May 1, 2009

Dr. Donald McIsaac, Executive Director
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 101
Portland, OR 97220-1384

RE: Proposal to the Pacific Fishery Management Council To Modify Groundfish Essential Fish Habitat Conservation Areas: Juan De Fuca Coral Canyons & Grays Canyon Sponge Reefs Important Ecological Areas

Dear Dr. McIsaac:

We are submitting the attached proposal in response to the Pacific Fishery Management Council’s call for proposals for changes to Groundfish Essential Fish Habitat (EFH). We recommend modification to the Olympic 2 and Grays Canyon EFH closures to increase protections for identified deep-sea coral and sponge habitat from bottom trawling and, in Juan de Fuca Canyon, from other bottom contact gear. This proposal follows the 2004 and 2006 research on deep sea coral and sponge communities in the Olympic Coast National Marine Sanctuary (OCNMS) and the 2007 and 2008 discoveries of glass sponge reef habitat near Grays Canyon. We have used the best available science, social and economic information, and direction provided by the law to design a practicable management approach that protects essential fish habitat while maintaining vibrant fisheries.

As you know, Oceana was actively engaged in the 2005 Pacific Groundfish EFH process, which resulted in significant conservation measures for EFH off the U.S. West Coast. In that process, the Council recognized the need for an adaptive management approach to modify EFH identification and conservation measures as new information becomes available. Thus, in 2006 and again in 2007, we brought to the Council’s attention the discovery of coral and sponge habitat inside and outside the Olympic 2 EFH Conservation Area and outside the Grays Canyon EFH Conservation Area.

Scientific understanding of the ecological importance of deep-sea coral and sponge ecosystems has continued to increase. In *State of Deep Coral Ecosystems of the United States* (Lumsden et al. 2007), NOAA scientists state, “Deep coral communities can be hot-spots of biodiversity in the deeper ocean, making them of particular conservation interest.” The authors find that the “three-dimensional structure of deep corals may function in very similar ways to their tropical counterparts, providing enhanced feeding opportunities for aggregating species, a hiding place from predators, a nursery area for juveniles, fish spawning aggregation sites, and attachment substrate for sedentary invertebrates (Fossa et al. 2002; Mortensen 2000; Reed 2002b).”

Further, the vulnerability of coral and sponge habitats to fishing gear impacts, particularly bottom trawling, remains high and the biological impacts severe and lasting. This is evidenced...
by the numerous studies conducted off the West Coast, Alaska and around the world, that are documented in the National Academy of Sciences, National Research Council report, *Effects of Trawling and Dredging on Seafloor Habitats* (NRC 2002). Perhaps most telling in this case is the likely destruction of a small *Lophelia* coral reef that, in 2004, was the first documented occurrence of this rare coral species in the OCNMS. Sadly, when scientists returned in 2006 to further study the corals at this site, live *Lophelia* corals could not be found and only rubble remained (Brancato et al. 2007). Lost fishing gear and bycatch records from the site suggest commercial fishing operations were responsible. The loss of the first *Lophelia* reef found off the West Coast is a poignant example of the reasons for which we must act quickly and decisively to protect corals and sponges.

Hard data documents the presence of corals and sponges in the Grays Canyon and Juan de Fuca Canyon areas. It is our responsibility as an ocean conservation organization, and the responsibility of the PFMC, National Marine Fisheries Service (NMFS), and National Marine Sanctuary (NMS) Program as ocean stewards, to ensure a comprehensive and permanent solution for habitat protection in and outside the sanctuaries and current EFH conservation areas. This approach must include protective measures, monitoring, research and enforcement. This proposal is our best attempt to achieve protection for these areas while minimizing short-term impacts on the groundfish fishery. We hope that, in addition to this work by the Council, the OCNMS will also consider these issues in their management plan process.

This proposal is intended to respect and honor the authorities and responsibilities of the Council, National Marine Fisheries Service, OCNMS, and Pacific Northwest Tribes. We recognize that the treaty rights of the Tribes require that any protective measure affecting treaty areas is a matter for consultation between NOAA and the Tribes and we encourage the on-going consultation on such matters of habitat protection.

We look forward to working with you to protect the corals and sponges in the waters off Washington State.

Sincerely,

Jim Ayers  
Vice-President


Proposal to the Pacific Fishery Management Council  
To Modify Groundfish Essential Fish Habitat Conservation Areas

Juan De Fuca Coral Canyons & Grays Canyon Sponge Reefs  
Important Ecological Areas

Top: Darkblotched and redbanded rockfish nestled in gorgonian coral in the Olympic Coast National Marine Sanctuary.  
Bottom: Glass sponge at 160m depth on Washington outer continental shelf  
All images courtesy of OCNMS and University of Washington

May 1, 2009
Proposal to the Pacific Fishery Management Council To Modify Groundfish Essential Fish Habitat Conservation Areas: Juan De Fuca Coral Canyons & Grays Canyon Sponge Reefs Important Ecological Areas

Deep-sea corals and sponges provide three-dimensional structures that form habitat for groundfish, shellfish, and other marine life. They generally occur in diverse biological communities with other invertebrates such as crinoids, basket stars, ascidians, annelids, and bryozoans. Scientists consider them as important to the biodiversity of the oceans and the sustainability of fisheries as coral reefs in shallow tropical seas. Corals and sponges are among the longest lived animals on Earth, and recovery from loss is on the order of decades to centuries or more. These long-lived habitat forming filter feeders may be important indicators of areas in the ocean that have consistently favorable ecological conditions, such as areas of high upwelling along the continental shelf break and submarine canyons.

This proposal recommends modification to the Olympic 2 and Grays Canyon EFH closures, see 50 C.F.R. §§ 660.306(h)(8) & 660.397(a), (d), to increase protections for identified deep-sea coral and sponge habitat from bottom trawling and, in Juan de Fuca Canyon, from other bottom contact gear. We have focused on areas where researchers have recently identified significant and important biogenic habitat outside of Essential Fish Habitat (EFH) closures recommended by the Pacific Fishery Management Council (PFMC) in 2005 and implemented by the National Marine Fisheries Service (NMFS) in 2006 as Amendment 19 to the Pacific Coast Groundfish Fishery Management Plan. 71 Fed. Reg. 27,408 (May 11, 2006) (codified at 50 C.F.R. Part 660). This proposal would protect sensitive coral and sponge habitats from bottom trawling and is consistent with the legal requirements of the Magnuson-Stevens Fishery Conservation and Management Act to minimize the adverse effects on EFH caused by fishing and to identify actions to encourage the conservation and enhancement of such habitat. See 16 U.S.C. § 1853(a)(7).

The proposal follows the structure of the EFH Review Committee Terms of Reference.

1. Date of application.

May 1, 2009

2. Applicant’s name, mailing address, email address, and telephone number, including contacts for any cooperating agencies or entities.

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3. A statement of the problem and the proposed action.

