Appendix C

Comprehensive Collaborative Alternative
Protecting Essential Fish Habitat in the Pacific While Maintaining Fisheries

October 2004

Summary 6
Need for Action 6
Spatial Management Measures 7
Areas Open to Bottom Trawling 7
Areas Closed to Bottom Trawling 8
Figure 42: Map of proposed areas open and closed to bottom trawling. 9
Table 42: Criterion for identifying areas of interest 10
Description of Selection Criterion 13
Hard Substrate 13
Habitat-forming invertebrates 13
Figure 43: Trawl survey track crossed by Delta submersible transects on Heceta Bank 16
Figure 44: Point density analysis of coral and sponge records. 17
Table 43: Number of coral and sponge observations within closed bottom trawl areas 18
Untrawlable areas 18
Submarine canyons 19
Seamounts 20
EFH habitat types of the Areas Closed to Bottom Trawling 22
Habitat Composition of Areas Closed to Bottom Trawling 22
Table 44: Proportion of hard and soft substrate within proposed areas 22
Table 45: Proportion of identified habitat types within proposed areas 23
Preliminary Economic Analysis Based on Available Data 24
Determination of Trawl Footprint 24
Rockfish Conservation Areas and Economic Analysis 24
Figure 45: Overlap of Rockfish Conservation Area with Proposed Areas 25
Economic Analysis of Trawl Area Closures 25
Table 46: Estimated annual displaced bottom trawl revenue (ex-vessel value in dollars) of closed areas using total block method and proportional closure method. 28
Table 47: Total Pacific Coast Bottom Trawl Fleet catches and ex-vessel revenue 2000-2003 29
Conclusion 30
APPENDIX 1: Description of individual areas 31
1) Olympic_1 32
Figure 1: Criterion used in determination of Olympic_1 area closed to bottom trawling 32
Table 1: Habitat types protected by Olympic_1 closed area, determined from EFH GIS data 33
33
2) Olympic_2 34
Figure 2: Criterion used in determination of Olympic_2 area closed to bottom trawling 34
Table 2: Habitat types protected by Olympic_2 closed area, determined from EFH GIS data 34
3) Biogenic Area_1 35
Figure 3: Criterion used in determination of Biogenic Area_1 area closed to bottom trawling 35
Table 3: Habitat types protected by Biogenic Area_1 closed area, determined from EFH GIS data 35
4) Biogenic Area_2 36
Figure 4: Criterion used in determination of Biogenic Area_2 area closed to bottom trawling 36
Table 4: Habitat types protected by Biogenic Area_2 closed area, determined from EFH GIS data 36
5) Grays Canyon 37
Figure 5: Criterion used in determination of Grays Canyon area closed to bottom trawling 37
Table 5: Habitat types protected by Grays Canyon closed area, determined from EFH GIS data 37
6) Biogenic Area_3 38
Figure 6: Criterion used in determination of Biogenic Area_3 area closed to bottom trawling 38

Table 6: Habitat types protected by Biogenic Area_3 closed area, determined from EFH GIS data 38
7) Astoria Canyon 39
Figure 7: Criterion used in determination of Astoria Canyon area closed to bottom trawling..... 39
Table 7: Habitat types protected by Astoria Canyon closed area, determined from EFH GIS data. 40
8) Ridges_Biogenic Area_5..... 41
Figure 8: Criterion used in determination of Ridges_biogenic_area_5 area closed to bottom trawling 41
Table 8: Habitat types protected by Ridges_biogenic_area_5 closed area, determined from EFH GIS data..... 41
9) Biogenic Area_6 42
Figure 9: Criterion used in determination of Biogenic area_6 area closed to bottom trawling 42
Table 9: Habitat types protected by Biogenic area_6 closed area, determined from EFH GIS data 42
10) Biogenic Area_7 43
Figure 10: Criterion used in determination of Biogenic area_7 area closed to bottom trawling 43
Table 10: Habitat types protected by Biogenic area_7 closed area, determined from EFH GIS data 43
11) Biogenic Area_8 44
Figure 11: Criterion used in determination of Biogenic_area_8 area closed to bottom trawling 44
Table 11: Habitat types protected by Biogenic_area_8 closed area, determined from EFH GIS data 44
12) Daisy Bank..... 45
Figure 12: Criterion used in determination of Daisy Bank area closed to bottom trawling 45
Table 12: Habitat types protected by Daisy Bank closed area, determined from EFH GIS data..... 45
13) Heceta Bank 46
Figure 13: Criterion used in determination of Heceta Bank area closed to bottom trawling 46
Table 13: Habitat types protected by Heceta Bank closed area, determined from EFH GIS data ... 47
14) Ridges_Biogenic Area_9..... 48
Figure 14: Criterion used in determination of Ridges_biogenic_area_9 area closed to bottom trawling 48
Table 14: Habitat types protected by Ridges_biogenic_area_9 closed area, determined from EFH GIS data..... 48
15) Ridges_Biogenic Area_10..... 49
Figure 15: Criterion used in determination of Ridges_biogenic_area_10 area closed to bottom trawling 49
Table 15: Habitat types protected by Ridges_biogenic_area_10 closed area, determined from EFH GIS data..... 49
16) Hard Bottom Feature_1 50
Figure 16: Criterion used in determination of Hard bottom feature_1 area closed to bottom trawling 50
Table 16: Habitat types protected by Hard bottom feature_1 closed area, determined from EFH GIS data 50
17) Rogue Canyon 51
Figure 17: Criterion used in determination of Rogue Canyon area closed to bottom trawling..... 51
Table 17: Habitat types protected by Rogue Canyon closed area, determined from EFH GIS data 52
18) Biogenic Area_11 53
Figure 18: Criterion used in determination of Biogenic area_11 area closed to bottom trawling 53
Table 18: Habitat types protected by Biogenic area_11 closed area, determined from EFH GIS data 53
19) Eel River Canyon..... 54
Figure 19: Criterion used in determination of Eel River Canyon area closed to bottom trawling.... 54

Table 19: Habitat types protected by Eel River Canyon closed area, determined from EFH GIS data 54
20) Mendocino Ridge 55
Figure 20: Criterion used in determination of Mendocino Ridge area closed to bottom trawling 55
Table 20: Habitat types protected by Mendocino Ridge closed area, determined from EFH GIS data 55
21) Hard Bottom Feature_2 56
Figure 21: Criterion used in determination of Hard bottom feature_2 area closed to bottom trawling 56
Table 21: Habitat types protected by Hard bottom feature_2 closed area, determined from EFH GIS data 56
22) Biogenic Area_12 57
Figure 22: Criterion used in determination of Biogenic area_12 area closed to bottom trawling 57
Table 22: Habitat types protected by Biogenic area_12 closed area, determined from EFH GIS data 57
23) Cordell Bank 58
Figure 23: Criterion used in determination of Cordell Bank area closed to bottom trawling 58
Table 23: Habitat types protected by Cordell Bank closed area, determined from EFH GIS data 59
24) Hard Bottom Feature_3 60
Figure 24: Criterion used in determination of Hard bottom feature_3 area closed to bottom trawling 60
Table 24: Habitat types protected by Hard bottom feature_3 closed area, determined from EFH GIS data 60
25) Hard Bottom Feature_4 61
Figure 25: Criterion used in determination of Hard bottom feature_4 area closed to bottom trawling 61
Table 25: Habitat types protected by Hard bottom feature_4 closed area, determined from EFH GIS data 61
26) Monterey Bay and Monterey Canyon 62
Figure 26: Criterion used in determination of Monterey Bay and Canyon area closed to bottom trawling 62
Table 26: Habitat types protected by Monterey Bay and Canyon closed area, determined from EFH GIS data 63
27) Hard Bottom Feature_5 64
Figure 27: Criterion used in determination of Hard bottom feature_5 area closed to bottom trawling 64
Table 27: Habitat types protected by Hard bottom feature_5 closed area, determined from EFH GIS data 64
28) Biogenic Area_13 65
Figure 28: Criterion used in determination of Biogenic area_13 area closed to bottom trawling 65
Table 28: Habitat types protected by Biogenic area_13 closed area, determined from EFH GIS data 65
29) Morro Ridge 66
Figure 29: Criterion used in determination of Morro Ridge area closed to bottom trawling 66
Table 29: Habitat types protected by Morro Ridge closed area, determined from EFH GIS data 66
30) Channel Islands 67
Figure 30: Criterion used in determination of Channel Islands area closed to bottom trawling 67
Table 30: Habitat types protected by Channel Islands closed area, determined from EFH GIS data 68
31) Cowcod Conservation Areas 69

Figure 31: Criterion used in determination of Cowcod conservation area_west area closed to bottom trawling 69
Table 31: Habitat types protected by Cowcod conservation area_west closed area, determined from EFH GIS data 70
32) Hard Bottom Feature_6 71
Figure 32: Criterion used in determination of Hard bottom feature_6 area closed to bottom trawling 71
Table 32: Habitat types protected by Hard bottom feature_6 closed area, determined from EFH GIS data 72
33) Cowcod Conservation Areas_East 73
Figure 33: Criterion used in determination of Cowcod conservation area_east area closed to bottom trawling 73
Table 33: Habitat types protected by Cowcod conservation area_east closed area, determined from EFH GIS data 73
34-41) Seamounts 74
34) Thompson Seamount 74
Figure 34: Criterion used in determination of Thompson Seamount area closed to bottom trawling 74
Table 34: Habitat types protected by Thompson Seamount closed area, determined from EFH GIS data 74
35) President Jackson Seamount 75
Figure 35: Criterion used in determination of President Jackson Seamount area closed to bottom trawling 75
Table 35: Habitat types protected by President Jackson Seamount closed area, determined from EFH GIS data 75
36) Taney Seamount 76
Figure 36: Criterion used in determination of Taney Seamount area closed to bottom trawling..... 76
Table 36: Habitat types protected by Taney Seamount closed area, determined from EFH GIS data 76
37) Gumdrop, (38) Pioneer and (39) Guide Seamount 77
Figure 37: Criterion used in determination of Gumdrop, Pioneer and Guide Seamount area closed to bottom trawling 77
Table 37: Habitat types protected by Gumdrop Seamount closed area, determined from EFH GIS data 77
Table 38: Habitat types protected by Pioneer Seamount closed area, determined from EFH GIS data 78
Table 39: Habitat types protected by Guide Seamount closed area, determined from EFH GIS data 78
40) Davidson Seamount 79
Figure 40: Criterion used in determination of Davidson Seamount area closed to bottom trawling 79
Table 40: Habitat types protected by Davidson Seamount closed area, determined from EFH GIS data 79
41) San Juan Seamount 80
Figure 41: Criterion used in determination of San Juan Seamount area closed to bottom trawling . 80
Table 41: Habitat types protected by San Juan Seamount closed area, determined from EFH GIS data 80
Bibliography of 231 References on the Identification and Protection of Essential Fish Habitat 81

APPENDIX 3: Points of Latitude and Longitude in Decimal Degrees (NAD 1983) Defining Vertices of Areas Closed to Bottom Trawling 92

Comprehensive Collaborative Alternative
Protecting Essential Fish Habitat in the Pacific While Maintaining Fisheries

Summary

The Comprehensive Alternative represents a thorough and practicable suite of fishery management measures designed using the best available scientific and economic data available to the public to mitigate the adverse effects of bottom trawling on Essential Fish Habitat off the U.S. West Coast. The approach protects habitat most at risk from bottom trawl damage and provides continued opportunity for commercial bottom trawl fisheries. The Alternative represents the best attempt to develop a practical management with the limited data provided by NMFS. The alternative meets these objectives by combining the following management measures:

1. **Spatial management** of bottom trawling by determining open and closed areas based on benthic habitat type, current trawl closures, distribution of vulnerable fish habitats, unique geological and topographic features, and the value of bottom trawl catch in each area.
2. **Catch reductions** which may be determined by the Council as appropriate.
3. **Expansion of current gear restrictions** to set maximum footrope sizes of 8 inches throughout the PFMC region.
4. **Monitoring of habitat damage** using Vessel Monitoring Systems and onboard observers that report bycatch of habitat-forming invertebrates, enabling fishery managers and the public to accurately evaluate the habitat impacts of individual trawl vessels and the trawl fleet as a whole.
5. **Benthic research and mapping** program to improve the spatial resolution of benthic habitat distribution and provide habitat use information for all life stages of all FMP species and other ecosystem indicator species to the highest degree possible.

The remainder of this document provides a detailed description of the methodology and the scientific justification for each module of the Comprehensive Alternative.

Need for Action

Bottom trawling off the Pacific Coast causes long-term, adverse impacts to fish habitat. There is general scientific consensus that bottom trawling has wide ranging effects on habitats and ecosystems. These include:

- changes in physical habitat of ecosystems
- changes in biologic structure of ecosystems
- reductions in benthic habitat complexity
- changes in availability of organic matter for microbial food webs
- changes in species composition
- reductions in biodiversity[1]

[1] National Research Council, "Effects of Trawling & Dredging on Seafloor Habitat" at 29.

Bottom trawling removes epifauna, thereby reducing habitat complexity and species diversity of the benthic community (Collie et al. 2000, Kaiser et al. 2000). According to the National Academy of Sciences, if disturbance from trawling exceeds the resiliency threshold, then irrevocable long-term ecological effects will occur (NAS 2002). Gravel pavement substrate disturbed by bottom trawling on Georges Bank in the Northeast Atlantic, for example, had significantly less emergent epifauna, shrimp, polychaetes, brittlestars, and small fish than undisturbed sites (Collie et al., 2000).

Bottom trawling decreases benthic productivity. Trawled areas of the North Sea, off the coast of Ireland, were significantly less productive when compared to untrawled areas of similar habitat type (Jennings et al. 2001). Areas disturbed by mobile fishing gear on Georges Bank had lower levels of benthic production (both biomass and energy) when compared to undisturbed areas (Hermsen et al. 2003).

Research from around the world indicates the destruction of living seafloor negatively impacts fish populations. Destruction of bryozoan growths by trawling in Tasman Bay, New Zealand resulted in a marked reduction in numbers of associated juvenile fish (Turner et al. 1999). Predation rate on juvenile Atlantic cod (*Gadus morhua*) increases with decreasing habitat complexity (Walters & Juanes 1993). Case studies in New Zealand and Australia suggested that loss of habitat structure through removal of large epibenthic organisms by fishing had negative effects on associated fish species (Turner et al. 1999). Dense aggregations of Pacific ocean perch (*Sebastes alutus*) and euphausiids were associated with biogenic habitats (sea whip groves) in a Bering Sea submarine canyon, while areas with damaged biogenic structures had far fewer rockfish, and areas in the canyon without biogenic structure had no rockfish (Brodeur 2001). Removal of epifaunal organisms may lead to the degradation of habitat such that it is no longer suitable for associated fish species (Auster et al. 1996).

In order to ensure long-term sustainability of our fisheries, management measures to protect habitat from the adverse effects of bottom trawling must be instituted now.

Spatial Management Measures

The spatial management measures of the Comprehensive Alternative define the areas that are open and closed to bottom trawling. These management measures are additive to existing closures. These areas are currently determined based on several criteria described in detail in the following sections. Areas closed to bottom trawling are based on the locations of sensitive and complex habitat areas and/or areas with low economic value to the bottom trawl fleet. Boundaries were drawn to minimize overlap with high value fishing areas and to closely follow the habitat features. The overall formulation of the spatial management measures is based on a combination of various data layers provided by NMFS and other data sources.

Areas Open to Bottom Trawling

The objective of defining areas in which bottom trawling is permitted is twofold:

1. To prevent further geographic expansion of bottom trawling, and
2. Limit the bottom trawl footprint to historically trawled areas of the most economic importance

This objective is driven by studies that demonstrate that the relative impacts of trawling are greater when areas are trawled for the first time or trawled infrequently (for example Dinmore et al. 2003).

To define the open bottom trawl areas, we examined bottom trawl records of groundfish catch occurring from 2000-2003 from the PACFIN dataset aggregated to 10-minute blocks with species or species group resolution and excluding any information which the Fisheries Service asserted is confidential. Data with a finer resolution is preferable and is much more useful for spatial analysis, but the public faces a tradeoff when requesting spatial fishery data from the Fisheries Service. Requesting data on a fine scale results in a significant loss of data, since the Fisheries Service withholds information if less than 3 fishing vessels operate in the area for which fishing information is requested. Given the constraints placed upon the data by the Fisheries Service, a spatial resolution of 10-minute blocks was selected to ensure consistency with the analyses performed by Terralogic and MRAG for the Pacific Groundfish EFH EIS and to minimize data loss due to confidentiality. A span of years from 2000-2003 was selected to reflect variability in annual trawl effort and the effort under current conditions. In 2000, a footrope restriction in some areas altered the distribution of trawl effort (Bellman and Heppell, in press). Trawl restrictions in the Rockfish Conservation Areas (RCA) also altered distribution of trawl effort over this period.

Areas of the open bottom trawl footprint do not supercede existing management closures, such as where the bottom trawl footprint overlaps areas of the RCA.

Areas Closed to Bottom Trawling

Closed areas can protect living habitats from damage by bottom trawling. In addition, closed areas can promote recovery in habitats already impacted by bottom trawling. Ideally placement of closed areas would occur across a range of vulnerable, representative habitat types (NRC 2002). Only year round bottom trawl closures for all species are considered to provide protection to EFH.

Within the area currently being bottom trawled, 41 areas of importance were identified using the following criteria:

- Hard substrate
- Habitat-forming invertebrates
- Canyons and Gullies
- Rocky Ridges
- Rocky Slopes
- Trawl hangs and abandoned trawl survey stations ("untrawlable area")
- Seamounts
- Highest 20% habitat suitability for overfished groundfish species

Pursuant to this draft Comprehensive Alternative, no bottom trawling would be permitted within the following 41 areas (Fig. 42). Table 42 shows the criterion used in the selection and boundary determination of each area. Appendix 1 provides a map and description of each area. Appendix 3 describes the latitude and longitude points of the vertices of the boundaries of the areas.

Figure 42: Map of proposed areas open and closed to bottom trawling.

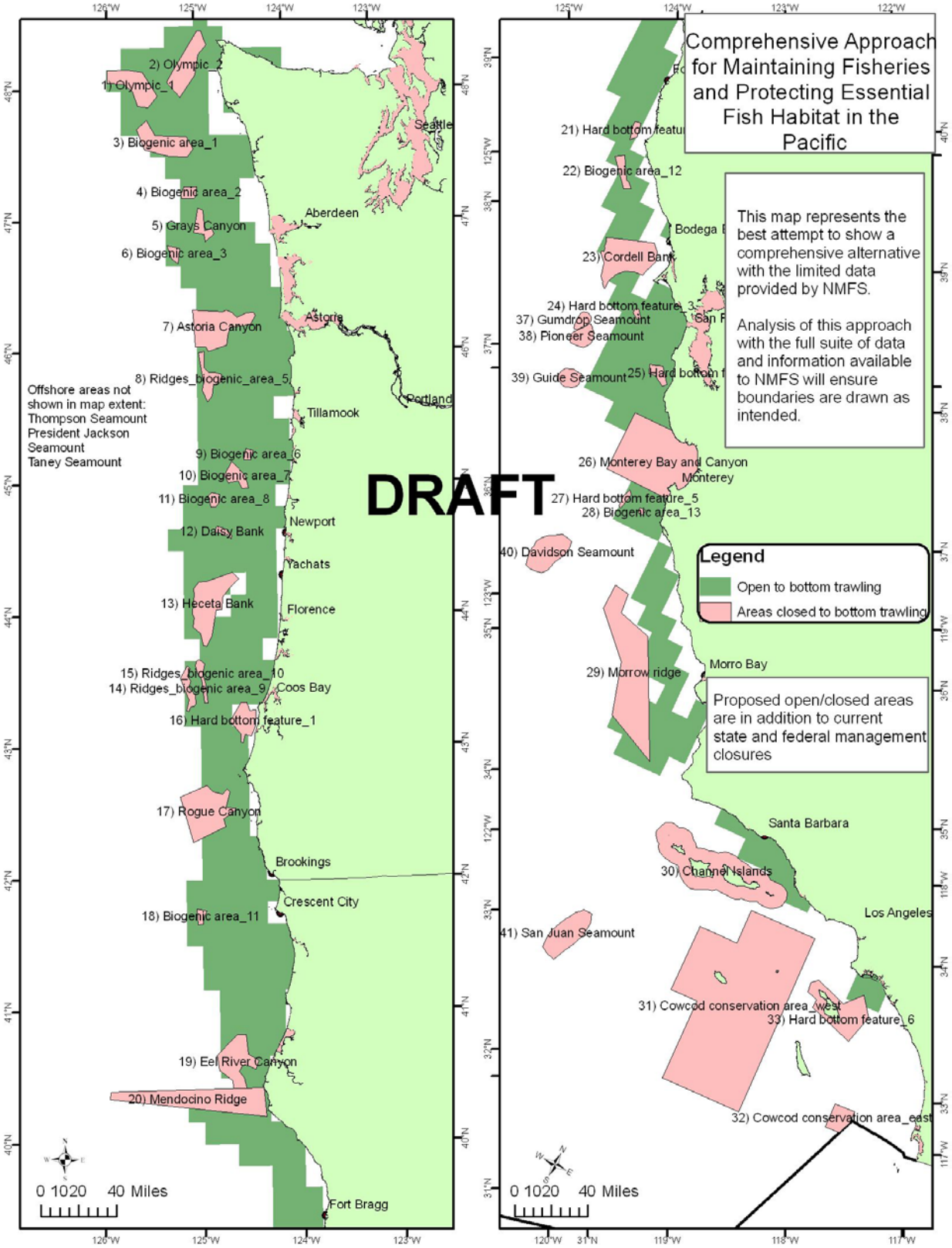

Table 42: Criterion for identifying areas of interest

	Proposed closed area	Hard substrate[1]	Documented structure forming invertebrates[2]	Canyon or gully habitat[1]	Rocky ridge habitat[1]	Rocky slope habitat[2]
1	Olympic_1	no*	yes	yes	no	no
2	Olympic_2	no*	yes	yes	no	no
3	Biogenic area_1	no	yes	yes	no	no
4	Biogenic area_2	no	yes	yes	no	no
5	Grays Canyon	no	yes	yes	no	no
6	Biogenic area_3	no	yes	no	no	no
7	Astoria Canyon	yes	yes	yes	yes	yes
8	Ridges_biogenic_area_5	yes	yes	no	yes	yes
9	Biogenic area_6	no	yes	no	no	no
10	Biogenic area_7	no	yes	no	no	no
11	Biogenic area_8	yes	yes	no	yes	yes
12	Daisy Bank	yes	yes	no	yes	yes
13	Heceta Bank	yes	yes	yes	yes	yes
14	Ridges_biogenic area_9	yes	yes	no	no	yes
15	Ridges_biogenic area_10	yes	yes	no	yes	yes
16	Hard bottom feature_1	yes	yes	no	no	yes
17	Rogue Canyon	yes	yes	yes	no	yes
18	Biogenic area_11	no	yes	yes	no	no
19	Eel River Canyon	yes	yes	yes	yes	no
20	Mendocino Ridge	yes	yes	yes	yes	no
21	Hard bottom feature_2	yes	no	no	no	no
22	Biogenic area_12	yes	yes	no	no	no
23	Cordell Bank	yes	yes	yes	no	no
24	Hard bottom feature_3	yes	yes	yes	no	no
25	Hard bottom feature_4	yes	no	no	no	no
26	Monterey Bay and Canyon	yes	yes	yes	no	yes
27	Hard bottom feature_5	yes	no	yes	yes	no
28	Biogenic area_13	yes	yes	no	no	no
29	Morro ridge	yes	yes	no	yes	yes
30	Channel Islands	yes	yes	yes	yes	yes
31	Cowcod conservation area_west	yes	yes	yes	yes	yes
32	Hard bottom feature_6	yes	yes	yes	yes	yes
33	Cowcod conservation area_east	no	no	no	yes	no
34	Thompson Seamount	unk**	no	unk**	unk**	unk**
35	President Jackson Seamount	unk**	no	no	no	no
36	Taney Seamount	unk**	no	no	no	no
37	Gumdrop Seamount	yes	yes	yes	yes	no
38	Pioneer Seamount	yes	yes	yes	yes	no
39	Guide Seamount	yes	no	yes	yes	yes
40	Davidson Seamount	yes	yes	yes	yes	no
41	San Juan Seamount	yes	no	no	yes	no

Table 42: Continued….

	Proposed closed area	Trawl hangs[3]	Abandoned survey stations[3]	Highest 20% habitat suitability for overfished species[4]
1	Olympic_1	yes	yes	yes
2	Olympic_2	yes	yes	yes
3	Biogenic area_1	yes	no	yes
4	Biogenic area_2	no	no	yes
5	Grays Canyon	yes	yes	yes
6	Biogenic area_3	n/a	n/a	yes
7	Astoria Canyon	yes	yes	yes
8	Ridges_biogenic_area_5	yes	no	yes
9	Biogenic area_6	no	no	yes
10	Biogenic area_7	yes	yes	yes
11	Biogenic area_8	yes	yes	yes
12	Daisy Bank	yes	no	yes
13	Heceta Bank	yes	yes	yes
14	Ridges_biogenic area_9	n/a	n/a	yes
15	Ridges_biogenic area_10	n/a	n/a	yes
16	Hard bottom feature_1	yes	yes	yes
17	Rogue Canyon	yes	yes	yes
18	Biogenic area_11	n/a	n/a	yes
19	Eel River Canyon	yes	yes	yes
20	Mendocino Ridge	yes	yes	yes
21	Hard bottom feature_2	no	no	yes
22	Biogenic area_12	yes	yes	yes
23	Cordell Bank	yes	yes	yes
24	Hard bottom feature_3	n/a	n/a	yes
25	Hard bottom feature_4	yes	no	yes
26	Monterey Bay and Canyon	yes	yes	yes
27	Hard bottom feature_5	n/a	n/a	yes
28	Biogenic area_13	no	no	yes
29	Morro ridge	yes	yes	yes
30	Channel Islands	n/a	n/a	yes
31	Cowcod conservation area_west	n/a	n/a	yes
32	Hard bottom feature_6	n/a	n/a	yes
33	Cowcod conservation area_east	n/a	n/a	yes
34	Thompson Seamount	n/a	n/a	no
35	President Jackson Seamount	n/a	n/a	no
36	Taney Seamount	n/a	n/a	no
37	Gumdrop Seamount	n/a	n/a	yes
38	Pioneer Seamount	n/a	n/a	no
39	Guide Seamount	no	no	yes
40	Davidson Seamount	n/a	n/a	yes
41	San Juan Seamount	n/a	n/a	no

[1] Evidence of hard substrate and habitat types as defined by and documented in the *Consolidated GIS Data, Volume 1, Physical and Biological Habitat data disk*

[2] *Preliminary Report on Occurrences of Structure-Forming Megafaunal Invertebrates off the West Coast of Washington, Oregon and California*, 2004, Fishery Resource and Monitoring Division NWFSC. Associated datasets from AFSC trawl surveys 1977-2001, NWFSC trawl surveys 2001-2003, MCBI database of deep-sea corals (Etnoyer and Morgan 2002), submersible dive data (Wakefield, unpublished data). Does not include database of habitat-forming invertebrate bycatch from West Coast Observer Program
[3] Zimmerman, M. 2003.
[4] Pacific EFH Risk Assessment

* Localized multi-beam mapping of the area was not integrated into the EFH habitat map, possibly due to compatibility of data (Steve Intelmann, GIS analyst, Olympic Marine Sanctuary, pers. com.). As a result, the EFH habitat polygons show an area known to contain pinnacles and high relief, rocky habitat displayed as "sedimentary shelf" (Steve Intelmann, pers. com.)

** These areas have not been multi-beam mapped

Description of Selection Criterion

Hard Substrate

Hard substrates are one of the least abundant benthic habitats, yet they are among the most important habitats for fishes (Pacific EFH PDEIS). Hard substrates are also the seafloor substrate most sensitive to bottom trawling (NAS 2002, Pacific EFH PDEIS).

Many groundfish species managed by the PFMC use hard bottom habitats during one or more of their life stages. These include aurora rockfish, bank rockfish, black rockfish, black-and-yellow rockfish, blackgill rockfish, blue rockfish, bocaccio, bronzespotted rockfish, brown rockfish, cabezon, calico rockfish, California scorpionfish, canary rockfish, chilipepper, China rockfish, copper rockfish, cowcod, dusky rockfish, flag rockfish, gopher rockfish, grass rockfish, greenblotched rockfish, greenspotted rockfish, greenstriped rockfish, harlequin rockfish, honeycomb rockfish, kelp greenling, kelp rockfish, leopard shark, lingcod, Mexican rockfish, olive rockfish, Pacific cod, Pacific ocean perch, pink rockfish, quillback rockfish, redstripe rockfish, rosethorn rockfish, rosy rockfish, rougheye rockfish, sharpchin rockfish, shortbelly rockfish, shortraker rockfish, silvergray rockfish, speckled rockfish, spotted ratfish, squarespot rockfish, starry rockfish, stripetail rockfish, tiger rockfish, treefish, vermilion rockfish, widow rockfish, yelloweye rockfish, yellowmouth rockfish, and yellowtail rockfish (Pacific EFH PDEIS).

Location of hard substrate polygons from the *Consolidated GIS Data, Volume 1, Physical and Biological Habitat data disk* (PFMC 2003) were plotted in GIS to identify sensitive habitat and determine boundaries of areas closed to bottom trawling.

