	*2*	173	229	76
	Δ%	9.5	-	-	10.6	-	48.4	0.0	3.8	3.2	2.4	13.1	25.8	10.0
Pt Chehalis to Cape Blanco	mi^2	1,336	233	***143***	960	-	178	***34***	45	128	79	***3,487***	***2,789***	***2,453***
	Δ%	74	113	145	64	**	328	5	79	67	88	122	52	51
Cape Blanco to Cape Mendocino	mi^2	519	*19*	-	499	0	*94*	17	39	38	47	1,629	1,524	735
	Δ%	148	1,102	**	143	**	82	10	229	173	392	297	252	4,083
Cape Mendocino to Pt Conception	mi^2	881	150	7	724	-	114	10	106	142	153	141	432	396
	Δ%	27	25	68	27	-	42	234	34	41	33	45	122	193
Pt Conception to US/Mexico Border	mi^2	***11,360***	***540***	-	***10,776***	***44***	***269***	-	***181***	***652***	***199***	-	-	-
	Δ%	2	1	-	2	4	2	**	0	1	1	**	**	**
Grand Total	mi^2	14,238	943	149	13,102	44	760	61	374	967	480	5,430	4,974	3,660
	Δ%	98.3	71.7	43.2	102.6	80.4	98.0	6.4	38.7	64.3	51.2	107.9	68.8	63.2

Table A-10. Alternative 1.b, the Oceana et al. Alternative, net habitat metrics (closures minus reopenings), summarized by depth zone. Values in underlined italics are lowest for that metric and values in bold italics are highest for that metric, among the latitudinal zones. Δ% = net change from No-action Alternative. "-"= true zero. 0 mi2 = <1mi2; 0.0% = <0.1%. ** = 0 in No-action Alternative. Values in parentheses are negative.

Depth Zone		METRICS													
		Spatial extent (mi2)	Substrate Type (mi^2)				Priority Habitats								
							Canyon	OFS	Habitat-Forming Invertebrates						
									Presence			Bycatch			
			Hard	Mixed	Soft	Unknown			DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen	
0-30 fm	mi^2	3	1	1	1	-	-	-	1	1	-	-	-	-	
	Δ%	0.7	3.3	9.0	0.3	-	**	**	2.9	4.8	-	**	**	**	
30-100fm	mi^2	975	269	***125***	582	0	10	***40***	82	152	110	369	549	389	
	Δ%	51	80	112	40	1	84	72	41	48	55	203	89	110	
100-150fm	mi^2	1	0	0	1	0	0	0	1	1	1	1	1	-	
	Δ%	0	0	0	0	26	0	0	0	0	0	0	0	-	
150-700fm	mi^2	***13,264***	***673***	23	***12,524***	***43***	***752***	21	***290***	***813***	***369***	***5,060***	***4,424***	***3,271***	
	Δ%	142	78	18	151	106	136	21	76	131	90	182	102	110	
>700fm	mi^2	*(5)*	*(0)*	-	*(5)*	-	*(3)*	-	-	-	-	-	-	-	
	Δ%	**	**	**	**	**	**	**	**	**	**	**	**	**	
Grand Total	mi^2	14,238	943	149	13,102	44	760	61	374	967	480	5,430	4,974	3,660	
	Δ%	98.3	71.7	43.2	102.6	80.4	98.0	6.4	38.7	64.3	51.2	107.9	68.8	63.2	

Table A-11 Alternative 1.b, the Oceana et al. Alternative, net habitat metrics (closed minus reopen) by geographic break. Δ% = net change from No-action Alternative. "-"= true zero. 0 mi2 = <1mi2; 0.0% = <0.1%. Values in parentheses are negative.