According to scientists, “deep-sea coral and sponge communities appear to be as important to the biodiversity of the oceans and the sustainability of fisheries as their analogues in shallow tropical seas” (MCBI and Oceana 2004). Dive surveys have recently discovered complex deep-sea corals and glass sponge reefs vulnerable to disturbance that are outside of areas currently closed to protect habitat.

NOAA has identified that fishing operations along the narrow continental shelf off the Pacific coast, “particularly bottom trawling, pose the most immediate and widespread threats to deep coral communities” (Whitmire and Clarke 2007). The adverse impacts of bottom trawling on seafloor habitat include changes in physical habitat and biological structure of ecosystems, as well as reductions in benthic habitat complexity and biodiversity (NRC 2002). These impacts are far more pronounced in areas of biogenic habitat, such as coral and sponge, where longevity and recovery times can be on the order of centuries or more. The likely consequence of bottom trawling in these areas is the loss of these unique and fragile living marine resources as well as the benefits they provide to the rest of the ecosystem—including the long-term sustainability of commercial fisheries targeting species that use coral and sponge habitat.

The proposed action would modify the boundaries of the Olympic 2 and Grays Canyon EFH Closed Areas, see 50 C.F.R. § 660.397(a), (d) (current boundaries for Olympic 2 and Grays Canyon), to encompass and protect identified coral and sponge habitat as well as additional suitable habitat in the surrounding Grays and Juan de Fuca submarine canyons. In addition, two areas in the Juan De Fuca Canyon with documented coral habitat would be closed to all fixed or anchored non-trawl bottom contact gear, such as bottom longlines, gillnets and pots and traps. The current measures prohibiting the use of bottom trawl gear in these ecologically important closed areas would be maintained. *Id.* at § 660.306(h)(8) (prohibition for fishing in conservation areas, including Olympic 2 and Grays Canyon). We recognize that the treaty rights of Pacific Northwest Tribes require that any protective measure affecting treaty areas is a matter for consultation between NOAA and the Tribes and we encourage the on-going consultation on such matters of habitat protection.

4. An explanation why the proposal is warranted, including:

a. How it is consistent with the Council’s requirement to identify and protect EFH and to mitigate for the adverse effects of groundfish fishing activities.

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires the National Marine Fisheries Service (NMFS) and fishery management councils to “describe and identify essential fish habitat” and “minimize to the extent practicable adverse effects on such habitat caused by fishing” while also identifying “other actions to encourage the conservation and enhancement of such habitat.” 16 U.S.C. § 1853(a)(7). Essential fish habitat is defined as “those

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1“Fixed gear (anchored nontrawl gear) includes the following gear types: longline, trap or pot, set net, and stationary hook-and-line (including commercial vertical hook-and-line) gears.” 50 C.F.R. § 660.302
waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.”  
*Id.* at § 1802(a)(10).  The EFH implementing regulations define “waters” to include “aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish” and “substrate” to include “sediment, hard bottom, structures underlying the waters, and associated biological communities.”  50 C.F.R. § 600.10.  “‘Necessary’ means “the habitat required to support a sustainable fishery and the managed species contribution to a healthy ecosystem; and ‘spawning, breeding, feeding, or growth to maturity’ covers a species’ full life cycle.”  *Id.*

To protect EFH, Councils are required to “prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable, if there is evidence that a fishing activity adversely affects EFH in a manner that is more than minimal and not temporary in nature…[.]”  *Id.* at § 600.815(a)(2)(ii).  Adverse effects mean “any impact that reduces quality and/or quality of EFH” and may include “direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH.”  *Id.* at § 600.810(a).

To implement these requirements, the Pacific Council developed Amendment 19 to the Pacific Coast Groundfish Fishery Management Plan (Groundfish FMP), which protected many of the coral and sponge hotspots known at that time. In finalizing Amendment 19, NMFS concluded that “adverse impacts to habitat were possible [from fishing] that could impair the ability of fish to carry out basic biological functions and potentially have long-lasting or permanent implications at the scale of the ecosystem.”  71 Fed. Reg. 27,408, 27,410 (May 11, 2006). Therefore, “to protect EFH from the adverse effects of fishing, the Council … identified areas that are closed to bottom trawling …” Pacific Coast Groundfish FMP (Groundfish FMP), Section 6.2.4, at72 (2006); see also *id.*, Sections 6.8 and 7.4. The precautionary management measures were carried out in the agency’s final rule implementing Amendment 19.  71 Fed. Reg. 27,408 (May 11, 2006) (codified at 50 C.F.R. § 660.396).

NMFS and the Council’s responsibilities to protect EFH do not end at the implementation of Amendment 19.  The Pacific Council clearly recognizes its continuing responsibility through initiation of this review process for groundfish EFH.  As the FMP states, “[p]rotecting, conserving, and enhancing EFH are long-term goals of the Council, and these EFH provisions … are an important element in the Council’s commitment to a better understanding, and conservation and management, of Pacific Coast groundfish populations and their habitat needs.”  Groundfish FMP, Section 7.0, at 106.

Since the Council’s original EFH action, NOAA has further clarified the need for protection of sensitive deep water corals.  “Over the past decade, science has demonstrated that deep corals are often extremely long-lived, slow-growing animals, characteristics that make them particularly vulnerable to physical disturbance, especially from activities such as bottom trawling.”  (Whitmire and Clarke 2007).  That report also states “deep coral habitats appear to be much more extensive and important than previously known, particularly with respect to supporting biologically diverse assemblages.”  Deep-sea sponges often share these same characteristics.
Finally, NOAA has identified that fishing operations along the narrow continental shelf off the Pacific coast, “particularly bottom trawling, pose the most immediate and widespread threats to deep coral communities” (Whitmire and Clarke 2007). As this proposal details, the best scientific information available supports the protection for the coral and sponge communities identified for addition to the currently protected Olympic 2 and Grays Canyon Important Ecological Areas.

Modifying these areas to include additional deep-sea coral and sponge habitat is clearly consistent with the Council’s responsibilities. The law requires the Council to minimize to the extent practicable adverse effects of fishing on EFH. As stated above, NOAA has clearly identified that coral communities are particularly vulnerable to activities like bottom trawling. The potential adverse impacts to sensitive deep-sea coral and sponge alone, based on the rationale used in Amendment 19 justify adding the proposed areas. Moreover, corals identified in this area have likely already been adversely affected by fishing (see 4.b below), amplifying the need for protecting these habitats before additional impacts occur. Finally, protecting these habitats from fishing is also practicable, as it would have minimal economic impact on the fishery (see 6.e and 7.e below). Therefore, adding the proposed areas of sensitive habitat known to be important groundfish habitat is clearly consistent with the Council’s obligations and previous actions to protect EFH from the adverse effects of groundfish fishing activities.

b. Why an interim review is necessary prior to the periodic 5-year review.

