Essential Fish Habitat and Closed Areas in Federal Waters of the North Pacific

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Abstract

Along with other conventional methods of managing fisheries that have been largely successful in the North Pacific, the North Pacific Fishery Management Council has adopted over a dozen closed areas in the Bering Sea/Aleutian Islands and Gulf of Alaska as of 1997. In May 1998, the National Marine Fisheries Service implemented essential fish habitat (EFH) provisions of the Magnuson-Stevens Fishery Conservation and Management Act and developed draft recommendations for the identification of EFH for all fishery management plans (FMPs). In June 1998, the Council amended its five FMPs to identify EFH and other actions to encourage habitat conservation and enhancement. Also in 1998, the Council closed the Cape Edgecumbe pinnacles near Sitka, Alaska to all federal fishing and anchoring. The 3.1 nm^2 area comprises two volcanic necks that support extremely high biodiversity and dense concentrations of marine fauna. For 1999 and beyond, the Council is requesting recommendations for additional habitat areas of particular concern (HAPC) from its scientific advisors and the public. While these closures and HAPCs may not meet precise definitions of marine reserves, they provide similar protection for many diverse marine species.

Keywords: closed areas; essential fish habitat; fisheries management; habitat; habitat area of particular concern; marine reserves; marine refugia

Introduction

Since its establishment in 1976, a primary management goal of the North Pacific Fishery Management Council has been to conserve fishery resources, optimize resource utilization, maintain habitat, and consider ecosystem interactions. This approach was institutionalized in the Council's comprehensive goals that were adopted in 1984. Then in 1988, the Council adopted a comprehensive habitat policy (Figure 1). Its objectives are to maintain the current quantity and productive capacity of habitats and restore and rehabilitate any habitats previously degraded.

Over the past 23 years, the Council has developed over a dozen seasonal and year-round closed areas to all fishing gear and specific to trawl gear in the Bering Sea/Aleutian Islands (BSAI) and Gulf of Alaska (GOA). These are summarized in Witherell and Pautzke (1997), along with a history of closed areas adopted since 1935. While these closed areas may not meet a strict definition of marine reserves, they do protect key habitats and species and have contributed to the precautionary approach the Council has undertaken to manage its fisheries. These year-round closed areas to trawling comprise approximately 60,000 nm^2 of the BSAI and GOA.

These closed areas represent just one element of the overall precautionary approach the Council has taken in managing North Pacific stocks. More conventional elements include license limitation, conservative quotas, gear restrictions, seasonal and area allocations, observer coverage, and comprehensive catch reporting. This approach has proven successful in the long-term. Of 230 stocks under the Council's management jurisdiction, none were identified as overfished or approaching overfishing as of 1998 (NMFS, 1998a).

More holistic, ecosystem-based management is becoming the new standard for fisheries management. National Marine Fisheries Service (NMFS) scientists have begun to incorporate ecosystem approaches to modeling the abundance of the GOA walleye pollock (Theragra chalcogramma) stock assessment by incorporating climatological data and predation interactions (Hollowed et al., 1997; 1998) and are examining the applicability of potential marine reserves and experiments on no-take and limited take zones and time-area closures (NMFS 1998b). Marine reserves are thought to be most beneficial to species that have been overfished, reach great sizes or ages, and have limited movements or sedentary behavior. They provide one of the few management tools for the implementation of several provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) which cannot be addressed by traditional management tools, including protection of essential fish habitat (EFH), incorporation of ecosystem-based versus single species-based fisheries management practices and the adoption of a precautionary approach to management (Bohnsack, 1996; Clark, 1996; Yoklavich, 1998). Reserves may also benefit well-managed stocks by further protecting spawning stocks, juveniles, and critical habitat.

Essential Fish Habitat

Though the Council has had an official habitat policy since 1988, the Sustainable Fisheries Act (SFA) of 1996 amended the MSFCMA and added momentum to protecting habitat by requiring the Councils and NMFS to identify and describe EFH and adverse impacts on EFH in all fishery management plans (FMPs), and take action to conserve and enhance EFH. The Council responded in June 1998 by adopting FMP amendments to identify EFH in its BSAI groundfish, GOA groundfish, BSAI crab, scallop and salmon FMPs. Efforts are now underway to identify habitat areas of particular concern (HAPCs) for major groundfish and shellfish stocks.