Habitat-forming invertebrates

Corals, sponges, and other habitat-forming invertebrates provide three-dimensional structure on the seafloor that increases the complexity of benthic substrates. While corals and sponges are the most conspicuous and easily observable biogenic structures, they generally occur in diverse biological communities with other invertebrates such as crinoids, basket stars, ascidians, annelids, and bryozoans. Henry (2001) found thirteen hydroid species collected from only four coral specimens, suggesting that northern corals support highly diverse epifaunal communities. Beaulieu (2001) observed 139 taxa associated with deep-sea sponge communities in the northeast Pacific. Buhl-Mortensen and Mortensen (2004) found 17 species of Pandalus shrimp, isopods, amphipods, copepods, and decapods associated with Paragorgia arborea and Primnoa resedaeformis in Nova Scotia, including an obligate associated copepod. Removal of habitat structure in relatively low-structure soft-sediment systems significantly decreases biodiversity, and consequently that of the wider marine ecosystem (Thrush et al. 2001). Therefore, protecting known areas of coral and sponge habitat inherently protects areas of high benthic diversity and a host of benthic organisms that provide habitat for fish in the form of food and shelter.

Structure-forming invertebrates (or biogenic habitat) are sensitive to impacts from bottom trawl gear (NAS 2002, Anderson et al. 2002, Krieger 1999, MacDonald et al. 1996, Van Santbrink and Bergman 1994). Deep-sea corals and sponges are long-lived and are not resilient to anthropogenic disturbance. Hexactinellid sponges can be up to 220 years old with average growth rates of 1.98 cm/year (Leys and Lauzon 1998). The colonies of the deep sea coral

Primnoa resedaeformis, have been aged to over 300 years old, suggesting recovery rates of over 100 years or more (Risk et al. 2002). The estimated age of the deep sea coral *Anthomastus ritteri* was 25-30 years in California's Monterey Bay (Cordes et al. 2001).

Deep sea corals and sponges provide three dimensional structures that form habitat for commercial groundfish, shellfish, and other marine life (Husebo et al. 2002; Krieger and Wing 2002; Malecha et al. 2002; Heifetz 2002). They are found at depths from 30 meters to over 3,000 meters (Krieger and Wing 2002). Many cup corals, hydrocorals, and *Metridium* anemones are found at depths as shallow as 15 m. Some larger species of deep sea corals, such as *Paragorgia sp*. can grow over 3 m tall. Because these long-lived filter feeders are attached to the seafloor, they may be important indicators of areas in the ocean that have consistently favorable ecological conditions, such as areas of high upwelling that are worth protecting for other reasons as well.

The following species are known to associate with corals and sponges: rougheye rockfish, redbanded rockfish, shortraker rockfish, sharpchin rockfish, Pacific Ocean perch, dusky rockfish, yelloweye rockfish, northern rockfish, shortspine thornyhead, several species of flatfish, Atka mackerel, golden king crab, shrimp, Pacific cod, walleye pollock, greenling, Greenland turbot, sablefish, and various non-commercial marine species (Freese 2000; Krieger and Wing 2002; Heifetz 1999; Else et al. 2002; Heifetz 2002). Red tree corals (*Primnoa sp*.) are known to provide protection from predators, shelter, feeding areas, spawning habitat, and breeding areas for fish and shellfish and are found throughout the U.S. West Coast (Krieger and Wing 2002). Stone (preliminary data, 2004) found an 87% rate of association between adult Alaskan FMP species and biogenic habitat and a 100% association rate for juveniles. Kaiser et al. (1999) found that biogenic habitat structure is an important component of demersal fish habitat, and observed higher densities of gadoid fish species associated with structural fauna such as soft corals, hydroids, bryozoans, and sponges in the southern North Sea and eastern English Channel. Husebo et al. (2002) found that the largest catches of redfish (*Sebastes marinus*) were made with long-line fleets set in deep sea coral reef habitats. Rocha et al. (2000) found that sponges are habitat 'oases' in a desert of rubble and flat rocky bottoms in Brazil. Reed (2002) in a study of deep water *Oculina* reefs along eastern Florida, noted extensive areas of *Oculina* rubble in part as the result of bottom fishing and major declines in commercial fish populations in the reefs from 1970-1990. Prevention of damage by bottom trawls to corals and other “living substrates” may increase the amount of protective cover available to slope rockfish to escape predation, increase survival of juvenile fish and thus have a positive impact on the stocks (North Pacific EFH EIS).

Managed fish species in the PFMC management region using structure-forming invertebrates (such as corals, basketstars, brittlestars, demosponges, gooseneck barnacles, sea anemones, sea lilies, sea urchins, sea whips, tube worms, and vase sponges) as biogenic habitat include arrowtooth flounder, big skate, bocaccio, California skate, cowcod, Dover sole, flag rockfish, greenspotted rockfish, lingcod, longspine thornyhead, Pacific ocean perch, quillback rockfish, rosethorn rockfish, sablefish, sharpchin rockfish, shortspine thornyhead, spotted ratfish, starry rockfish, tiger rockfish, vermilion rockfish, yelloweye rockfish, and yellowtail rockfish (Pacific EFH PDEIS).

Bycatch of habitat-forming invertebrates is the most direct evidence of adverse impacts of fishing to biogenic habitat. The West Coast groundfish observer program (WCGOP) was

established to obtain more precise estimates of fishery discards and total catch (NMFS 2003). For the same reasons that the WCGOP improves the accuracy of catch estimates for overfished groundfish, observer data can and should be used to both evaluate the impacts of fishing on EFH and develop mitigation measures in the EFH EIS. In fact, a repeated criticism of the Alaska Region EFH DEIS by the Center for Independent Experts was that coral, sponge, and bryozoan bycatch from observer records were not analyzed, utilized, or incorporated (Drinkwater 2004). Specifically, the Center for Independent Experts recommended that NMFS "…analyze catch and effort data, observer by catch data, field studies and consult with the industry to assess the damage done to the long-lived corals and sponges as well as the possible encroachment of fishing trawls into new areas containing corals and sponges."

Due to apparent confidentiality constraints, NMFS has not shared the Pacific observer bycatch dataset with the public. At the September 2004 PFMC meeting, we specifically requested NMFS to conduct an analysis of observer data on biogenic habitat bycatch before the November 2004 meeting so it could be incorporated into the Comprehensive Alternative. However, this analysis has not been conducted by NMFS to our knowledge. Therefore, the map showing locations of proposed closures based on presence of biogenic habitat may be incomplete because it does not incorporate data on biogenic habitat bycatch from the WCGOP. We expect NMFS to fully utilize and incorporate the observer dataset on biogenic habitat bycatch to identify additional closure areas to the proposed alternative prior to analysis. Since we do not have access to this data, we expect NMFS to conduct a point density analysis similar to what we conducted for the trawl survey data in the paragraphs below.

Coral and sponge records from trawl surveys must be considered a conservative estimate of the presence of biogenic habitat. Unfortunately, little information exists to ground-truth the extensive trawl survey databases with seafloor habitat. Of the thousands of NOAA trawl survey hauls that have occurred through the years, only one trawl survey track has been crossed by known submersible dive transects. The survey track, which occurred in 1986, was crossed by three dive transects on Heceta Bank in 2002 (Fig. 43). That 1986 trawl survey haul recorded 4 kg of an unidentified sponge species, or an estimated CPUE of 1 kg/hr. In 2002, the three dive transects that crossed this survey track recorded high densities of sponge of up to 167 vase sponges/ 100m^2 (Wakefield, unpublished data). This reflects that a coral or sponge record from a trawl survey is indicative of areas of biogenic habitat. An initial focus on regions where corals and sponges have been documented, either from trawl surveys or other sources, is a reasonable approach. We recognize that there are some limitations the coral and sponge data, as the all with all marine and fisheries databases. Nevertheless, given the importance and sensitivities of these habitats, and the recognized need to be precautionary in management decisions we developed what we believe is a responsible and reasonable approach to consider all available data in making management decisions.

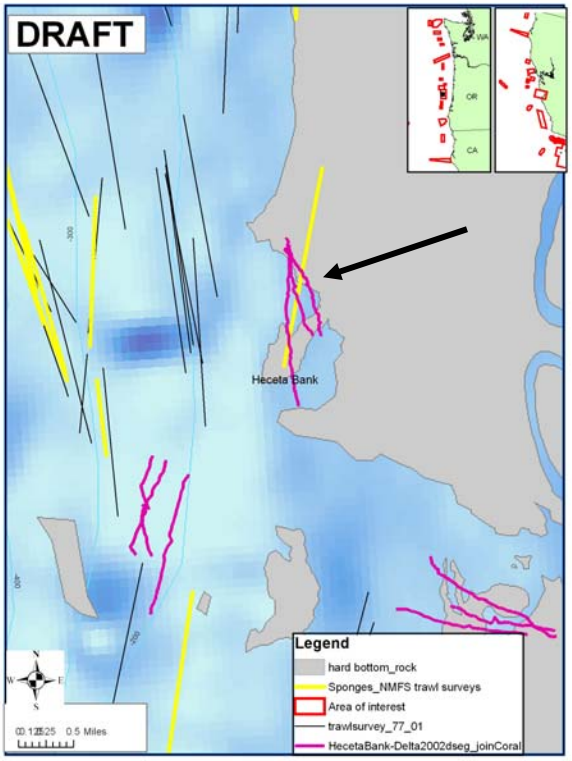

Figure 43: Trawl survey track crossed by Delta submersible transects on Heceta Bank

An extensive database was used to determine "hotspots" where the presence of habitat-forming invertebrates was frequently recorded or large samples of these invertebrates occurred. The database comprised records from AFSC slope and shelf trawl surveys from 1977 to 2001, NWFSC slope and shelf trawl surveys from 2001 to 2003, and MCBI's database of deep-sea coral records. MCBI's database includes coral records from the California Academy of Science, Smithsonian Institution, MBARI, and Scripps compiled from various research cruises and scientific collections (Etnoyer and Morgan 2003). For purposes of the analyses and site selection, only records of corals (including sea whips and sea pens) and sponges were considered. Habitat-forming anemones appear to have a ubiquitous distribution (Liz Clarke, NWFSC, pers. com) and were excluded from the analysis.

Two types of point density analyses were performed using the ArcView 9.0 Spatial Analyst Point Density Tool (ESRI 2004) to determine clusters of coral and sponge records. The first analysis explored the density of records, with each point weighted equally. A total of 3,691 coral and sponge records were used in the analysis. For trawl survey data (3,291 records), the start point of the trawl was used to plot points. For other coral and sponge data (400 records from MCBI dataset) the sample location point was plotted. Using a cell size of 2,000 meters and a search radius of 10,000 meters, the point density function outputs the mean density per kilometer of coral and sponge records. The utility is to identify areas that have had numerous records of habitat-forming invertebrates.

The second analysis explored clusters of coral and sponge records with high survey catches. Only trawl survey data, with associated records for catch weight and CPUE, were used in the analysis. A total of 3,291 survey start points from NOAA trawl surveys from 1977-2003 were plotted. This density analysis weighted the points by the rounded integer of the catch of coral or

sponge. For example, a CPUE of 10 kg/km^2 would be counted ten times. The utility of this exercise is to identify, at least qualitatively, those areas which had documented records of high densities of habitat-forming invertebrates. Both analyses were useful for identifying "hotspots" of records of habitat-forming invertebrates.

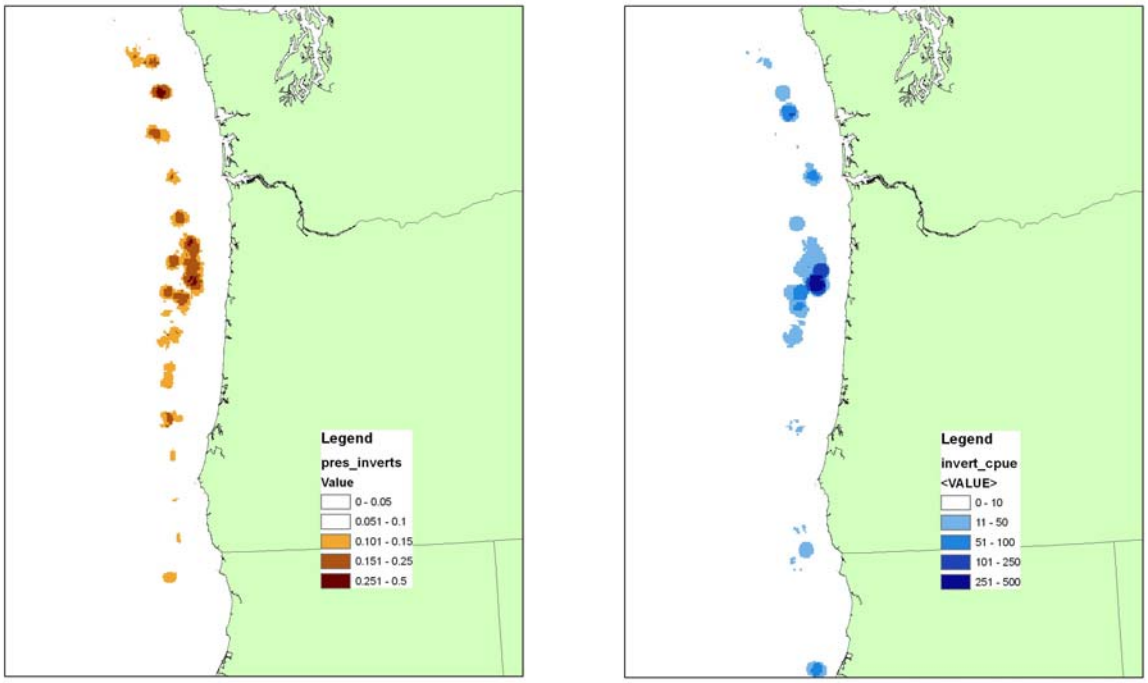

Figure 44: Point density analysis of coral and sponge records. The figure on the left displays output when all points are weighted equally. The legend shows density of points per square kilometer. The figure on the right displays output from point density analysis with points weighted by CPUE. The legend shows mean CPUE per square kilometer.

The point density analysis provided a focus for using documented records of coral and sponge in the selection and boundary determination of the areas closed to bottom trawling. Of these records, 1,553 documented occurrences of coral and sponge were contained within the proposed closed areas (Table 43). These locations also included the highest densities of corals and sponges recorded. Of the over 16,000 kg of corals and sponges sampled during trawl surveys, the closed areas encompass areas where 10,000 kg of these samples were recorded.

Table 43: Number of coral and sponge observations within closed bottom trawl areas

Area	Number of coral and sponge observations
1) Olympic_1	62
2) Olympic_2	18
3) Biogenic area_1	126
4) Biogenic area_2	88
5) Grays Canyon	20
6) Biogenic area_3	46
7) Astoria Canyon	101
8) Ridges_biogenic_area_5	68
9) Biogenic area_6	20
10) Biogenic area_7	83
11) Biogenic area_8	39
12) Daisy Bank	7
13) Heceta Bank	99
14) Ridges_biogenic area_9	17
15) Ridges_biogenic area_10	31
16) Hard bottom feature_1	2
17) Rogue Canyon	50
18) Biogenic area_12	35
19) Eel River Canyon	50
20) Mendocino Ridge	19
22) Biogenic area_12	40
23) Cordell Bank	28
24) Hard bottom feature_3	3
26) Monterey Bay and Canyon	336
27) Hard bottom feature_6	10
28) Biogenic area_13	22
29) Morrow ridge	89
30) Channel Islands	10
33) Cowcod conservation area_west	5
37) Gumdrop Seamount	1
38) Pioneer Seamount	1
40) Davidson Seamount	27
Grand Total	1553

Untrawlable areas

The Zimmerman (2003) database includes all records from the NMFS West Coast Triennial Trawl Survey where major trawl net hangs were recorded. Since these areas are considered unsuitable for trawling, the assumption is that these records indicate areas of high structural complexity, such as boulders or rock outcrops (Zimmerman, pers.com.). Trawl hangs (or substrate/structure that induces a trawl hang) provide habitat for juvenile fish. A study off the

coast of New England determined that significantly higher densities of juvenile groundfish occurred in areas with records of trawl hangs (Link and Demarest 2003). The study found that a buffer of 3.7 km (2 nautical miles) around these features would encompass 17-30% of juvenile fish. Since most trawl net hangs are concentrated these authors recommend a methodology of identifying these concentrations and establishing a no-trawl buffer around them. Other work on this topic suggests that such a methodology would only close 1-4% of the ocean bottom to trawling (Link 1997).

Furthermore, it is expensive to fisherman to replace trawl gear that has been damaged or lost due to contact with benthic structure. Since fishermen wish to avoid hangs, closing areas with high relative densities of areas known to be "untrawlable" will help avoid damage to trawl nets and close areas fishermen probably avoid anyway. Therefore, the economic effects of bottom trawl closures based on the Zimmerman dataset are likely to be negligible.

The GIS data used in the manuscript by Zimmerman (2003) was obtained and plotted in GIS. The GIS polygons of untrawlable areas were considered in the selection and placement of boundaries of the areas closed to bottom trawling.

Submarine canyons

Submarine canyons are known to be areas of enhanced productivity due to topographically induced upwelling along their axes (Freeland and Denman 1982). For this reason, canyons show enhanced concentrations of macrobenthos (Haedrich et al. 1980; Sarda et al. 1994; Vetter and Dayton 1998), micronekton (Cartes et al. 1994; Macquart-Moulin and Patriti 1996), demersal fishes (Stefanescu et al. 1994), and cetaceans (Kenney and Winn 1987; Schoenherr 1991) relative to surrounding areas on the slope and shelf. In the North Pacific Ocean, rockfishes in the genus *Sebastes* often inhabit the offshore edges of banks or canyons and are known to capitalize on advected prey resources such as euphausiids (Pereyra et al. 1969; Brodeur and Pearcy 1984; Chess et al. 1988; Genin et al. 1988). Brodeur (2001) found dense aggregations of Pacific ocean perch (*Sebastes alutus*) and euphausiids associated with biogenic habitats in a Bering Sea submarine canyon, while areas with damaged biogenic structures had far fewer rockfish, and areas in the canyon without biogenic structure had no rockfish. Therefore, submarine canyons provide essential habitat for groundfish that is highly vulnerable to fishing impacts.

Vetter and Dayton (2001) found that submarine canyons in Southern California provide large quantities of food in aggregated form on the deep sea floor by acting as conduits for marine macrophyte production produced in the intertidal and shallow subtidal zone. This study also found elevated abundance of Pacific hake and turbot in these canyons. Starr et al. (2002) found evidence for site fidelity in green-spotted rockfish (*S. chlorostictus*) and suggested large-scale reserves for boccacio (*S. paucispinus*) at a canyon in Monterey Bay.

Submarine canyons provide habitat for larger sized rockfish that seem to prefer structures of high relief such as boulders, vertical walls, and ridges. Yoklavich et al. (2000) found high abundance of large rockfish associated with complex structural habitat in Soquel Canyon with lower size and abundance in fished areas. Canyon heads are the upper, shallower portions of submarine canyons where coastal upwelling fronts have been shown to contain high abundance of rockfish larvae (Bjorkstedt 2002). Additionally, Hooker (1999) found higher abundance of cetaceans in a submarine canyon known as "The Gully" off Nova Scotia relative to surrounding areas of the

shelf and slope. The cover and protection offered by submarine canyons allow pockets of rockfish populations to flourish, in contrast to more exposed areas where the populations are more easily fished. Because submarine canyons are typically upwelling zones, they often contain higher abundances of filter feeding invertebrates, such as corals, sponges, tunicates, and bryozoans, which contribute to the structural complexity of the seafloor.

The deepest and largest submarine canyon on the coast of North America is the Monterey Canyon, just south of San Francisco, California. This canyon is 470 km long, approximately 12 km wide at its widest point, and has a maximum rim to floor relief of 1,700 m, making it much larger than Arizona's Grand Canyon. The largest submarine canyon in the Pacific Northwest is Astoria Canyon, off the mouth of the Columbia River. Other major submarine canyons on the U.S. West Coast include Grays Canyon, Rogue Canyon, and Eel River Canyon, which are also included in this alternative. Portions of other canyon habitats are also included in many of the other closed areas.

Location of canyon habitat polygons from the *Consolidated GIS Data, Volume 1, Physical and Biological Habitat data disk* (PFMC 2003) were plotted in GIS to identify and determine boundaries of areas closed to bottom trawling.

Seamounts

A seamount is an area of volcanic origin rising over 1,000 meters above the surrounding seafloor. Using the polygons developed by NOAA in the EFH process, we have identified 8 seamounts in this alternative. Recent studies conducted by the Monterey Bay Aquarium Research Institute on West Coast seamounts have documented unique and diverse biological communities. Along the crests and slopes of several seamounts, MBARI scientists observed long-lived coral and sponge habitats. DeVogelaere et al. (2003) found 24 coral taxa on Davidson Seamount off California and described numerous species associations, particularly that *Paragorgia sp*. were found in areas with highest species diversity. Guyots are a type of volcanic seamount with a flat top or plateau. Because the tops are flat, they may be particularly vulnerable to trawling due to the relative ease of setting trawl gear. The rarity and uniqueness of seamount faunal communities provides strong scientific justification for a highly precautionary approach. Koslow et al. (2001) conducted a survey of Tasmanian seamounts where 30% of species identified were new to science and 30-60% were endemic to particular seamounts. Seamounts provide an area of vertical relief from the relatively flat and featureless abyssal plain.[2] As such, seamounts are sites of enriched biological activity with enhanced biomass of pelagic and benthic organisms relative to the surrounding waters.[3] Studies indicate that seamounts function as deep sea islands of localized species distributions, dominated by suspension feeders like corals and sponges[4] which can be easily damaged by fishing gear that makes contact with the bottom.

On the U.S. West Coast, the major seamounts include Thompson Seamount (428 km^2), San Juan Seamount (940 km^2), Davidson Seamount (600 km^2), Gumdrop Seamount (149 km^2), Pioneer

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[2] Airame, S., S. Gaines and C. Caldow. 2003. Ecological Linkages: Marine and Estuarine Ecosystems of Central and Northern California. NOAA, National Ocean Service. Silver Spring, MD. 164 p.

[3] Mullineaux and Mills. 1997.; Dower and Perry. 2001; Haury et. al. 2000).

[4] Monterey Bay National Marine Sanctuary, Sanctuary Integrated Monitoring Network at www.mbnms-simon.org/sections/seamounts/overview.php

Seamount (295 km^2), Guide Seamount (270 km^2), President Jackson Seamount (986 km^2), and Taney Seamount (978 km^2). This represents a total area of 4,639 km^2 of seamounts on the west coast within the U.S. EEZ. Current PACFIN data documents no trawling on any seamounts on the U.S. West Coast. Therefore, there would be no economic impacts from bottom trawl closures that prevent future damage to these unique geological features.

Location of seamounts from the *Consolidated GIS Data, Volume 1, Physical and Biological Habitat data disk* (PFMC 2003) were plotted in GIS to identify and determine boundaries of areas closed to bottom trawling.

EFH habitat types of the Areas Closed to Bottom Trawling

The tables below display the area coverage of habitat types as defined by the *Consolidated GIS Data, Volume 1, Physical and Biological Habitat data disk* in the areas closed to bottom trawling. The shape of all 41 areas closed to bottom trawling were clipped from the habitat polygons and the resulting polygon area was calculated. The total area of all habitat types identified off the Pacific Coast (PFMC Region) was summed for comparison.

Habitat Composition of Areas Closed to Bottom Trawling

Table 44: Proportion of hard and soft substrate within proposed areas

Substrate type (from EFH GIS data)	Substrate type within closed areas (km^2)	Total area (km^2) of identified substrate off Pacific Coast	Percent of total within closed area
Hard	8378	19549	42.9%
Soft	31334	222321	14.1%
(blank)	805	1254	64.1%
Grand Total	40517	243124	16.7%

The proposed closed areas cover 42.9% of all identified hard benthic substrate off the Pacific coast. Hard substrate was a primary factor in the consideration of the boundaries of the proposed areas.

Table 45: Proportion of identified habitat types within proposed areas

HAB_TYPE	Habitat type within closed area (km^2)	Total area (km^2) of identified habitat type off Pacific Coast	Percent of identified habitat closed
Rocky Slope Canyon Floor	98.5	104.0	94.7%
Rocky Slope Gully	26.8	28.4	94.3%
Rocky Shelf Canyon Wall	52.7	60.0	87.9%
Sedimentary Basin Gully Floor	4.2	5.0	85.5%
Island	764.0	915.5	83.5%
Rocky Apron	1.0	1.3	77.2%
Rocky Slope Canyon Wall	281.0	405.5	69.3%
Sedimentary Shelf Gully	215.2	373.4	57.6%
Sedimentary Shelf Canyon Wall	200.6	426.6	47.0%
Rocky Slope	603.6	1297.8	46.5%
Rocky Ridge	5691.7	13038.9	43.7%
Rocky Shelf	1372.1	3160.3	43.4%
Sedimentary Glacial Shelf Deposit	390.0	1016.9	38.4%
Sedimentary Basin Canyon Floor	2.1	5.8	35.6%
Sedimentary Slope Canyon Wall	2046.9	7274.6	28.1%
Sedimentary Shelf Canyon Floor	22.4	79.8	28.0%
Sedimentary Basin Gully	2.0	8.1	24.3%
Sedimentary Basin	5494.2	27332.3	20.1%
Sedimentary Slope Gully Floor	72.3	373.1	19.4%
Sedimentary Ridge	5927.6	31664.9	18.7%
Rocky Slope Landslide	250.9	1383.0	18.1%
Sedimentary Slope Canyon Floor	940.0	5653.3	16.6%
Sedimentary Slope	8933.2	65902.6	13.6%
Sedimentary Slope Landslide	809.3	6221.7	13.0%
no data	40.6	338.8	12.0%
Sedimentary Apron Canyon Floor	38.5	338.3	11.4%
Sedimentary Shelf	5550.7	52306.2	10.6%
Sedimentary Basin Canyon Wall	1.5	18.8	7.7%
Sedimentary Slope Gully	293.6	5072.0	5.8%
Sedimentary Shelf Gully Floor	0.7	19.5	3.6%
Sedimentary Apron Canyon Wall	32.4	904.0	3.6%
Sedimentary Apron	356.7	16932.2	2.1%
Rocky Basin	0.1	49.9	0.3%
Rocky Apron Canyon Wall	0.0	15.6	0.0%
Rocky Glacial Shelf Deposit	0.0	4.1	0.0%
Sedimentary Apron Gully	0.0	2.2	0.0%
Sedimentary Apron Landslide	0.0	389.5	0.0%

Preliminary Economic Analysis Based on Available Data

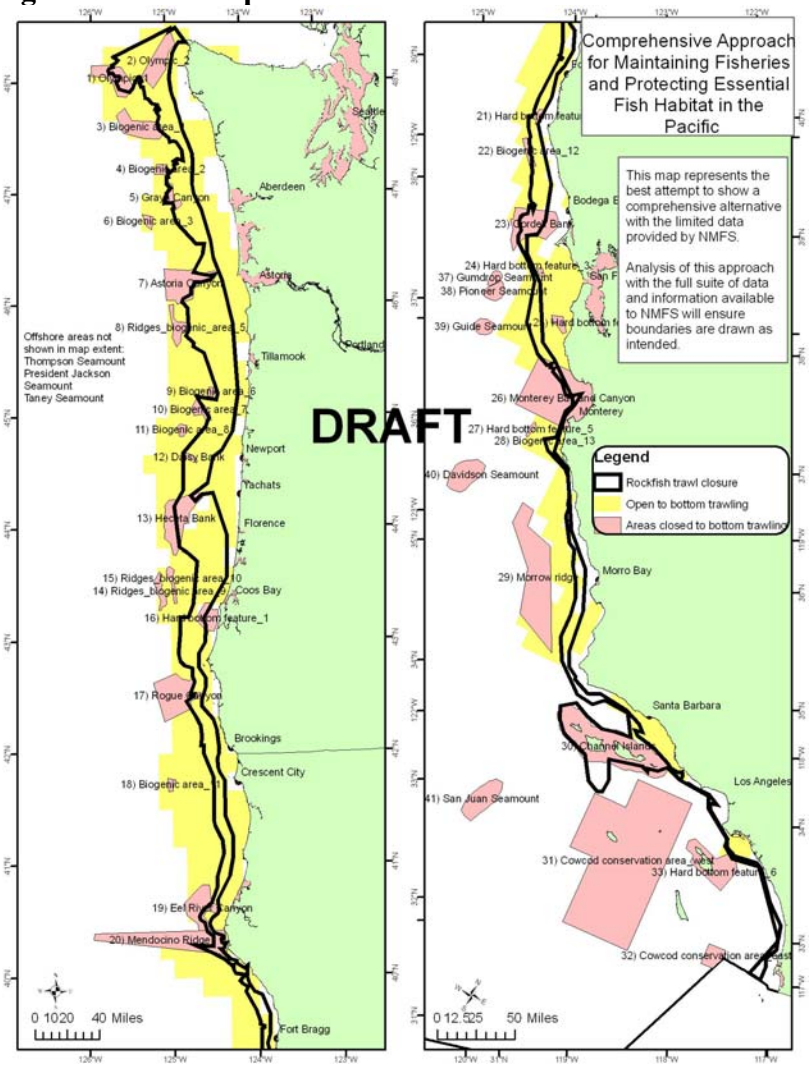
Determination of Trawl Footprint

The data available to us to conduct a preliminary economic analysis was limited. We examined bottom trawl records of groundfish catch occurring from 2000-2003 from the PACFIN dataset aggregated to 10-minute blocks with species or species group resolution and excluding any confidential data. A spatial resolution of 10-minute blocks was selected to ensure consistency with the analyses performed by Terralogic and MRAG for the Pacific Groundfish EFH EIS and to minimize data loss due to confidentiality. A span of years from 2000-2004 were selected to reflect variability in annual trawl effort and the effort under current conditions. In 2000, a footrope restriction in some areas altered the distribution of trawl effort (Bellman and Heppell, in press). Trawl restrictions in the Rockfish Conservation Areas also altered distribution of trawl effort over this period. It should be noted that our analysis did not include analysis of pre-existing closures and measures. With those measures taken into account, the economic impact will be considerably less.