As laid out in this document, biogenic habitat such as coral and sponge is among the most vulnerable habitat to bottom trawling and the slowest to recover from disturbance. Their fragility, slow growth, and longevity means that even a single pass of a bottom trawl can destroy centuries of growth. Dive surveys have already documented *Lophelia pertusa* banks that have been reduced to rubble in the Olympic Coast National Marine Sanctuary (OCNMS). Permanent closures are needed to protect this habitat.

The current boundaries (2009-2010 schedule) of the groundfish trawl Rockfish Conservation Area (RCA) encompass the area bounded by this proposal (with small exceptions). The RCA closure, put into place to reduce the catch of overfished rockfish, is a temporary and variable bycatch control measure not designed to protect habitat. Although it does restrict bottom trawling in the area, it can and does change temporally and spatially as frequently as every two months. Accordingly, it does not afford the permanent protection needed to protect long-lived and fragile coral and sponge habitat. Even if the current schedule stays in place through the end of 2010, there is no guarantee the boundaries will remain the same from 2011 onwards. As the five-year review is not scheduled for completion until the beginning of 2013, it is imperative that these closures are implemented through the interim review process.
5. A detailed description of the proposed action(s), including:

a. Spatial changes to currently protected areas such as boundary modifications, elimination of current areas of EFH, HAPC, and HCA or addition of new areas of EFH, HAPC, or HCA. Latitude and longitude coordinates (DDD° mm.mmm′) and maps, including before and after change, and digital files if available (e.g., GIS shape files, navigation plotter data).

The attached maps (Figures 1-3) and Table 1 detail the proposed area modifications. In addition to the referenced reports and literature, the following GIS datasets were among those used in this analysis:

**Habitat and substrate data**
1. OCNMS 2006 ROV dive location data from Figure 4 in Brancato et al (2007).
4. Surficial Geologic Habitat version 3. Downloaded from PacOOS West Coast Habitat Server, February 2009.

**Trawling data**

b. Gear regulation changes, (e.g., allowing or disallowing gear types, tow technique, mesh size, weight of gear, time of bottom contact, tow time, number of pots or hooks).

The current bottom trawl gear restrictions in the Olympic 2 and Grays Canyon EFH closures would be maintained. Bottom trawling would be a prohibited activity in the areas proposed at Grays Canyon and Juan de Fuca Canyon. No bottom contact (trawls, longlines, pots) would be permitted in the sites with the Juan de Fuca Canyon proposed for no bottom contact (see figures 1-3).

c. Other changes.

None.
Table 1: Latitude and longitude coordinates of proposed area modifications.

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6. All relevant and applicable information on the following characteristics, including the attendant impacts of the proposed action:

a. Biological and ecological characteristics (e.g., habitat function, vulnerability, index of recovery, species associations, including reference to any ESA-listed species, and biogenic components).

Research in the Juan de Fuca Canyon

Most of the available information for Juan de Fuca Canyon is from surveys conducted in 2004 and 2006. A pilot project was conducted in the area in June 2004 (Hyland et al. 2005). NOAA then led a follow-up research cruise from May 22 to June 4, 2006 to conduct a series of dives in the OCNMS with the goal of documenting deep coral and sponge communities (Brancato et al. 2007). The survey locations included sites both inside and outside the Olympic 2 EFH conservation area. Several species of corals and sponges were documented at 14 of 15 survey sites including gorgonians, stony corals and reef building sponges. The researchers also documented dead gorgonians, lost fishing gear and coral rubble supporting concerns over the risk of disturbance to coral health (Brancato et al. 2007).

Callogorgia sp. in OCNMS
The 2004 dives discovered colonies of the scleractinian coral species *Lophelia pertusa*, the first to be found in the sanctuary (Hyland et al. 2005). This species had been documented off the west coast before these dives, but not in the large bank-like complexes (lithoherms) found throughout the Atlantic, including the Darwin Mounds off of Ireland and in the Norwegian fjords. In the sanctuary, *L. pertusa* was observed on rock faces with lithoherms forming at the base of the rock face (Brancato et al. 2007). These more recent dives also discovered several other species, including the cup coral *Desmophyllum dianthus*, a potentially undescribed species of hydrocoral (*Stylaster* sp.) and small patches of the reef-building sponge *Farrea occa* (OCNMS 2008). In the 2006 dives, corals were found at 14 of the 15 sites surveyed, both within and outside the Olympic 2 EFH conservation area (Brancato et al. 2007).
Prior to the 2004 and 2006 dives to document hard substrate and associated communities, information on habitat-forming corals in the sanctuary was extremely limited and was based on observations from NMFS trawl surveys and occasional observations by academic institutions. At that time, the only species of zoantharian coral that had been documented in the literature in sanctuary waters was a black coral (\textit{Bathypathes} sp.) (Etnoyer and Morgan 2003; Etnoyer and Morgan 2005). Sanctuary dive surveys to document recovery along a fiber optic cable route from 2000-2004 identified several other species including gorgonians (\textit{Paragorgia} sp., \textit{Swiftia} sp. and an unidentified paramuriceid coral), hydrocorals (\textit{Stylaster venustus}), cup corals (\textit{Balanophyllia} sp.) and numerous sponges (Brancato et al. 2007).

Colony of apparently healthy ivory tree coral (\textit{L. pertusa}) in OCNMS
Research in the vicinity of Grays Canyon

Recent research, including ROV surveys off of the Washington Coast have uncovered glass sponge reefs (Class Hexactinellida) in the vicinity of Grays Canyon (Johnson et al. 2007, Bjorklund et al. 2008). Glass sponges are remarkable benthic suspension feeders. Despite being single-celled animals, individuals produce a skeleton made of nearly pure silica that can reach a meter or more in height (Leys et al. 2004; Yahel et al. 2005; Conway et al. 1991, 2004). Although individual glass sponges can be found in the deep oceans at 500 to 3000 meters, they are found in relatively shallow waters in only a few areas of the world—Antarctica, New Zealand, a few caves in the Mediterranean, and in the Pacific Northwest (Johnson 2006).

Glass sponges off the Washington outer continental shelf

Until very recently, glass sponge reefs in the northwest Pacific were known to occur only off British Columbia (e.g. Conway et al. 1991, 2001, 2004, 2005: Cook 2005). These sponge reefs are among the largest known biomasses of sponges anywhere on Earth, covering thousands of kilometers along the coastline in the Hecate Strait and Strait of Georgia (Whitney et al. 2005; Leys et al. 2004; Yahel et al. 2005). Almost identical environmental conditions between the Strait of Georgia and the continental margins of Washington and Oregon, coupled with sidescan sonar data and NMFS trawl bycatch records suggested the presence of glass sponge reefs in the Grays Canyon area (Johnson 2006). A 2008 cruise by scientists from Washington Sea Grant and the University of Washington (Bjorklund et al. 2008) was the first to formally document the existence of these ancient reefs off the U.S. West Coast. The dive also recorded the existence of methane seeps in the vicinity of the coral reefs as well as swarms of krill.
There are three known reef building glass sponge species: *Aphrocallistes vastus* (vase sponge), *Heterochone calyx*, and *Farrea occa* (Cook 2005). Data from the 2008 cruise (Bjorklund et al. 2008) and NMFS trawl surveys indicate the presence of at least *A. vastus* and *H. calyx* in the vicinity of Grays Canyon, while *F. occa* has been recorded during the OCNMS dives further north. Many species of non-reef building sponges are also known from bycatch records in the area, such as the cloud sponge *Rhabdocalyptus* sp., the hermit sponge *Suberites* sp., the ball sponge *Tethya* sp., the tree sponge *Mycale loveni*, the spiny vase sponge *Leucandra heathi*, the fibreoptic sponge *Hylonema* sp., and the barrel sponge *Halichondria panicea*. In addition, many bycatch records only identify to the level of ‘glass sponge’ or even simply ‘sponge’ (NMFS 2007).

