HABITAT AREAS OF PARTICULAR CONCERN (HAPC) PROPOSAL

Date: January 9, 2004

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Please check applicable box (es):
☐ GOA Groundfish FMP
☑ BSAI Groundfish FMP
☑ Scallop FMP
☑ BSAI Crab FMP
☑ Salmon FMP

Title of Proposal.
Zhemchug and Pribilof Canyons Marine Reserve

HAPC Site Location.
(*Specific latitude/longitude or geographic reference. Include NOAA Chart number, if known.)*
Pribilof Canyon (56 degrees North, 168-170 degrees West)
Zhemchug Canyon (58 degrees North, 173-175 degrees West) includes Zhemchug Pinnacles #2 (58°30 North, 175°05 West) #3 (58°20 North, 175°10 West), and #4 (58°20 North, 175°20 West). Please refer to Appendix B-Map A.

Summary Statement of the Proposal.
(*Provide a brief paragraph concisely describing the HAPC.*)
Zhemchug Canyon and Pinnacles and Pribilof Canyon are located in the Bering Sea. The immense deepwater canyons and pinnacles are part of the Bering Sea continental shelf edge (commonly referred to as the Green Belt) and are known to be areas of high biodiversity and productivity. The concentration of primary and secondary producers in this region attracts large numbers of fish, squid, marine mammals and birds. These canyons and pinnacles are possible sources of dispersal and export for surrounding systems and require protection as HAPC for the benefit of future research, fisheries health, and the conservation of several sensitive species including long-lived and slow-reproducing fish such as rougheye and shortraker rockfish, rare marine mammals such as the harbor seal, and rare seabirds such as the short-tailed albatross.

Statement of Purpose and Need.
(Provide a specific purpose as why the HAPC needs to be identified.)
Pribilof and Zhemchug canyons in the Bering Sea represent some of the world's largest and deepest canyons. Pribilof Canyon is approximately 1800 meters deep and 30 miles wide and starts less than 20 miles north of St. George Island. Zhemchug Canyon is even larger and deeper reaching 2730 meters in depth and spanning over 60 miles in width. St. Paul Island is approximately 100 miles west of the edge of Zhemchug Canyon.

Greater in size and depth than North America's Grand Canyon, both canyons are known to be part of a "highly productive habitat, or Green Belt" located along the edge of the continental shelf of the Bering Sea (Springer et al. 1996). Due to its high productivity of primary and secondary producers, the area is seasonally frequented by commercial and non-commercial fish species as well as an abundance of marine mammals and seabirds (NRC 1996; Springer et al. 1996; Loughlin et al. 1999). In recent years, certain marine mammals populations have experienced significant declines in the area and fishing effort above the canyons has occasionally resulted in the catch of rare seabirds (NRC 1996; NOAA 2000).

Although the Bering Sea includes over 450 species of fish and invertebrates (NRC 1996), our current knowledge of seasonal and temporal distribution, habitat, abundance, and life history, is limited to approximately 25 commercially important species (Loughlin et al. 1999). The existing knowledge and research of these canyons indicates that the areas provide important habitat for a wide array of biodiversity and that the areas offer an important opportunity to further research the characteristics and contributions of the larger "Green Belt" area. Protection of the area as a no-take marine reserve network would provide refugia for commercial and non-commercial fish species as well as marine mammals and seabirds while allowing continued access for research and native subsistence activities.

Habitat Type and Species Information.
(Identify any habitat type(s) and FMP species of the HAPC.)
The high productivity of the Bering Sea shelf-break or Green Belt has been documented for many years. Springer et al. summarize the contributions of the area stating that "sustained primary productivity, intense food web exchange and high transfer efficiency at the shelf edge are important to biomass yield at numerous trophic levels and to ecosystem production of the Bering Sea" (Springer et al. 1996). Zhemchug Pinnacles and Zhemchug and Pribilof Canyons are important parts of this larger system and contain important habitat for a variety of commercial and non-commercial fish species as well as marine mammals and seabirds.

NOAA's EFH queriable database indicates that Zhemchug canyon (58° 11.835', -174° -21.679') is designated as EFH for the following species: Golden King Crab -- Adults, Eggs, Late Juveniles (Map C); Scarlet King Crab -- Adults, Eggs, Snow Crab – Larvae; Grooved Tanner Crab -- Adults, Eggs; Triangle Tanner Crab – Adults; Tanner Crab -- Eggs, Larvae, Late Juveniles (Map I); Pacific Ocean Perch -- Adults, Late Juveniles (Map F); Walleye Pollock – Adults (Map K); Dusky Rockfish -- Adults, Late Juveniles (Map B); Northern Rockfish -- Adults, Late Juveniles (Map E); Shortraker and Rougheye Rockfish -- Adults, Late Juveniles (Map H); and Sculpin -- Adults, Late Juveniles (NOAA 2003).

Likewise, Pribilof Canyon (56° 0.04', -169° -1.021') is designated as EFH for the following species: Golden King Crab -- Adults, Eggs, Late Juveniles (Map C); Scarlet King Crab -- Adults, Eggs; Snow Crab – Larvae; Grooved Tanner Crab -- Adults, Eggs; Triangle Tanner Crab – Adults; Tanner Crab -- Eggs, Larvae (Map I); Dusky Rockfish -- Adults, Late Juveniles (Map B); Shortraker and Rougheye Rockfish -- Adults, Late Juveniles (Map H); and Thornyhead Rockfish -- Adults, Late Juveniles (Map J) (NOAA 2003).

The database lists the following EFH species for Zhemchug Pinnacles #2, #3, and #4 (58° 21.639' -175° -12.285'): Golden King Crab -- Adults, Eggs, Late Juveniles (Map C); Scarlet King Crab – Adults, Eggs; Snow Crab – Larvae; Grooved Tanner Crab -- Adults, Eggs; Triangle

Tanner Crab – Adults; Tanner Crab -- Eggs, Larvae, Late Juveniles (Map I); Pacific Ocean Perch -- Adults, Late Juveniles (Map F); Walleye Pollock – Adults (Map K); Northern Rockfish – Adults, Late Juveniles (Map E); Shortraker and Rougheye Rockfish -- Adults, Late Juveniles (Map H); Thornyhead Rockfish -- Adults, Late Juveniles (Map J); and Sculpin -- Adults, Late Juveniles (NOAA 2003).