Rockfish Conservation Areas and Economic Analysis

Some of the proposed areas closed to bottom trawling overlap the existing trawl closures within the Rockfish Conservation Areas (Fig.45). However, the proposed bottom trawl closures are not duplicative, since bottom trawling still occurs within the RCA. During the course of this analysis it was discovered that large catches of groundfish are still being reported within the Rockfish Conservation Area. Nonetheless, the economic analysis and calculation of displaced revenue for this mitigation alternative should take into account the reduction of trawl effort already in place within existing trawl closures. The present analysis does not take these closures into account, therefore the displaced revenue reported in Table 46 will be considerably less if existing closures are considered.

Figure 45: Overlap of Rockfish Conservation Area with Proposed Areas



Economic Analysis of Trawl Area Closures

Economic analysis is an important tool in evaluating the practicability of management measures that mitigate adverse fishing impacts to EFH. For this reason, it is essential that economic analysis of management measures reflect actual consequences as accurately as possible. The following discussion is provided in the spirit of helping ensure that the economic analysis conducted in the EFH DEIS is as accurate as possible given the data constraints.

The first decision point in economic analysis is the measurement unit of economic benefit in each area. The options appear to be total hours trawled, total catch, or revenue generated in each block. While the latter options may provide some useful information, the revenue generated appears to be the most relevant because it actually measures economic impacts in dollars. In this approach, an economic value is generated for each block by multiplying the weight of catch for each species by the ex-vessel value of each species and summing this product for all species. In other words, the economic revenue for each block in any given year is given by:

$$\sum_i C_i V_i$$

where i is each species, C_i is the catch of species i in pounds, and V_i is the ex-vessel value per pound of species i. This methodology outputs the economic revenue generated in each block and is more accurate than hours trawled or total catch because it takes into consideration differences in catch per unit effort, catch composition, and value of different species between each block.

NMFS staff have made it clear thus far that economic data on trawl catches will be queried by 10 x 10 minute block. However, the gear-specific area closures presented in the Comprehensive Alternative are at a much finer scale to reflect more adequately the habitat features identified through the EFH process in the most practicable way. Therefore, despite the coarse scale of the available economic data, every effort should be made to ensure that the displaced revenue calculations are based on the actual closure boundaries described in the alternative, rather than on the number of blocks wholly or partially encompassed by a closed area.

One methodology proposed by NMFS is to analyze the alternative as if all blocks with even a small percentage of area in a closure become completely closed. Since this method assumes closures are much larger than they actually are, the results will be systematically biased toward gross overestimation. This will only serve to confuse the public and decision makers.

Rather than assuming that an entire block becomes closed when there is any degree of overlap, a proportional approach will provide results based on the amount of area actually closed. A reasonable methodology is to calculate the proportion of each 10 x 10 minute block that is overlapped by an area closure and estimated displaced revenue in each block by this proportion.

$\sum_i C_i V_i * p$ where p = the proportion of the block proposed closed

The implicit assumption behind this approach is that revenue is generated equivalently throughout each area. In fact, even this assumption is likely to bias results toward overestimation simply because the closed areas within each block are focused on rocky, hard, biogenic, and complex substrate habitat, which are areas likely to have lower relative trawl effort than nearby areas within the block. For example, Bellman and Heppell (in press) found that trawl footrope restrictions displaced trawl effort out of areas of rocky, complex substrate. Therefore, it is likely that a formal area closure based on complex, sensitive substrate will cause less displaced revenue than if trawl effort were evenly distributed throughout each block. Thus, estimates of displaced effort using a proportional approach may be the best way to analyze data aggregated by 10 x 10 block, but they should be seen as "worst-case scenarios" because of the implicit assumptions (Table 46).

A further way to improve the economic analysis is to obtain data at a finer scale than 10 x 10 minutes. Vessel monitoring systems currently in place for trawl vessels have the ability to show trawl tracks at a much higher precision than logbook or fish ticket data. For example, Drouin (2001) found that VMS systems could more accurately show fishing locations in relation to area closures in the Bering Sea, where NMFS had previously been unable to track vessels with such precision. Incorporating VMS data to improve the spatial resolution of the economic analysis will greatly improve the validity of the results.

Our estimates almost surely overestimate the economic consequences by assuming that revenue from a closed area would be foregone. Because of this, and the spatial scale of the economic data used in the analyses, the preliminary economic estimates are almost certainty biased upward. More refined analyses would result in more accurate and smaller amounts. Finally, we must all recognize that economic analyses of fisheries management measures must include not only considerations of the short-term costs, but also of the long-term benefits of protecting important habitats. While we have not attempted to do so in our economic analysis, we expect that the Council and agency will ensure that such analyses are included in the public Draft EFH EIS.

Table 46: **Estimated annual displaced bottom trawl revenue (ex-vessel value in dollars) of closed areas using total block method and proportional closure method.**

	Area	Displaced Revenue determined by summation of all 10x10 aggregated fishing effort blocks that contact closed area regardless of degree of overlap	Displaced Revenue determined by proportional overlap of closed area with 10x10 minute aggregated fishing effort block
1	Olympic_1	1,662,559	829,413
2	Olympic_2	1,414,201	541,740
3	Biogenic area_1	200,763	119,392
4	Biogenic area_2	89,908	11,131
5	Grays Canyon	207,042	58,735
6	Biogenic area_3	confidential	confidential
7	Astoria Canyon	740,918	462,042
8	Ridges_biogenic_area_5	571,842	168,824
9	Biogenic area_6	41,779	9,278
10	Biogenic area_7	385,379	74,219
11	Biogenic area_8	100,377	18,980
12	Daisy Bank	143,262	11,514
13	Heceta Bank	654,137	349,105
14	Ridges_biogenic area_9	58,791	13,200
15	Ridges_biogenic area_10	240,080	39,830
16	Hard bottom feature_1	146,155	14,081
17	Rogue Canyon	779,441	278,924
18	Biogenic area_11	83,151	6,262
19	Eel River Canyon	943,159	622,250
20	Mendocino Ridge	482,048	282,791
21	Hard bottom feature_2	253,206	44,469
22	Biogenic area_12	230,710	60,066
23	Cordell Bank	405,821	138,984
24	Hard bottom feature_3	102,054	4,364
25	Hard bottom feature_4	251,224	38,892
26	Monterey Bay and Canyon	598,445	456,398
27	Hard bottom feature_5	40,468	3,158
28	Biogenic area_13	240,462	12,483
29	Morrow ridge	382,100	117,308
30	Channel Islands	58,061	16,593
31	Cowcod conservation area_west	confidential	confidential
32	Hard bottom feature_6	43,562	2,986
33	Cowcod conservation area_east	0	0
34	Thompson Seamount	0	0
35	President Jackson Seamount	0	0
36	Taney Seamount	0	0
37	Gumdrop Seamount	0	0
38	Pioneer Seamount	confidential	confidential
39	Guide Seamount	confidential	confidential
40	Davidson Seamount	0	0
41	San Juan Seamount	0	0
	Total w/out confidential data	11,551,105	4,807,410
	Grand Total	11,563,141	**4,810,730**

Table 47: Total Pacific Coast Bottom Trawl Fleet catches and ex-vessel revenue 2000-2003

Pacific Coast Bottom Trawl Fleet catches and ex-vessel revenue 2000-2003					
		YEAR			
Species	Data Aggregation	**2000**	**2001**	**2002**	**2003**
Arrowtooth Flounder	Landed weight (lbs)	7,170,535	5,425,216	4,582,835	5,103,482
	Exvessel revenue	831,860	648,699	498,703	554,443
Flatfish	Landed weight (lbs)	8,354,981	8,481,175	7,741,412	8,057,403
	Exvessel revenue	2,580,275	2,885,416	2,768,998	2,695,104
Dover Sole/ Thornyhead/ Sablefish (DTS)	Landed weight (lbs)	29,553,603	23,842,889	22,506,474	25,802,494
	Exvessel revenue	18,170,505	15,409,466	13,763,840	15,335,537
Petrale Sole	Landed weight (lbs)	4,155,603	4,036,024	3,936,352	4,394,213
	Exvessel revenue	4,215,263	4,045,334	3,606,273	4,374,169
Shelf Rock	Landed weight (lbs)	1,518,322	1,313,795	1,374,925	735,935
	Exvessel revenue	755,398	632,278	640,293	277,546
Slope Rock	Landed weight (lbs)	2,220,702	2,110,762	1,858,987	1,532,948
	Exvessel revenue	846,602	804,769	752,806	556,636
Nearshore Rock	Landed weight (lbs)	6,854	7,037	11,621	4,408
	Exvessel revenue	6,046	8,136	14,438	3,518
Other Groundfish	Landed weight (lbs)	221,850	238,368	313,064	327,130
	Exvessel revenue	141,014	161,835	224,873	169,197
Pacific Cod	Landed weight (lbs)	608,042	706,417	1,650,161	2,739,199
	Exvessel revenue	286,320	355,598	840,080	1,421,739
Total Landed weight (lbs)		53,810,492	46,161,683	43,975,831	48,697,212
Total Exvessel revenue		**27,833,283**	**24,951,531**	**23,110,305**	**25,387,890**
source: Merrick Burden, NOAA					

Conclusion

As a steward for public resources, the Fisheries Service has an obligation to conserve, protect, and manage living marine resources responsibly. In the Sustainable Fisheries Act of 1996, Congress amended the federal statute governing fishing in the waters off of America's coasts by adding conservation provisions. The Magnuson Stevens Act requires that the Fisheries Service describe and identify Essential Fish Habitat, and minimize the adverse effects of fishing on that habitat to the extent practicable. It was the Fisheries Service's failure to comply with that obligation that resulted in a court order to prepare the EFH EIS now in progress. The Court emphasized that the "[m]ost significant[]" defect in the challenged documents was that "they fail to consider all relevant and feasible alternative." In particular, the Court noted, "There is no substantive discussion of how fishing practices and gear may damage corals, disrupt fish habitat, and destroy benthic life that helps support healthy fish populations." American Oceans Campaign v. Daley, 183 F.Supp. 2d 1, 20 (D.C.C. 2000).

With input from a broad coalition of conservation organizations, recreational fishermen, and commercial fishermen, and based on all of the information we have available to us, we have developed a viable and practicable management alternative for the Pacific. This Comprehensive Alternative recognizes both the importance of corals, sponges, and other sensitive habitats as essential fish habitat, and the importance of maintaining healthy vibrant fisheries in the Pacific. We request the agency and Council adopt this Comprehensive Alternative as the preferred alternative in the Final EIS.

APPENDIX 1: Description of individual areas

The following figures display the GIS data layers that were used in the identification and boundary placement for each of the areas closed to bottom trawling. The tables reflect the number of habitat polygons and area of each habitat type wholly and in part within the boundaries of the area in question.

1) Olympic_1

The areas Olympic_1 and Olympic_2 encompass a portion of the Olympic National Marine Sanctuary. The five National Marine Sanctuaries on the U.S. west coast are "underwater parks" that "embrace part of our collective riches as a nation" (NOAA pamphlet). They were initially designated based on their biological importance and are clearly areas in the ocean deserving of special protection. The area defined as Olympic_1 contains the site of a rare discovery of Lophelia pertusa that represents one of the only discoveries of this reef-forming deep sea coral species in the Pacific Ocean. Both areas contain a high density of "untrawlable" areas as defined in the Zimmerman (2003) dataset. There are also numerous records of deep sea corals, including gorgonian corals, and sponges in this area from trawl survey records and the MCBI dataset.

Figure 1: Criterion used in determination of Olympic_1 area closed to bottom trawling

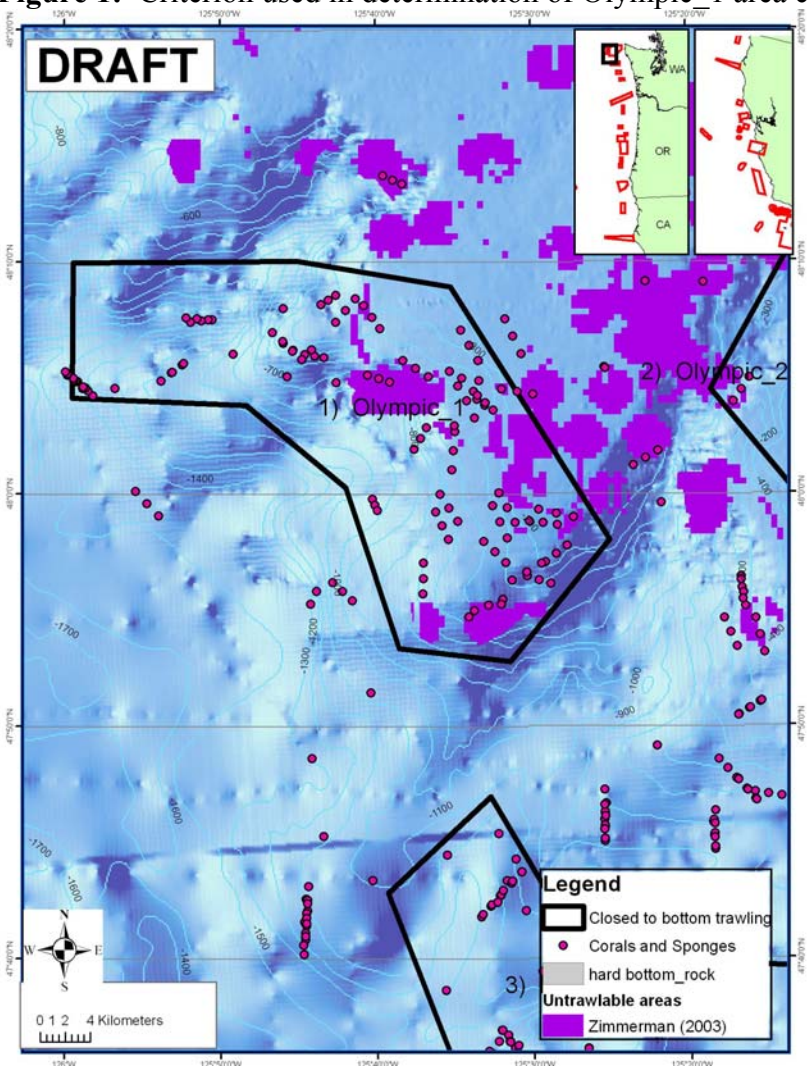


Table 1: Habitat types protected by Olympic_1 closed area, determined from EFH GIS data

HAB_TYPE*	Count_polygons	**Area (km2)**
Sedimentary Slope	5	331.4
Sedimentary Shelf	7	189.2
Sedimentary Slope Canyon Wall	5	97.7
Sedimentary Slope Canyon Floor	3	72.1
Sedimentary Shelf Canyon Wall	7	10.9
Sedimentary Shelf Canyon Floor	1	0.1
Grand Total	28	701.4

* Note: Habitat polygons as defined by the EFH GIS data in the Olympic Marine Sanctuary area are questionable. Localized multibeam mapping of the area was not integrated into the EFH habitat map, possibly due to compatibility of data (Steve Intelmann, GIS analyst, Olympic Marine Sanctuary, pers. com.). As a result, the EFH habitat polygons show an area known to contain pinnacles and high relief, rocky habitat displayed as "sedimentary shelf" (Steve Intelmann, pers. com.). In addition, Zimmerman (2003) showed a large proportion of the area to be untrawlable.

2) Olympic_2

Figure 2: Criterion used in determination of Olympic_2 area closed to bottom trawling

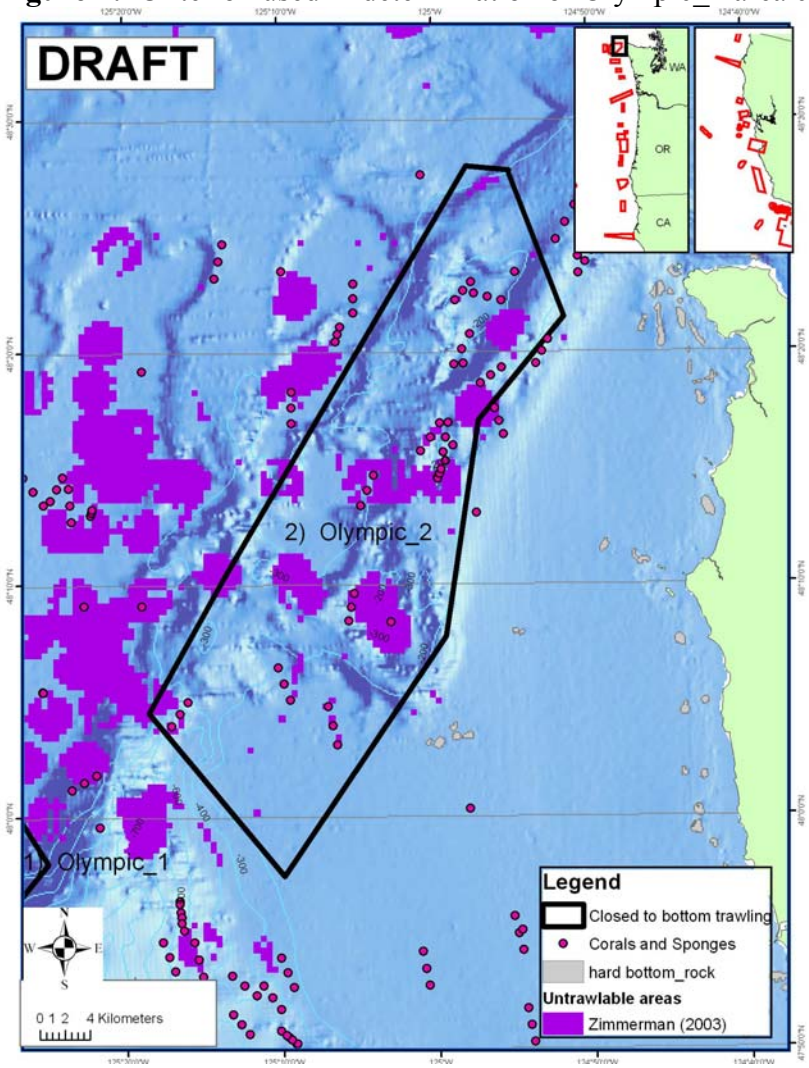


Table 2: Habitat types protected by Olympic_2 closed area, determined from EFH GIS data

HAB_TYPE*	Count_polygons	Area (km2)
Sedimentary Glacial Shelf Deposit	8	390.0
Sedimentary Shelf Gully	2	215.0
Sedimentary Shelf	5	155.0
Grand Total	15	760.0

*note-Habitat polygons as defined by the EFH GIS data in the Olympic Marine Sanctuary area are questionable. Localized multibeam mapping of the area was not integrated into the EFH habitat map, possibly due to compatibility of data (Steve Intelmann, GIS analyst, Olympic Marine Sanctuary, pers. com.). As a result, the EFH habitat polygons show an area known to contain pinnacles and high relief, rocky habitat displayed as "sedimentary shelf" (Steve Intelmann, pers. com.) . In addition, Zimmerman (2003) showed a large proportion of the area to be untrawlable.

3) Biogenic Area_1

This area, located off the slope and outside of Olympic Marine Sanctuary, contains deep-water biogenic habitat. The area encompasses 126 records of coral and sponge. While the number of documented records of corals and sponges has increased over the years, the CPUE of corals and sponges has decreased since 1992.

Figure 3: Criterion used in determination of Biogenic Area_1 area closed to bottom trawling

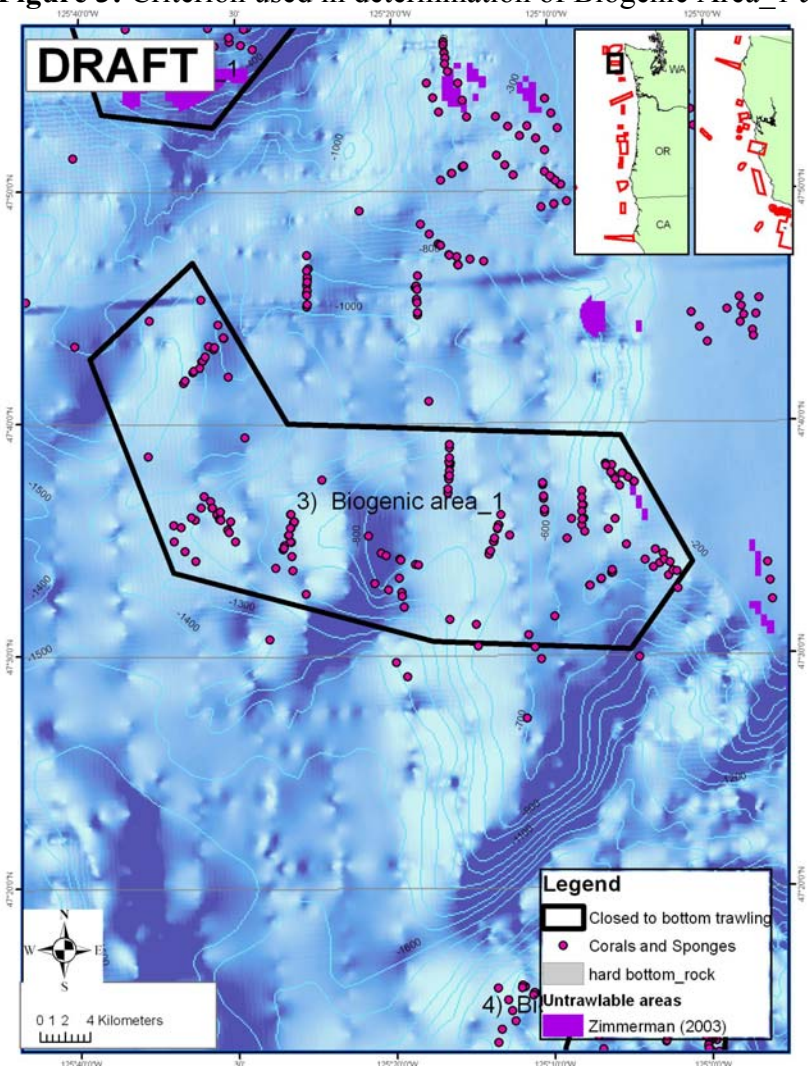


Table 3: Habitat types protected by Biogenic Area_1 closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	**Area (km2)**
Sedimentary Slope	1	401.5
Sedimentary Slope Canyon Wall	6	273.9
Sedimentary Basin	3	43.6
Sedimentary Slope Canyon Floor	3	20.4
Sedimentary Slope Gully	2	11.6
Grand Total	15	**751.1**

4) Biogenic Area_2

Figure 4: Criterion used in determination of Biogenic Area_2 area closed to bottom trawling

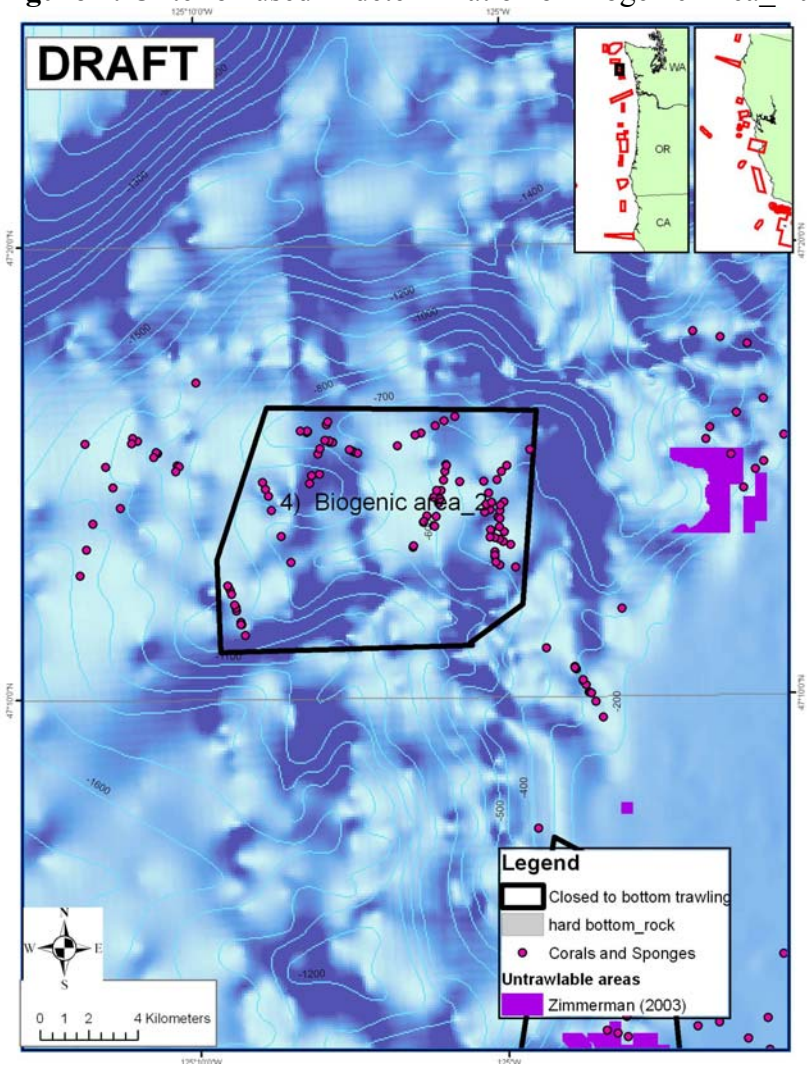


Table 4: Habitat types protected by Biogenic Area_2 closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Slope	1	93.2
Sedimentary Slope Canyon Wall	1	23.7
Grand Total	2	117.0

5) Grays Canyon

This site is known to have high upwelling and to be one of the most productive offshore sites off the Washington coast. It is also the site of major ecotourism and birdwatching operations.

Figure 5: Criterion used in determination of Grays Canyon area closed to bottom trawling

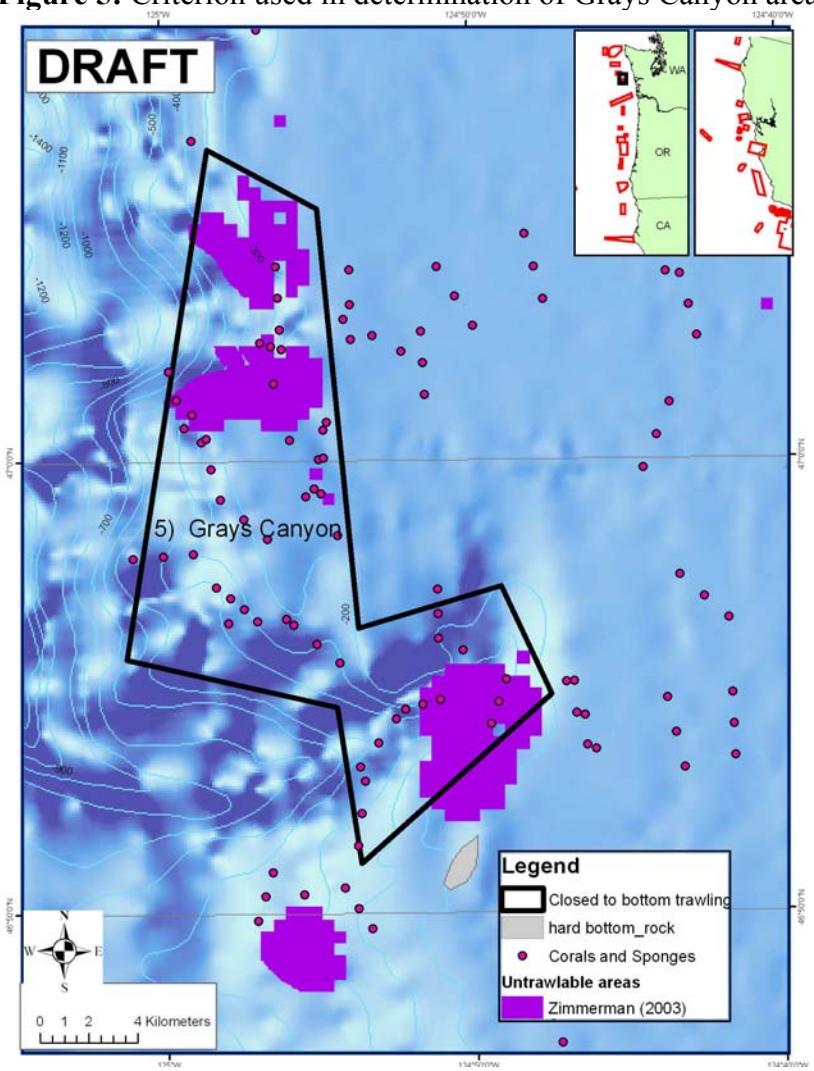


Table 5: Habitat types protected by Grays Canyon closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Shelf	2	90.3
Sedimentary Shelf Canyon Wall	3	55.4
Sedimentary Slope Canyon Wall	2	34.5
Sedimentary Slope	5	19.4
Sedimentary Shelf Canyon Floor	1	6.8
Grand Total	13	206.3

6) Biogenic Area_3

Figure 6: Criterion used in determination of Biogenic Area_3 area closed to bottom trawling

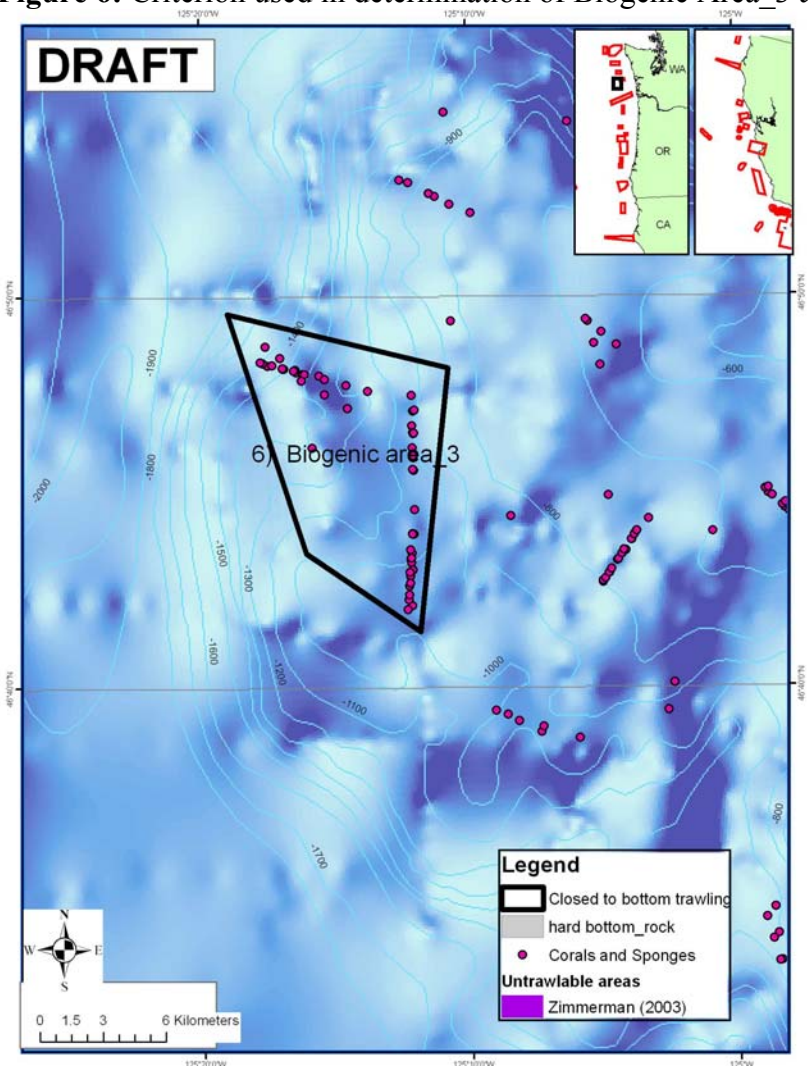


Table 6: Habitat types protected by Biogenic Area_3 closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Slope	1	91.2
Grand Total	1	91.2

7) Astoria Canyon

The largest submarine canyon in the Pacific Northwest is Astoria Canyon, off the mouth of the Columbia River. This canyon contains a range of habitat types from sedimentary slopes to hard rock canyon walls. There are many records of biogenic habitats in this canyon (Clarke 2004, Etnoyer & Morgan 2003). Within the proposed Astoria Canyon closed area, 101 deep-sea coral and sponge records have been documented. This canyon has also been studied using ROPOS submersibles.