**Deep-sea corals and sponges: Ecological importance and species associations**

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

Deep-sea corals and sponges provide three-dimensional structures that form habitat for groundfish, shellfish, and other marine life (Husebo et al. 2002; Krieger and Wing 2002; Malecha et al. 2002; Heifetz 2002). Deep-sea corals and sponges 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 to 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.

Based on the best available science, cold water coral and sponge habitat is an important component of Essential Fish Habitat vulnerable to the impacts of bottom trawling. In February 2004, over 1,100 scientists signed a consensus statement declaring that “In short, based on current knowledge, deep-sea coral and sponge communities appear to be as important to the biodiversity of the oceans and the sustainability of fisheries as their analogues in shallow tropical seas” (MCBI and Oceana 2004). This statement is corroborated by numerous scientific studies documenting the importance of cold-water corals as habitat for fish and invertebrates. Here are 12 examples:

1. Hyland et al. (2004) conclude that coral and sponge ecosystems in the Olympic Coast National Marine Sanctuary are valuable habitat for demersal fisheries on the U.S. West Coast and important “reservoirs of marine biodiversity.” This study documented bottom trawl marks in the vicinity and a large proportion of dead or broken corals.
2. Krieger and Wing (2002) identified 10 megafaunal groups associated with *Primnoa* sp. deep-sea corals that use the corals for feeding, breeding and protection from predators. Six rockfish species were either beneath, among, or above the coral colonies. Shrimp were among the coral polyps, and a pair of mating king crabs was hiding beneath the coral. The authors conclude that removal of these slow-growing corals could cause long-term changes in associated megafauna.
3. Dr. Milton Love (pers. comm.) identified large schools of juvenile rockfish (including widow and squarespot rockfish) closely associated among the branches of the Christmas tree coral, likely using the coral for protection. This deep-sea coral species was named based on the numerous associated species that clung to the branches like Christmas ornaments (Opresko 2005).
5. Buhl-Mortensen and Mortensen (2004) documented 17 crustacean species associated with cold-water gorgonian corals off Canada, most of which were using the habitat as protection from predators. Some species were obligate to the corals. This study suggests corals provide habitat for commercial fish prey.

6. Husebo et al. (2002) found that the largest catches of redfish (Sebastes marinus) were made by long-line fleets set in deep-sea coral reef habitats. Fish caught in coral habitats tended to be larger in size than in non-coral habitats. Reasons given for the associations were feeding and physical structure of coral.

7. Christiansen and Lutter (2003) cite evidence that commercially caught demersal and pelagic fish species, mainly redfish, saithe, ling and tusk, have a higher abundance near deep-sea coral reefs and patches.

8. Costello et al. (2003) found that fish species and abundance was greater on the deep-sea coral habitat than surrounding seabed; 69% of species and 79% of abundance was associated with the reefs.

9. Koenig et al. (2003) state that important predatory fish species have been seen aggregating around the larger structures of Oculina sp. deep-sea corals off Florida and that small fish have taken up residence inside the modules.

10. Scott and Risk (2003) found many fish associated with Primnoa which are not common in areas where coral is absent. The authors state that deep-sea corals off Canada are being rapidly depleted by bottom trawling, which in turn appears to have an impact on fish stocks.

11. Sulak et al. (2003) listed economically important fish species observed in deep-sea coral habitat, several of which were restricted to this habitat. The authors also found several poorly known fish species associated with deep-sea corals.


Hexactinellid sponges and demosponges have not received the same level of attention as corals. However, sponges are a diverse group of large, slow-growing seafloor animals that provide habitat for fish and invertebrates on the U.S. West Coast. Reef-forming glass sponges in particular are considered ‘foundation species’ in that through modification, maintenance and creation of a habitat they exert a disproportionately large influence on the structure of the associated biological community (Jones et al., 1997, Dayton et al. 1975). The marine reef-forming foundation species, which include both glass sponges and corals, reduce both physical and biological stresses within a semi-closed environment, limit the intensity of bottom boundary currents, modify the sedimentation regime, reduce biological competition and predation, increase or decrease the bacterial cell counts, and in some cases, change the chemistry of the near-bottom seawater, particularly the dissolved oxygen levels. Studies have demonstrated that glass sponge reefs produce a biological environment of richness, high individual abundance, and diversity of megafaunal groups (e.g., Cook 2005).

Like corals, the new and complex habitat created by glass sponges extends beyond the areas with live individuals to regions of the reef with dead sponges and areas adjacent to the reefs (Cook 2005). In British Columbia sponge reefs for example, sponge skeletons provide a variety of physical niches that support a varied diversity of organisms such as crabs, shrimp, prawns, krill,
squat lobsters and juvenile rockfish (Conway et al. 2005; Whitney et al. 2005; Leys et al. 2004; Cook 2005). Several studies have documented the importance of sponges as fish habitat:

1. Freese and Wing (2003) documented that *Aphrocallistes* sponges provide habitat for juvenile red rockfish in the Gulf of Alaska. The authors state that the fish observed in the study benefited from the sponges through predator avoidance and that bottom trawl damage to sponge communities would be expected to have a negative impact on juvenile red rockfish survival rates.

2. Eastman and Eakin (1999) documented that fishes of the genus *Armedidraco* are associated with sponge beds in the Ross Sea of Antarctica.

3. Tokranov (1998) described the association of the sponge sculpin (*Thyriscus anoplus*) with sponge beds in the northern Kuril Islands.

4. Konecki and Targett (1989) found that cod icefish (*Lepidonotothen larsenii*) lay their eggs on the biogenic substrate provided by the spongocoel of the hexactinellid sponge *Rossella nuda* off Antarctica. The authors state that glass sponges serve as important nesting and refuge sites for Antarctic fishes and that destruction of sponge communities by bottom trawling could have an adverse impact on the fish ecology of the region.

5. Moreno (1980) and Daniels (1978) documented several species of fishes known to utilize sponges as spawning and nesting sites and for predator avoidance.

6. Munehara (1991) established that silverspotted sculpin (*Blepsias cirrhosus*) use the sponge *Mycale adhaerens* as a spawning bed and that the eggs benefit from the association through predator avoidance, oxygen supply and the antibacterial and antifungal properties of the sponges.