Due to an abundance of primary and secondary producers as well as warmer waters from fall to spring, fish and squid have been found to concentrate in this narrow corridor. The collective presence of zooplankton, fish and squid has been shown to attract large numbers of birds and mammals (Springer et al. 1996).

Mesopelagic species such as fish and juvenile squid living at depths of 200-1000 meters during the day and migrating into the upper 200 meters at night have been shown to be ecologically important to the Bering Sea. Research indicates that they account for more than 90 percent of the seasonal food of some marine mammals including fur seals and serve as one of the primary prey for various seabirds (Sinclair et al 1999). They also provide an important prey base for salmon and pollock (Nagasawa 1997).

Seabirds known to gather and feed above the canyon areas include: Black-footed Albatross, Laysan Albatross, Short-tailed albatross, Northern fulmar, Shearwater spp., Fork-tailed storm-petrel, Leach's storm-petrel, Cormorant spp., Black-legged kittiwake, Red-legged kittiwake, Thick-billed murres, Common murres, small auklets (least, crested), Parakeet auklet, Ancient Murrelet, Pigeon guillemot, Horned puffin, Tufted puffin, Jaeger spp., large gull spp., Arctic tern, and Phalarope spp. The rare red-legged kittiwake and the parakeet auklet are found in higher concentrations above the canyons than compared with their overall distribution throughout the Bering Sea (Review 2002). Recent data suggests that the general abundance of kittiwakes and murres has declined in recent years (Loughlin et al. 1999).

Winter studies from the 1960s recorded average densities of seabirds at 10 to 20 birds per square kilometer at Zhemchug Canyon and approximately 5 birds per square kilometer at Pribilof Canyon. Summer studies discovered densities of more than 100 birds per square kilometer at Zhemchug Canyon (Shuntov 1993).

The canyons and the Green Belt as a whole are particularly important to marine mammals. Feeding territory of MMPA-listed fur seals has been shown to include both canyons and Springer et al. noted that fur seals of the Pribilof Islands feed primarily, though not exclusively, along the Green Belt (Springer et al. 1996). Fur seals from the south side of St. Paul Island have been found to use Zhemchug Canyon as part of their feeding territory while Pribilof Canyon has been documented as feeding territory for fur seals from St. George (Robson 2001). Ribbon seals, Stellar sea lions and walrus are also known to seasonally frequent the Green Belt (Springer et al. 1996).

The majority of whale biomass in the Bering Sea is currently or was historically associated with the Green Belt. Species known to presently or historically occur along the continental shelf break and Zhemchug and Pribilof Canyons include: Sperm whales (ESA-listed), fin whales, bowhead whales (ESA-listed), northern right whales (ESA-listed), minke whales, blue whales (ESA-listed), humpback whales (ESA-listed), killer whales, Dall's porpoise, and Stejneger's beaked whales (Springer et al. 1996; Loughlin et al. 1999). The fact that these whales rely on a

wide diversity of trophic levels is evidence of the incredible production and food web interactions within this area (Springer et al. 1996).

Describe How the Proposal Addresses the each of the 4 HAPC Considerations (*50CFR 600.815*):

√ The **IMPORTANCE** of the ecological function provided by the habitat.

Scientists around the world have identified unique biological process occurring within submarine canyons, including[1]:

1. Canyons appear to be important sites of enhanced secondary production and, due to the nature of the canyons' topography and dramatic profiles, these sites provide diverse habitats perhaps not seen anywhere else on continental slopes. (DeDeckker 2003)
2. Organic enrichment macrophyte detritus from canyon heads down to depths >500 m – combined with strong currents also transporting sediments – contribute to a much higher biomass compared to areas adjacent to canyons. In addition, species diversity was also found to be higher in canyons. (Vetter and Dayton 1998).
3. Ecological processes in canyons can be quite different than surrounding waters as a result of the high level of physical disturbance in combination with organic enrichment. (Vetter and Dayton 1998).
4. Microfaunal biomass in canyons can be up to 50 times greater than in non-canyon regions. Values vary with depths, however, and again this may result from the availability of sediment, organic carbon, photodetritus, and oxygen concentration. (Vetter and Dayton 1998).
5. 3 million individuals with a biomass of >1kg. M^{-2} have been identified in La Jolla Canyon offshore California (Vetter, 1994).

Pribilof and Zhemchug canyons are part of the Bering Sea Green Belt and are areas of incredible productivity. Annual primary production is as much as 60 percent greater along the slope of the continental shelf in these areas than in the adjacent outer shelf domain and perhaps 200 percent greater than in the deep ocean (Springer et al. 1996).

The Green Belt contains the greatest biomass of zooplankton in the Bering Sea (Loughlin et al. 1999). Annual secondary production within this Green Belt was also shown to average approximately 60 percent higher than estimates for the adjacent outer shelf domain and 260 percent greater than the deep ocean (Springer et al 1996). Due to this abundance of food as well as warmer waters from fall to spring, fish and squid have been found to concentrate in this narrow corridor. The collective presence of zooplankton, fish and squid has been shown to attract large numbers of birds and mammals (Springer et al. 1996).

In addition, a high presence of corals and a moderate level of seawhips and sponges has been recorded at or near Zhemchug Pinnacles according to the 2002 Eastern Bering Sea Slope Groundfish Survey (Hoff 2002). These benthic invertebrates are known to provide important habitat for rockfish and other sensitive EFH species. Pinnacles in general are known to provide important habitat for a range of species and recently, pinnacles such as the Sitka pinnacles area have been shown to provide important refuge for aggregations of juvenile and adult rockfish as well as spawning habitat for lingcod (NPFMC 2000).

[1] The five points are adapted from DeDecker 2003.

Zhemchug and Pribilof canyons and the associated pinnacles are prominent and unique habitat features within the Bering Sea which is known to be the seasonal or year round home to some of the largest marine mammal, bird, fish and invertebrate populations among the world's oceans and support some of the world's largest commercial harvests of seafoods, including groundfish, salmon, and crabs. In addition, the areas provide subsistence, food, clothing and cultural traditions for the native inhabitants of coastal communities (Loughlin et al. 1999).

Finally, although not an ecological function per se, deep-sea canyons such as Zhemchug and Pribilof Canyons contain invaluable potential to unravel the mysteries of North Pacific regime shifts. "In the deep ocean, the base of such canyons act like giant sediment traps which are geological archives of sediment transport and deposition/erosion. These deposits are referred to as delta fans, and their study ought to inform on the long-term history of environmental changes…" (De Decker 2003).