Figure 7: Criterion used in determination of Astoria Canyon area closed to bottom trawling

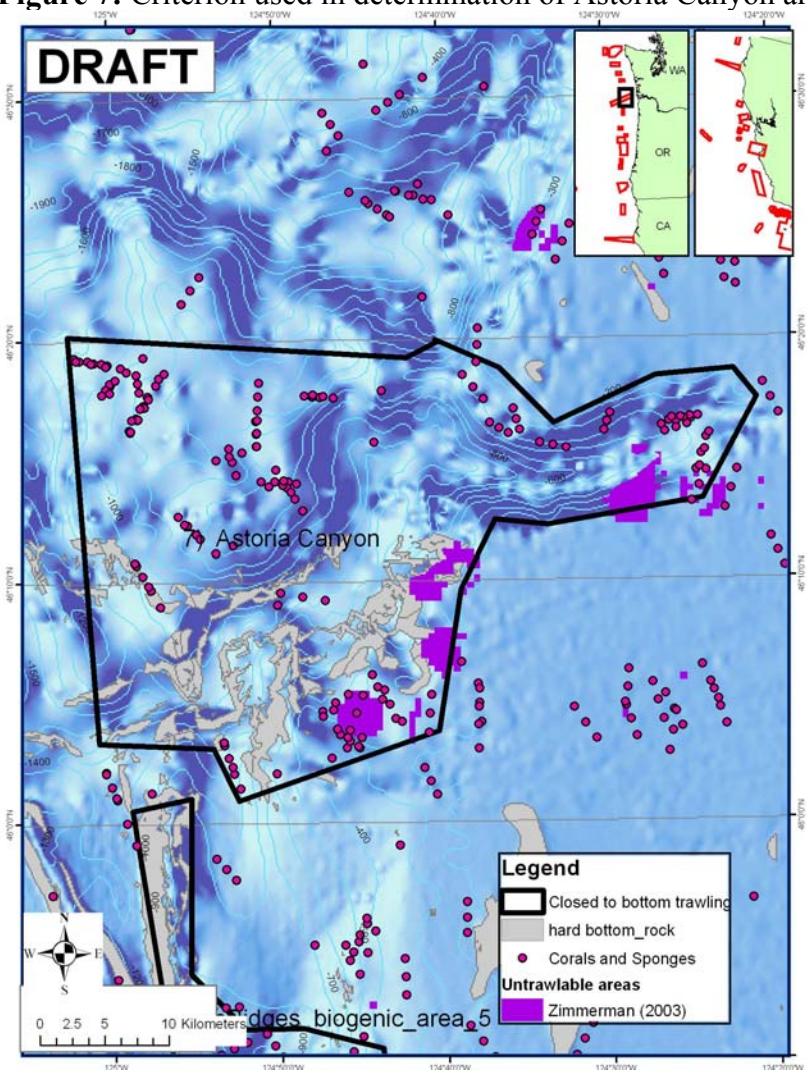


Table 7: Habitat types protected by Astoria Canyon closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	**Area (km2)**
Sedimentary Slope	24	412.9
Sedimentary Slope Canyon Wall	104	193.3
Sedimentary Slope Canyon Floor	9	159.6
Sedimentary Ridge	36	105.6
Rocky Slope Canyon Wall	56	63.7
Sedimentary Shelf Canyon Wall	13	49.6
Sedimentary Shelf	12	35.2
Sedimentary Basin	10	24.5
Rocky Ridge	8	22.8
Rocky Slope	47	21.9
Sedimentary Shelf Canyon Floor	1	14.5
Sedimentary Slope Landslide	10	11.9
Rocky Slope Landslide	2	8.3
Rocky Slope Canyon Floor	22	3.3
Rocky Basin	2	0.0
Grand Total	356	**1127.1**

8) Ridges_Biogenic Area_5

Figure 8: Criterion used in determination of Ridges_biogenic_area_5 area closed to bottom trawling

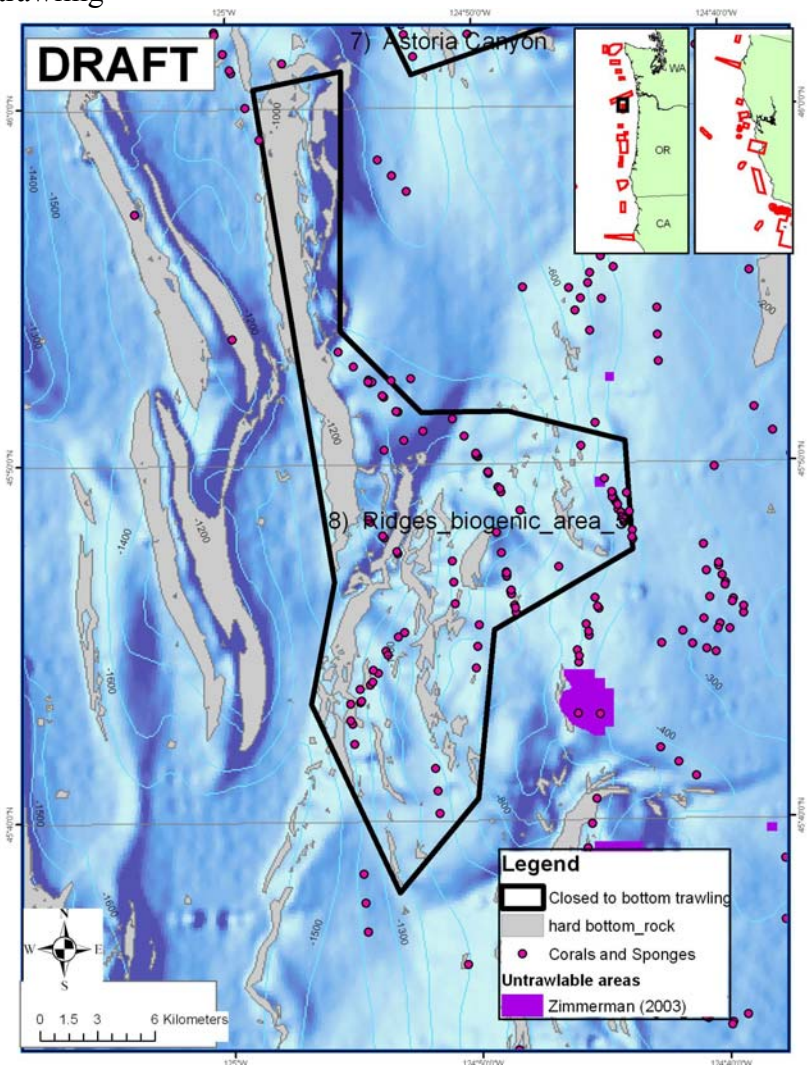


Table 8: Habitat types protected by Ridges_biogenic_area_5 closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Ridge	30	179.8
Rocky Ridge	105	76.8
Sedimentary Slope	3	29.2
Sedimentary Shelf	1	15.9
Sedimentary Basin	3	13.4
Rocky Slope	12	0.6
Rocky Basin	2	0.1
Rocky Shelf	3	0.1
Grand Total	159	315.8

9) Biogenic Area_6

Figure 9: Criterion used in determination of Biogenic area_6 area closed to bottom trawling

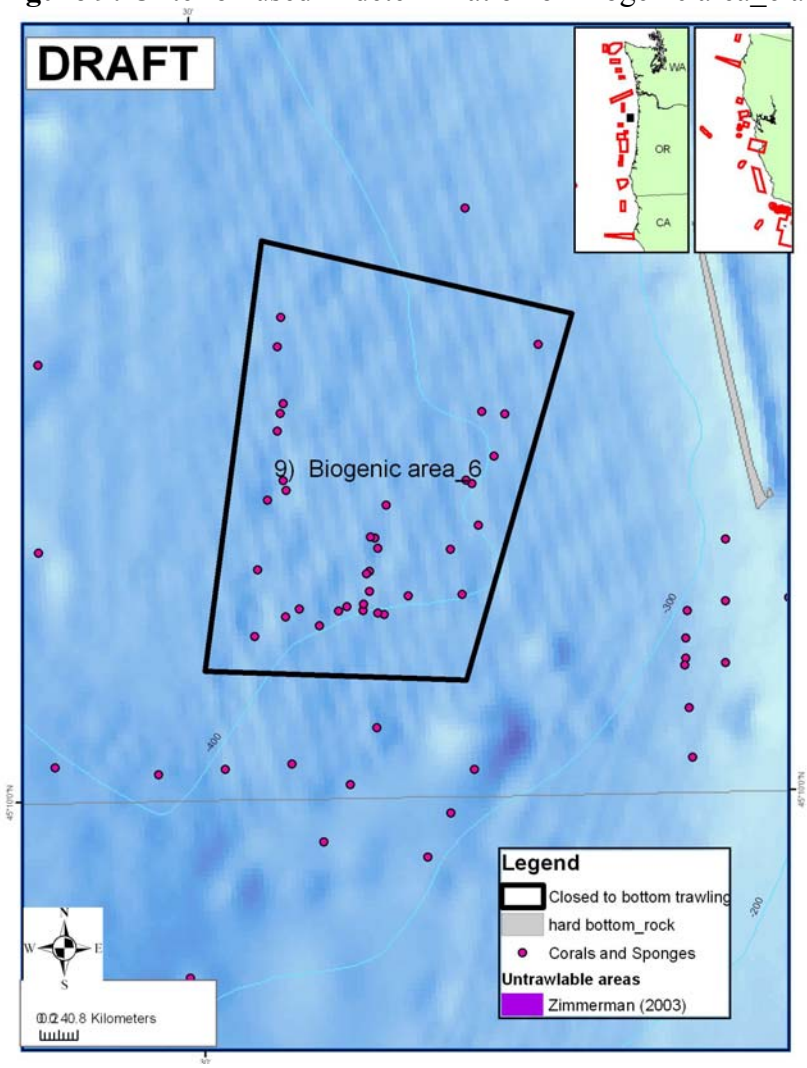


Table 9: Habitat types protected by Biogenic area_6 closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Slope	1	53.8
Grand Total	1	53.8

10) Biogenic Area_7

Figure 10: Criterion used in determination of Biogenic area_7 area closed to bottom trawling

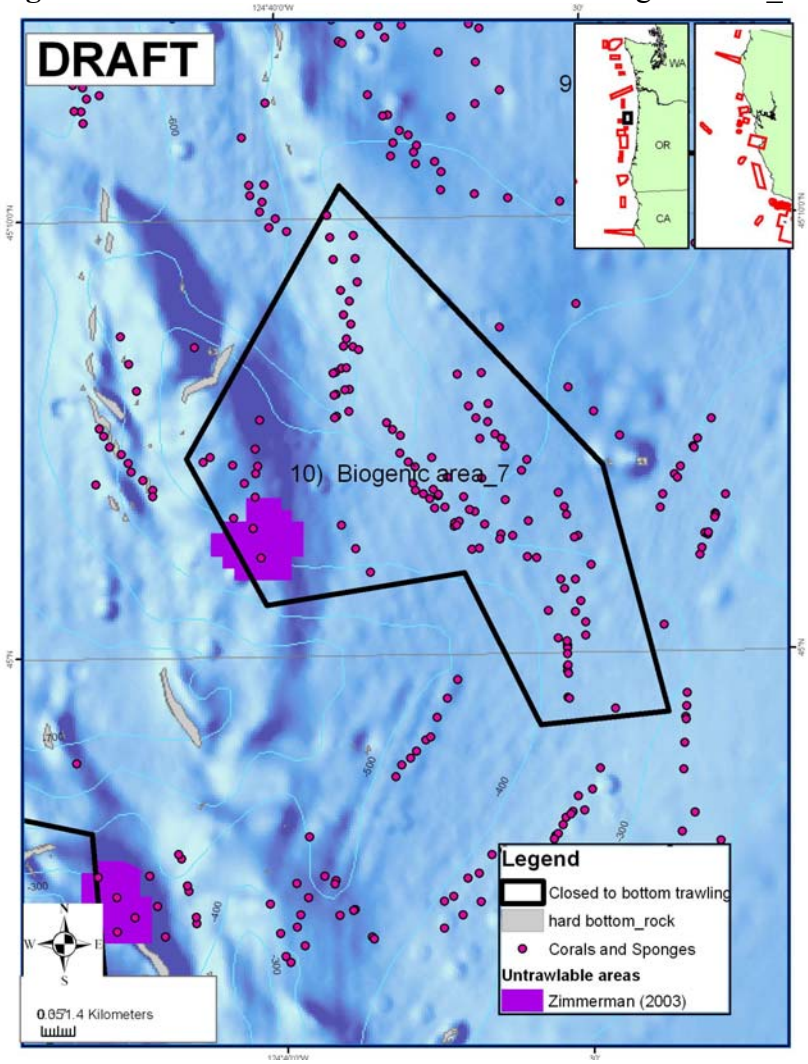


Table 10: Habitat types protected by Biogenic area_7 closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Slope	1	195.2
Sedimentary Ridge	2	35.5
Grand Total	3	230.7

11) Biogenic Area_8

Figure 11: Criterion used in determination of Biogenic_area_8 area closed to bottom trawling

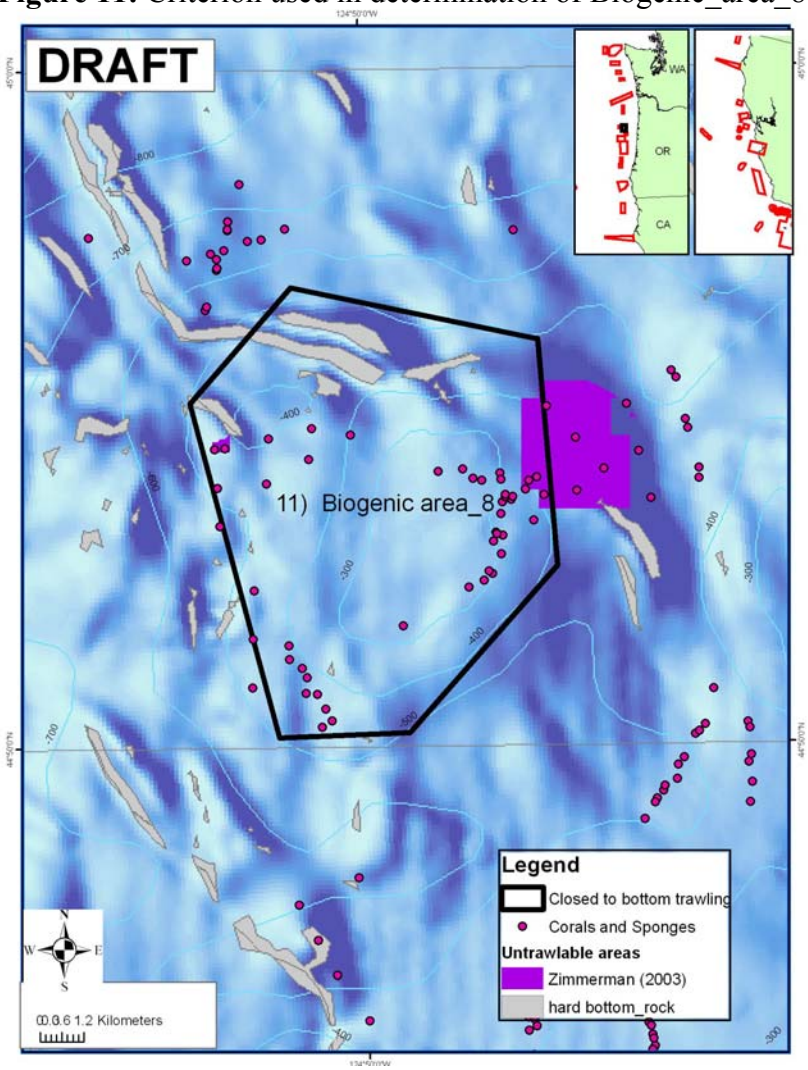


Table 11: Habitat types protected by Biogenic_area_8 closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Slope	1	71.5
Sedimentary Ridge	4	16.5
Rocky Ridge	11	3.8
Rocky Slope	10	0.2
Grand Total	26	92.1

12) Daisy Bank

Daisy Bank, north of Heceta Bank, has been less heavily fished and is also comprised largely of hard bottom habitat. Hixon (1991) documented large sponge beds on this bank. Daisy Bank has been likened to the "Sitka Pinnacles (a biodiverse MPA in Alaska) of the Pacific Northwest" (Hixon, pers. com.).

Figure 12: Criterion used in determination of Daisy Bank area closed to bottom trawling

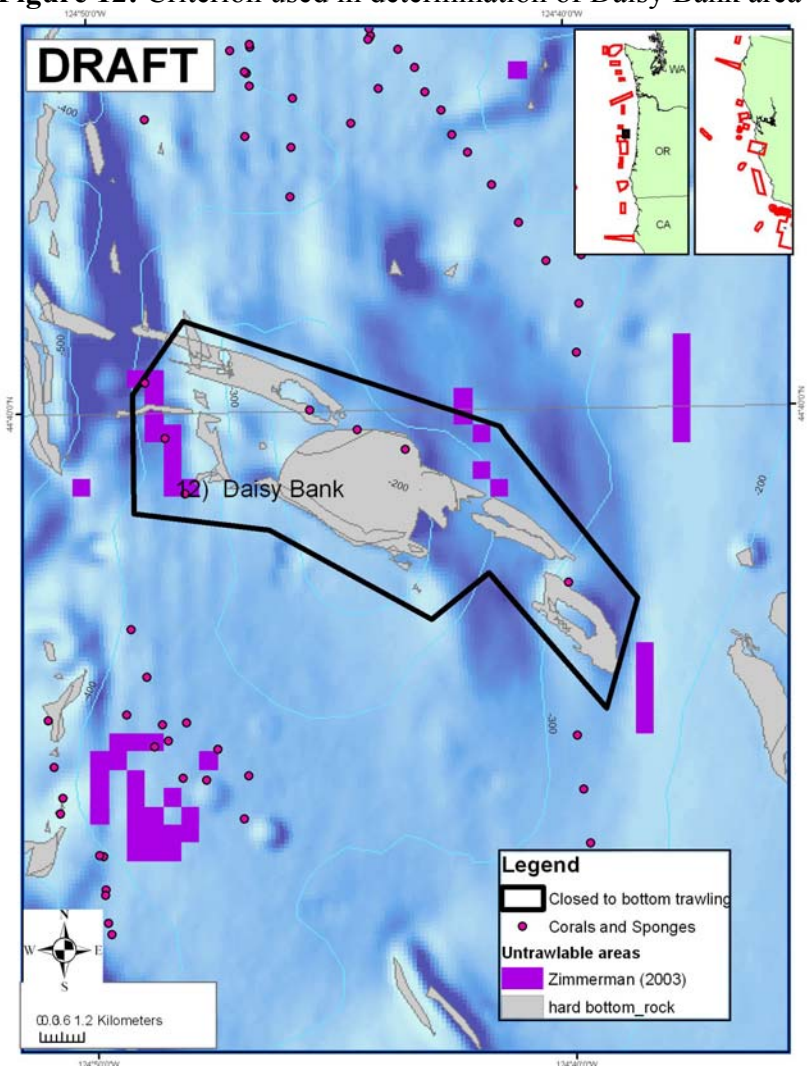


Table 12: Habitat types protected by Daisy Bank closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Slope	12	37.8
Rocky Ridge	15	11.6
Rocky Slope	30	8.9
Sedimentary Ridge	6	7.6
Grand Total	63	65.9

13) Heceta Bank

Heceta Bank is the largest rocky reef in the Pacific northwest. This large bank off the coast of central Oregon is largely comprised of hard bottom substrate. Recent explorations have documented key areas of sponges and crinoids. Wakefield (unpublished data) discovered high abundances of crinoids and sponges creating biogenic habitat for groundfish in some areas of Heceta Bank.

Figure 13: Criterion used in determination of Heceta Bank area closed to bottom trawling

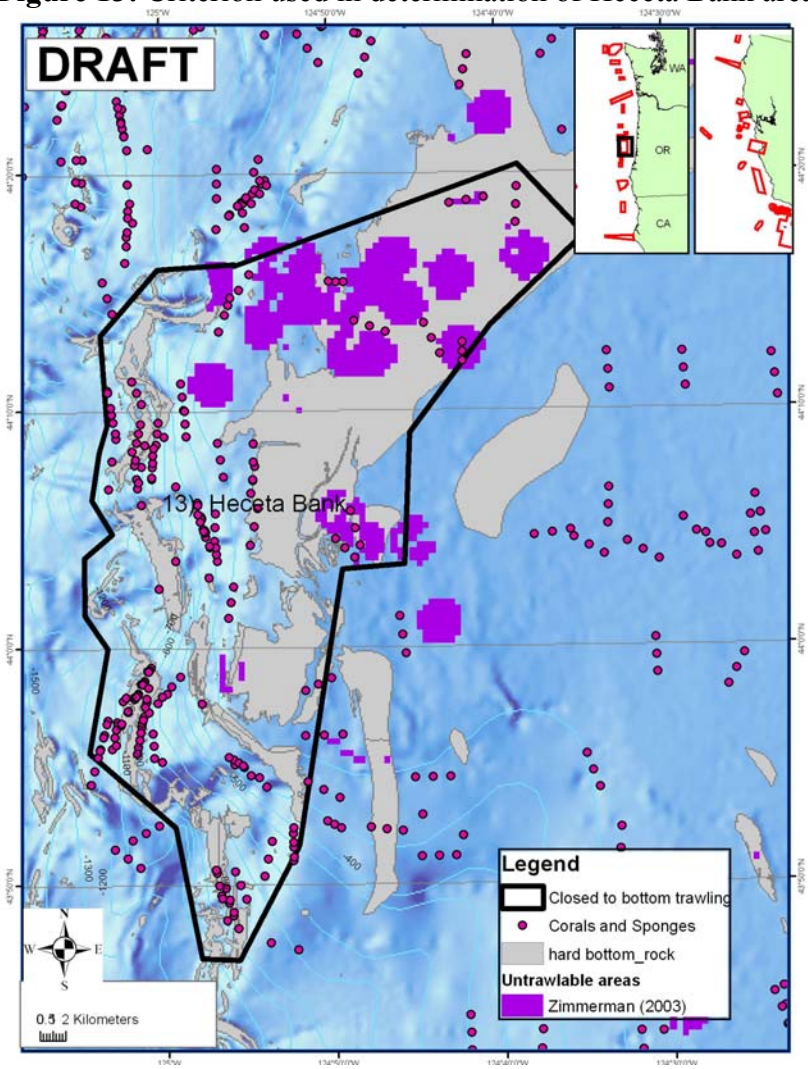


Table 13: Habitat types protected by Heceta Bank closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	**Area (km2)**
Rocky Shelf	39	429.3
Sedimentary Slope	22	266.7
Sedimentary Shelf	4	216.0
Sedimentary Slope Landslide	70	116.0
Rocky Slope Landslide	50	59.1
Rocky Slope	117	51.4
Rocky Ridge	5	9.1
Rocky Slope Canyon Wall	3	6.2
Sedimentary Ridge	13	4.5
Sedimentary Slope Canyon Floor	1	2.8
Sedimentary Slope Canyon Wall	16	1.8
Rocky Slope Canyon Floor	11	0.1
Grand Total	351	1163.0

14) Ridges_Biogenic Area_9

Figure 14: Criterion used in determination of Ridges_biogenic_area_9 area closed to bottom trawling

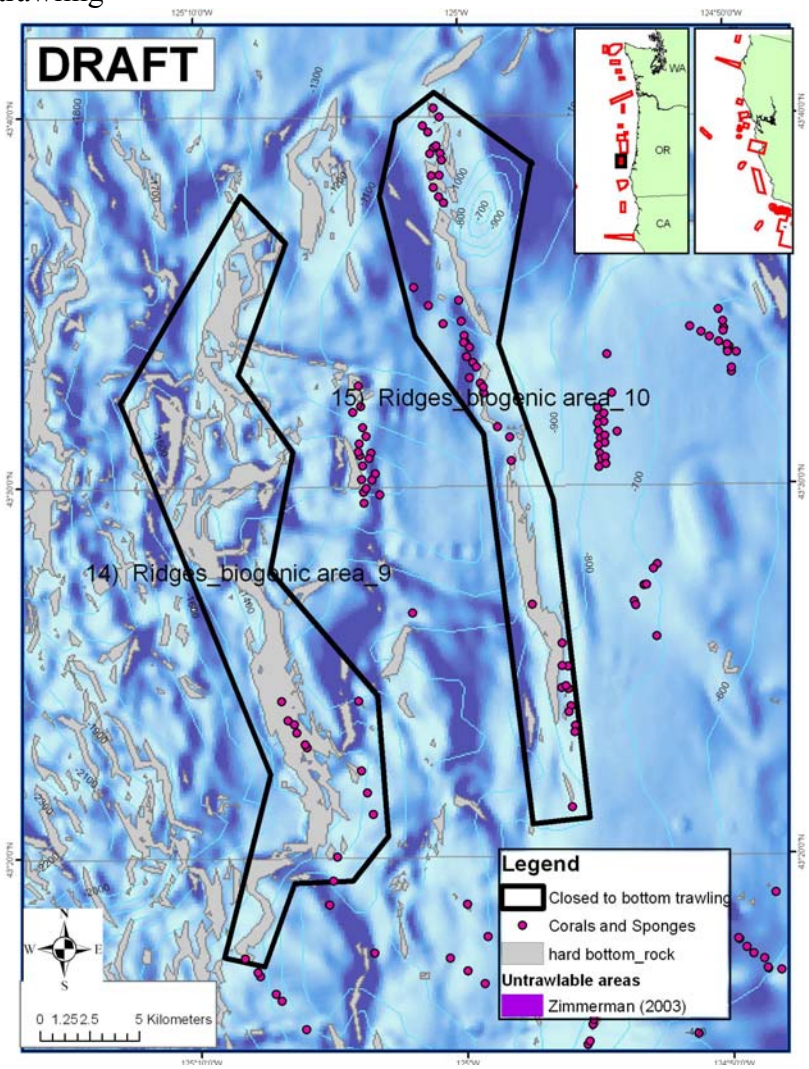


Table 14: Habitat types protected by Ridges_biogenic_area_9 closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Slope Landslide	48	96.2
Rocky Slope Landslide	45	56.3
Sedimentary Slope	3	40.1
Rocky Slope	39	6.1
Grand Total	135	198.8

15) Ridges_Biogenic Area_10

Figure 15: Criterion used in determination of Ridges_biogenic_area_10 area closed to bottom trawling