Latitudinal Zone	Depth Zone	METRICS												
		Spatial extent (mi2)	Substrate Type (mi^2)				Priority Habitats							
							Canyon	OFS	Habitat-Forming Invertebrates					
									Presence			Bycatch		
			Hard	Mixed	Soft	Unkn			DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
Cape Flattery to Pt Chehalis	0fm-30fm	-	-	-	-	-	-	-	-	-	-	-	-	-
	30fm-100fm	0	-	-	0	-	-	0	-	-	-	-	-	-
	100fm-150fm	-	-	-	-	-	-	-	-	-	-	-	-	-
	150fm-700fm	143	-	-	143	-	105	-	3	7	2	173	229	76
	Total	143	-	-	143	-	105	0	3	7	2	173	229	76
	Δ%	9.5	-	-	10.6	-	48.4	0.0	3.8	3.2	2.4	13.1	25.8	10.0
Pt Chehalis to Cape Blanco	0fm-30fm	3	1	1	1	-	-	-	1	1	-	-	-	-
	30fm-100fm	659	225	124	310	-	0	25	20	61	23	353	476	356
	100fm-150fm	0	-	0	0	-	-	-	-	-	-	-	-	-
	150fm-700fm	673	8	18	648	-	178	9	24	66	56	3134	2313	2,097
	Total	0	0	0	0	-	0	0	0	0	0	0	0	0
	Δ%	74.4	113.1	144.7	64.4	-	328.0	4.7	78.9	67.4	87.8	122.1	51.8	51.1
Cape Blanco to Cape Mendocino	0fm-30fm	-	-	-	-	-	-	-	-	-	-	-	-	-
	30fm-100fm	46	10	-	35	-	6	15	1	3	2	22	48	-
	100fm-150fm	1	0	-	1	-	0	0	1	1	1	1	1	-
	150fm-700fm	472	9	-	464	0	88	2	37	34	44	1,606	1,475	735
	Total	519	19	-	499	0	94	17	39	38	47	1,629	1,524	735
	Δ%	148.1	1,101.9	=	143.4	**	81.9	9.9	229.4	172.7	391.7	296.7	252.3	4,083.3
Cape Mendocino to Pt Conception	0fm-30fm	0	-	-	0	-	-	-	-	-	-	-	-	-
	30fm-100fm	254	30	1	223	-	2	-	53	74	73	(6)	25	33
	100fm-150fm	-	-	-	-	-	-	-	-	-	-	-	-	-
	150fm-700fm	632	121	6	506	-	114	10	53	68	80	147	407	363
	>700fm	(5)	(0)	-	(5)	-	(3)	-	-	-	-	-	-	-
	Total	881	150	7	724	-	114	10	106	142	153	141	432	396
	Δ%	26.6	24.8	68.0	27.2	-	42.1	234.2	34.2	41.2	32.6	45.5	121.7	193.2

Latitudinal Zone	Depth Zone	METRICS												
		Spatial extent (mi2)	Substrate Type (mi^2)				Priority Habitats							
							Canyon	OFS	Habitat-Forming Invertebrates					
									Presence			Bycatch		
			Hard	Mixed	Soft	Unkn			DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
Pt Conception to US/Mexico Border	0fm-30fm	-	-	-	-	-	-	-	-	-	-	-	-	-
	30fm-100fm	16	3	-	13	0	2	-	8	14	12	-	-	-
	100fm-150fm	0	-	-	-	0	-	-	-	-	-	-	-	-
	150fm-700fm	11343	536	-	10763	43	266	-	173	638	187	-	-	-
	Total	11360	540	-	10776	44	269	-	181	652	199	-	-	-
	Δ%	150.9	113.1	-	155.6	385.2	226.3	-	35.9	89.4	71.1	-	-	-
Grand Total		14238	943	149	13102	44	760	61	374	967	480	5430	4974	3660
Coastwide Δ%		98.3	71.7	43.2	102.6	80.4	98.0	6.4	38.7	64.3	51.2	107.9	68.8	63.2

** 0= in No-action Alternative

Table A12 Alternative 1.b, the Oceana et al. Alternative, habitat metrics for polygons. Color codes indicate extent of priority habitat in each polygon (see Section 1). "-" = true zero. 0 = <1 mi^2.