7. Herrnkind and Butler (1994) identified sponges as “benthic juvenile shelter” for spiny lobster in Florida Bay, documenting them as among the most productive sites for survival of postlarvae.

8. Rocha et al. (2000) found that sponges are habitat 'oases' in a desert of rubble and flat rocky bottoms in Brazil. The study identified fish associations with shallow and deepwater sponges, including several obligate associations and four endemic species of fishes.

9. Cook (2005) and Cook et al. (2008) documented that glass sponge reefs in the Queen Charlotte Basin, British Columbia support diverse megafaunal communities distinct from surrounding habitats and act as juvenile nursery habitat for rockfish (*Sebastes* sp.).

The following species are known to associate with corals and sponges: roughey 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 (2006) found that 85% of the economically important fish species observed on dive transects were associated with corals and other emergent epifauna. 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. In a study of deep water Oculina reefs along eastern Florida, Reed (2002) noted extensive areas of Oculina rubble as the result, in part, 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 have a positive impact on the stocks by increasing the amount of protective cover available to slope rockfish and increasing survival of juvenile fish (NMFS 2005a).

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 (NMFS 2005b).

Longevity and recovery rates

It is clear that corals and sponges have growth rates on the order of millimeters per year, living to be hundreds to thousands of years old. The large glass sponges found off the coast of British Columbia have been age dated to be 220 years old, and the average age based on current knowledge of growth rates is 35 years (Leys and Lauzon 1998). The largest of the mounds formed by these sponges has been estimated at 9000 years old (Jamieson and Chew 2002), although evidence of iceberg gouges in the sponge reefs at the Grays Canyon site indicate these may date back to the last glacial period, 125,000 years ago (Bjorklund et al. 2008). Studies to date indicate the extreme longevity and slow recovery rates for many of these species, including:

1. Andrews et al. (2003) found growth rates of 1.74 cm/yr for Primnoa, 1 cm/yr for Corallium, and ages of 30 to over 200 years for deep-sea coral species of Davidson Seamount.
2. Cordes et al. (2001) found ages of 25-30 years for the deep-sea coral Anthomastus ritteri in California's Monterey Bay, noting that the results agree with the general notion that growth rates are reduced and longevity increased in deep-sea species.
3. Roark et al. (2003) sampled corals from Hawaii and the Gulf of Alaska and dated a living Gerardia sp. to be 2700 years old and a black coral to be 2200 yrs old, using radiocarbon dating techniques.
4. Leys and Lauzon (1998) found large deep water Hexactinellid sponges to be 220 years old with average growth rates of 1.98 cm/yr.
5. Probert et al. (1997) found recovery times greater than 100 years for deep-sea corals.
6. Jones (1992) review of trawl impact literature revealed that recovery time for deep-sea benthos with little natural disturbance is on the scale of decades.
7. Koslow et al. (2000) discusses the higher longevity and vulnerability of deepwater
ecosystems to trawling, particularly on seamounts, which are known to have benthic fauna (i.e. corals) with high levels of endemism.

8. Risk et al. (2002) found ages of over 300 years for *Primnoa resedaeformis*.

9. Heikoop et al. (2002) found that deep-sea corals (*Primnoa*) in Alaska and elsewhere have lifespans of several centuries. The authors describe the potential of these corals to contain extended records of surface productivity, deep ocean temperature and chemistry that are of value to climatologists and fisheries managers.


In addition, the estimated ages of biogenic habitats may underestimate their actual recovery time because it omits the time necessary for recolonization. If corals and sponges take a long time to settle and begin growth in damaged areas, overall recovery is much longer. Evidence for long recolonization times is presented in Koenig et al. (2003), which found no evidence of recolonization of *Oculina* deep-sea corals into denuded areas and offered two explanations: continued trawling and the fact that rubble areas do not provide suitable substrate for planular settlement of coral larvae. Additionally, the Krieger (2002) study cited in NMFS (2005a) found no evidence for recolonization of corals seven years after trawling.

b. **Geological characteristics (e.g., substrate type, grain size, relief, morphology, depth).**

*Juan De Fuca Canyon:* The mean depths of the sites surveyed ranged from 89 to 313m, with the majority of sites in the 200-300m range. Roughly 6 percent of the seafloor in the sanctuary is hard substrate with the potential to host biologically structured habitat (OCNMS 2008). Table 2 provides a summary of the mean depth, substrate types, and biogenic habitat discovered at each site, provided in more detail in Brancato et al (2007).

*Grays Canyon:* The Grays Canyon area proposed for expanded protections has very similar geological, physical oceanographic, and chemical characteristics to the areas of sponge reef in British Columbia. The seafloor morphology consists of elevated banks or pre-existing ridges, rising above the near-bottom transport of muddy sediment at the continental margin at 150-200m. Sediment type is coarse/immobile sediment stable against transport by nearbottom currents for hundreds to thousands of years, such as glacial till/diamictite; also a small amount of continuous clay sedimentation.
c. **Physical oceanographic characteristics (e.g., temperature, salinity, circulation, waves).**

*Juan De Fuca Canyon:* Mean temperature and salinity varied little between sites, with the shallower sites being predictably slightly warmer, and with slightly higher dissolved oxygen levels (DO) than the deeper sites. Temperature ranged from 6.5 to 7.9 °C, with shallower sites (89-131m depth) about one half degree warmer than deeper sites. Salinity ranged from 32.0 to 34.0 psu, except at survey sites 30 and 40, at which the mean salinity was low, measuring 30.1 and 26.7 psu, respectively (Brancato et al. 2007). See Table 3 for the mean temperature, salinity and current speed values for each site.

*Grays Canyon:* Similar to the British Columbia reef areas. Bottom currents in the range of 10 to 25 cm/second. Sediment content of < 7 mg/L and >35% transmissivity (Johnson 2006).

d. **Chemical characteristics (e.g., nutrients, dissolved oxygen).**

*Juan De Fuca Canyon:* Mean DO values also varied little between the dive sites, ranging from 2.2 to 4.6 mg/L (all sites included) and from 2.2 to 3.4 mg/L with the two shallowest sites excluded (Brancato et al. 2007). See Table 3 for the mean DO value for each site.

*Grays Canyon:* Similar to British Columbia Reef sites. A minimum of 43 to 70 µmol/L of dissolved silica, and a minimum of 62 to 152 µmol/L DO (Johnson 2006).

e. **Socioeconomic characteristics (see 7.e below).**

The proposed closures have been designed to protect coral and sponge habitat while continuing to allow fishing in areas where non-confidential trawl track and trawl catch data indicate areas of high economic value. In the long term, biogenic habitat protection would likely maintain or improve fishing opportunities for other gear types.
Table 2: Geological and Biogenic Habitat Characteristics of the OCNMS dive sites, 2006. Of the complete universe of 55 sites, the 20 sites below were preselected randomly before the cruise (Brancato et al. 2007).