[√] The extent to which the habitat is **SENSITIVE** to human-induced degradation.

A report on the Bering Sea by the National Research Council of the National Academies states that "since at least the mid-1970's, system-wide shifts in the biomass and composition of the marine community have occurred due to the synergistic effects of environmental fluctuation and disproportionate fishing pressures (NRC 1996). This research demonstrates that the Bering Sea as a whole, including individual features such as Zhemchug and Pribilof canyons and Zhemchug Pinnacles, have experienced historic decline in fishing stock due in large part to commercial fishing effort.

As previously noted, the 2002 Eastern Bering Sea Slope Groundfish Survey indicates a high presence of corals and a moderate level of seawhips and sponges at or near Zhemchug Pinnacles as well as a moderate presence of benthic attached invertebrates at the western edge of both canyons (Hoff 2002). Bottom trawling has been shown to damage coral habitat and a study in Gulf of Alaska reported that 50% of coral had been removed or broken in a single bottom trawl pass. In a review of the site seven months later, the corals had not recovered (Kreiger 2002).

Rockfish and other fish species such as Atka mackerel, Pacific cod, Walleye Pollock and Greenland turbot are associated with a variety of coral species (Heifetz 2000; Krieger 2002). These waters are known to provide essential habitat for the declining populations of rougheye and shortraker rockfish (Map H) (NOAA 2003). Rockfish species are known to have very low productivity and are some of the longest-lived fishes known to science. The maximum ages for many species span over 50 years and some approach 150 years. These factors combine make them extremely vulnerable to fishing pressure and habitat disturbance (Parker et al. 2003). Sablefish, which is a highly valuable commercial species and is present in both canyons (Map G), has suffered population declines in the past and are also susceptible to overfishing (Sigler et al 2003).

In addition to commercial fish species, the canyons are also home to rare and threatened marine mammals and seabirds. Although limited data is available, fishing activity in the area is known to result in the death of seabirds and marine mammals via bycatch. For example, two endangered short-tailed albatross were caught during the 1998-2000 hook and line Pacific cod fishery at the lip of Zhemchug Canyon (Rivera et al. 2001). A photo on NOAA's website shows "as many as 23 short-tailed albatross around a longline vessel fishing in Zhemchug Canyon (58.22 N, 174.19

W) in mid-September, 2000 demonstrating that this is currently a significant management consideration (NOAA 2000).

The fact that seabirds and marine mammals are both characterized by low reproductive rates, low annual mortality, and long life span (Loughlin et al. 1999) makes them particularly sensitive to rapid population declines. Several marine mammal populations in the Bering Sea have suffered significant declines over the past several century. The canyons provide important habitat for the majority of the Bering Sea's MMPA-listed northern fur seals which make up the majority of the world's population for this species as well as habitat for steller sea lions and bowhead and right whales.

[√] Whether, and to what extent, the activity **STRESSES** the habitat type.

Pribilof and Zhemchug Canyons and the Bering Sea as a whole have been increasingly exploited for their abundance of natural resources over the past century. This exploitation has centered around commercial fishing for the past fifty years and has had undeniable effects on commercial and non commercial fish species, marine mammals and seabirds.

In the article "Summary of Biology and Ecosystem Dynamics" in the book "Dynamics of the Bering Sea", Loughlin et al. divide human resource development in the Bering Sea into four distinct but overlapping "periods"; the subsistence period (28,000 years ago to today), fur seal period (1786-1984), whaling period (1845-1914) and the commercial fishing period (1952 to present). The paper speculates that the commercial fishing period is "perhaps the most significant in terms of its impact on the Bering Sea ecosystem" (Loughlin et al. 1999).

As noted above, the National Research Council stated in their report "The Bering Sea ecosystem" that "since at least the mid-1970's, system-wide shifts in the biomass and composition of the marine community have occurred due to the synergistic effects of environmental fluctuation and disproportionate fishing pressures" (NRC 1996). The report continues by noting that during the above-mentioned commercial fishing period, the historical composition of the pelagic fish community and that of the fisheries has changed over the years; the change in historical populations are cited as being connected to the intertwined effects of human-induced and climatic and oceanographic conditions (NRC 1996; Loughlin et al 1999).

Furthermore, Loughlin et al. state that "reductions of biomass at lower trophic levels have precipitated depletions of top level predators such as seabirds and marine mammals, to the point where some species may be driven toward extinction" (Loughlin et al. 1999)

Modern fishing technology is currently destroying the habitat benefits provided by the unique geological structure of the canyons and adversely affecting the habitat within Zhimchug and Priblof Canyons. Fishing gear is adversely affecting infaunal and epifaunal species within both canyons. In some areas of Priblof Canyon 25.1% –50% of infaunal and epifaunal prey has suffered adverse affects of fishing. (NMFS EFH PDEIS 2003, Figures B.2-2a & B.2-3a). Living and non-living structural habitat within both canyons are also suffering adverse effects of fishing. In some areas of Priblof Canyon 50.1% – 75% of living structural habitat has already suffered the adverse affects of fishing. (NMFS EFH PDEIS 2003, Figure B.2-4a).

√ The **RARITY** of the habitat type. (*Mandatory requirement*).

Greater in size and depth than North America's Grand Canyon, Pribilof and Zhemchug canyons represent some of the world's largest and deepest underwater canyons. As previously noted, Pribilof and Zhemchug Canyons and the larger Green Belt are perhaps the most productive and diverse trophic systems in all of Alaska. Due to the concentration of primary and secondary producers, this region supports large populatins of fish, squid, marine mammals and birds (Springer et al. 1996).

The bottom waters in the deep basin of the Bering Sea are possibly the oldest in the world and contain the highest concentrations of naturally occurring macronutrients in the world's oceans (Review 2002). The unique physical process of tidal mixing and transverse circulation and eddies at the continental shelf break and within Zhemchug and Pribilof canyon bring nutrients into the euphotic zone and contribute to increased primary and secondary production (Springer et al. 1996) These waters are important for the declining populations of rougheye and shortraker rockfish, which are long-lived and slow-reproducing species. They are also important forage areas for the majority of the Bering Sea's MMPA listed northern fur seals, which make up the majority of the world's population of this species.