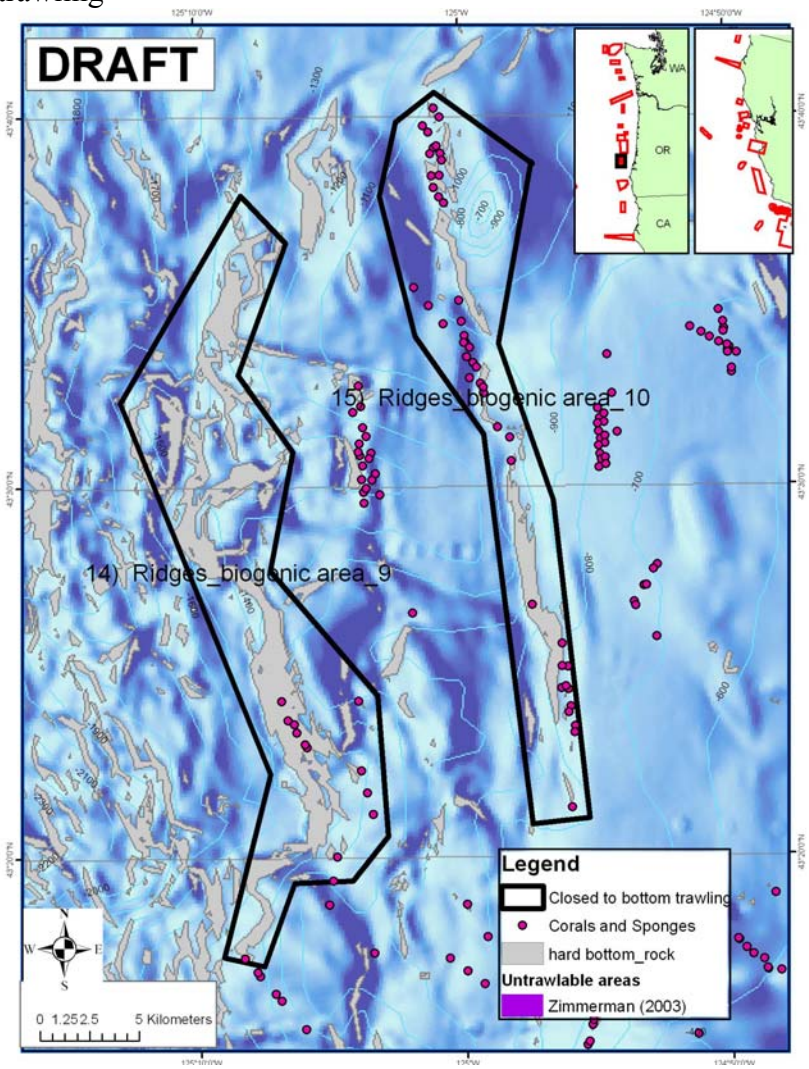


Table 15: Habitat types protected by Ridges_biogenic_area_10 closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Ridge	7	62.1
Sedimentary Slope	1	56.1
Rocky Ridge	30	16.2
Sedimentary Basin	1	5.7
Rocky Slope	6	0.7
Sedimentary Slope Landslide	1	0.5
Grand Total	46	141.3

16) Hard Bottom Feature_1

Figure 16: Criterion used in determination of Hard bottom feature_1 area closed to bottom trawling

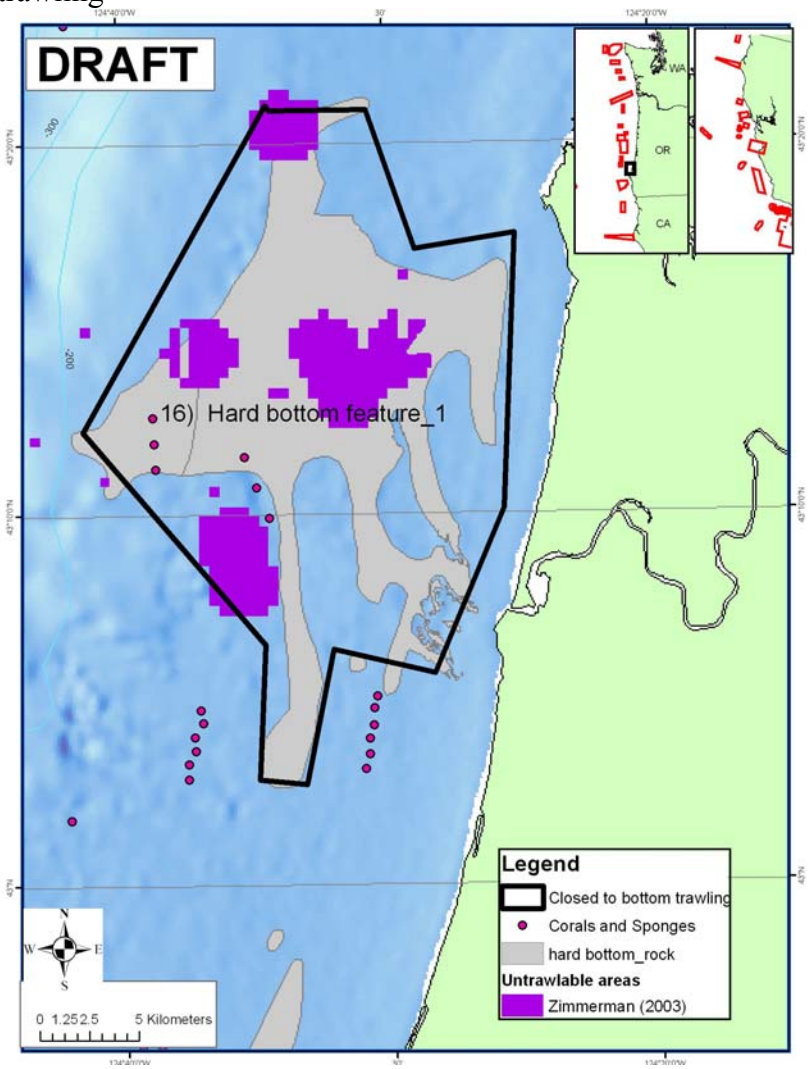


Table 16: Habitat types protected by Hard bottom feature_1 closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Rocky Shelf	18	211.6
Sedimentary Shelf	8	171.1
Rocky Slope	1	24.8
Sedimentary Slope	2	22.0
Grand Total	29	429.5

17) Rogue Canyon

This submarine canyon contains high amounts of hard substrate (NOAA), a high relative density of megafaunal invertebrate records, and is known for its large canyon walls and ridges.

Figure 17: Criterion used in determination of Rogue Canyon area closed to bottom trawling

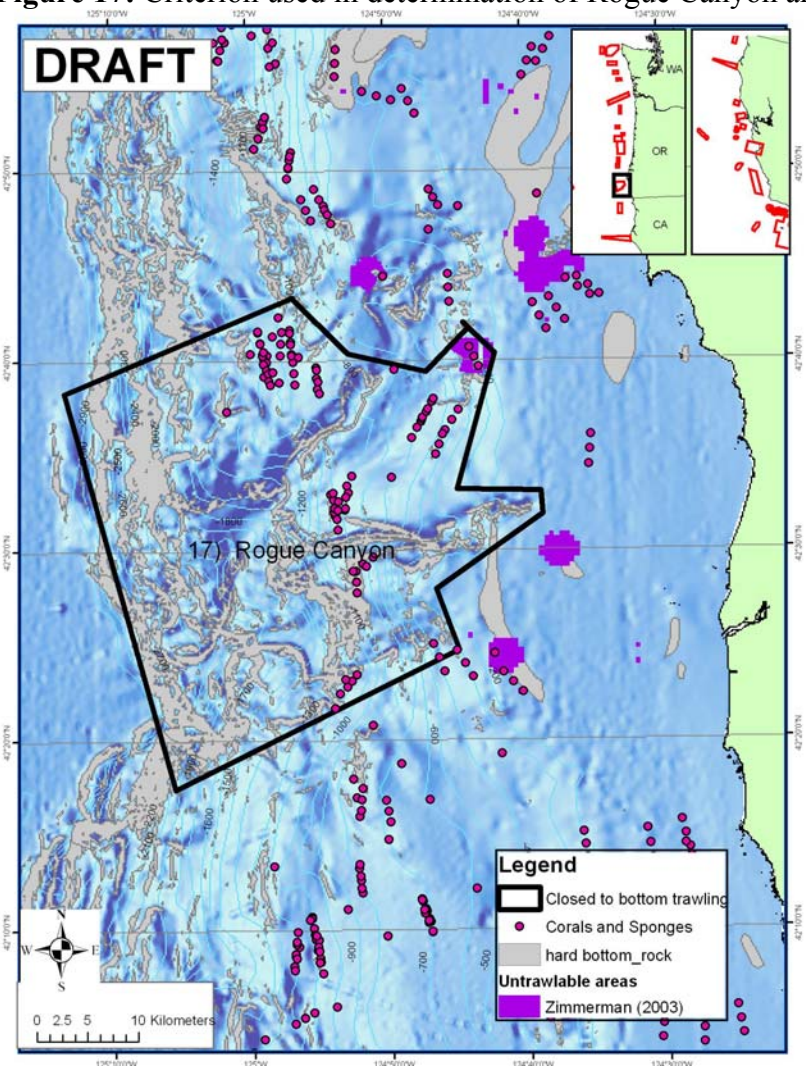


Table 17: Habitat types protected by Rogue Canyon closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	**Area (km2)**
Sedimentary Slope Landslide	77	545.2
Sedimentary Slope Canyon Wall	350	273.4
Rocky Slope Canyon Wall	171	126.3
Rocky Slope Landslide	241	123.3
Sedimentary Slope	6	95.3
Rocky Slope Canyon Floor	138	88.8
Sedimentary Slope Canyon Floor	48	61.4
Sedimentary Shelf	4	18.3
Sedimentary Shelf Canyon Wall	21	2.2
Rocky Slope	18	1.5
Rocky Shelf	5	0.9
Rocky Shelf Canyon Wall	1	0.2
Grand Total	1080	1336.7

18) Biogenic Area_11

Figure 18: Criterion used in determination of Biogenic area_11 area closed to bottom trawling

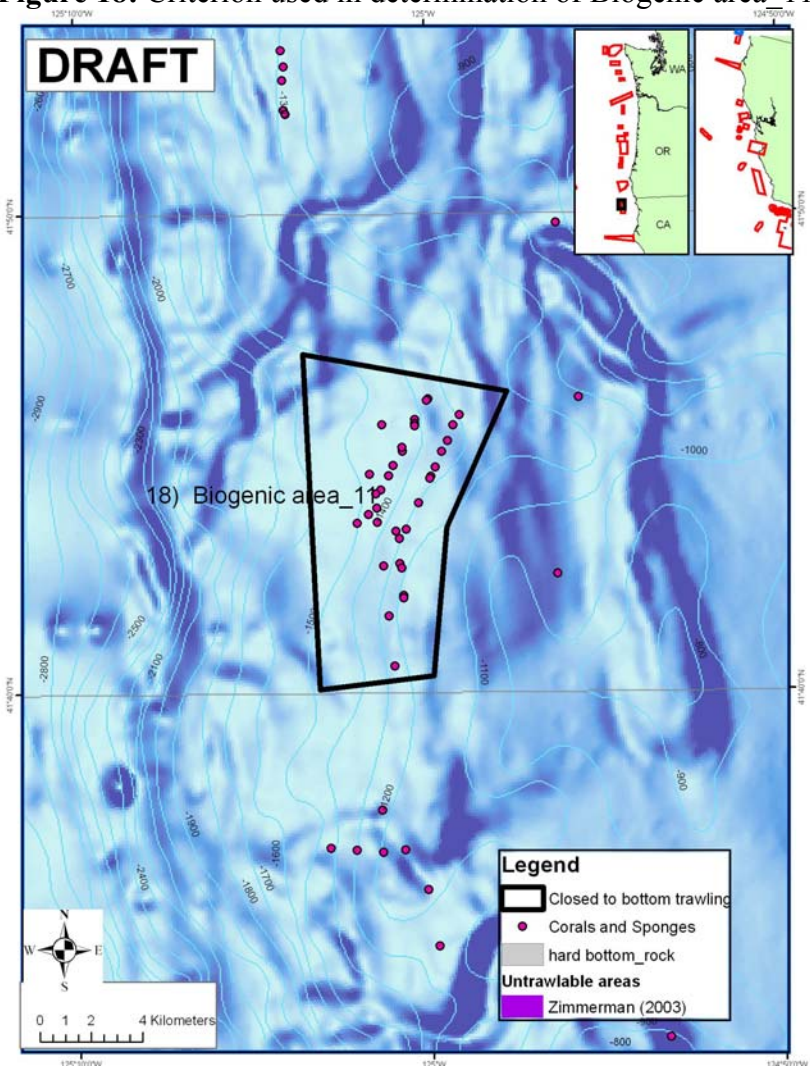


Table 18: Habitat types protected by Biogenic area_11 closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Slope	1	48.5
Sedimentary Slope Canyon Wall	3	12.3
Sedimentary Slope Canyon Floor	1	9.2
Grand Total	5	70.1

19) Eel River Canyon

Figure 19: Criterion used in determination of Eel River Canyon area closed to bottom trawling

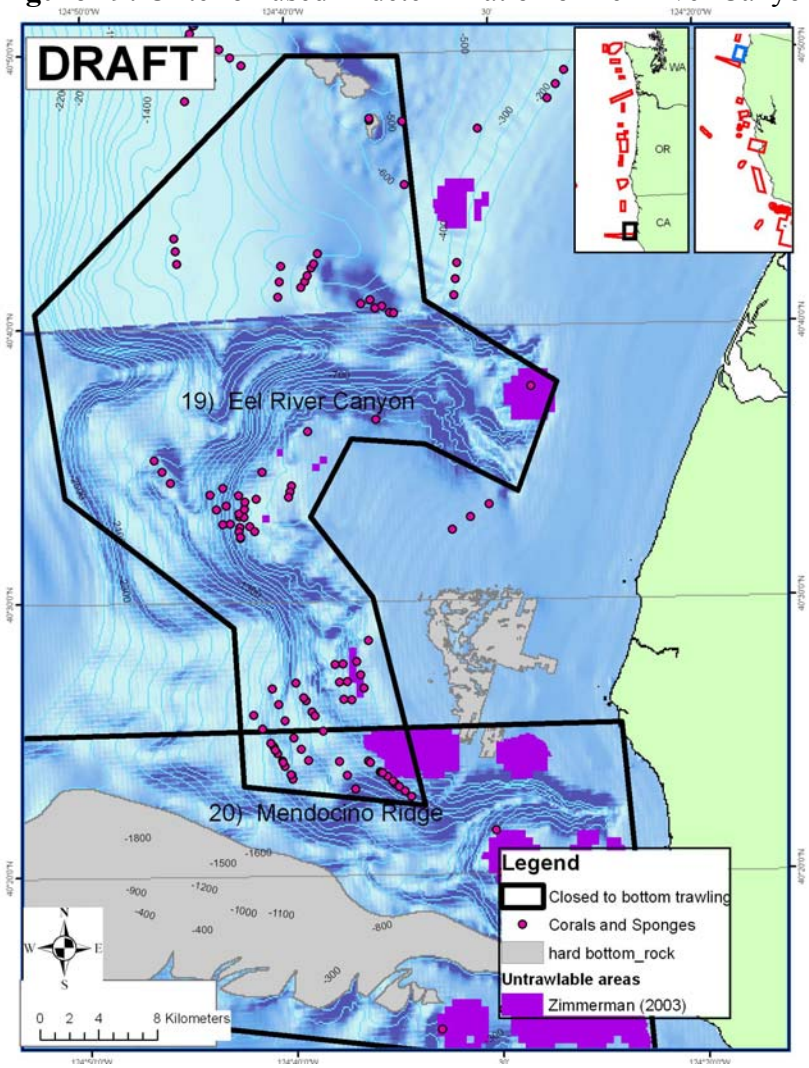


Table 19: Habitat types protected by Eel River Canyon closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	**Area (km2)**
Sedimentary Slope	3	461.8
Sedimentary Slope Canyon Wall	7	146.6
Sedimentary Slope Gully	2	137.3
Sedimentary Slope Canyon Floor	5	89.6
Sedimentary Shelf	1	62.5
Sedimentary Apron	1	9.4
Rocky Ridge	3	5.8
Sedimentary Apron Canyon Floor	1	3.7
Grand Total	23	916.7

20) Mendocino Ridge

Mendocino Ridge, also known as the Gorda Escarpment, is a large underwater ridge running east to west separating two major marine ecological provinces.

Figure 20: Criterion used in determination of Mendocino Ridge area closed to bottom trawling

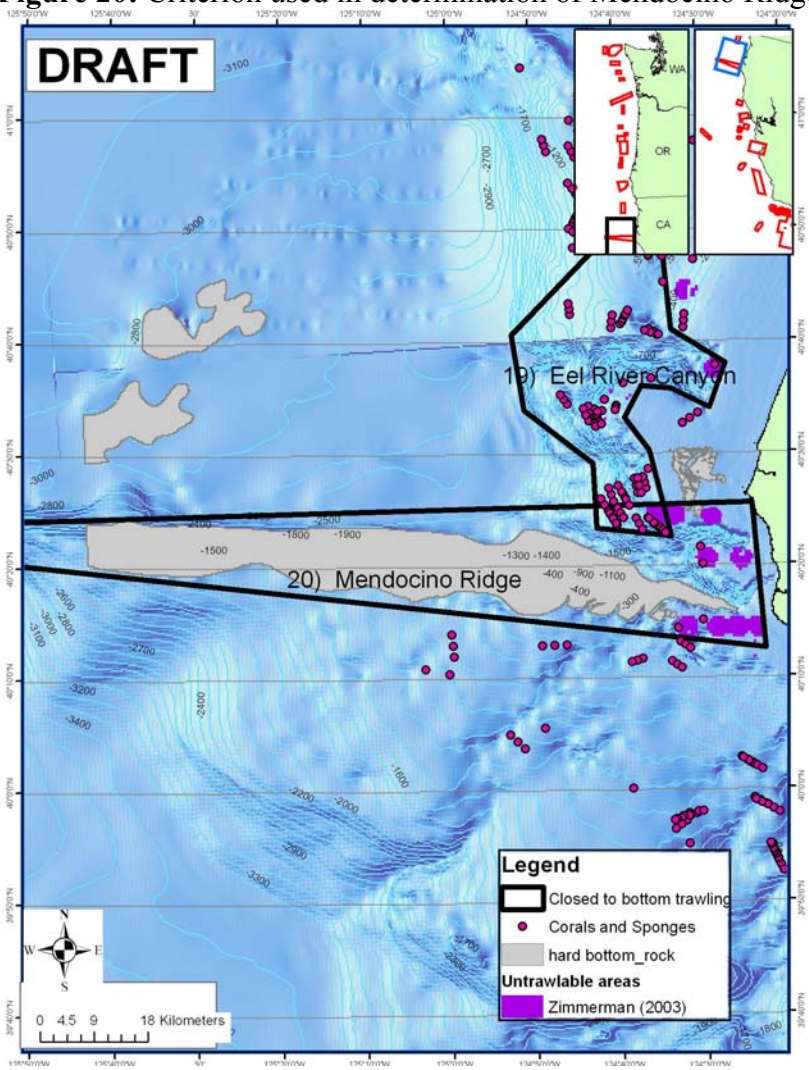


Table 20: Habitat types protected by Mendocino Ridge closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Rocky Ridge	1	909.4
Sedimentary Shelf	24	194.9
Sedimentary Slope Canyon Floor	5	192.5
Sedimentary Slope Canyon Wall	2	182.5
Sedimentary Slope	7	123.3
Sedimentary Apron	3	114.0
Rocky Shelf	5	3.3
Sedimentary Apron Canyon Floor	2	1.8
Grand Total	49	1721.7

21) Hard Bottom Feature_2

Figure 21: Criterion used in determination of Hard bottom feature_2 area closed to bottom trawling

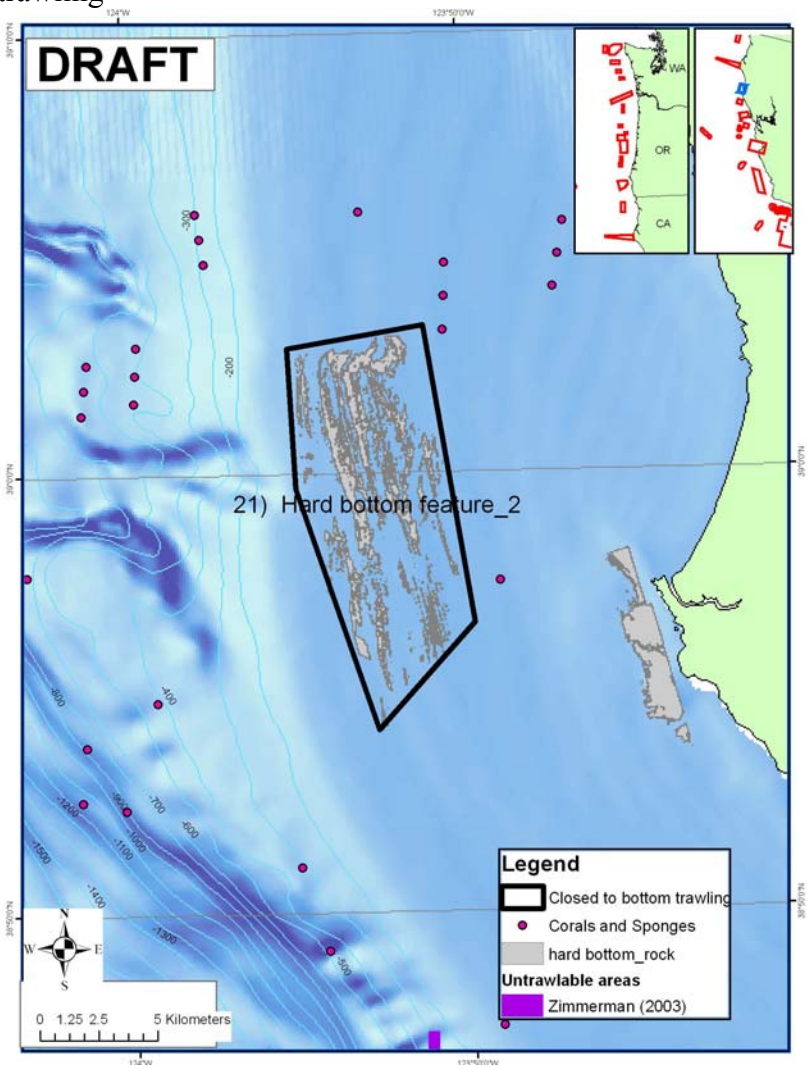


Table 21: Habitat types protected by Hard bottom feature_2 closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Shelf	254	70.0
Rocky Shelf	1054	18.1
Grand Total	1308	88.0

22) Biogenic Area_12

Figure 22: Criterion used in determination of Biogenic area_12 area closed to bottom trawling

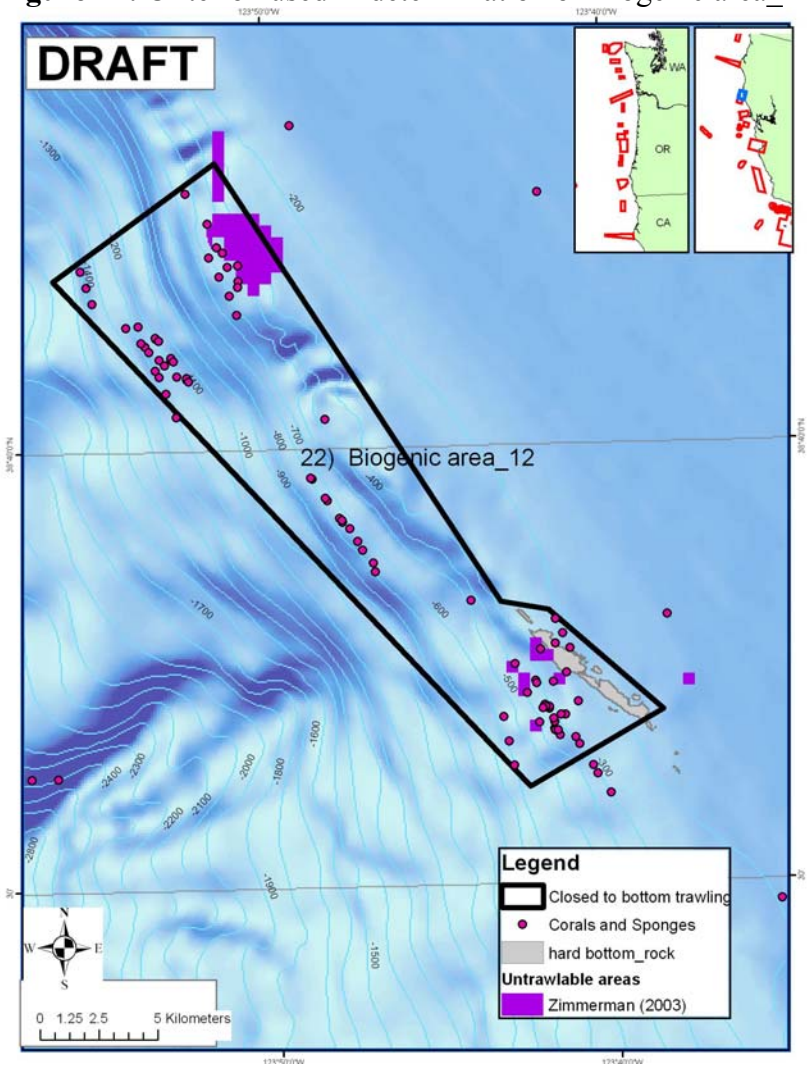


Table 22: Habitat types protected by Biogenic area_12 closed area, determined from EFH GIS data

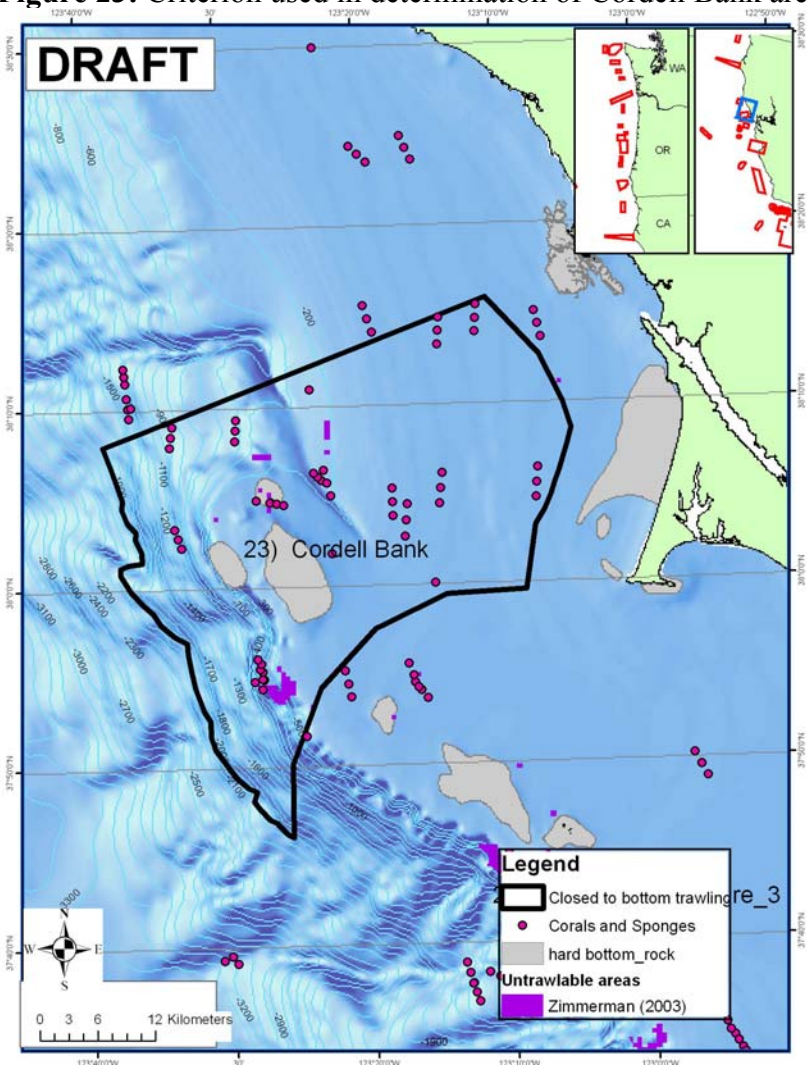
HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Slope	1	179.2
Sedimentary Shelf	3	5.9
Rocky Shelf	8	3.3
Grand Total	12	188.3

23) Cordell Bank

Cordell Bank is an underwater island surrounded by deep water on three sides. At depths between 35 m and 50 m, the rocky habitats are carpeted with sponges, ascidians, hydrocorals, anemones, and sea stars. Fed by the productive currents, this seafloor habitat creates complex living structures for juvenile rockfish, lingcod, and many species of adult rockfish.