<table>
<thead>
<tr>
<th>Survey Site</th>
<th>Inside Olympic 2</th>
<th>Depth (m)</th>
<th>Substrate</th>
<th>Biogenic habitat</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>y</td>
<td>313</td>
<td>cobble, pebbles, scattered boulders</td>
<td>L. pertusa, Stylaster sp., P. arborea pacifica, Swiftia sp.</td>
</tr>
<tr>
<td>1</td>
<td>y</td>
<td>249</td>
<td>rock outcrop, boulders, cobble and clay, and a steep, crumbly wall with benches.</td>
<td>P. arborea pacifica, Plumarella longispina, Primnoa pacifica, Swiftia sp., Muriceides, Desmophyllum dianthus, Stylaster sp.</td>
</tr>
<tr>
<td>2</td>
<td>y</td>
<td>276</td>
<td>glacial erratic more than 8m tall, sand, clay, occasional boulder.</td>
<td>L. pertusa, P. pacifica, D. dianthus</td>
</tr>
<tr>
<td>3</td>
<td>y</td>
<td>245</td>
<td>low relief site, muddy bottom, occasional cobble, boulders, rocky ledge forming a small wall.</td>
<td>Swiftia pacifica, Swiftia beringi, P. arborea pacifica</td>
</tr>
<tr>
<td>6</td>
<td>n</td>
<td>232</td>
<td>long rock wall, steep on its eastern side, occasional boulders</td>
<td>L. pertusa rubble, L. pertusa, five gorgonian coral species incl. two Swiftia species, D. dianthus</td>
</tr>
<tr>
<td>7</td>
<td>n</td>
<td>193</td>
<td>small wall of clay pavement, riddled with burrows, hard rock outcrop</td>
<td>Cup corals, Swiftia sp.</td>
</tr>
<tr>
<td>11</td>
<td>y</td>
<td>280</td>
<td>sand, occasional boulder</td>
<td>L. pertusa (dead), D. dianthus (dead), P. arborea pacifica (broken), P. longispina, P. pacifica, Stylaster sp</td>
</tr>
<tr>
<td>12</td>
<td>n</td>
<td>289</td>
<td>no hard substrate, soft sediment pockets, silt, gravel</td>
<td>no corals</td>
</tr>
<tr>
<td>13</td>
<td>y</td>
<td>247</td>
<td>cobble, boulders, silty seafloor, small rock outcrop</td>
<td>four gorgonian corals, D. dianthus, Stylaster sp., Farrea occa (sponge)</td>
</tr>
<tr>
<td>18</td>
<td>n</td>
<td>131</td>
<td>boulder field, cobble, trawl tracks</td>
<td>one coral species, sponge</td>
</tr>
<tr>
<td>20</td>
<td>n</td>
<td>103</td>
<td>boulders, cobble, sand waves</td>
<td>sea pens, sponges and corals (bycatch)</td>
</tr>
<tr>
<td>30</td>
<td>y</td>
<td>173</td>
<td>pebble, cobble, boulders</td>
<td>sponges and corals (bycatch), P. arborea pacifica, Swiftia sp., P. longispina, hydrocoral, Paragorgia (dead, damaged)</td>
</tr>
<tr>
<td>31</td>
<td>y</td>
<td>205</td>
<td>pebble, cobble, boulders, mud</td>
<td>sea pens, hydrocorals, P. arborea pacifica, P. longispina</td>
</tr>
<tr>
<td>40</td>
<td>y</td>
<td>201</td>
<td>muddy mixed, pebble, gravel, occasional boulders</td>
<td>P. arborea pacifica, Swiftia sp., S. beringi</td>
</tr>
<tr>
<td>45</td>
<td>n</td>
<td>89</td>
<td>cobble, boulders, rock outcrop</td>
<td>S. venustus, B. elegans, Swiftia spauldingi, hydroids, bryozoan Myriozoum</td>
</tr>
</tbody>
</table>

Sites Attempted But Not Completed

<table>
<thead>
<tr>
<th>Survey Site</th>
<th>Inside Olympic 2</th>
<th>Depth (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>y</td>
<td>290</td>
</tr>
<tr>
<td>10</td>
<td>y</td>
<td>261</td>
</tr>
<tr>
<td>17</td>
<td>n</td>
<td>107</td>
</tr>
<tr>
<td>44</td>
<td>n</td>
<td>121</td>
</tr>
<tr>
<td>49</td>
<td>n</td>
<td>318</td>
</tr>
</tbody>
</table>
Table 3: Physical Oceanography Characteristics of the OCNMS dive sites, 2006 (Brancato et al. 2007)

<table>
<thead>
<tr>
<th>Survey Site</th>
<th>DO (mg/L)</th>
<th>Salinity (psu)</th>
<th>Temp (ºC)</th>
<th>Typical Current Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3.0</td>
<td>32.0</td>
<td>6.9</td>
<td>3/4 knot to 2 knots</td>
</tr>
<tr>
<td>1</td>
<td>3.3</td>
<td>33.9</td>
<td>6.8</td>
<td>&lt;0.75 knots</td>
</tr>
<tr>
<td>2</td>
<td>ND1</td>
<td>ND</td>
<td>ND</td>
<td>&lt;1 knot</td>
</tr>
<tr>
<td>3</td>
<td>3.0</td>
<td>33.2</td>
<td>7.0</td>
<td>2 to 2.5 knots</td>
</tr>
<tr>
<td>6</td>
<td>2.9</td>
<td>33.8</td>
<td>6.9</td>
<td>&lt;0.5 knots</td>
</tr>
<tr>
<td>7</td>
<td>3.4</td>
<td>33.8</td>
<td>7.2</td>
<td>&lt;0.5 knots</td>
</tr>
<tr>
<td>11</td>
<td>2.9</td>
<td>33.6</td>
<td>6.5</td>
<td>1.25 knots</td>
</tr>
<tr>
<td>12</td>
<td>2.2</td>
<td>34.0</td>
<td>6.5</td>
<td>&lt;0.5 knots</td>
</tr>
<tr>
<td>13</td>
<td>2.6</td>
<td>33.7</td>
<td>6.7</td>
<td>&lt;0.5 knots</td>
</tr>
<tr>
<td>18</td>
<td>4.5</td>
<td>33.7</td>
<td>7.7</td>
<td>1 to 1.25 knots</td>
</tr>
<tr>
<td>20</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
<td>negligible</td>
</tr>
<tr>
<td>30</td>
<td>3.0</td>
<td>30.1</td>
<td>6.8</td>
<td>&lt;1 knot</td>
</tr>
<tr>
<td>31</td>
<td>3.4</td>
<td>33.9</td>
<td>6.7</td>
<td>&lt;0.5 knots</td>
</tr>
<tr>
<td>40</td>
<td>3.0</td>
<td>26.7</td>
<td>6.8</td>
<td>0.2 knots</td>
</tr>
<tr>
<td>45</td>
<td>4.6</td>
<td>33.3</td>
<td>7.9</td>
<td>0.5 to 3 knots</td>
</tr>
</tbody>
</table>

Sites Attempted But Not Completed

<table>
<thead>
<tr>
<th>Survey Site</th>
<th>DO (mg/L)</th>
<th>Salinity (psu)</th>
<th>Temp (ºC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>10</td>
<td>2.5</td>
<td>34.0</td>
<td>6.6</td>
</tr>
<tr>
<td>17</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>44</td>
<td>3.7</td>
<td>33.8</td>
<td>7.2</td>
</tr>
<tr>
<td>49</td>
<td>2.7</td>
<td>34.0</td>
<td>6.5</td>
</tr>
</tbody>
</table>

7. A discussion of the following topics as relevant to the proposed actions:

a. The importance of habitat types to any groundfish FMP stocks for their spawning, breeding, feeding, or growth to maturity.