Objectives of the Proposal.
(List objectives specific to the identification of the HAPC.)
The objectives of this proposal are to: 1) Conserve known and unknown fauna and habitat associated with Zhemchug and Pribilof Canyons, Zhemchug Pinnacles and the Bering Sea Green Belt; 2) Provide protection for these unique and rare areas from incidental disturbance from fishing effort and other human development; 3) Provide sanctuary for FMP and non-commercial fish and invertebrate species as well as seabirds and marine mammals; and 4) Preserve these relatively unknown but incredibly productive ecosystems for future conservation and fisheries research and native subsistence purposes.

Describe any Proposed Solutions to Achieve These Objectives.
(*How might the problem be solved? Include concepts of methods of measuring progress towards those objectives.)*
Proposed activities to achieve the above stated objectives include:

- Designate the proposed areas as no-take marine reserves with a 15 nautical mile radius buffer area.
- Create an inventory of the physical environments and biological communities that inhabit Zhemchug and Pribilof Canyons and the Green Belt of the Bering Sea;
- Improve our knowledge of the structure, function, and variability of the Green Belt ecosystems;
- Develop a more comprehensive understanding of the interaction between the bottom waters and continental shelf ecosystems;
- Further our understanding of the relationships and population dynamics between commercial and non-commercial species including marine mammals and seabirds which inhabit Zhemchug and Pribilof Canyons and the Green Belt; AND
- Further our knowledge of the local effects of establishing a harvest refugia on commercially and non-commercially fished species and the value of harvest refugia as a fisheries and marine management tool.

Describe any Proposed Management Measures for the HAPC.
(Include specific objectives, if appropriate.)
Although marine reserves have recently been shown to have significant benefits to ocean fisheries and habitat health, reserves encompass less than 1 percent of the world's oceans and less than 0.01 percent of U.S. waters (PISCO 2002). The Ocean Conservancy proposes that Zhemchug and Pribilof Canyon be designated and managed as no-take marine reserves. The proposed management boundary for each area is outlined in Appendix B-Map A.

The suggested management boundary for each of the canyons is a 15 nautical mile radius from the coordinates listed under the "HAPC site location" section. The boundary for Zhemchug Canyon encompasses Zhemchug Pinnacles #2, #3, and #4. Marine reserves in these diverse but largely undisturbed areas will provide important habitat for a wide range of fish, avian, and marine mammal species. The reserves would be closed to all forms of fishing and oil and gas development in order to avoid disturbance of the areas but would remain open to scientific research and native subsistence activities.

Identify any Expected Benefits to Habitat or FMP species.
(Include specific information regarding a species life history stage, if known.)
Most well-enforced marine reserves result in relatively large, rapid and long-lasting increases in population sizes, numbers of species and reproductive output of marine mammals and plants. For example, average biomass, or weight of all animals and plants, in studied areas was more than four times greater in reserves than in unprotected areas nearby. Furthermore, average density, or number of animals in an area, triples, and the number of species was 1.7 times higher in marine reserves than unprotected areas. Likewise, average body size of animals was 1.8 times larger in reserves than in fished areas. This statistic is particularly important because larger fish and invertebrates typically produce substantially more young (PISCO 2002).

Through spillover and export, marine reserves may also influence populations in adjacent waters. Some adults or juveniles may swim or crawl into neighboring areas to move into less-crowded areas to avoid competition for food and living space. In addition, larvae and plant propagules may drift out of a reserve and seed the surrounding waters (PISCO 2002). This is especially important for northern, shortraker, dusky, and rougheye rockfish, which are long-lived, slow-reproducing species facing population threats either at the North Pacific-wide or localized scale.[2] The American Fisheries Society has recommended the use of marine reserves in order to protect spawning areas and refugia for rockfish populations.

Identify Fishery, Stakeholders, and/or Communities, which may Benefit from the Proposed HAPC.
(Who may or may not benefit from the proposal? Include any known or indirect socioeconomic costs.)
Based on the data available from the NPFMC, there is currently very little active or no fishing activity in Zhemchug and Pribilof Canyons. Longline and trawl effort in both canyons is low according to NPFMC records. We do not anticipate any direct or indirect socioeconomic costs.

Due to the active fishing effort to the east and south of both canyons, commercial fisheries may benefit from export and dispersal from the proposal marine reserves as previously noted. The

[2] See The Ocean Conservancy letter on the 2004 TAC Specs EA dated 12/28/03.

proposal will also benefit the fishing community, research community and general public through the resulting research of deepwater canyons, the Green Belt system, and the myriad of marine mammal, fish, and seabird species associated with the areas.

Residents of the Pribilof Islands, who prosecute a subsistence harvest of northern fur seals should also benefit due to the importance of this habitat to MMPA listed fur seals. Both areas are also suspected spawning grounds for halibut, for which the Pribilovians similarly prosecute a local subsistence and commercial fishery.

Research benefits might include studies on long-term environmental change within the Bering Sea, life-history requirements, dispersal and recruitment, genetic variability, regional and local oceanographic influences, natural biodiversity, natural mortality, refugia design and effectiveness and human impact.

Support Data or Information Sources

(List data sources, information resource, literature, and any traditional knowledge for the proposal.)

Please refer to Appendix A-Literature Cited.