Designated as a national marine sanctuary in 1989, Cordell Bank is one of the most productive offshore areas in the United States. The combination of the California current, upwelling of nutrient rich ocean waters and the topography of the area provides for a flourishing ecosystem. This area is thickly covered by sponges, anemones, hydrocorals, and other invertebrates. It also hosts 180 species of fish, providing spawning habitat for lingcod. Finally this area hosts twenty six resident and migratory species of marine mammals.[5]

Figure 23: Criterion used in determination of Cordell Bank area closed to bottom trawling



[5] Cordell Bank State of the Sanctuary Report. http://sanctuaries.nos.noaa.gov/oms/omscordell/omscordell.html

Table 23: Habitat types protected by Cordell Bank closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	**Area (km2)**
Sedimentary Shelf	1	832.5
Sedimentary Slope	1	468.8
Rocky Shelf	3	63.3
Sedimentary Slope Canyon Floor	1	5.5
Grand Total	6	1370.1

24) Hard Bottom Feature_3

Figure 24: Criterion used in determination of Hard bottom feature_3 area closed to bottom trawling

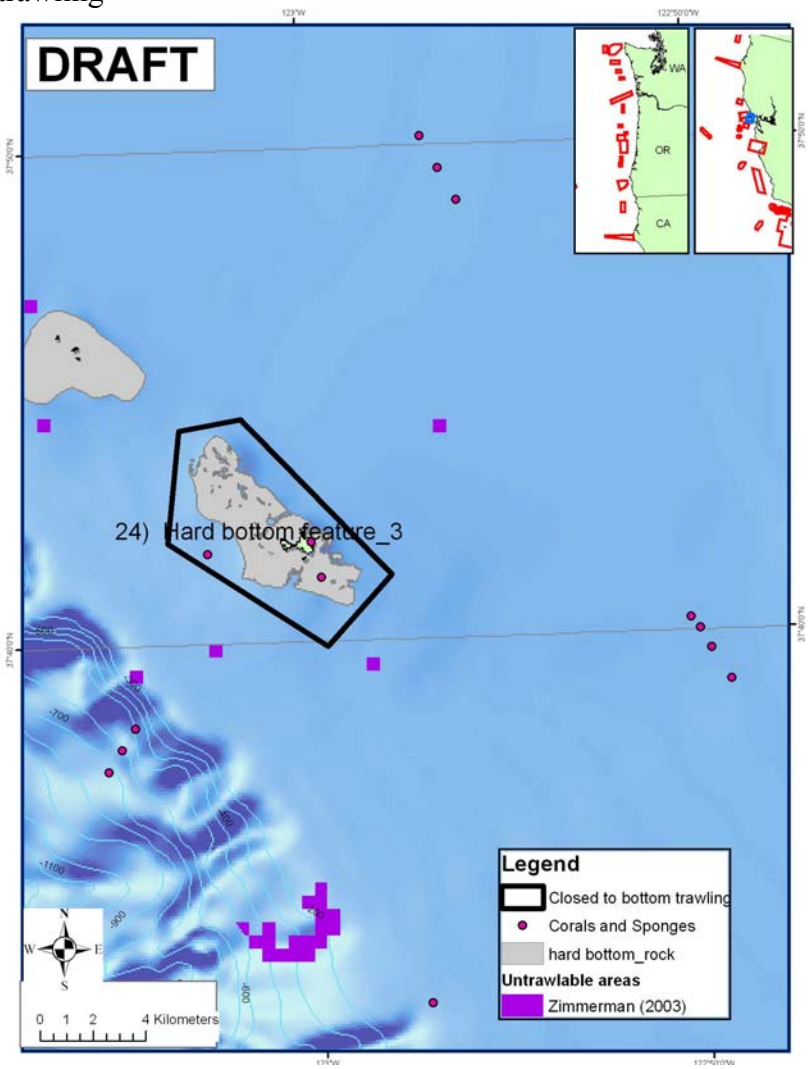


Table 24: Habitat types protected by Hard bottom feature_3 closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Shelf	36	23.2
Rocky Shelf	24	15.5
Island	7	0.4
Sedimentary Shelf Gully	21	0.2
Grand Total	88	39.3

25) Hard Bottom Feature_4

Figure 25: Criterion used in determination of Hard bottom feature_4 area closed to bottom trawling

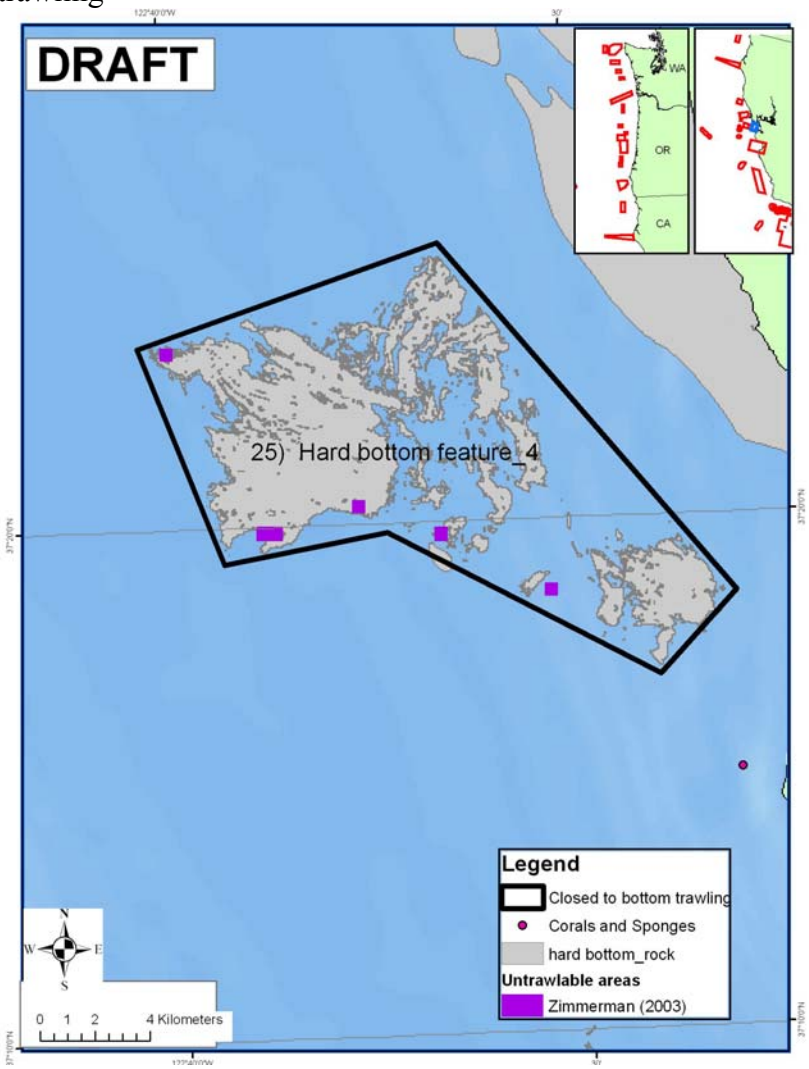


Table 25: Habitat types protected by Hard bottom feature_4 closed area, determined from EFH GIS data

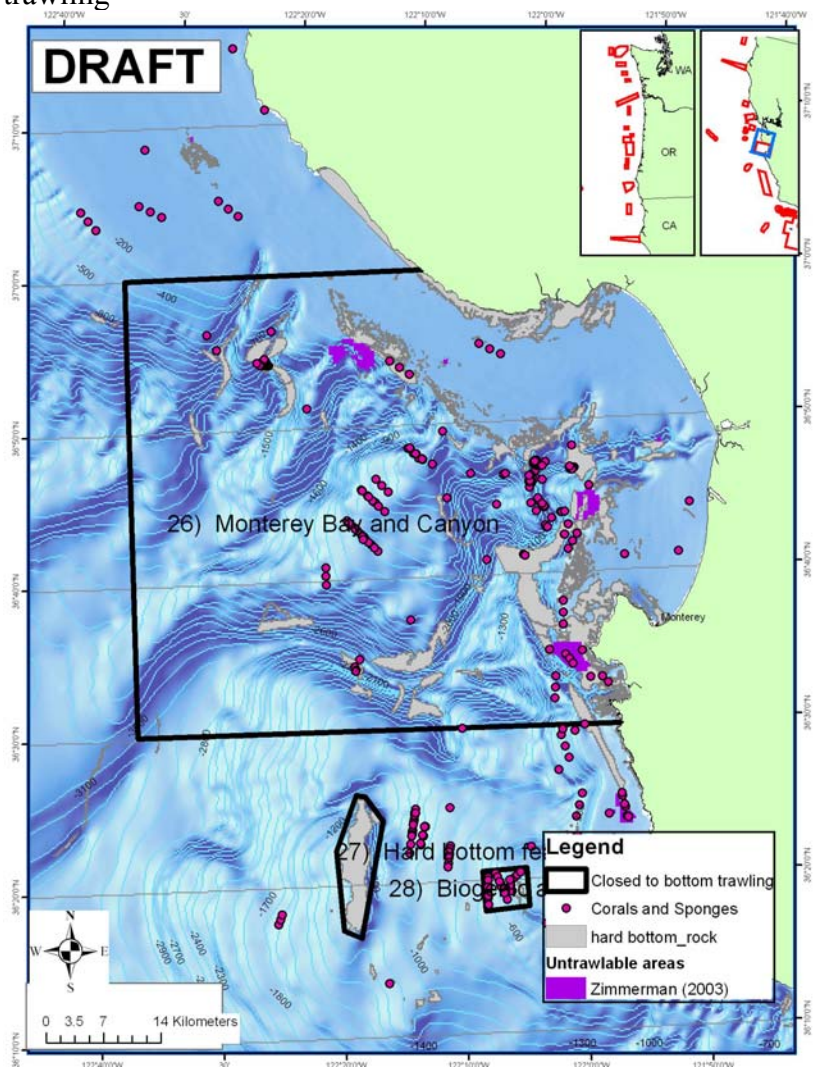
HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Shelf	318	100.7
Rocky Shelf	462	69.6
Grand Total	780	170.2

26) Monterey Bay and Monterey Canyon

The deepest and largest submarine canyon on the coast of North America is the Monterey Canyon, just south of San Francisco, California. This canyon is 470 km long, approximately 12 km wide at its widest point, and has a maximum rim to floor relief of 1,700 m, making it much larger than Arizona's Grand Canyon.

Monterey Bay and Canyon are part of the Monterey Bay National Marine Sanctuary designated in 1992. These areas contain a rich array of habitats from rugged rocky shores and lush kelp forests and one of the largest underwater canyons in North America. The sanctuary supports thirty three species of marine mammals, ninety-four species of seabirds, 345 species of fish, four species of sea turtles and thousands of species of invertebrates.[6]

Figure 26: Criterion used in determination of Monterey Bay and Canyon area closed to bottom trawling



[6] State of the Sanctuary Report. Monterey Bay National Marine Sanctuary. http://www.mbnms.nos.noaa.gov

Table 26: Habitat types protected by Monterey Bay and Canyon closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	**Area (km2)**
Sedimentary Slope	23	1063.4
Sedimentary Shelf	487	930.1
Sedimentary Slope Canyon Wall	55	696.2
Sedimentary Slope Canyon Floor	5	276.2
Rocky Shelf	1565	169.9
Sedimentary Slope Gully	13	82.5
Sedimentary Shelf Canyon Wall	31	76.8
Sedimentary Slope Gully Floor	35	69.1
Rocky Slope Canyon Wall	26	61.0
Rocky Shelf Canyon Wall	38	52.5
Sedimentary Apron Canyon Wall	1	32.4
Sedimentary Slope Landslide	12	30.7
Rocky Slope	13	27.9
Rocky Slope Landslide	3	3.9
Sedimentary Shelf Canyon Floor	7	1.0
Rocky Slope Gully	53	0.8
Island	49	0.5
Sedimentary Apron	1	0.4
Grand Total	2417	3575.5

27) Hard Bottom Feature_5

Figure 27: Criterion used in determination of Hard bottom feature_5 area closed to bottom trawling

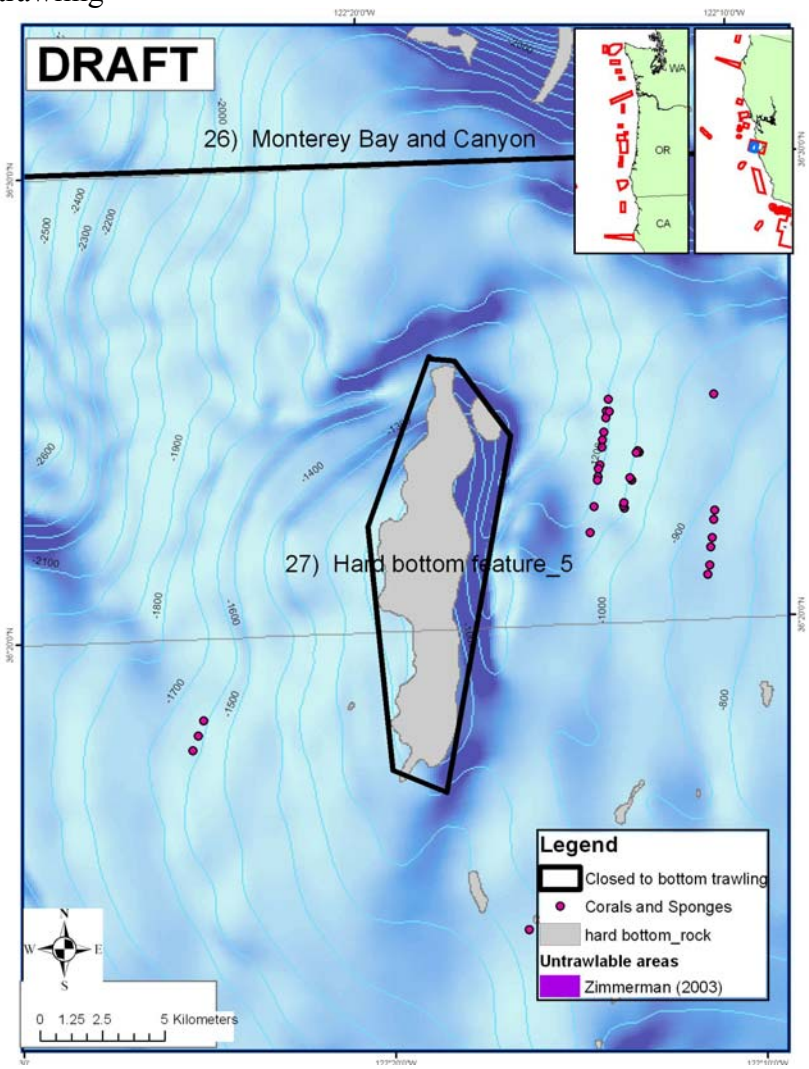


Table 27: Habitat types protected by Hard bottom feature_5 closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Rocky Ridge	2	36.5
Sedimentary Slope	1	23.9
Sedimentary Slope Gully Floor	1	1.6
Sedimentary Slope Gully	1	0.5
Grand Total	5	62.6

28) Biogenic Area_13

Figure 28: Criterion used in determination of Biogenic area_13 area closed to bottom trawling

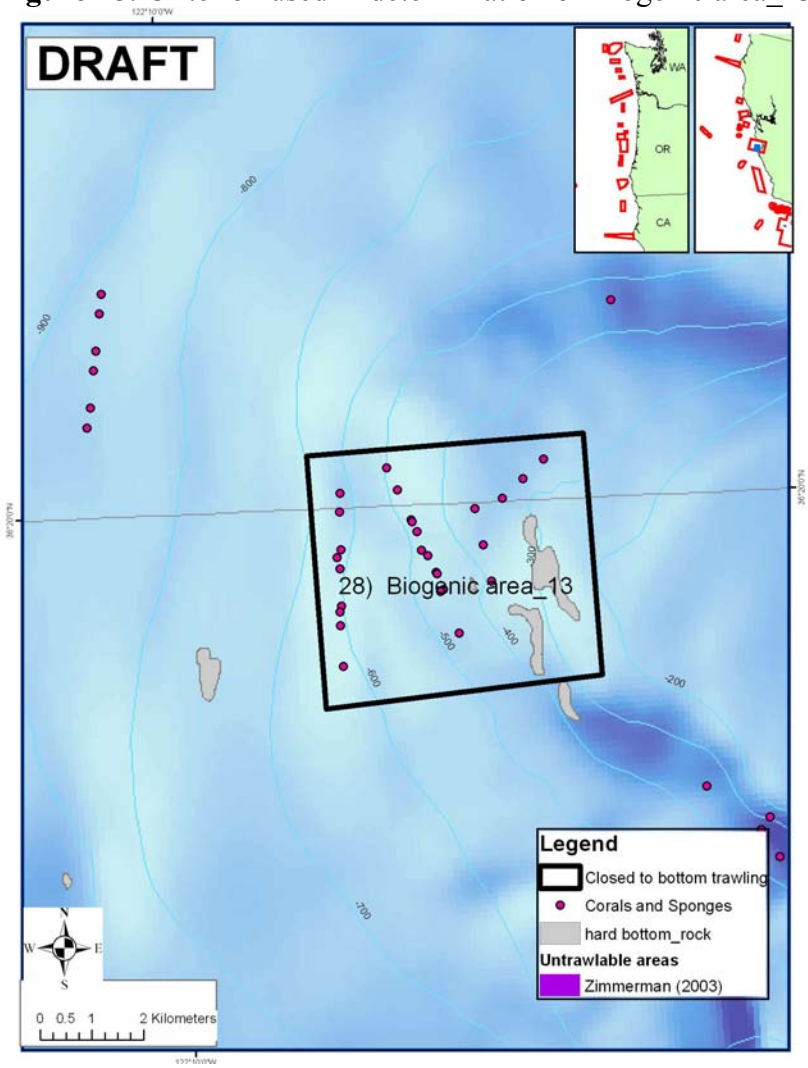


Table 28: Habitat types protected by Biogenic area_13 closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Slope	1	24.6
Rocky Slope	4	1.0
Sedimentary Shelf	1	0.1
Grand Total	6	25.7

29) Morro Ridge

Morro Ridge is a long ridge of hard substrate off the Central California coast. It contains numerous records of megafaunal invertebrates from NOAA.

Figure 29: Criterion used in determination of Morro Ridge area closed to bottom trawling

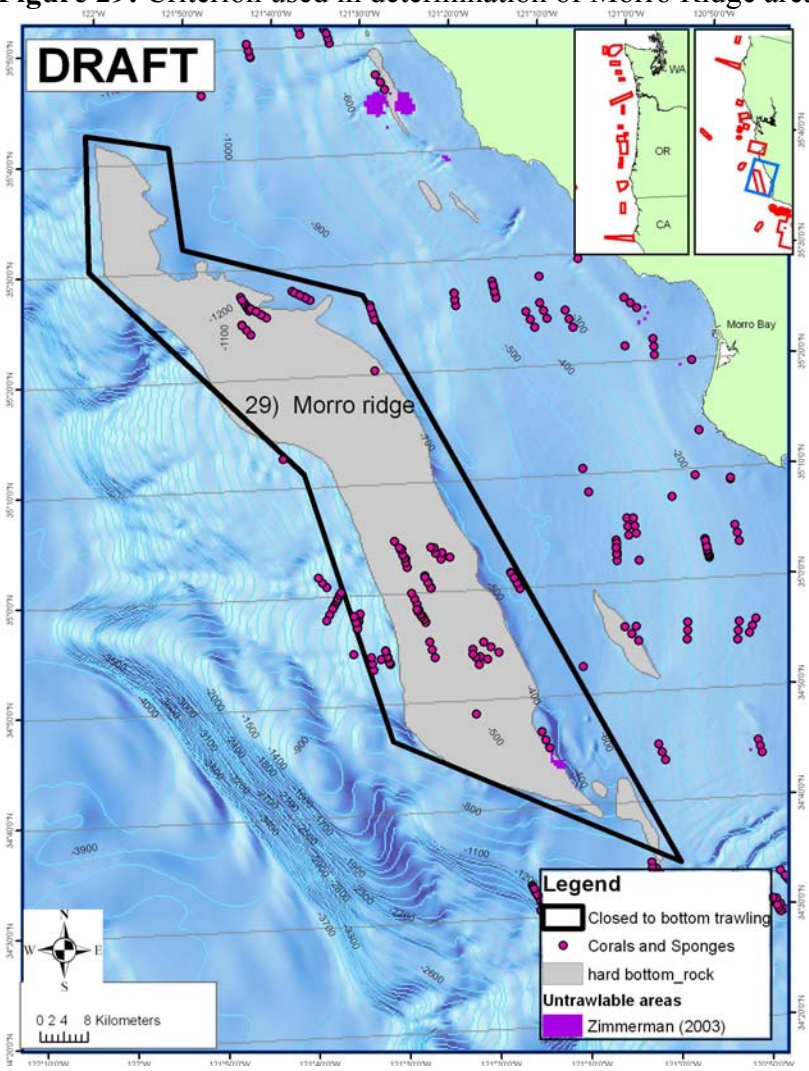


Table 29: Habitat types protected by Morro Ridge closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Rocky Ridge	1	2111.6
Sedimentary Slope	2	1190.9
Rocky Slope	2	39.0
no data	1	28.6
Grand Total	6	3370.1

30) Channel Islands

The Channel Islands National Marine Sanctuary contains numerous records of biogenic habitat, particularly gorgonian corals and sponges. It is located at the meeting point between two major oceanographic currents, and therefore has a relatively high diversity of marine life from both tropical and temperate marine ecosystems.

Figure 30: Criterion used in determination of Channel Islands area closed to bottom trawling

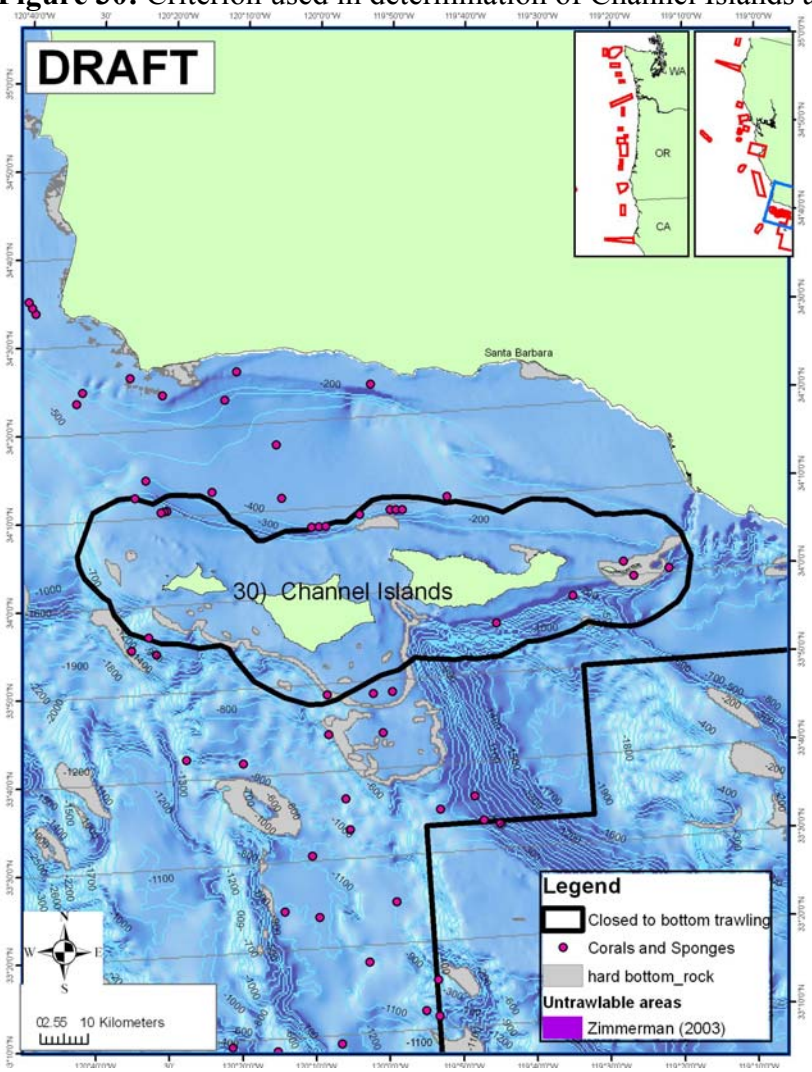


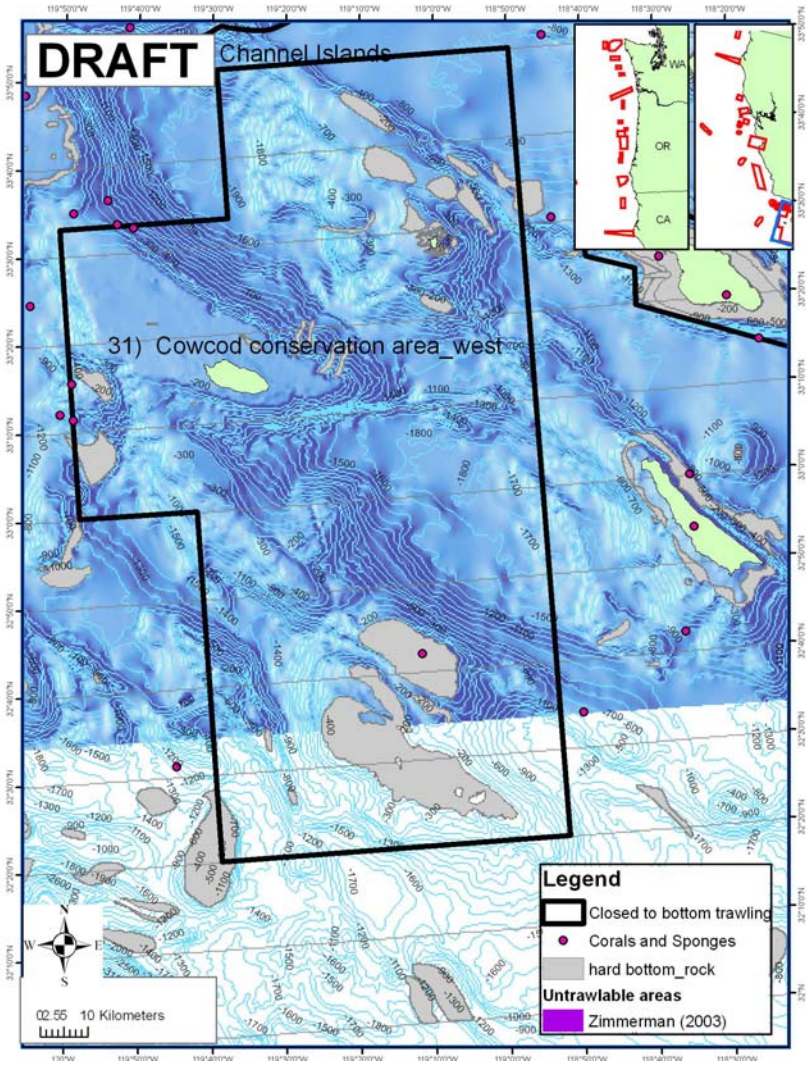
Table 30: Habitat types protected by Channel Islands closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	**Area (km2)**
Sedimentary Shelf	3	1805.1
Sedimentary Slope	7	796.6
Island	10	506.8
Sedimentary Basin	3	372.0
Rocky Shelf	13	99.9
Rocky Slope	3	95.9
Sedimentary Slope Canyon Wall	2	35.7
Sedimentary Slope Canyon Floor	1	21.5
Rocky Ridge	4	18.3
no data	2	11.6
Sedimentary Ridge	1	10.9
Sedimentary Shelf Canyon Wall	1	5.7
Grand Total	50	3780.1

31) Cowcod Conservation Areas

The Cowcod Conservation Areas were established in 2001 to help protect and rebuild cowcod stocks which have been driven down by eighty nine to ninety six percent of unfished levels. These areas contain hard bottom habitats including a number of offshore banks.[7] These areas also have documented occurrences of black corals.[8] Finally, these areas are extremely important for restoring depleted cowcod. Cowcod is a long lived species with low productivity requiring almost a century to rebuild the population.[9] Due to the low levels of allowable mortality necessary to rebuild cowcod, the primary rebuilding strategy is avoidance.[10]

Figure 31: Criterion used in determination of Cowcod conservation area_west area closed to bottom trawling



[7] Analysis provided by NMFS for the EIS Oversight Committee in Portland, OR on August 16-18, 2004.

[8] Preliminary Report on Occurences of Structiure-Forming Megafaunal Invertebrates off the West Coast of Washington, Oregon and California. Northwest Fishery Science Center. August 2004.

[9] Final Environmental Impact Statement for Amendment 16-3 to the Pacific Coast Groundfish Fishery Management Plans for Bocaccio, Cowcod, Widow rockfish and Yelloweye Rockfish. July 2004. Pacific Fishery Management Council. at p. 63.

[10] *Id*. at 45.