Following national guidelines developed by NMFS, the Council has described EFH as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (NPFMC, 1998). For the purpose of interpreting the definition of EFH: "waters" includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

Specifically, the SFA required the Councils to amend their FMPs by October 1998 to:

1. identify and describe EFH for species managed under a FMP;
2. describe adverse impacts to that habitat from fishing activities;
3. describe adverse impacts to that habitat from non-fishing activities; and
4. recommend conservation and enhancement measures necessary to help minimize impacts, protect, and restore that habitat.

The SFA also recommended that FMPs identify HAPCs within EFH. In determining whether a type or area of EFH is an HAPC, one or more of the following criteria must be met:

1. the importance of the ecological function provided by the habitat;
2. the extent to which the habitat is sensitive to human-induced environmental degradation;
3. whether, and to what extent, development activities are, or will be, stressing the habitat type; and/or
4. the rarity of the habitat type.

The SFA further recommended that the Council strive to obtain data sufficient to describe habitat at the highest level of detail as described below. Due to the paucity of data for many species, the Council added Level 0 as a subset of Level 1 to address species for which no life history information is available. Essential fish habitat information levels for BSAI and GOA groundfish, BSAI crab, scallops and salmon in the North Pacific are summarized in Tables 1 and 2.

Level 0: No systematic sampling has been conducted for this species and life stage; may have been caught opportunistically in small numbers during other research.

Level 1: Presence/absence distribution data are available for some or all portions of the geographic range of the species. At this level, only presence/absence data are available to describe the distribution of a species (or life history stage) in relation to potential habitats. Care should be taken to ensure that all potential habitats have been sampled adequately. In the event that distribution data are available for only portions of the geographic area occupied by a particular life history stage of a species, EFH can be inferred on the basis of distributions among habitats where the species has been found and on information about its habitat requirements and behavior.

Level 2: Habitat-related densities of the species are available. At this level, quantitative data (i.e., density or relative abundance) are available for the habitats occupied by a species or life history stage. Because the efficiency of sampling methods is often affected by habitat characteristics, strict quality assurance criteria should be used to ensure that density estimates are comparable among methods and habitats. Density data should reflect habitat utilization, and the degree that a habitat is utilized is assumed to be indicative of habitat value. When assessing habitat value on the basis

of fish densities in this manner, temporal changes in habitat availability and utilization should be considered.

Level 3: Growth, reproduction, or survival rates within habitats are available. At this level, data are available on habitat-related growth, reproduction, and/or survival by life history stage. The habitats contributing the most to productivity should be those that support the highest growth, reproduction, and survival of the species (or life history stage).

Level 4: Production rates by habitat are available. At this level, data are available that directly relate the production rates of a species or life history stage to habitat type, quantity, quality, and location. Essential habitats are those necessary to maintain fish production consistent with a sustainable fishery and the managed species' contribution to a healthy ecosystem.

The Council adopted the recommendations of its groundfish technical team, which used level 2 general distribution or known concentrations to define EFH for species' life stage. A general distribution of a species' life stage is a subset of its current and historic range, and is the geographic area containing most (approximately 95%) of the individuals across all seasons. EFH designation solely on known concentrations would not ensure that adequate areas were protected. Specific reasons supporting this conclusion were:

1. Areas of known concentrations based on current information do not adequately address unpredictable annual differences in spatial distributions of a life stage, nor changes due to long-term shifts in oceanographic regimes. Annual differences in distribution of high concentrations of adults, particularly for pelagic or semi-demersal species (e.g., pollock, Pacific cod (Gadus macrocephalus)) occur and are unpredictable. Within the last 20 years, from which most data have been obtained, long-term changes in concentrations have been observed in Alaska groundfish. The spawning distribution of GOA pollock has changed dramatically since the 1970s. Relative distribution of the sablefish (Anoplopoma fimbria) stock between the BS, AI, and GOA has cycled since the late 1970s.

2. All habitats occupied by a species contribute to production at some level. Although contributions from individual locations may be small, collectively they can account for a significant part of total production.

3. A stock's long-term productivity is based on both high and low levels of abundance and the entire general distribution may be required during times of high abundance.