APPENDIX A-LITERATURE CITED

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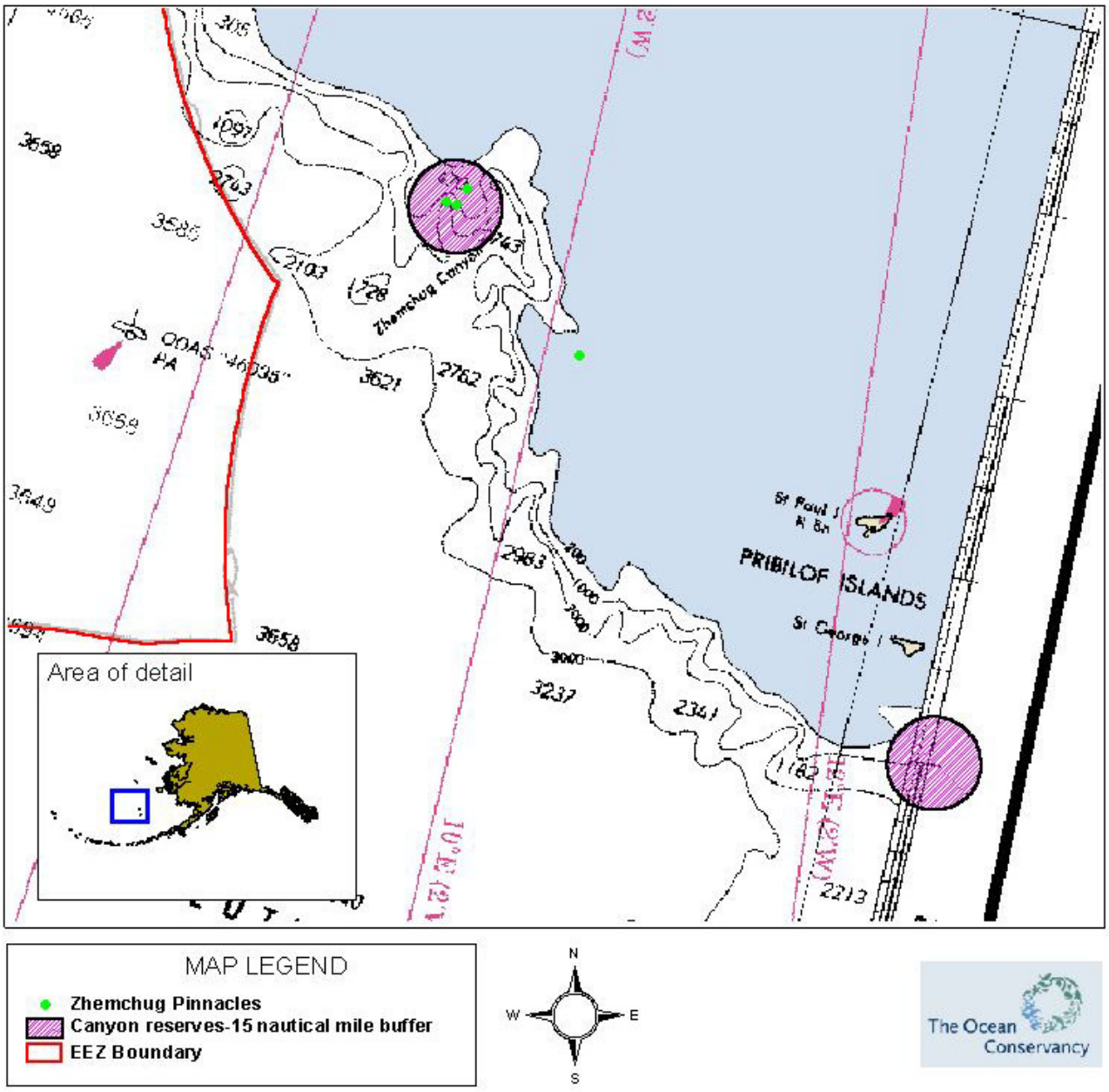
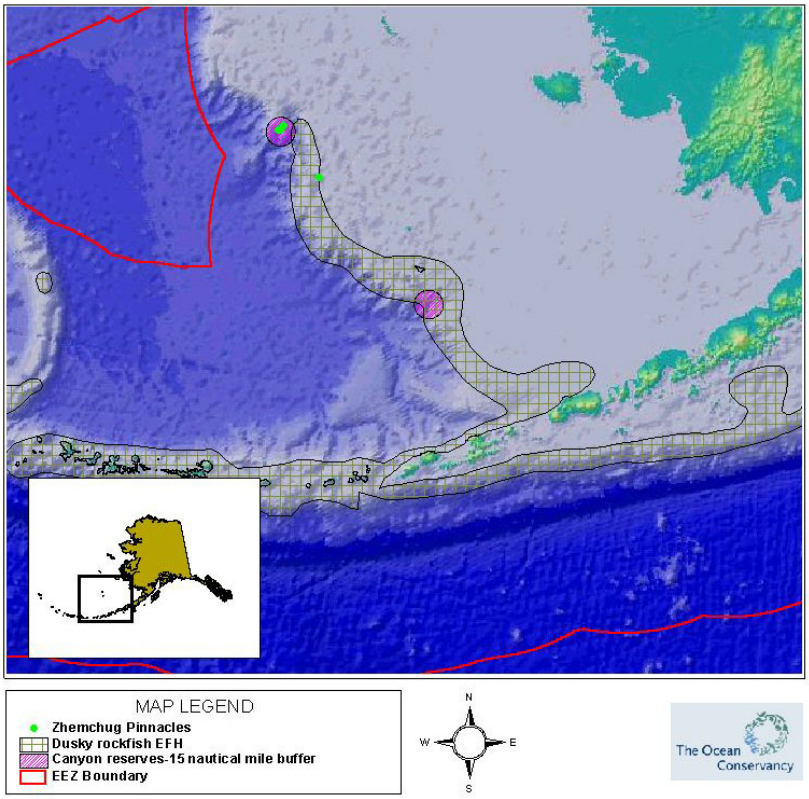
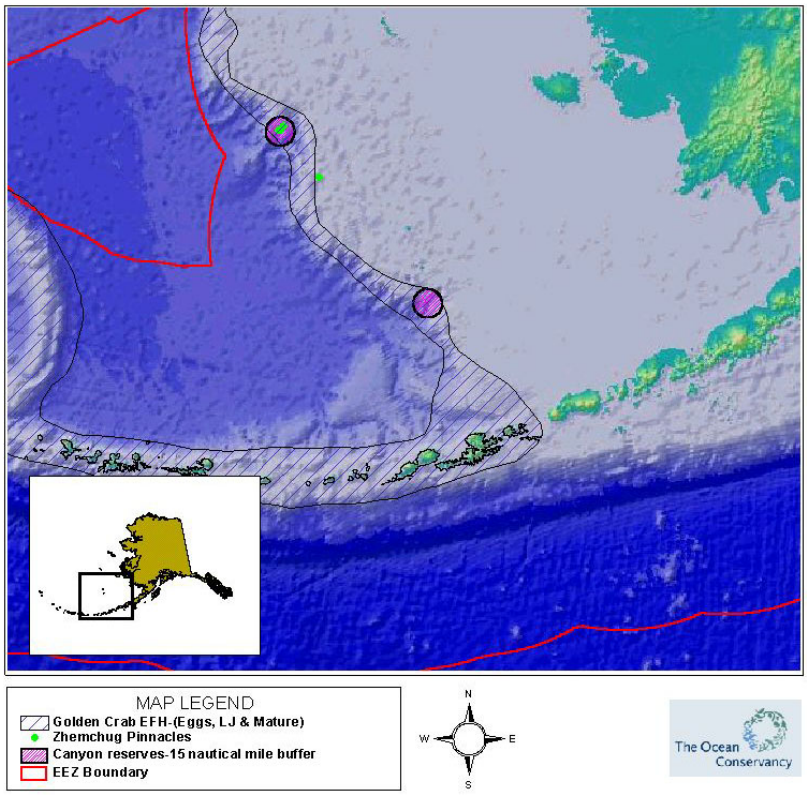
APPENDIX B-MAPS