See 6.a above.

b. The presence and location of important habitat (as defined in 7.a above).

See 6.a above.

c. The presence and location of habitat that is vulnerable to the effects of fishing and other activities as relevant.

The literature documenting the effects of bottom trawling, dredging and other fishing on seafloor habitat is substantial, consisting of well over 100 studies globally (Johnson 2002 in NMFS 2005b, Appendix C). There is general scientific consensus that bottom trawling has wide-ranging effects on habitats and ecosystems. According to the National Research Council (2002)
Report on the Effects of Trawling and Dredging on Seafloor Habitat, these adverse impacts 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

Bottom trawling is the leading, most widespread cause of reduced habitat complexity in the major fishing grounds along the North American continental shelf. As trawl gear can crush, displace, expose and bury marine life on the sea floor, habitats that are trawled are far more likely to have reduced overall species diversity. Those organisms remaining after extensive periods of trawling tend to be “comprised of large numbers of a few opportunistic species” (Norse and Watling 1999). That study found that the extent of disruption to habitat complexity is dependent upon how long the area has to recover between trawls, how extensive the damage is from the trawling gear, and whether the habitat is constituted primarily of quick-recovering, short-lived species or of slow growing, long-lived species.

Ivory tree coral (L. pertusa) rubble in OCNMS

The National Research Council (2002) report concluded that the impacts of trawling can lead to measurable changes in benthic habitats over time, with the greatest impact on those communities which are ecologically most complex. Extended trawling over the same habitat can lead to “a shift from communities dominated by species with relatively large adult body size towards dominance by high abundances of small-bodied organisms.” More significantly, areas of intense
Trawling activities have the potential to be permanently affected and will lead to the emergence of short-lived organisms which are “readapted to conditions of frequent physical disturbance” (NRC 2002).

Biogenic habitat, such as corals and glass sponge reefs are particularly vulnerable to bottom trawling (Conway et al. 1991; Cook 2005; N. Lowrie, pers. comm. 2005: Whitmire and Clarke 2007). Many studies corroborate this conclusion, for example:

1. Hyland et al. (2004) documented bottom trawl marks in the vicinity of coral and sponge beds in the OCNMS and observed a large proportion of dead or broken corals.
2. Engel and Kvitek (1998) compared heavily trawled and lightly trawled areas in otherwise similar regions off Big Sur, CA, finding lower epifaunal invertebrate densities at the more heavily trawled site. The authors conclude that intensive trawling significantly decreased physical habitat heterogeneity and biodiversity.
3. Grehan et al. (2003) found evidence that deep-sea corals are being destroyed by trawling, as evidenced by trawl scars, flattened coral rubble, barren sediment and lost trawl gear. The authors state that this provides irrefutable proof of a serious threat to the marine ecosystem caused by fishing that warrants immediate emergency measures to protect the remaining corals.
4. Conway et al. (2003) studied the environmental conditions where sponge reefs are found and discovered that like deep-sea coral reefs, many of the hexactinosan sponge reefs in British Columbia have been damaged or destroyed by the groundfish trawl fishery.
5. Hall-Spencer et al. (2002) documented widespread trawling damage to cold-water coral reefs at 840-1300m depth along the West Ireland continental shelf break and at 200m depth off West Norway. The trawled coral matrix was at least 4550 years old. The authors discuss the need for urgent conservation measures to protect these corals.
6. Lundalv and Jonsson (2003) found about that 50% of investigated coral sites in the Kosterfjord area were destroyed by recent bottom trawling, while the remaining areas exhibit major signs of trawl damage.
7. Mortensen et al. (2003) found signs of fishing impact such as broken live corals, tilted corals and scattered skeletons. Broken or tilted corals were observed along 29% of the transects. A total of 4 % of the coral colonies observed were impacted.
8. Fossa et al. (2002) estimated that 30-50% of the deep-sea coral *Lophelia* reefs in Norway have been damaged by bottom trawling and stated that fishermen claim that catches are significantly lowered in areas where the reefs are damaged.
9. Koslow et al. (2001) sampled the benthic fauna of Tasmanian seamounts and found high abundance and diversity of hard and soft corals, hydroids, sponges, ophiuroids, and sea stars, a large fraction of which were new to science. This study also found that heavy trawling has completely removed the reef aggregations.
10. Wassenberg et al. (2002) documented direct removal of sponges caused by trawling, accompanied by long-term changes in species composition over time.
11. Ardizzone and Pelusi (1983) and Ardizzone et al. (2000) found that bottom trawling reduced the quality and quantity of *Posidonia oceanica* beds, a biogenic habitat in the Mediterranean Sea.
12. Hall-Spencer and Moore (2000) found a 70% reduction in maerl thalli habitats, which
have important ecological functions, with no recovery after four years.

13. Kaiser et al. (1996) conducted a multivariate analysis showing that both beam trawling and dredging reduce the abundance of most epifaunal species in the Irish Sea.

14. Kaiser et al. (2000a) found that chronic fishing has caused a shift from communities dominated by relatively sessile, emergent, high biomass species to communities dominated by infaunal, smaller-bodied fauna. Removal of emergent fauna has thus degraded the topographic complexity of seabed habitats in areas of high fishing effort. The authors note that communities within these areas currently may be in an alternative stable state.

15. Ault et al. (1997) found conspicuous long-term damage to sponges and soft corals after one pass of a trawl and that the sponge *Ircina felix* and corals of the genus *Pseudoplexaura* appeared to be the taxa most vulnerable to breakage or dislodgement by trawling.

16. Collie et al. (1996), Collie et al. (1997), and Collie et al. (2000) found significantly reduced abundance of colonial epifaunal species that provide complex habitat for shrimp, polychaetes, brittle stars, and small fish at sites disturbed by bottom fishing in Georges Bank. These studies found that many species whose abundances were reduced were also prey for commercial fish.

17. DeAlteris et al. (2000) discuss physical impacts and biological alterations in community structure caused by trawling in New England and recommend closure areas to reduce the impact of mobile fishing gear on habitat and biodiversity.