Table 31: Habitat types protected by Cowcod conservation area_west closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	**Area (km2)**
Sedimentary Ridge	7	4935.0
Sedimentary Basin	6	4841.3
Sedimentary Slope	5	1701.2
Rocky Ridge	19	918.0
Sedimentary Shelf	27	632.7
Sedimentary Slope Canyon Wall	2	75.2
Rocky Slope	6	74.4
Island	3	62.4
Rocky Shelf	17	37.6
Sedimentary Slope Canyon Floor	2	27.0
Rocky Slope Gully	4	26.0
Rocky Slope Canyon Wall	1	8.9
Sedimentary Shelf Gully Floor	43	0.7
no data	1	0.4
Grand Total	143	13340.7

32) Hard Bottom Feature_6

Figure 32: Criterion used in determination of Hard bottom feature_6 area closed to bottom trawling

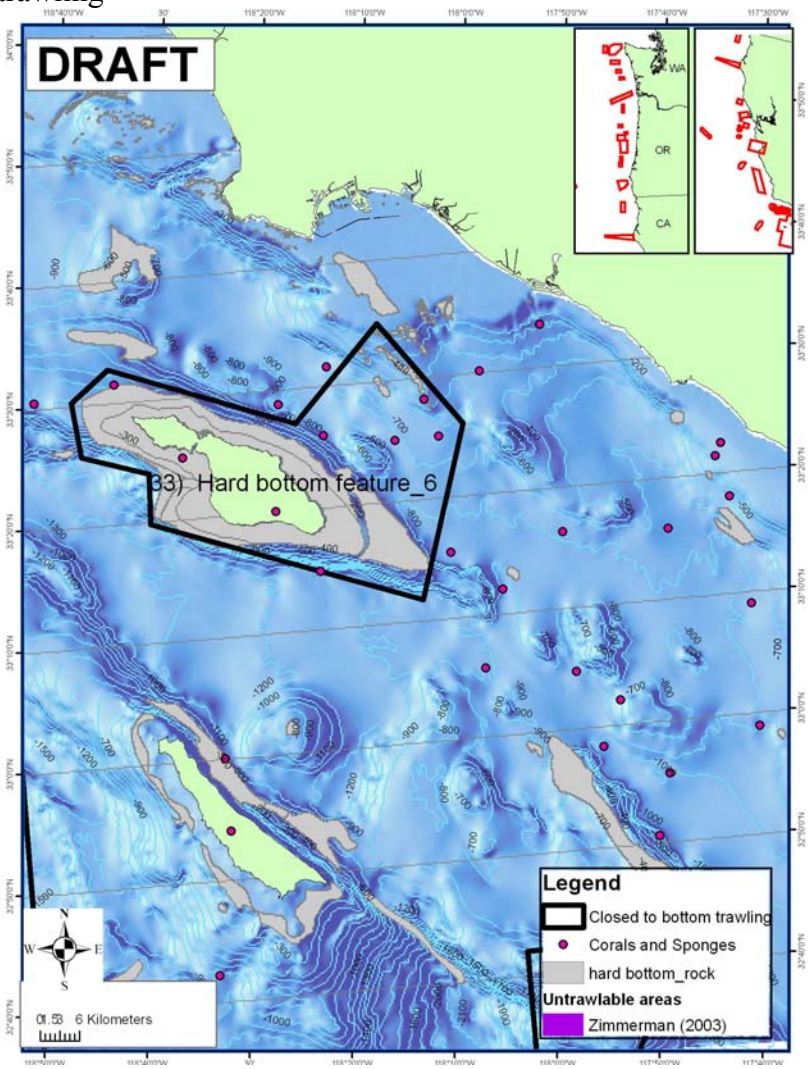


Table 32: Habitat types protected by Hard bottom feature_6 closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	**Area (km2)**
Sedimentary Slope	3	407.1
Rocky Shelf	82	249.8
Rocky Slope	10	249.1
Island	1	194.0
Sedimentary Basin	3	181.8
Sedimentary Ridge	2	52.7
Rocky Slope Canyon Wall	2	15.0
Sedimentary Slope Gully	2	11.6
Rocky Slope Canyon Floor	1	6.4
Sedimentary Basin Gully Floor	9	4.2
Sedimentary Shelf	4	2.2
Sedimentary Basin Canyon Floor	1	2.1
Sedimentary Basin Gully	4	2.0
Sedimentary Slope Canyon Floor	2	1.6
Sedimentary Slope Gully Floor	11	1.5
Sedimentary Basin Canyon Wall	2	1.5
Sedimentary Slope Canyon Wall	1	0.1
no data	2	0.0
Sedimentary Shelf Gully	1	0.0
Rocky Ridge	1	0.0
Grand Total	144	1382.6

33) Cowcod Conservation Areas_East

Figure 33: Criterion used in determination of Cowcod conservation area_east area closed to bottom trawling

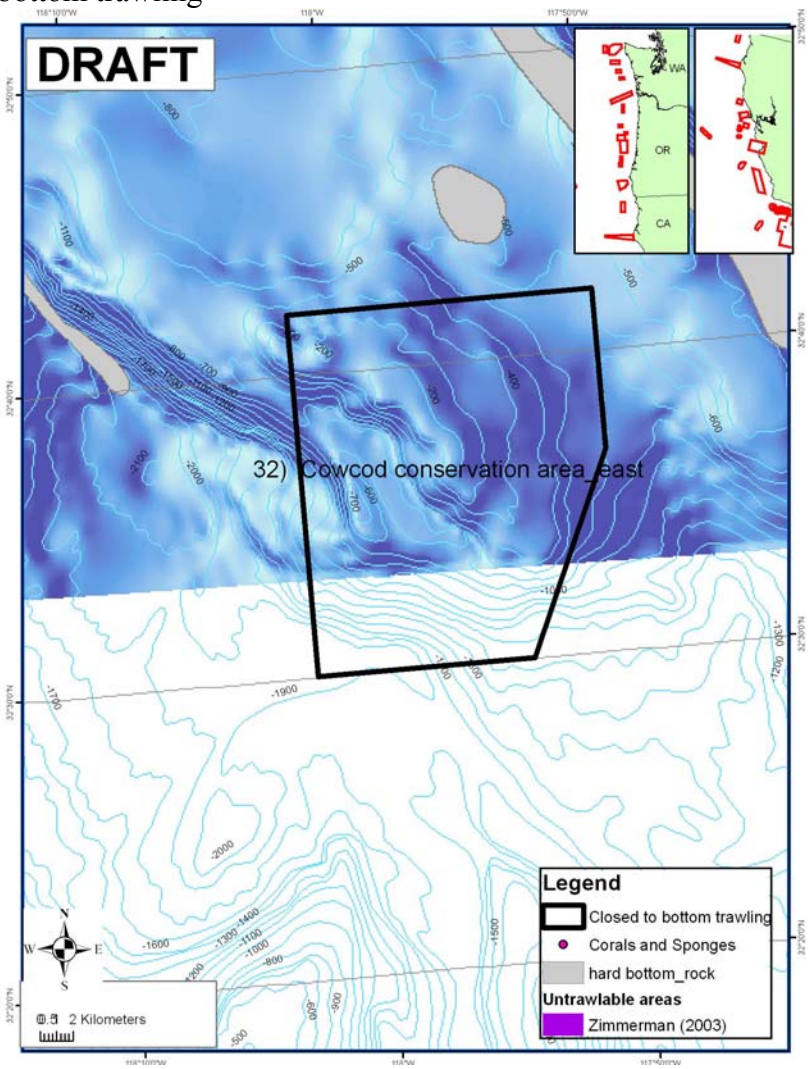


Table 33: Habitat types protected by Cowcod conservation area_east closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Sedimentary Ridge	1	366.2
Sedimentary Basin	1	11.9
Rocky Ridge	1	0.0
Grand Total	3	378.1

34-41) Seamounts

34) Thompson Seamount

Figure 34: Criterion used in determination of Thompson Seamount area closed to bottom trawling

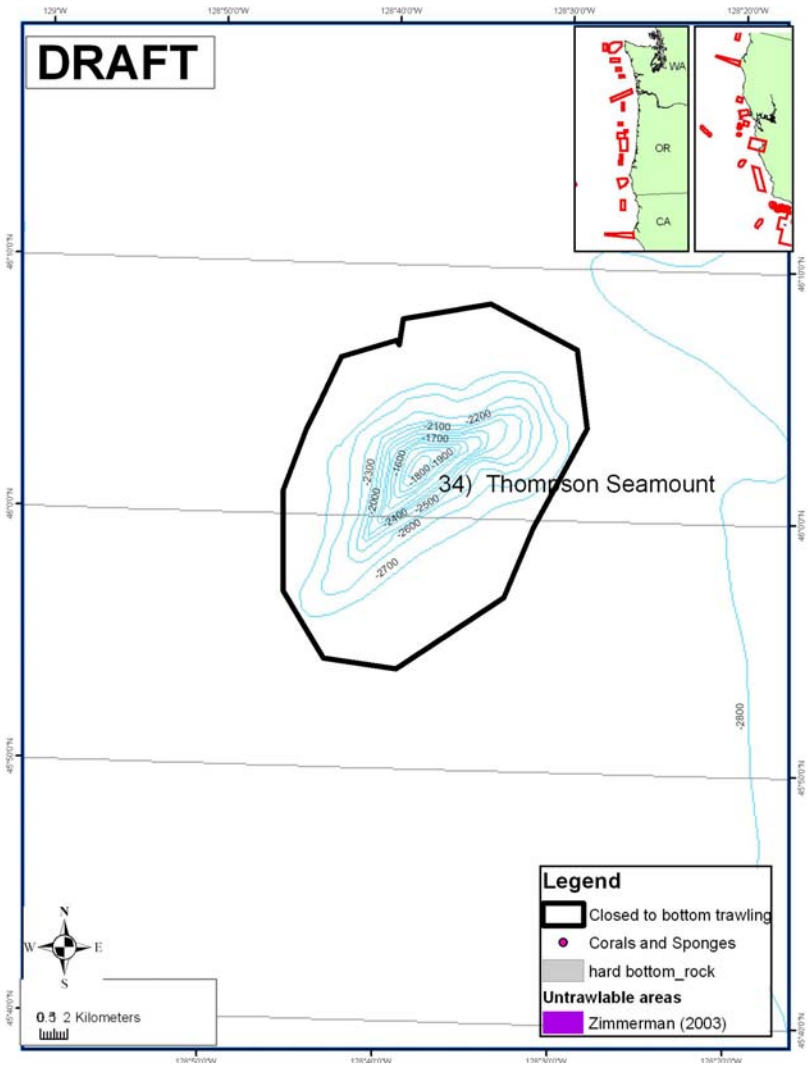


Table 34: Habitat types protected by Thompson Seamount closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
No data	n/a	428.2

35) President Jackson Seamount

Figure 35: Criterion used in determination of President Jackson Seamount area closed to bottom trawling

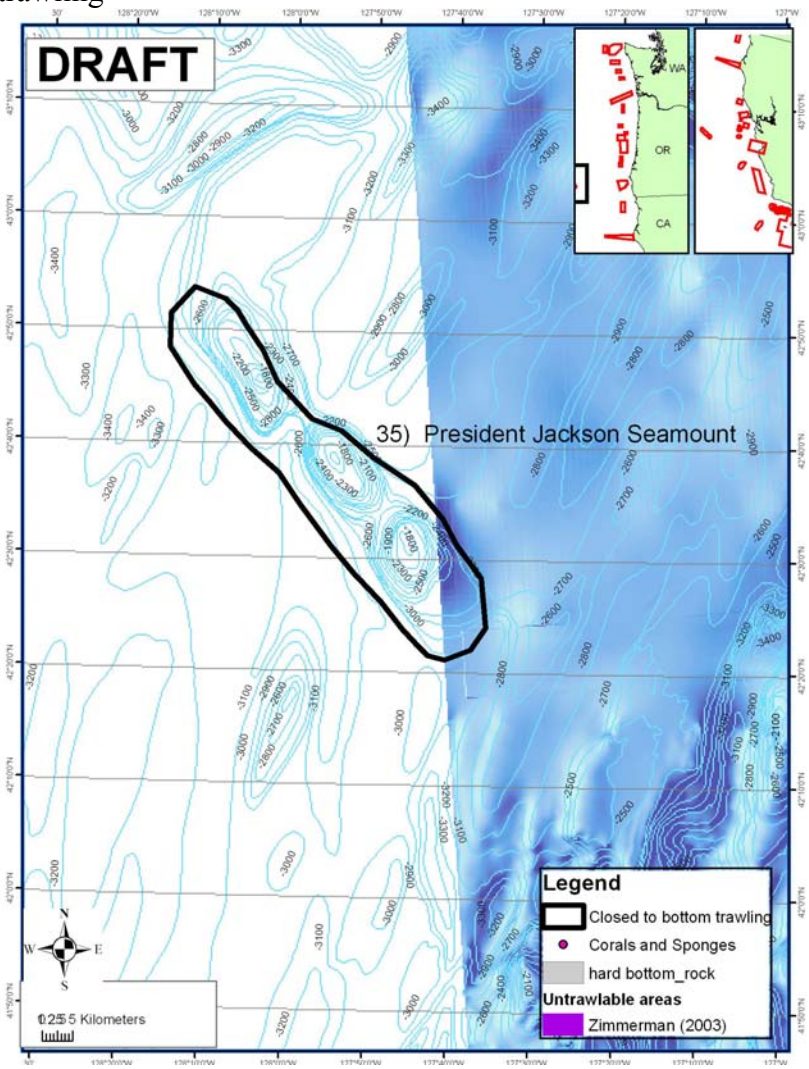


Table 35: Habitat types protected by President Jackson Seamount closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
No data	n/a	986.3

36) Taney Seamount

Figure 36: Criterion used in determination of Taney Seamount area closed to bottom trawling

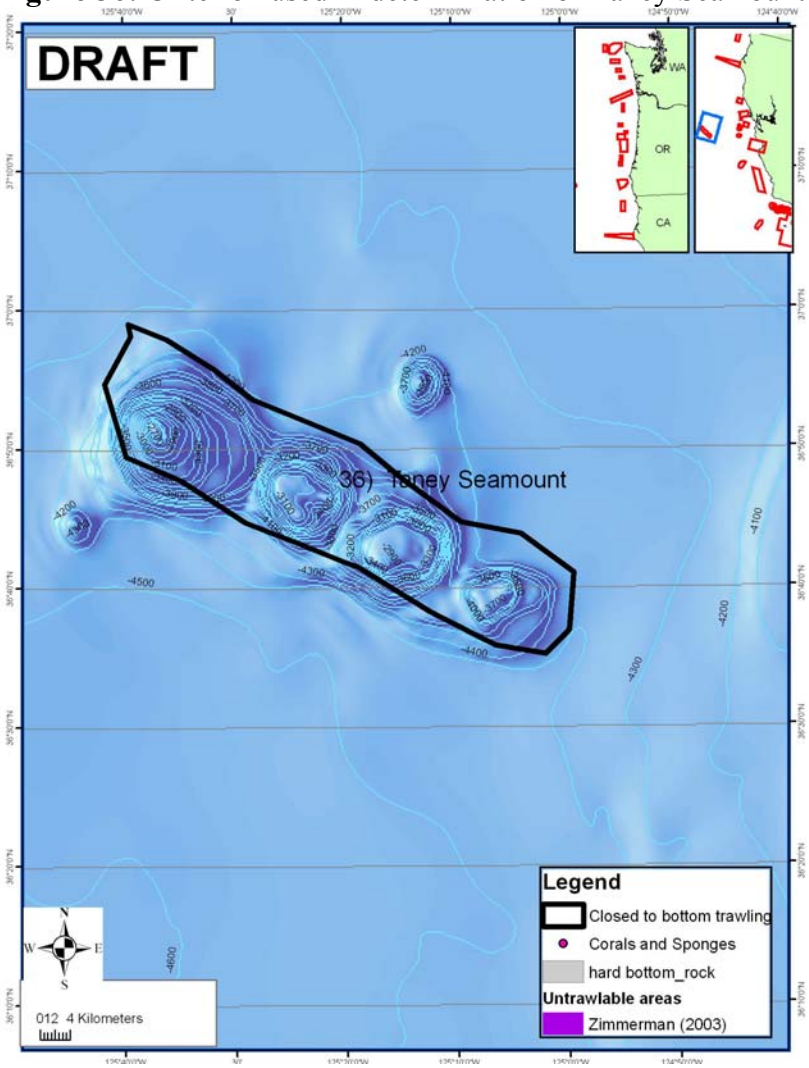


Table 36: Habitat types protected by Taney Seamount closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
No data	n/a	978.7

37) Gumdrop, (38) Pioneer and (39) Guide Seamount

Figure 37: Criterion used in determination of Gumdrop, Pioneer and Guide Seamount area closed to bottom trawling

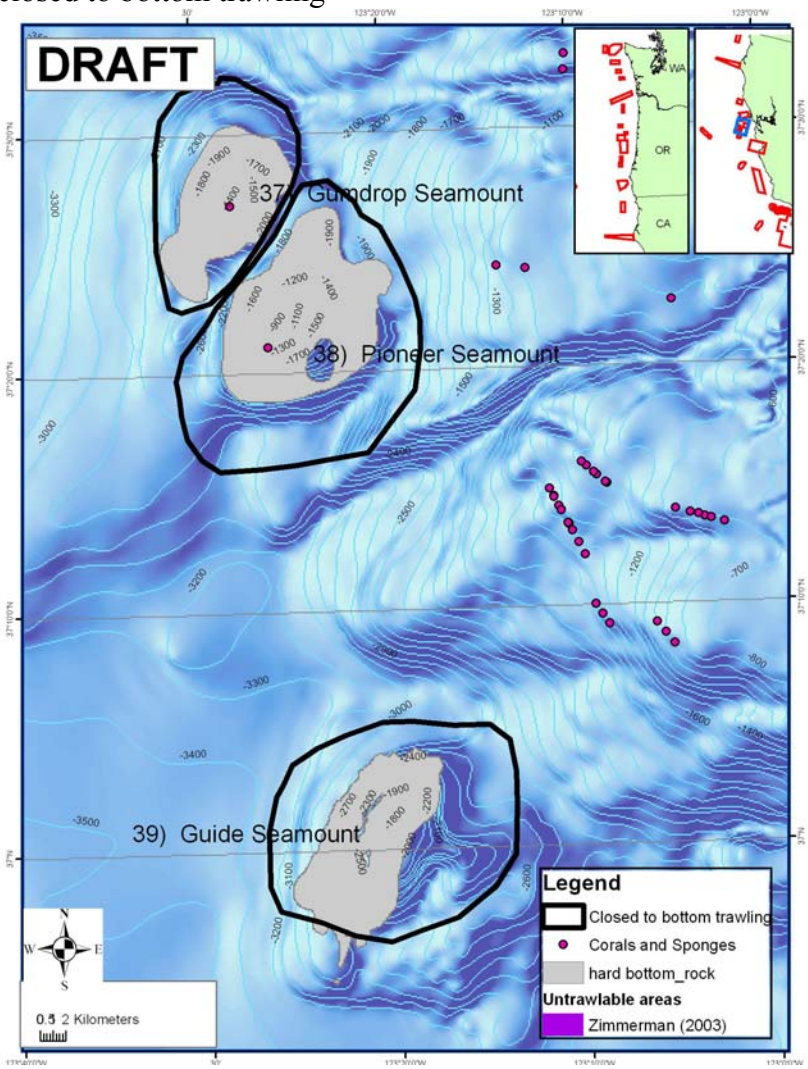


Table 37: Habitat types protected by Gumdrop Seamount closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Rocky Ridge	1	79.1
Sedimentary Slope	1	61.2
Sedimentary Slope Gully	1	8.9
Sedimentary Slope Canyon Floor	1	0.4
Grand Total	4	149.5

Table 38: Habitat types protected by Pioneer Seamount closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	**Area (km2)**
Sedimentary Slope	2	127.4
Rocky Ridge	1	125.7
Sedimentary Slope Gully	2	37.8
Sedimentary Slope Landslide	1	4.3
Sedimentary Slope Canyon Wall	1	0.0
Grand Total	7	295.3

Table 39: Habitat types protected by Guide Seamount closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	**Area (km2)**
Sedimentary Ridge	5	130.2
Rocky Ridge	1	95.0
Sedimentary Slope	2	37.7
Sedimentary Slope Landslide	1	4.4
Sedimentary Slope Gully	1	3.3
Rocky Slope	1	0.0
Grand Total	11	270.6

40) Davidson Seamount

Figure 40: Criterion used in determination of Davidson Seamount area closed to bottom trawling

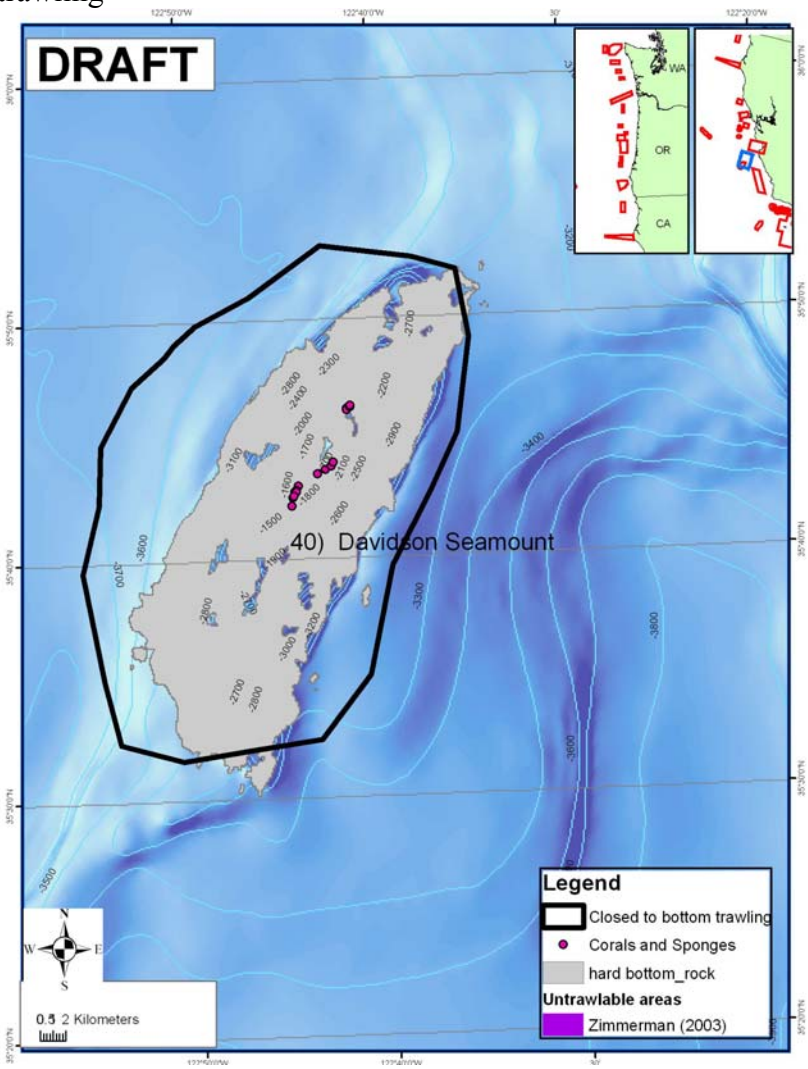


Table 40: Habitat types protected by Davidson Seamount closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Rocky Ridge	7	446.7
Sedimentary Apron	4	97.7
Sedimentary Apron Canyon Floor	1	33.1
Sedimentary Ridge	15	21.0
Rocky Apron	2	1.0
Grand Total	29	599.5

41) San Juan Seamount

Figure 41: Criterion used in determination of San Juan Seamount area closed to bottom trawling

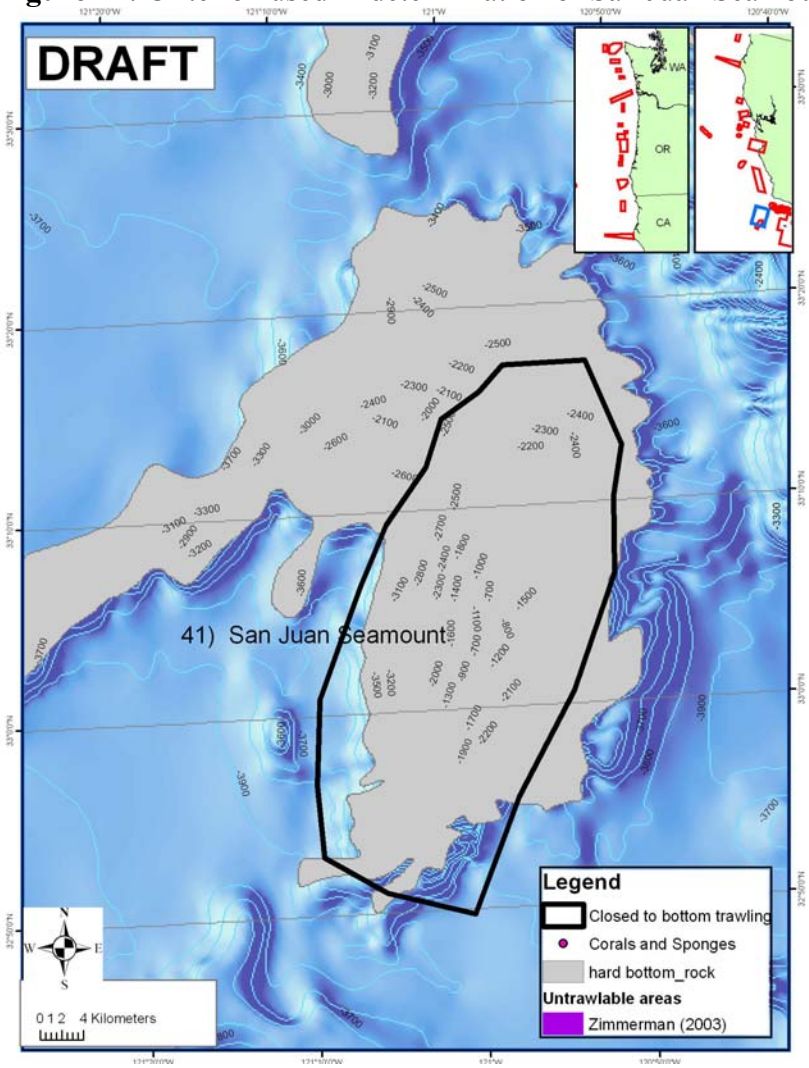


Table 41: Habitat types protected by San Juan Seamount closed area, determined from EFH GIS data

HAB_TYPE	Count_polygons	Area (km2)
Rocky Ridge	1	805.2
Sedimentary Apron	1	135.2
Grand Total	2	940.4

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Compiled by Geoff Shester for
Regional Marine Conservation Program
October 26, 2004

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APPENDIX 3: Points of Latitude and Longitude in Decimal Degrees (NAD 1983) Defining Vertices of Areas Closed to Bottom Trawling

Id	Name	Longitude	Latitude
1	Olympic_1	-125.991863	48.068618
1	Olympic_1	-125.990859	48.165925
1	Olympic_1	-125.750255	48.166567
1	Olympic_1	-125.586563	48.148036
1	Olympic_1	-125.417575	47.966531
1	Olympic_1	-125.523975	47.878908
1	Olympic_1	-125.642892	47.888296
1	Olympic_1	-125.699221	48.004083
1	Olympic_1	-125.805383	48.063409
1	Olympic_1	-125.991863	48.068618
2	Olympic_2	-124.918916	48.462917
2	Olympic_2	-124.860104	48.357674
2	Olympic_2	-124.952966	48.283384
2	Olympic_2	-124.990111	48.128613
2	Olympic_2	-125.165001	47.956818
2	Olympic_2	-125.308938	48.074444
2	Olympic_2	-125.228457	48.170401
2	Olympic_2	-124.963800	48.466013
2	Olympic_2	-124.918916	48.462917
3	Biogenic area_1	-125.017013	47.565969
3	Biogenic area_1	-125.082730	47.503381
3	Biogenic area_1	-125.292400	47.509640
3	Biogenic area_1	-125.567786	47.559710
3	Biogenic area_1	-125.655409	47.713050
3	Biogenic area_1	-125.545880	47.781897
3	Biogenic area_1	-125.445740	47.666109
3	Biogenic area_1	-125.092119	47.656721
3	Biogenic area_1	-125.017013	47.565969
4	Biogenic area_2	-125.019400	47.186269
4	Biogenic area_2	-125.154229	47.183772
4	Biogenic area_2	-125.155893	47.217895
4	Biogenic area_2	-125.128428	47.273658
4	Biogenic area_2	-124.981948	47.271993
4	Biogenic area_2	-124.990270	47.200417
4	Biogenic area_2	-125.019400	47.186269
5	Grays Canyon	-124.895177	46.851396
5	Grays Canyon	-124.907446	46.908964
5	Grays Canyon	-125.020803	46.927021
5	Grays Canyon	-124.974657	47.114612
5	Grays Canyon	-124.915471	47.092542
5	Grays Canyon	-124.895408	46.938056
5	Grays Canyon	-124.818164	46.953103
5	Grays Canyon	-124.791581	46.913113
5	Grays Canyon	-124.895177	46.851396
6	Biogenic area_3	-125.316522	46.825893
6	Biogenic area_3	-125.179197	46.802590

Id	Name	Longitude	Latitude
6	Biogenic area_3	-125.197507	46.690233
6	Biogenic area_3	-125.268250	46.723524
6	Biogenic area_3	-125.316522	46.825893
7	Astoria Canyon	-124.670219	46.330652
7	Astoria Canyon	-124.671703	46.332146
7	Astoria Canyon	-124.607751	46.312553
7	Astoria Canyon	-124.553330	46.273963
7	Astoria Canyon	-124.450004	46.306064
7	Astoria Canyon	-124.371758	46.310077
7	Astoria Canyon	-124.348685	46.290014
7	Astoria Canyon	-124.403859	46.220796
7	Astoria Canyon	-124.560352	46.203742
7	Astoria Canyon	-124.613519	46.207754
7	Astoria Canyon	-124.648630	46.159603
7	Astoria Canyon	-124.672706	46.062296
7	Astoria Canyon	-124.874341	46.015148
7	Astoria Canyon	-124.899420	46.051261
7	Astoria Canyon	-125.013781	46.055274
7	Astoria Canyon	-125.032841	46.244871
7	Astoria Canyon	-125.041869	46.336159
7	Astoria Canyon	-124.700794	46.320108
7	Astoria Canyon	-124.670219	46.330652
8	Ridges_biogenic_area_5	-124.921875	46.016777
8	Ridges_biogenic_area_5	-124.924121	45.895468
8	Ridges_biogenic_area_5	-124.870207	45.857278
8	Ridges_biogenic_area_5	-124.811799	45.857278
8	Ridges_biogenic_area_5	-124.732869	45.843004
8	Ridges_biogenic_area_5	-124.728694	45.792204
8	Ridges_biogenic_area_5	-124.822639	45.755322
8	Ridges_biogenic_area_5	-124.834469	45.676686
8	Ridges_biogenic_area_5	-124.888053	45.632844
8	Ridges_biogenic_area_5	-124.946508	45.721223
8	Ridges_biogenic_area_5	-124.929807	45.778286
8	Ridges_biogenic_area_5	-124.981303	46.008627
8	Ridges_biogenic_area_5	-124.921875	46.016777
9	Biogenic area_6	-124.396026	45.258719
9	Biogenic area_6	-124.426820	45.188807
9	Biogenic area_6	-124.498395	45.191304
9	Biogenic area_6	-124.480918	45.273700
9	Biogenic area_6	-124.396026	45.258719
10	Biogenic area_7	-124.490555	45.071018
10	Biogenic area_7	-124.456858	44.976667
10	Biogenic area_7	-124.526499	44.972174
10	Biogenic area_7	-124.566935	45.030582
10	Biogenic area_7	-124.674765	45.019350
10	Biogenic area_7	-124.717447	45.075511
10	Biogenic area_7	-124.632082	45.178848
10	Biogenic area_7	-124.631965	45.178774
10	Biogenic area_7	-124.490555	45.071018