4. Descriptions of known concentrations are primarily based on seasonal survey information, while general distribution is based on the best available scientific information, as well as fishery and local knowledge of a species life stage.

5. Distinctions between known concentrations and general distribution of a species' life stage have no scientific basis.

6. Observed concentrations or densities do not necessarily reflect all habitat essential to maintain healthy stocks within the ecosystem.

The NMFS guidelines advised the Council to use risk-averse and ecosystem approaches, and the best scientific information available suggests that general distribution should be used to designate EFH necessary

to maintain healthy stocks and ecosystems and sustain productive fisheries. While areas of known concentration are identified for some species' life stages, the Council defined EFH as the general distribution for all groundfish species life stages in the BSAI and GOA. Habitats occupied by the species' life stages are located within each general distribution. Rare observations that extend a species range during anomalous environmental conditions would not be considered part of its general distribution.

For life stages with information levels 1 and 2, general distributions were determined geographically as the area encompassing at least 95 percent of positive survey samples in Fritz et al. (1998) and supplemented as necessary by distribution information available in NOAA (1987; 1990), Wolotira et al. (1993), and Allen and Smith (1988) to allow for survey coverage limitations, and by any relevant knowledge of life history or habitat associations. Maps were prepared illustrating general distributions for species life stages for which level 1 or 2 information is available. For life stages with level 0 information, general distributions were inferred from where a species has been observed and any relevant knowledge of its life history and habitat associations. No maps for life stages with level 0 information were prepared.

Areas of known concentrations within a general distribution were defined by the approximate area encompassing survey or fishery hauls with density (catch per unit effort) observations in the upper 66th percentile of positive observations of a species' life stage in Fritz et al. (1998), and supplemented as necessary by distribution information available in NOAA (1987;1990), Wolotira et al. (1993), and Allen and Smith (1988) to allow for survey coverage limitations, and by any relevant knowledge of life history or habitat associations. Known concentrations were defined and mapped only for species life stages for which level 2 knowledge is available (only for the adult stages of certain groundfish).

If a species is overfished, and habitat loss or degradation may be contributing to the species being overfished, all habitats currently used by the species would be considered essential. In addition, certain historic habitats necessary for rebuilding the fishery and for which restoration is technologically and economically feasible should be included. Once the fishery is no longer considered overfished, the EFH identification should be reviewed, and the FMP amended, if appropriate. EFH will always be greater than or equal to aquatic areas that have been identified as "critical habitat" for any managed species listed as threatened or endangered under the Endangered Species Act. Where a stock of a species is considered to be healthy, EFH should be a subset of all existing habitat for the species.

Cape Edgecumbe Pinnacles Closure

Since 1989, the Alaska Department of Fish and Game (ADF&G) has conducted in-situ assessments of groundfish in the GOA using a manned submersible to collect information on habitat-specific density of demersal shelf rockfishes (Sebastes sp.) and lingcod (Ophiodon elongatus) (O'Connell, 1993; O'Connell and Carlile 1993, O'Connell et al. 1998). Over 300 dives have been made in Southeast Alaska. The area off Cape Edgecumbe is dominated by two large volcanic pinnacles with steep walls, complex rockfish habitat, and a diversity and density of fishes not seen in surrounding areas (Figure 2) (O'Connell et al. 1998). The pinnacles, which occur in federal waters, provide a unique habitat of extremely complex vertical relief including columnar basalts and large boulder fields. The top of the pinnacles are blanketed with Metridium and other fragile invertebrate communities that provide cover for young fishes. The area attracts and shelters an extremely high density of juvenile rockfishes, particularly in late spring and early summer. Lingcod inhabit the pinnacles seasonally for spawning, nest-guarding, and post-nesting feeding. It is also an important fishing ground for Pacific halibut (Hippoglossus stenolepis) and salmon (Onchorhynchus sp.) (O'Connell et al. 1998) .