18. Magorrian (1995) found otter trawling to remove emergent epifauna and reduce the structural complexity of mussel beds in Strangford Lough, and recommended marine reserves as a management tool.

19. McAllister and Spiller (1994) found that trawling and dredging have major impacts on marine habitats by removing protruding invertebrate animal life including sea anemones, sponges, sea squirts, crinoids and many others which provide shelter and food sources for juvenile fish and shellfish. Specific trawling effects in the study included shearing off higher hummocks, filling in low spots, changing the configuration of the bottom, removing areas more exposed to or protected from the current, exposing shellfish, worms and other sediment dwelling species to predation and stirring up clouds of mud and other sediment that plug gills and similar structures of filter feeders. The authors recommend closures, control areas and conversions to less damaging gear types.

20. Norse and Watling (1999) state that trawling damages refuges from predation and feeding places for demersal fish, which are correlated with species diversity and post settlement survivorship of some commercial species.

21. Pitcher et al. (2000) found that total annual removal of benthic fauna ranged from very low to over 80% in areas of highest trawl intensity in Australia’s Great Barrier Reef. These studies found that highly vulnerable populations of epifaunal species may be depleted by about 55% overall and that there will be a substantial alteration in most trawled grids with a shift to less vulnerable species.

22. Reed (2002), in a study of deep water *Oculina* reefs along eastern Florida, noted extensive areas of *Oculina* rubble and major declines in commercial fish populations in the reefs from 1970-1990.

23. Rumohr et al. (1994) found reductions in abundance of epifauna and absence of inner
structures (feeding burrows, living chambers, tubes) in areas impacted by trawling in the German Bight.

24. Bavestrello et al. (1997) found fishing damage to gorgonian corals in the Ligurian Sea and slow recolonization and recovery rates for these corals, and recommended special protection for these corals as a Natural Marine Park.

25. Stone and Malecha (2003) state that “gardens of corals, sponges, and other sessile invertebrates” were similar in structural complexity to tropical coral reefs with which they shared several important characteristics including complex vertical relief and high taxonomic diversity. The authors note the particular sensitivity of these habitats to disturbance and observed anthropogenic disturbance to corals.

26. Wheeler et al. (2003) found broken coral rubble and dead coral in areas of higher trawl intensity, whereas untrawled areas had a much higher abundance of undisturbed upright coral colonies.

27. Van Santbrink and Bergman (1994) documented 70% mortality to anthozoans after two passes of a beam trawl in the southern North Sea.

28. The NMFS Alaska Fisheries Science Center website (NMFS 2004) shows several underwater video clips taken with a Remotely Operated Vehicle. Clip 9 shows heavily trawled coral habitat containing “broken-up coral debris in this area -- heavily damaged” (http://www.afsc.noaa.gov/race/media/videos/vids_habitat.htm).


30. MacDonald et al. (1996) made several estimates of habitat sensitivities to physical disturbance, concluding that fragile, slow recruiting animals are the most susceptible to disturbance.

The effects of fishing gears other than bottom trawling on seafloor habitat are not as well documented in the literature (NMFS 2005b, Appendix C). Bottom (set) longlines and gillnets can affect structure-forming biogenic habitat through direct contact with weights or anchors and by hooking or otherwise catching corals and sponges in the line itself (NMFS 2005a, Appendix B). Observers in Alaska have recorded anemones, corals, sea pens, sea whips, and sponges being brought to the surface hooked on longline gear, indicating that the lines move some distance across the seafloor and can affect benthic organisms (NMFS 2005a, Appendix B). These activities result in corals that are broken, tipped over or dragged along the seafloor (71 Fed. Reg. 36,694, 36,697 (June 28, 2006)). Photographic evidence from the OCNMS dives and elsewhere indicates lost longline gear caught on dead corals (Brancato et al. 2007), a phenomenon also documented with longlines and gillnets elsewhere in the world (e.g., Fossa 2004, Sulak 2003). Pots and traps can also disturb coral and sponge habitat by direct contact as the pot is dropped to the seafloor or when the pot is dragged across the seafloor by bad weather, currents or hauling (NMFS 2005a, Appendix B).
d. The presence and location of unique, rare, or threatened habitat.

See 6.a above.

e. The socioeconomic and management-related effects of proposed actions, including changes in the location and intensity of bottom contact fishing effort, the displacement or loss of revenue from fishing, and social and economic effects to fishing communities attributable to the location and extent of closed areas. Applicants are encouraged to collaborate with socioeconomic experts as well as affected fishermen and communities in order to identify socioeconomic costs and benefits.

As noted in 4.b and 6.e above, we have strived to ensure this proposal will protect coral and sponge habitat while continuing to allow fishing in areas that generate substantial economic revenue. Pertinent datasets available to us were the 2009-2010 RCA schedules, 2005 trawl tracks (set and haulout points) from logbooks, and 2005 trawl catch data summarized by 10x10 minute block from fish tickets. These latter two datasets were obtained from PacFIN in 2007. These three datasets provide an indication of the important trawl grounds before the original
EFH closures went into place in 2006 and the trawl grounds now inside and outside the 
groundfish trawl RCA.

Both habitat conservation areas were designed to avoid areas of heavy bottom trawling. Further, 
the proposed modification at Juan De Fuca Canyon falls almost entirely within the current 
groundfish trawl RCA. Thus, we expect there to be little short term economic impact to the 
commercial bottom trawl fleet by implementation of both habitat conservation areas, as the areas 
are for the most part currently untrawled. Accordingly, there should be little economic impact to 
fishing communities reliant on the catch from the bottom trawl fleet.

Due to confidentiality issues, the data we used in our analysis to evaluate the economic value of 
groundfish trawl areas may be incomplete. We have requested updated groundfish trawl data 
from PacFin so that we can conduct further economic analyses using the most recent non-
confidential data available to the public. This additional analysis of fishing data may elucidate a 
more optimal design. In addition, we expect further analysis by the PFMC and NMFS to be able 
to provide a more complete picture of any social and economic impacts associated with these 
proposed habitat protection areas as the interim process moves forward.

Again, we recognize that the treaty rights of Pacific Northwest Tribes require that any protective 
measure affecting treaty areas is a matter for consultation between NOAA and the Tribes and we 
encourage the on-going consultation on such matters of habitat protection. In the future, we 
believe biogenic habitat protection will likely improve long-term sustainable fishing 
opportunities for other gear types.
References


International Symposium on Deep-sea Corals, Erlangen, Germany.


Sulak, K.J. 2003. Presentation to the House of Representatives Ocean Caucus and NMFS, (March 14 2003), background materials.


Figure 1: Proposed modifications to two EFH Closed Areas off the Washington Coast

Oceana recognizes that the treaty rights of Pacific Northwest tribes require that any protective measure affecting treaty areas is a matter for consultation between NOAA and the Tribes and we encourage the on-going consultation on such matters of habitat protection.
Figure 2: Juan De Fuca Coral Canyons Important Ecological Area Proposed EFH Closure Modification

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