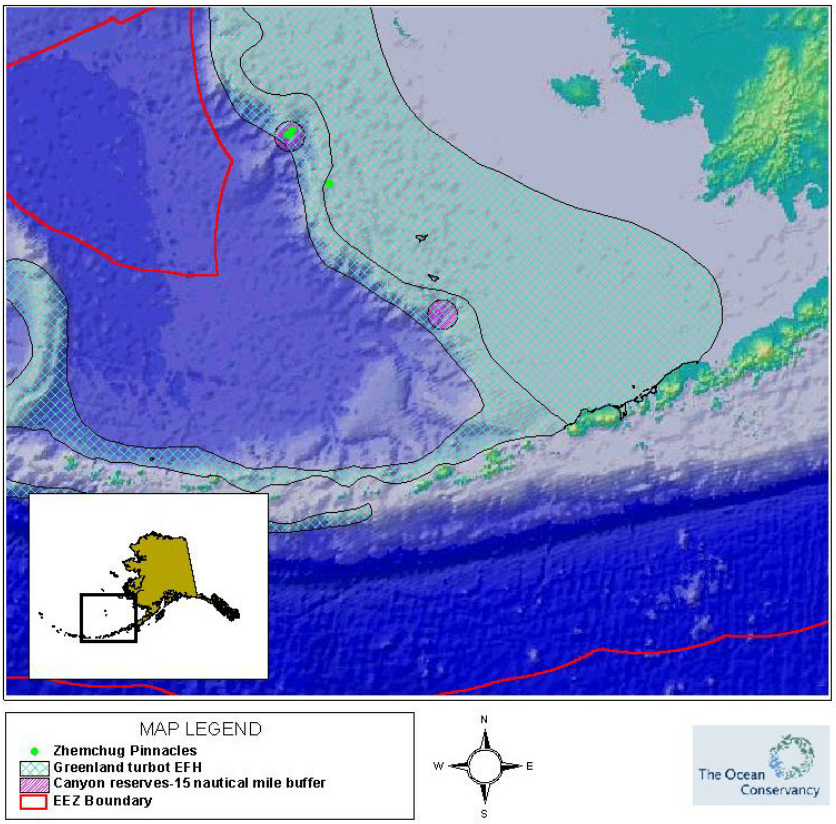
MAP A. Proposed Zhemchug and Pribilof Canyons Marine Reserves



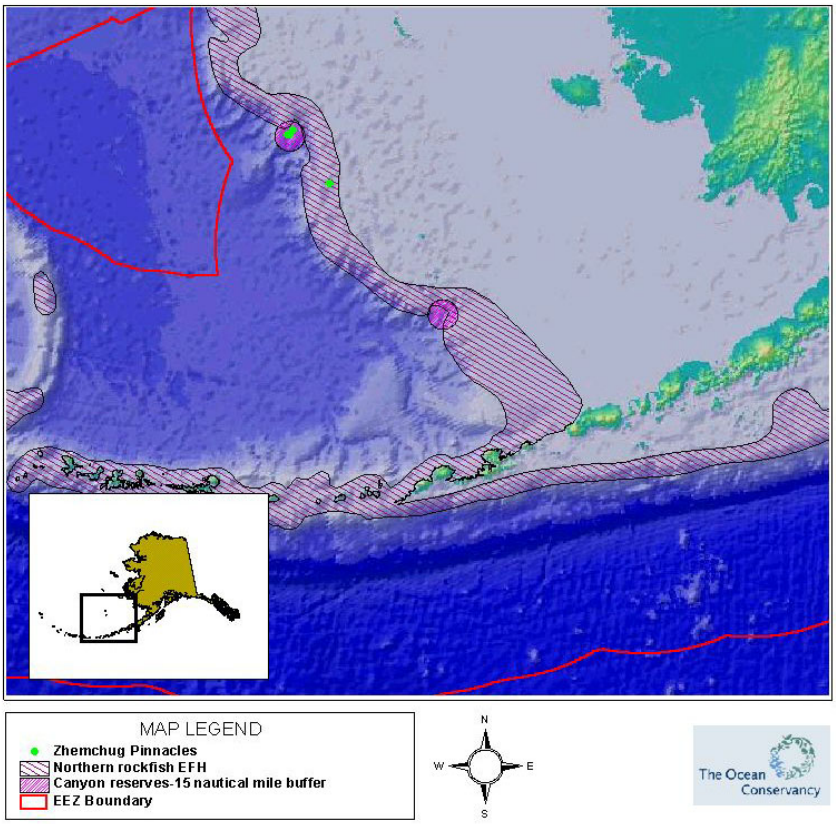
MAP B. Dusky Rockfish EFH map



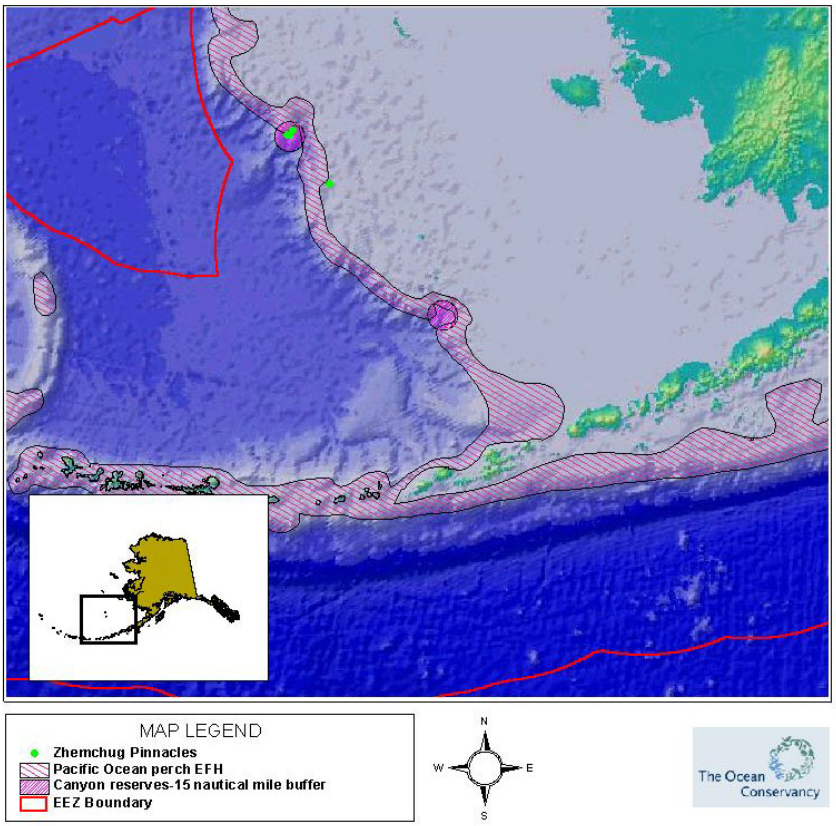
MAP C. Golden Crab EFH-Eggs, Late Juveniles & Mature