Polygon Name	Spatial Extent (mi^2)	Sediment				Priority Habitats							
						Canyons	OFS	Habitat-Forming Invertebrates					
								Presence			Bycatch		
		Hard	Mixed	Soft	Unknown								
		mi2	mi2	mi2	mi2	mi2	mi2	DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
Proposed Closures													
Ano Nuevo Canyonhead	2	0	-	2	-	2	-	2	4	2	-	-	-
Ascension Canyonhead	4	0	-	4	-	3	-	6	5	6	-	-	-
Astoria Canyonhead	18	-	-	18	-	14	12	-	2	-	39	-	126
Astoria Footprint Modification	379	-	-	379	-	174	-	9	27	25	1,616	813	1,276
Blunt Reef Expansion	9	3	-	6	-	2	-	1	1	-	-	-	-
Cabrillo Canyon	31	1	-	30	-	14	-	1	2	-	10	-	-
Cape Arago Reef	127	11	90	26	-	-	0	6	9	3	-	4	1
Cascadia Shelf Hotspot	152	-	-	152	-	-	52	2	29	17	732	1,107	970
Cochrane Bank	9	4	-	6	-	-	-	3	5	3	-	-	-
Cordell Bank Expansion	71	6	0	65	-	-	-	9	-	14	-	-	31
Crescent City Deepwater Hotspot	52	-	-	52	-	9	-	6	6	4	514	528	265
Delgada Canyon Deep	69	-	-	69	-	39	-	2	1	6	-	-	8
East Santa Lucia Bank (Northwest Expansion)	114	48	-	66	-	-	-	3	11	13	-	58	147
East Santa Lucia Bank (Southeast Expansion)	57	17	-	41	-	-	-	-	-	4	28	67	98
Eureka Footprint Modification	157	-	-	157	-	42	-	5	8	14	522	407	255
Fanny Shoals Shelf Extension	27	1	0	26	-	-	-	-	-	2	-	-	-
Farallon Escarpment to Pioneer Canyon Deep	173	-	-	173	-	22	-	4	3	6	-	-	-
Gobbler's Knob	18	-	11	7	-	1	-	4	5	7	-	-	-
Grays Canyon	20	0	-	19	-	-	11	2	3	1	146	22	63
Heceta Bank	329	153	17	159	-	-	-	4	31	5	44	373	241

Polygon Name	Spatial Extent (mi^2)	Sediment				Priority Habitats							
						Canyons	OFS	Habitat-Forming Invertebrates					
								Presence			Bycatch		
		Hard	Mixed	Soft	Unknown								
		mi2	mi2	mi2	mi2	mi2	mi2	DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
Heceta Bank West	68	10	22	36	-	0	9	2	8	1	211	402	137
Hydrate Ridge/ Central OR Footrpint Modification	197	7	-	190	-	-	-	9	8	13	844	539	-
La Cruz Canyon to Piedras Blancas	37	8	-	29	-	-	-	1	3	2	-	-	-
MBNMS Ascension and Ano Nuevo Canyon Complex / ONO Lower portion of Ascension and Ano Nuevo canyons	20	5	-	14	-	14	-	6	5	6	-	44	-
MBNMS Between Partington Point and Lopez Point	74	-	-	74	-	20	-	2	2	11	-	-	-
MBNMS Outer Soquel Canyon	6	2	-	4	-	1	-	16	19	17	-	-	-
MBNMS Point Sur Platform / ONO Sur Platform Rocks	11	8	-	3	-	-	-	9	10	4	-	24	2
MBNMS South of Davenport	6	3	-	3	-	-	-	16	20	14	-	-	-
MBNMS SW of Smooth Ridge	6	-	-	6	-	-	-	1	-	4	-	-	-
MBNMS Triangle S of Surveyors Knoll	9	1	-	9	-	-	-	1	-	3	-	-	-
MBNMS W of Sobranes Point	24	-	-	24	-	5	-	-	-	1	-	21	2
Mendocino Ridge Expansion	78	48	-	29	-	-	10	9	12	2	98	187	70
N. Daisy Bank	19	-	7	11	-	-	1	2	8	2	-	107	157
N. Eel River Canyon	23	-	-	23	-	10	1	5	4	2	-	194	-
N. Stonewall Bank	58	24	-	34	-	-	-	-	7	2	-	-	-
Navarro Canyon	25	-	-	25	-	-	-	3	2	2	-	-	-
Noyo Canyonhead	6	0	-	6	-	5	-	3	3	1	-	-	-