As described by O'Connell et al. (1998), fisheries for yelloweye rockfish (S. ruberrimus) by bottom longliners and lingcod by trollers using dinglebar gear began in the late 1980s. In 1991, the State of Alaska, which has jurisdiction for managing demersal shelf rockfishes, salmon, and lingcod in both state and federal waters, closed all harvest of lingcod from December 1 through April 30 in the waters from Cape Edgecumbe to Biorka Island, including the pinnacles (Figure 3). In 1997 and 1998, the State prohibited retention of all groundfish by commercial fisheries in a 3.1 nm^2 area around the pinnacles. Concurrently, the sport charter fleet rapidly expanded in Sitka and many of these vessels began targeting the pinnacles.

In 1998, the State permanently closed the pinnacles to all bottomfishing and anchoring to prevent localized overfishing, protect nursery habitat provided by rock outcrop and invertebrate epifauna, and to create a bottom refuge. This action affected all commercial, sport, charter, bycatch and subsistence users. The Council took similar action to close the pinnacles in federal waters to all fishing for groundfish, halibut, and scallops. The State is scheduled to consider closing the pinnacles to all other state-managed species, such as salmon, crab, herring, sea cucumbers, sea urchins, etc., in 2000.

While the Cape Edgecumbe pinnacles closed area may not be designated a marine reserve, it does provide substantial protection of a vital ecosystem within an area surrounded by heavy fishing pressure. The lava fields and cobble flats adjacent to the pinnacles remain open to substantial halibut and yelloweye rockfish fisheries (O'Connell et al. 1998). Upon approval of the amendment to close the pinnacles in federal waters to all fishing and anchoring by the Secretary of Commerce and proposed action by the State to close the pinnacles to all fishing in State waters, the pinnacles will augment other no-take areas in the North Pacific, heretofore limited to 3-mile buffer zones around all Steller sea lions (Eumetopias jubatus) rookeries in the BSAI and GOA since 1990. Despite its small size, the pinnacles encompass a wide range of depths and rock habitats (O'Connell et al. 1998). It is similar to those implemented in other areas of the U.S. (Bohnsack, 1996). More than 400 marine reserves occur in more than 65 countries and territories; more than 150 are less than 1 km^2 in size (Spalding, pers. comm.).

Evaluating the success of closed areas as criteria for HAPC status

The ADF&G will be able to monitor changes in diversity, distribution, and abundance of organisms because baseline information in the pinnacles has been collected since July 1997, when several permanent transect sites were marked. The Council will reevaluate the pinnacle area for consideration as a HAPC based on this information. Pinnacles and seamounts are among those habitat types identified as eligible for HAPC status.

Other existing closed areas may be evaluated for HAPC status. Between 1995 and 1996, the Council adopted three king crab closures in Bristol Bay, Alaska to protect crab stocks (Figure 4). These three adjacent areas, combined, comprise about 30,000 nm^2, or approximately 25% of the continental shelf where commercial quantities of groundfish can be taken with bottom trawl gear (Fritz et al., 1998). Their area exceeds the theoretical minimum of 20% of available habitat, the lower limit of an effective marine reserve suggested by Lauck et al. (1998). The Pribilof Islands conservation area was closed to all trawling and dredging year-round to protect juvenile blue king crab (Paralithodes platypus) habitat (primarily shell hash). The red king crab savings area established a year-round non-pelagic (bottom) trawl and dredge closure area in an area of known high densities of adult red king crab (P. camtshaticus). The nearshore waters of Bristol Bay were closed year-round to trawling to protect juvenile red king crab and critical rearing habitat, although a small subarea on its northern boundary opens from April 1 to June 15 to allow a yellowfin sole (Limanda aspera) trawl fishery. A limited longline fishery for Pacific halibut (Hippoglossus stenolepis) and Pacific cod and pot fisheries for cod and red king crab occur within all three of these trawl closed areas.

The Bristol Bay closures reduced crab bycatch and protected all red king crab life-history stages and habitat from potential degradation due to trawling (Ackley and Witherell, in press). A large 1990 year-class has grown to spawning size and has recruited to the fishery. The spawning stock has increased to a level above the rebuilding threshold, allowing the exploitation rate to be increased to 15% (Zheng et al., 1998). The directed crab fishery opened on November 1, 1998 with a preseason guideline harvest level of 7,438 mt, which was double the 1997 catch. These closures offered additional protection to Tanner crabs (Chionoecetes bairdi), marine mammals, migrating and nesting sea birds, salmon (Onchorhynchus sp.), and Pacific herring (Clupea harengus) (Ackley and Witherell, in press).