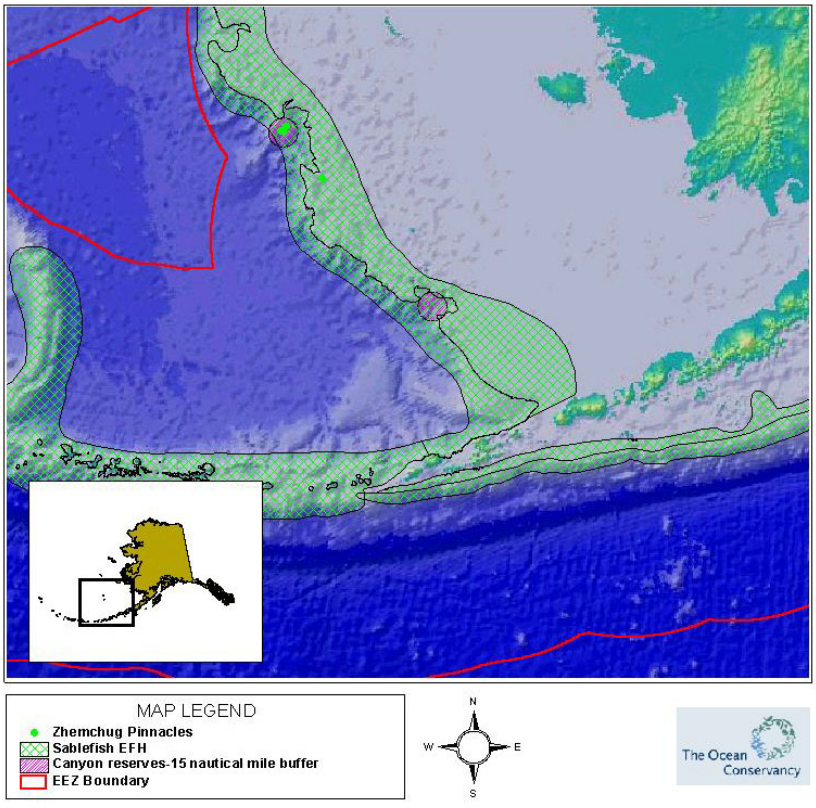
MAP D. Greenland turbot EFH



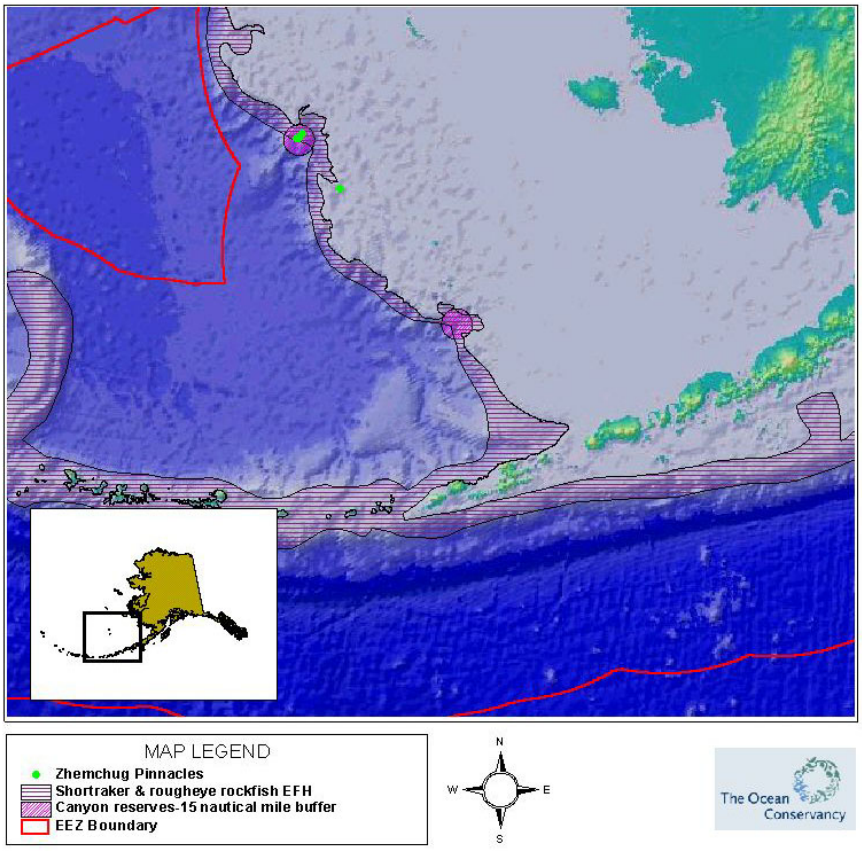
MAP E. Northern Rockfish EFH



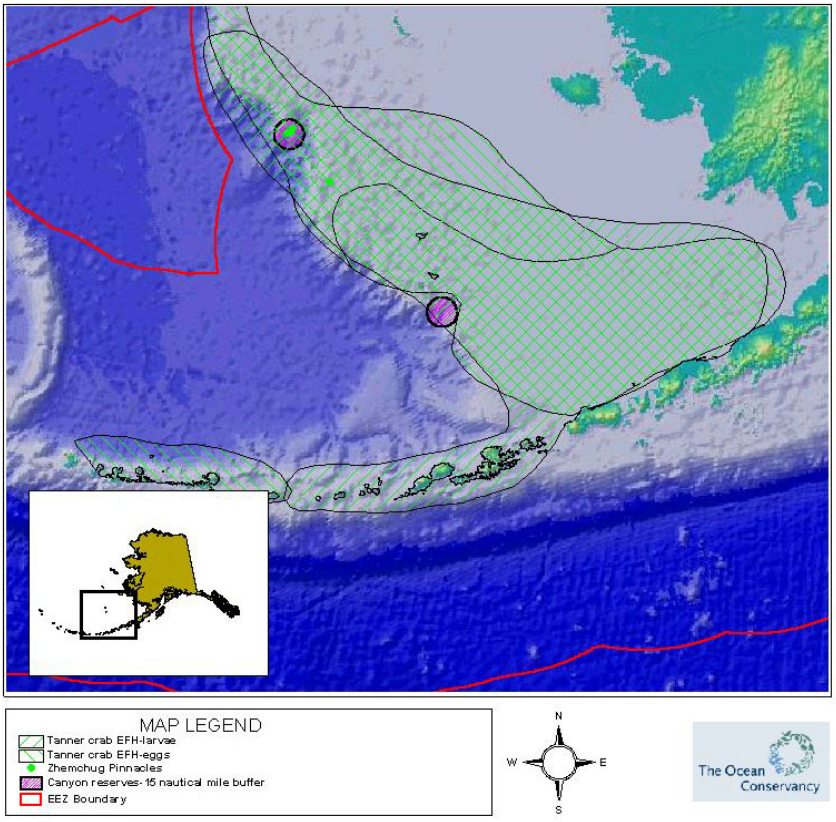
MAP F. Pacific Ocean perch EFH



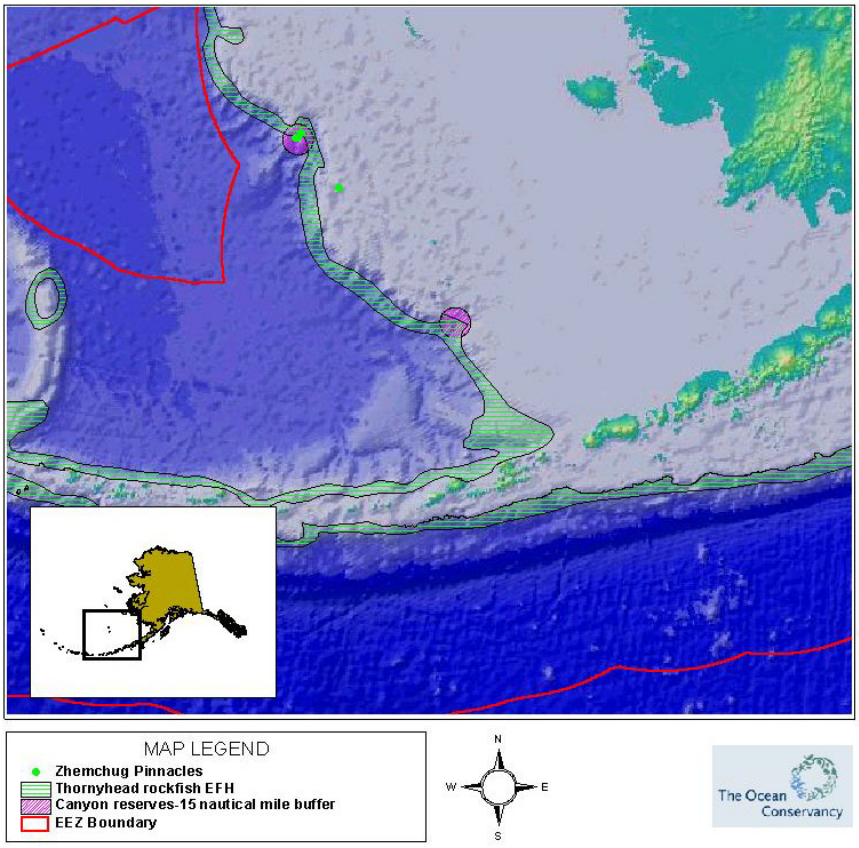