Polygon Name	Spatial Extent (mi^2)	Sediment				Priority Habitats							
						Canyons	OFS	Habitat-Forming Invertebrates					
		Hard	Mixed	Soft	Unknown			Presence			Bycatch		
		mi2	mi2	mi2	mi2	mi2	mi2	DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
Olympic Footprint Modification	97	-	-	97	-	82	-	3	6	2	81	125	13
Pescadero Reef	7	1	-	6	-	-	-	-	-	-	-	-	-
Pioneer Canyon	13	-	-	13	-	11	-	1	1	3	-	31	47
Pioneer Canyonhead	14	-	-	14	-	-	-	-	-	2	-	-	-
Pt Arena Biogenic South Expansion	7	0	-	7	-	-	-	-	1	-	-	-	-
Pt. Arena Canyonheads	6	-	-	6	-	1	-	-	-	-	-	28	-
Pt. Arguello	90	-	-	90	-	0	-	2	13	17	-	-	-
Pt. Buchon	49	1	0	48	-	-	-	-	7	6	-	-	-
Quinault Canyon	45	-	-	45	-	23	-	-	1	-	92	104	63
Reading Rock Canyonheads	29	-	-	29	-	7	26	1	1	2	70	-	-
Rittenberg Bank	17	1	-	16	-	-	-	5	6	8	-	-	-
Rogue Canyonhead	26	10	-	16	-	5	0	-	2	-	-	57	-
Russian River	20	-	-	20	-	-	-	3	8	4	49	3	-
S. Eel River Canyon	18	-	-	18	-	9	6	-	3	-	-	14	6
S. Nehalem Reef	104	28	3	73	-	-	13	8	8	11	-	21	12
S. Oregon Footrpint Modifcation	129	-	-	129	0	17	-	7	4	11	523	228	80
Samoa Deepwater	101	7	-	94	-	5	-	8	7	10	47	123	129
Samoa Reef	16	2	-	14	-	2	6	7	5	3	-	7	-
Saunders Reef	33	-	-	33	-	-	-	-	-	3	-	-	-
Siletz Hotspot	59	0	18	41	-	-	8	6	14	13	404	614	445
South Delgada Canyonheads	14	-	-	14	-	5	-	-	-	1	-	-	-
Southern CA Bight	16184	853	38	15,246	46	337	-	390	959	293	-	-	-
Spanish Canyon	28	0	-	28	-	3	-	2	3	2	38	94	-
Willapa Canyonhead	44	6	-	39	-	6	16	1	1	2	21	157	89
Proposed Reopenings													
Delgada Canyon Reopening	2	0	-	2	-	-	-	-	-	-	6	-	-

Polygon Name	Spatial Extent (mi^2)	Sediment				Priority Habitats							
						Canyons	OFS	Habitat-Forming Invertebrates					
		Hard	Mixed	Soft	Unknown			Presence			Bycatch		
		mi2	mi2	mi2	mi2	mi2	mi2	DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
MBNMS E of Sur Ridge	27	-	-	27	-	1	-	1	-	4	-	1	-
MBNMS Lower Portion of Cabrillo Canyon	17	0	-	17	-	14	-	1	-	1	-	-	3
MBNMS S of Mars Cable	1	-	-	1	-	0	-	1	-	1	-	-	-
MBNMS Sur Canyon Slot Canyons	45	0	-	44	-	9	-	-	-	2	-	-	-
MBNMS W of Carmel Canyon	9	-	-	9	-	-	-	1	1	1	-	-	6
Pt. Arena Biogenic Reopening	42	-	-	42	-	-	-	-	1	4	-	-	-

Alternative 1.c, the MTC Alternative L2

Geographic Break L3

Tables A-13 shows the habitat metrics summarized by depth zone.

Polygon analysis L3

The MTC Alternative would contain nine proposed closures and four proposed reopenings. The closures would range in size from less than1 mi^2 (the Shale Pile East Side and the Daisy Bank Southern Modification) to 69 mi^2 (the Heceta Bank Northeastern Modification) (Table A-14).