Id	Name	Longitude	Latitude
11	Biogenic area_8	-124.772214	44.932966
11	Biogenic area_8	-124.771382	44.932966
11	Biogenic area_8	-124.765556	44.877203
11	Biogenic area_8	-124.817989	44.836422
11	Biogenic area_8	-124.863764	44.835590
11	Biogenic area_8	-124.893726	44.917985
11	Biogenic area_8	-124.857938	44.946282
11	Biogenic area_8	-124.772214	44.932966
12	Daisy Bank	-124.690490	44.662163
12	Daisy Bank	-124.688243	44.659917
12	Daisy Bank	-124.643314	44.619480
12	Daisy Bank	-124.654547	44.592523
12	Daisy Bank	-124.694983	44.626220
12	Daisy Bank	-124.715201	44.614987
12	Daisy Bank	-124.771362	44.637452
12	Daisy Bank	-124.818538	44.641945
12	Daisy Bank	-124.818538	44.671149
12	Daisy Bank	-124.800566	44.689120
12	Daisy Bank	-124.690490	44.662163
13	Heceta Bank	-124.927170	44.269081
13	Heceta Bank	-124.927126	44.268055
13	Heceta Bank	-124.645251	44.338272
13	Heceta Bank	-124.579574	44.288300
13	Heceta Bank	-124.674054	44.225314
13	Heceta Bank	-124.755037	44.149954
13	Heceta Bank	-124.761786	44.057723
13	Heceta Bank	-124.823648	44.054349
13	Heceta Bank	-124.869109	43.860116
13	Heceta Bank	-124.870324	43.858486
13	Heceta Bank	-124.929376	43.779906
13	Heceta Bank	-124.966493	43.781031
13	Heceta Bank	-124.991238	43.873262
13	Heceta Bank	-125.075595	43.926126
13	Heceta Bank	-125.056474	43.999236
13	Heceta Bank	-125.078970	44.022856
13	Heceta Bank	-125.078970	44.063347
13	Heceta Bank	-125.050851	44.080219
13	Heceta Bank	-125.071096	44.103839
13	Heceta Bank	-125.063223	44.137582
13	Heceta Bank	-125.055350	44.156703
13	Heceta Bank	-125.060973	44.219690
13	Heceta Bank	-125.003610	44.265805
13	Heceta Bank	-124.927170	44.269081
14	Ridges_biogenic area_9	-125.122602	43.371617
14	Ridges_biogenic area_9	-125.214152	43.538072
14	Ridges_biogenic area_9	-125.137583	43.631287
14	Ridges_biogenic area_9	-125.109286	43.609648
14	Ridges_biogenic area_9	-125.140080	43.550556
14	Ridges_biogenic area_9	-125.105957	43.515601

Id	Name	Longitude	Latitude
14	Ridges_biogenic area_9	-125.120938	43.462335
14	Ridges_biogenic area_9	-125.054356	43.405740
14	Ridges_biogenic area_9	-125.048530	43.342487
14	Ridges_biogenic area_9	-125.071001	43.322513
14	Ridges_biogenic area_9	-125.107621	43.321680
14	Ridges_biogenic area_9	-125.126763	43.284228
14	Ridges_biogenic area_9	-125.151732	43.288389
14	Ridges_biogenic area_9	-125.121770	43.370785
14	Ridges_biogenic area_9	-125.122602	43.371617
15	Ridges_biogenic area_10	-125.050194	43.630455
15	Ridges_biogenic area_10	-125.039375	43.663746
15	Ridges_biogenic area_10	-125.015239	43.677062
15	Ridges_biogenic area_10	-124.954574	43.645090
15	Ridges_biogenic area_10	-124.976122	43.563873
15	Ridges_biogenic area_10	-124.942831	43.493129
15	Ridges_biogenic area_10	-124.922024	43.349978
15	Ridges_biogenic area_10	-124.957812	43.347481
15	Ridges_biogenic area_10	-124.986109	43.523091
15	Ridges_biogenic area_10	-125.028555	43.567202
15	Ridges_biogenic area_10	-125.050194	43.630455
15	Ridges_biogenic area_10	-124.953650	43.644603
15	Ridges_biogenic area_10	-124.954574	43.645090
15	Ridges_biogenic area_10	-124.954482	43.645436
15	Ridges_biogenic area_10	-124.953650	43.644603
16	Hard bottom feature_1	-124.573674	43.350232
16	Hard bottom feature_1	-124.571428	43.347985
16	Hard bottom feature_1	-124.510773	43.347985
16	Hard bottom feature_1	-124.481569	43.285085
16	Hard bottom feature_1	-124.418669	43.291824
16	Hard bottom feature_1	-124.427654	43.168269
16	Hard bottom feature_1	-124.472584	43.094136
16	Hard bottom feature_1	-124.535484	43.105368
16	Hard bottom feature_1	-124.553456	43.044714
16	Hard bottom feature_1	-124.582660	43.046960
16	Hard bottom feature_1	-124.578167	43.107615
16	Hard bottom feature_1	-124.690490	43.204212
16	Hard bottom feature_1	-124.573674	43.350232
17	Rogue Canyon	-125.222900	42.638105
17	Rogue Canyon	-124.946586	42.721224
17	Rogue Canyon	-124.879192	42.671802
17	Rogue Canyon	-124.784841	42.656077
17	Rogue Canyon	-124.733356	42.694131
17	Rogue Canyon	-124.701722	42.671802
17	Rogue Canyon	-124.748898	42.552740
17	Rogue Canyon	-124.647807	42.550493
17	Rogue Canyon	-124.645561	42.530275
17	Rogue Canyon	-124.775855	42.465128
17	Rogue Canyon	-124.748898	42.411213
17	Rogue Canyon	-125.092606	42.289904

Id	Name	Longitude	Latitude
17	Rogue Canyon	-125.222900	42.638105
18	Biogenic area_11	-125.052170	41.667635
18	Biogenic area_11	-125.058909	41.784451
18	Biogenic area_11	-124.962311	41.770972
18	Biogenic area_11	-124.991515	41.723797
18	Biogenic area_11	-124.998255	41.672128
18	Biogenic area_11	-125.052170	41.667635
19	Eel River Canyon	-124.481520	40.565299
19	Eel River Canyon	-124.556417	40.594496
19	Eel River Canyon	-124.616081	40.598305
19	Eel River Canyon	-124.650356	40.551335
19	Eel River Canyon	-124.600848	40.501827
19	Eel River Canyon	-124.560225	40.374882
19	Eel River Canyon	-124.707481	40.387577
19	Eel River Canyon	-124.713828	40.484055
19	Eel River Canyon	-124.849659	40.564030
19	Eel River Canyon	-124.872509	40.675741
19	Eel River Canyon	-124.665589	40.831883
19	Eel River Canyon	-124.574189	40.830613
19	Eel River Canyon	-124.555148	40.682088
19	Eel River Canyon	-124.448514	40.631310
19	Eel River Canyon	-124.481520	40.565299
20	Mendocino Ridge	-125.947806	40.395299
20	Mendocino Ridge	-125.947194	40.399410
20	Mendocino Ridge	-125.947001	40.400702
20	Mendocino Ridge	-124.400023	40.423883
20	Mendocino Ridge	-124.376486	40.208258
20	Mendocino Ridge	-125.955242	40.345350
20	Mendocino Ridge	-125.947806	40.395299
21	Hard bottom feature_2	-123.852440	39.055301
21	Hard bottom feature_2	-123.829859	38.942400
21	Hard bottom feature_2	-123.878246	38.902078
21	Hard bottom feature_2	-123.916955	38.994012
21	Hard bottom feature_2	-123.920180	39.047237
21	Hard bottom feature_2	-123.852440	39.055301
22	Biogenic area_12	-123.642506	38.564678
22	Biogenic area_12	-123.708823	38.536356
22	Biogenic area_12	-123.938166	38.731850
22	Biogenic area_12	-123.857343	38.775370
22	Biogenic area_12	-123.721257	38.606816
22	Biogenic area_12	-123.697770	38.603363
22	Biogenic area_12	-123.642506	38.564678
23	Cordell Bank	-123.629554	38.135929
23	Cordell Bank	-123.600568	38.144206
23	Cordell Bank	-123.181380	38.263900
23	Cordell Bank	-123.119130	38.210010
23	Cordell Bank	-123.092070	38.165760
23	Cordell Bank	-123.082370	38.140720
23	Cordell Bank	-123.087420	38.128290

Id	Name	Longitude	Latitude
23	Cordell Bank	-123.098040	38.102150
23	Cordell Bank	-123.103870	38.090690
23	Cordell Bank	-123.109240	38.078980
23	Cordell Bank	-123.117110	38.065050
23	Cordell Bank	-123.128270	38.052020
23	Cordell Bank	-123.141370	37.992270
23	Cordell Bank	-123.236150	37.989470
23	Cordell Bank	-123.323120	37.958800
23	Cordell Bank	-123.389580	37.904640
23	Cordell Bank	-123.425790	37.834800
23	Cordell Bank	-123.426940	37.766870
23	Cordell Bank	-123.434660	37.770330
23	Cordell Bank	-123.446940	37.781090
23	Cordell Bank	-123.454660	37.783830
23	Cordell Bank	-123.467210	37.794870
23	Cordell Bank	-123.473130	37.800940
23	Cordell Bank	-123.468970	37.810260
23	Cordell Bank	-123.479060	37.813650
23	Cordell Bank	-123.492800	37.822960
23	Cordell Bank	-123.517490	37.849880
23	Cordell Bank	-123.521970	37.861890
23	Cordell Bank	-123.521920	37.876370
23	Cordell Bank	-123.529670	37.885410
23	Cordell Bank	-123.539370	37.907250
23	Cordell Bank	-123.543600	37.922880
23	Cordell Bank	-123.547010	37.938580
23	Cordell Bank	-123.547770	37.949010
23	Cordell Bank	-123.561990	37.955280
23	Cordell Bank	-123.578590	37.966830
23	Cordell Bank	-123.587460	37.977610
23	Cordell Bank	-123.599880	37.986780
23	Cordell Bank	-123.613310	37.998470
23	Cordell Bank	-123.624940	38.013660
23	Cordell Bank	-123.624500	38.019870
23	Cordell Bank	-123.615310	38.022860
23	Cordell Bank	-123.598640	38.024190
23	Cordell Bank	-123.599040	38.034090
23	Cordell Bank	-123.606110	38.046140
23	Cordell Bank	-123.605490	38.053080
23	Cordell Bank	-123.615460	38.061880
23	Cordell Bank	-123.621620	38.074510
23	Cordell Bank	-123.620650	38.082890
23	Cordell Bank	-123.633440	38.112560
23	Cordell Bank	-123.642650	38.132190
23	Cordell Bank	-123.629554	38.135929
24	Hard bottom feature_3	-123.028799	37.742019
24	Hard bottom feature_3	-122.965555	37.688261
24	Hard bottom feature_3	-122.994015	37.664545
24	Hard bottom feature_3	-123.062002	37.700910

Id	Name	Longitude	Latitude
24	Hard bottom feature_3	-123.055678	37.738857
24	Hard bottom feature_3	-123.028799	37.742019
25	Hard bottom feature_4	-122.434751	37.307399
25	Hard bottom feature_4	-122.467393	37.280997
25	Hard bottom feature_4	-122.578281	37.329960
25	Hard bottom feature_4	-122.645965	37.321320
25	Hard bottom feature_4	-122.679087	37.392365
25	Hard bottom feature_4	-122.553319	37.423567
25	Hard bottom feature_4	-122.434751	37.307399
26	Monterey Bay and Canyon	-122.597027	36.999724
26	Monterey Bay and Canyon	-121.639041	36.999708
26	Monterey Bay and Canyon	-121.636225	36.495205
26	Monterey Bay and Canyon	-122.602074	36.501646
26	Monterey Bay and Canyon	-122.597027	36.999724
27	Hard bottom feature_5	-122.294561	36.429156
27	Hard bottom feature_5	-122.270732	36.401515
27	Hard bottom feature_5	-122.305998	36.274748
27	Hard bottom feature_5	-122.329827	36.283326
27	Hard bottom feature_5	-122.336499	36.371015
27	Hard bottom feature_5	-122.305998	36.431063
27	Hard bottom feature_5	-122.294561	36.429156
28	Biogenic area_13	-122.075339	36.302389
28	Biogenic area_13	-122.135387	36.298577
28	Biogenic area_13	-122.137293	36.342421
28	Biogenic area_13	-122.077245	36.344327
28	Biogenic area_13	-122.075339	36.302389
29	Morrow ridge	-121.870487	35.688088
29	Morrow ridge	-121.852181	35.533793
29	Morrow ridge	-121.520054	35.452722
29	Morrow ridge	-120.983944	34.571410
29	Morrow ridge	-121.504363	34.775393
29	Morrow ridge	-121.645582	35.185975
29	Morrow ridge	-122.030012	35.505026
29	Morrow ridge	-122.024782	35.711624
29	Morrow ridge	-121.870487	35.688088
30	Channel Islands	-120.586621	34.187072
30	Channel Islands	-120.539874	34.204864
30	Channel Islands	-120.507278	34.205400
30	Channel Islands	-120.460414	34.192544
30	Channel Islands	-120.428593	34.205202
30	Channel Islands	-120.418006	34.207067
30	Channel Islands	-120.351216	34.202237
30	Channel Islands	-120.325763	34.191174
30	Channel Islands	-120.312236	34.182312
30	Channel Islands	-120.293103	34.164079
30	Channel Islands	-120.286268	34.153409
30	Channel Islands	-120.252924	34.136317
30	Channel Islands	-120.227067	34.111284
30	Channel Islands	-120.211898	34.110076

Id	Name	Longitude	Latitude
30	Channel Islands	-120.160759	34.125189
30	Channel Islands	-120.111042	34.124808
30	Channel Islands	-120.085815	34.129935
30	Channel Islands	-120.042058	34.136984
30	Channel Islands	-120.019642	34.135349
30	Channel Islands	-119.958300	34.172578
30	Channel Islands	-119.933570	34.176818
30	Channel Islands	-119.889034	34.175878
30	Channel Islands	-119.852395	34.172664
30	Channel Islands	-119.836426	34.169617
30	Channel Islands	-119.803470	34.162131
30	Channel Islands	-119.793267	34.159278
30	Channel Islands	-119.778003	34.159065
30	Channel Islands	-119.766878	34.159880
30	Channel Islands	-119.697802	34.146355
30	Channel Islands	-119.660244	34.134108
30	Channel Islands	-119.612540	34.151419
30	Channel Islands	-119.590587	34.154662
30	Channel Islands	-119.511943	34.147843
30	Channel Islands	-119.491980	34.138249
30	Channel Islands	-119.480814	34.133890
30	Channel Islands	-119.448440	34.116642
30	Channel Islands	-119.428956	34.117124
30	Channel Islands	-119.402115	34.114343
30	Channel Islands	-119.391200	34.116110
30	Channel Islands	-119.330403	34.115228
30	Channel Islands	-119.291778	34.101853
30	Channel Islands	-119.256861	34.073395
30	Channel Islands	-119.236425	34.026074
30	Channel Islands	-119.250098	33.967762
30	Channel Islands	-119.274220	33.941385
30	Channel Islands	-119.322063	33.918295
30	Channel Islands	-119.332800	33.913037
30	Channel Islands	-119.353447	33.906348
30	Channel Islands	-119.363328	33.903983
30	Channel Islands	-119.383727	33.901308
30	Channel Islands	-119.407295	33.902187
30	Channel Islands	-119.424221	33.904239
30	Channel Islands	-119.461371	33.910937
30	Channel Islands	-119.482633	33.915685
30	Channel Islands	-119.519363	33.900639
30	Channel Islands	-119.548615	33.894136
30	Channel Islands	-119.582779	33.888095
30	Channel Islands	-119.594231	33.886884
30	Channel Islands	-119.626174	33.885942
30	Channel Islands	-119.655043	33.873302
30	Channel Islands	-119.687830	33.862335
30	Channel Islands	-119.743901	33.859953
30	Channel Islands	-119.771297	33.863506

Id	Name	Longitude	Latitude
30	Channel Islands	-119.790169	33.861097
30	Channel Islands	-119.870604	33.868036
30	Channel Islands	-119.882471	33.870379
30	Channel Islands	-119.923164	33.848655
30	Channel Islands	-119.965076	33.841254
30	Channel Islands	-120.031584	33.814499
30	Channel Islands	-120.043513	33.810758
30	Channel Islands	-120.069954	33.799827
30	Channel Islands	-120.102075	33.793790
30	Channel Islands	-120.134216	33.794251
30	Channel Islands	-120.187305	33.810029
30	Channel Islands	-120.202842	33.817626
30	Channel Islands	-120.229274	33.831465
30	Channel Islands	-120.254823	33.844444
30	Channel Islands	-120.295397	33.889759
30	Channel Islands	-120.308570	33.909559
30	Channel Islands	-120.325065	33.917122
30	Channel Islands	-120.375851	33.914034
30	Channel Islands	-120.421703	33.925010
30	Channel Islands	-120.461318	33.926936
30	Channel Islands	-120.532824	33.950395
30	Channel Islands	-120.565825	33.986975
30	Channel Islands	-120.574637	34.013489
30	Channel Islands	-120.585666	34.019402
30	Channel Islands	-120.628622	34.058479
30	Channel Islands	-120.638945	34.081510
30	Channel Islands	-120.642078	34.102075
30	Channel Islands	-120.606046	34.171039
30	Channel Islands	-120.600412	34.181824
30	Channel Islands	-120.586621	34.187072
31	Cowcod conservation area_west	-119.883333	33.534436
31	Cowcod conservation area_west	-119.883333	33.538093
31	Cowcod conservation area_west	-119.883333	33.550000
31	Cowcod conservation area_west	-119.500000	33.550000
31	Cowcod conservation area_west	-119.500000	33.833333
31	Cowcod conservation area_west	-118.833333	33.833333
31	Cowcod conservation area_west	-118.833333	32.333333
31	Cowcod conservation area_west	-119.616667	32.333333
31	Cowcod conservation area_west	-119.616667	33.000000
31	Cowcod conservation area_west	-119.883333	33.000000
31	Cowcod conservation	-119.883333	33.534436

Id	Name	Longitude	Latitude
	area_west		
32	Cowcod conservation area_east	-118.033333	32.700000
32	Cowcod conservation area_east	-117.833333	32.700000
32	Cowcod conservation area_east	-117.833333	32.611667
32	Cowcod conservation area_east	-117.891667	32.500000
32	Cowcod conservation area_east	-118.033333	32.500000
32	Cowcod conservation area_east	-118.033333	32.700000
33	Hard bottom feature_6	-118.189939	33.578534
33	Hard bottom feature_6	-118.062605	33.431354
33	Hard bottom feature_6	-118.153558	33.194875
33	Hard bottom feature_6	-118.590135	33.328825
33	Hard bottom feature_6	-118.585174	33.398280
33	Hard bottom feature_6	-118.694318	33.428047
33	Hard bottom feature_6	-118.704240	33.504117
33	Hard bottom feature_6	-118.639746	33.545460
33	Hard bottom feature_6	-118.338772	33.451199
33	Hard bottom feature_6	-118.189939	33.578534
34	Thompson Seamount	-128.737279	46.069533
34	Thompson Seamount	-128.714978	46.103998
34	Thompson Seamount	-128.662909	46.115569
34	Thompson Seamount	-128.660016	46.112676
34	Thompson Seamount	-128.657123	46.130033
34	Thompson Seamount	-128.573234	46.141604
34	Thompson Seamount	-128.489345	46.112676
34	Thompson Seamount	-128.477774	46.060607
34	Thompson Seamount	-128.526950	45.994074
34	Thompson Seamount	-128.552985	45.947791
34	Thompson Seamount	-128.654231	45.898614
34	Thompson Seamount	-128.723656	45.904400
34	Thompson Seamount	-128.764154	45.947791
34	Thompson Seamount	-128.767047	46.014323
34	Thompson Seamount	-128.764426	46.019566
34	Thompson Seamount	-128.746798	46.054822
34	Thompson Seamount	-128.737279	46.069533
35	President Jackson Seamount	-128.096032	42.668085
35	President Jackson Seamount	-128.135465	42.696763
35	President Jackson Seamount	-128.167334	42.724080
35	President Jackson Seamount	-128.200721	42.749878
35	President Jackson Seamount	-128.250801	42.804511
35	President Jackson Seamount	-128.250801	42.854591
35	President Jackson Seamount	-128.203756	42.894048
35	President Jackson Seamount	-128.141535	42.877355
35	President Jackson Seamount	-128.115736	42.860662
35	President Jackson Seamount	-128.096008	42.837898

Id	Name	Longitude	Latitude
35	President Jackson Seamount	-128.062621	42.802994
35	President Jackson Seamount	-128.032269	42.757466
35	President Jackson Seamount	-127.959425	42.702833
35	President Jackson Seamount	-127.898722	42.686140
35	President Jackson Seamount	-127.831949	42.646683
35	President Jackson Seamount	-127.746964	42.607226
35	President Jackson Seamount	-127.689296	42.558663
35	President Jackson Seamount	-127.660462	42.520724
35	President Jackson Seamount	-127.608864	42.472161
35	President Jackson Seamount	-127.598241	42.399317
35	President Jackson Seamount	-127.628593	42.365931
35	President Jackson Seamount	-127.680191	42.350755
35	President Jackson Seamount	-127.715095	42.356825
35	President Jackson Seamount	-127.728753	42.365931
35	President Jackson Seamount	-127.768210	42.396282
35	President Jackson Seamount	-127.810703	42.434222
35	President Jackson Seamount	-127.868371	42.476714
35	President Jackson Seamount	-127.916933	42.517689
35	President Jackson Seamount	-127.980672	42.576874
35	President Jackson Seamount	-128.024681	42.622402
35	President Jackson Seamount	-128.058979	42.643838
35	President Jackson Seamount	-128.085385	42.660341
35	President Jackson Seamount	-128.096032	42.668085
36	Taney Seamount	-125.389500	36.715176
36	Taney Seamount	-125.413799	36.722987
36	Taney Seamount	-125.482402	36.744650
36	Taney Seamount	-125.579889	36.795199
36	Taney Seamount	-125.662933	36.824085
36	Taney Seamount	-125.695429	36.910740
36	Taney Seamount	-125.655712	36.968510
36	Taney Seamount	-125.659323	36.982953
36	Taney Seamount	-125.601553	36.964899
36	Taney Seamount	-125.529340	36.928793
36	Taney Seamount	-125.471570	36.892687
36	Taney Seamount	-125.309091	36.838527
36	Taney Seamount	-125.244099	36.795199
36	Taney Seamount	-125.157444	36.744650
36	Taney Seamount	-125.067178	36.730208
36	Taney Seamount	-124.987744	36.683270
36	Taney Seamount	-124.994965	36.614667
36	Taney Seamount	-125.031072	36.585782
36	Taney Seamount	-125.106895	36.596614
36	Taney Seamount	-125.204382	36.636331
36	Taney Seamount	-125.312702	36.690491
36	Taney Seamount	-125.333048	36.697031
36	Taney Seamount	-125.389500	36.715176
37	Gumdrop Seamount	-123.404700	37.495613
37	Gumdrop Seamount	-123.404700	37.488298
37	Gumdrop Seamount	-123.404700	37.478309

Id	Name	Longitude	Latitude
37	Gumdrop Seamount	-123.412059	37.462366
37	Gumdrop Seamount	-123.430455	37.437838
37	Gumdrop Seamount	-123.443945	37.420668
37	Gumdrop Seamount	-123.467247	37.396139
37	Gumdrop Seamount	-123.486870	37.382649
37	Gumdrop Seamount	-123.512625	37.376517
37	Gumdrop Seamount	-123.523663	37.380196
37	Gumdrop Seamount	-123.533474	37.419441
37	Gumdrop Seamount	-123.533474	37.447649
37	Gumdrop Seamount	-123.532248	37.475857
37	Gumdrop Seamount	-123.532248	37.488121
37	Gumdrop Seamount	-123.527342	37.510196
37	Gumdrop Seamount	-123.510172	37.528593
37	Gumdrop Seamount	-123.489323	37.534725
37	Gumdrop Seamount	-123.474606	37.535951
37	Gumdrop Seamount	-123.472153	37.539630
37	Gumdrop Seamount	-123.458662	37.538404
37	Gumdrop Seamount	-123.440266	37.529819
37	Gumdrop Seamount	-123.432908	37.527366
37	Gumdrop Seamount	-123.414511	37.517555
37	Gumdrop Seamount	-123.404700	37.497932
37	Gumdrop Seamount	-123.404700	37.495613
38	Pioneer Seamount	-123.316093	37.404115
38	Pioneer Seamount	-123.305360	37.382649
38	Pioneer Seamount	-123.301681	37.366705
38	Pioneer Seamount	-123.301681	37.347083
38	Pioneer Seamount	-123.307813	37.318875
38	Pioneer Seamount	-123.324983	37.301705
38	Pioneer Seamount	-123.350738	37.275950
38	Pioneer Seamount	-123.392436	37.271045
38	Pioneer Seamount	-123.413285	37.268592
38	Pioneer Seamount	-123.445172	37.266139
38	Pioneer Seamount	-123.481964	37.264912
38	Pioneer Seamount	-123.497908	37.273497
38	Pioneer Seamount	-123.510172	37.288214
38	Pioneer Seamount	-123.515078	37.304158
38	Pioneer Seamount	-123.516304	37.316422
38	Pioneer Seamount	-123.518757	37.328686
38	Pioneer Seamount	-123.512625	37.345856
38	Pioneer Seamount	-123.490549	37.367932
38	Pioneer Seamount	-123.481964	37.378969
38	Pioneer Seamount	-123.447625	37.409630
38	Pioneer Seamount	-123.428002	37.429253
38	Pioneer Seamount	-123.414511	37.447649
38	Pioneer Seamount	-123.407153	37.458687
38	Pioneer Seamount	-123.402247	37.463592
38	Pioneer Seamount	-123.380172	37.466045
38	Pioneer Seamount	-123.356870	37.451328
38	Pioneer Seamount	-123.350738	37.441517

Id	Name	Longitude	Latitude
38	Pioneer Seamount	-123.334794	37.432932
38	Pioneer Seamount	-123.321921	37.413622
38	Pioneer Seamount	-123.317624	37.407177
38	Pioneer Seamount	-123.316093	37.404115
39	Guide Seamount	-123.402576	37.071437
39	Guide Seamount	-123.377719	37.079723
39	Guide Seamount	-123.344605	37.088308
39	Guide Seamount	-123.317624	37.088308
39	Guide Seamount	-123.282058	37.084629
39	Guide Seamount	-123.272247	37.084629
39	Guide Seamount	-123.250171	37.084629
39	Guide Seamount	-123.233001	37.073591
39	Guide Seamount	-123.228096	37.051515
39	Guide Seamount	-123.228096	37.028213
39	Guide Seamount	-123.230548	36.993874
39	Guide Seamount	-123.248945	36.971798
39	Guide Seamount	-123.283284	36.950949
39	Guide Seamount	-123.316398	36.942364
39	Guide Seamount	-123.342153	36.935006
39	Guide Seamount	-123.374040	36.939911
39	Guide Seamount	-123.403474	36.949723
39	Guide Seamount	-123.439040	36.958308
39	Guide Seamount	-123.447625	36.975477
39	Guide Seamount	-123.447625	36.995100
39	Guide Seamount	-123.447625	37.013496
39	Guide Seamount	-123.440266	37.038025
39	Guide Seamount	-123.434134	37.046610
39	Guide Seamount	-123.425549	37.060100
39	Guide Seamount	-123.412403	37.066673
39	Guide Seamount	-123.403474	37.071138
39	Guide Seamount	-123.402576	37.071437
40	Davidson Seamount	-122.848772	35.810428
40	Davidson Seamount	-122.841630	35.817570
40	Davidson Seamount	-122.832767	35.823479
40	Davidson Seamount	-122.822693	35.830195
40	Davidson Seamount	-122.775351	35.849132
40	Davidson Seamount	-122.712228	35.883850
40	Davidson Seamount	-122.633324	35.874381
40	Davidson Seamount	-122.595450	35.864913
40	Davidson Seamount	-122.585982	35.817570
40	Davidson Seamount	-122.598606	35.751291
40	Davidson Seamount	-122.623855	35.710261
40	Davidson Seamount	-122.658573	35.659763
40	Davidson Seamount	-122.680666	35.584015
40	Davidson Seamount	-122.724852	35.539829
40	Davidson Seamount	-122.784819	35.533517
40	Davidson Seamount	-122.844786	35.527205
40	Davidson Seamount	-122.898440	35.539829
40	Davidson Seamount	-122.911065	35.584015

Id	Name	Longitude	Latitude
40	Davidson Seamount	-122.926846	35.659763
40	Davidson Seamount	-122.911065	35.707105
40	Davidson Seamount	-122.907909	35.748135
40	Davidson Seamount	-122.879504	35.789165
40	Davidson Seamount	-122.851098	35.808102
40	Davidson Seamount	-122.848772	35.810428
41	San Juan Seamount	-121.150295	33.011906
41	San Juan Seamount	-121.150203	33.012825
41	San Juan Seamount	-121.121746	33.069739
41	San Juan Seamount	-121.103961	33.105310
41	San Juan Seamount	-121.075504	33.155110
41	San Juan Seamount	-121.032818	33.201352
41	San Juan Seamount	-121.015033	33.240481
41	San Juan Seamount	-120.975904	33.261823
41	San Juan Seamount	-120.951004	33.283166
41	San Juan Seamount	-120.926105	33.283166
41	San Juan Seamount	-120.869191	33.283166
41	San Juan Seamount	-120.837177	33.212024
41	San Juan Seamount	-120.847848	33.169338
41	San Juan Seamount	-120.851405	33.105310
41	San Juan Seamount	-120.897648	33.009268
41	San Juan Seamount	-120.958119	32.923897
41	San Juan Seamount	-121.007918	32.827855
41	San Juan Seamount	-121.093289	32.849197
41	San Juan Seamount	-121.153760	32.881211
41	San Juan Seamount	-121.157317	32.941682
41	San Juan Seamount	-121.150433	33.010529
41	San Juan Seamount	-121.150295	33.011906