MAP G. Sablefish EFH



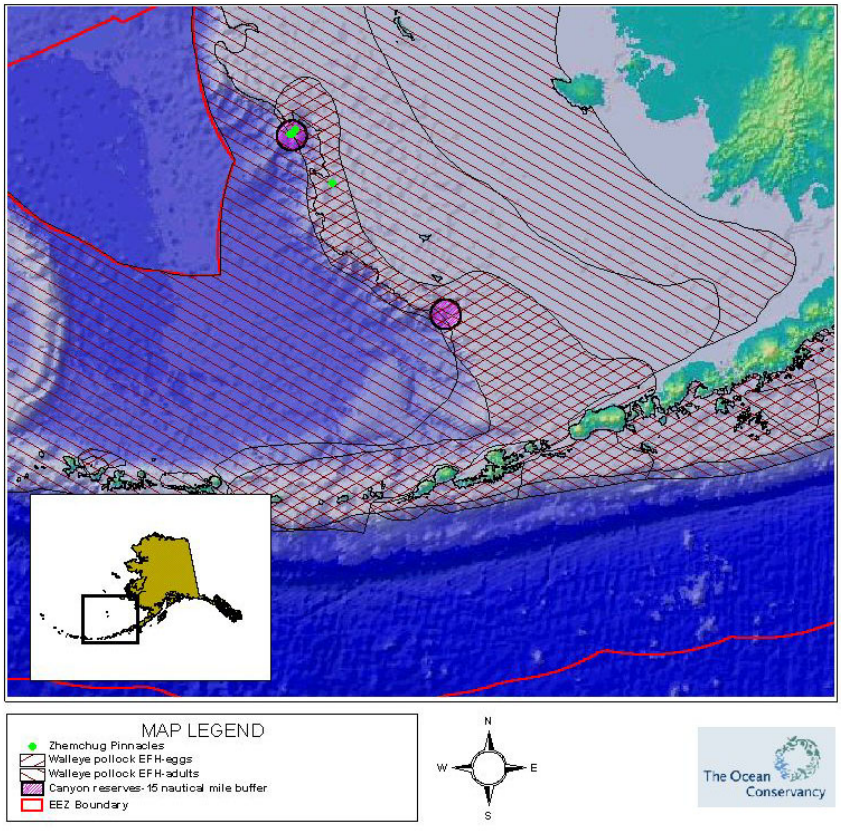
MAP H. Shortraker and Rougheye rockfish EFH



MAP I. Tanner crag EFH-Larvae and eggs



MAP J. Thornyhead rockfish EFH



MAP K. Walleye Pollock EFH-Eggs & adults