The four reopenings would range in size from 3 mi^2 (Daisy Bank Western Modification) to 5 mi^2 (the Shale Pile Northeast Side and the Daisy Bank Southeastern Modification)

Table A-13. Alternative 1.c, the MTC Alternative, net habitat metrics (closures minus reopenings), summarized by depth zone. Values in underlined italics are lowest for that metric and values in bold italics are highest for that metric, among the latitudinal zones. Δ% = net change from No-action Alternative. "-"= true zero. 0 mi2 = <1mi2; 0.0% = <0.1%. ** = 0 in No-action Alternative. Values in parentheses are negative.

Depth Zone		METRICS												
		Spatial extent (mi2)	Substrate Type (mi^2)				Priority Habitats							
							Canyon	OFS	Habitat-Forming Invertebrates					
									Presence			Bycatch		
			Hard	Mixed	Soft	Unknown			DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
0-30 fm	mi^2	-	-	-	-	-	-	-	-	-	-	-	-	-
	Δ%	-	-	-	-	-	-	-	-	-	-	-	-	-
30-100fm	mi^2	102	65	4	33	-	-	(1)	7	17	6	-	42	25
	Δ%	23.7	221.4	45.9	8.5	-	-	**	20.0	81.0	75.0	-	**	**
100-150fm	mi^2	-	-	-	-	-	-	-	-	-	-	-	-	-
	Δ%	-	-	-	-	-	-	-	-	-	-	-	-	-
150-700fm	mi^2	(0)	-	(0)	(0)	-	-	-	-	-	-	-	-	-
	Δ%	(0.0)	-	(0.0)	(0.0)	-	-	-	-	-	-	-	-	-
Grand Total	mi^2	102	65	4	33	-	-	(1)	7	17	6	-	42	25
	Δ%	1	8	3	0	-	-	(1)	2	3	1	-	1	1

Table A-14. Alternative 1.c, the MTC Alternative, habitat metrics for polygons. Color codes indicate extent of priority habitat in each polygon (see Section 1). "-" = true zero. 0 = <1 mi^2.

Polygon Name	Spatial Extent (mi^2)	Sediment (mi^2)				Priority Habitats							
						Canyon (mi^2)	OFS (mi^2)	Habitat-Forming Invertebrates					
								Presence			Bycatch		
		Hard	Mixed	Soft	Unknown			DSC	Sponge	Sea Pen	DSC	Sponge	Sea Pen
Proposed Closures													
Daisy Bank Northern Modification	5	-	3	2	-	-	1	1	5	-	-	30	42
Daisy Bank Southern Modification	1	-	1	0	-	0	-	-	1	-	-	-	-
Garibaldi Reef North	15	7	0	7	-	-	-	5	3	4	-	19	9
Garibaldi Reef South	3	0	0	2	-	-	-	-	-	-	-	1	-
Heceta Bank Northeastern Modification	69	46	-	23	-	-	-	1	10	1	-	-	-
Heceta Bank Southeastern Modification	2	1	1	1	-	-	-	-	-	-	-	-	-
Heceta Bank Southern Modification	5	2	3	1	-	-	-	1	2	-	-	22	16
Shale Pile East Side	1	0	-	0	-	-	-	-	-	-	-	-	-
Stonewall Bank Northwestern Modification	21	9	-	12	-	-	-	-	3	1	-	-	-
Proposed Reopenings													
Daisy Bank Southeastern Modification	5	-	2	3	-	-	-	1	4	-	-	30	27

Daisy Bank Western Modification	3	-	0	3	-	-	-	1	3	-	-	20	19
Shale Pile Northeast Side	5	0	-	5	-	-	1	-	1	-	-	-	-
Stonewall Bank Southern Modification	8	0	-	8	-	-	-	-	-	-	-	-	-

Appendix B
Habitat Metrics - Habitat Forming Invertebrates

Appendix C
Landings and Revenues by Alternative and by Polygon

Appendix D
Additional Methodology Descriptions

D-1 Data Source Selection Process for Catch, Revenue, and Protected Resources
D-2 Discrete Area Closure (DAC) Methodology/Hotspot Analysis

Appendix E
Proposals for EFHCA Changes