Conclusions

The SFA mandate to identify, conserve, and enhance essential fish habitat is regarded as an important tool for sustainable fisheries and healthy ecosystems. This mandate includes the role of ecosystem management and identifies EFH as the waters and substrate required by fish for reproduction, feeding, and growth. Closed areas are an additional tool in precautionary management of marine resources, and have long been used in North Pacific fisheries. The success of the Bristol Bay closed areas in the recovery of the red king crab stock and additional protection to other marine stocks lends support for their use. Public support for the adoption of the Cape Edgecumbe pinnacles will likely lead to the identification and adoption of additional closures necessary to protect other critical marine habitat. These closed areas rely heavily on voluntary compliance and public support for their success. Cooperation between state and federal management and research agencies and the general public is necessary for the identification, creation, enforcement, and monitoring of closed areas to optimize benefits that will likely accrue to the resource and its users. While they are not designated as marine reserves per se, these closed areas provide similar protection for habitat and marine resources, and are a critical element of sustainable fisheries management in North Pacific waters.

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Table 1. Levels of essential fish habitat information currently available for BSAI groundfish, by life history stage. Juveniles were subdivided into early and late juvenile stages based on survey selectivity curves.

	BSAI			GOA		
Species	**Eggs/Larvae/ Early Juveniles [2]**	**Late Juveniles**	**Adults**	**Eggs/Larvae/ Early Juveniles [2]**	**Late Juveniles**	**Adults**
Pollock	1	1	2	1	1	2
Pacific cod	0	1	2	0	1	2
Flatfish	0	1	2	0	0-1	1-2
Sablefish	0	1	2	0	1	2
Rockfish	-/0/0	1	1	-/0/0	0-1	1
Atka mackerel	0	0	2	0	0	1
Other species	0	0	0-1	0	0	0-1
Forage fish [1]	0	0	0	0	0	0

[1] Other forage fish includes all members of the lanternfish, deep sea smelt, sand lance, sandfish, gunnel, shanny, krill, bristlemouth families.

[2] Indicates a species that has internal fertilization and bears live young.

Table 2. Levels of essential fish habitat information currently available for BSAI king and Tanner crab by life history stage summarized across stocks. Juveniles were subdivided into early and late juvenile stages based on survey selectivity curves.

Species	Eggs	Early Larvae	Late Juveniles[1]	Juveniles[2]	Adults
Red King Crab	1-2	0-2	0-1	0-2	1-2
Blue King Crab	0-2	0-1	0-2	0-2	1-2
Golden King Crab	0-2	0	0	0-2	0-2
Scarlet King Crab	0	0	0	0	1
Tanner Crab (C. bairdi)	0-2	0-1	0-1	0-2	1-2
Snow Crab (C. opilio)	2	1	1	2	2
Grooved Crab (C. tanneri)	0	0	0	0	1
Triangle Crab. (C. angulatus)	1	0	0	0	1

[1] Early juvenile crab are defined as settled crab up through age 2.
[2] Late juvenile crab are defined as age 2 through earliest age of functional maturity.

List of Figures

The Council shall assume an aggressive role in the protection and enhancement of habitats important to marine and anadromous fishery resources. It shall actively enter Federal decision-making processes where proposed actions may otherwise compromise the productivity of fishery resources of concern to the Council. Recognizing that all species are dependent on the quantity and quality of their essential habitats, it is the policy of the North Pacific Fishery Management Council to:

Conserve, restore, and maintain habitats upon which commercial, recreational and subsistence marine fisheries depend, to increase their extent and to improve their productive capacity for the benefit of present and future generations. (For purposes of this policy, habitat is defined to include all those things physical, chemical, and biological that are necessary to the productivity of the species being managed.)

This policy shall be supported by three policy objectives which are to:

(1) Maintain the current quantity and productive capacity of habitats supporting important commercial, recreational and subsistence fisheries, including their food base. (This objective will be implemented using a guiding principle of NO NET HABITAT LOSS caused by human activities.)

(2) Restore and rehabilitate the productive capacity of habitats which have already been degraded by human activities.

(3) Maintain productive natural habitats where increased fishery productivity will benefit society.

Figure 1. NPFMC Habitat Policy Statement of 1988

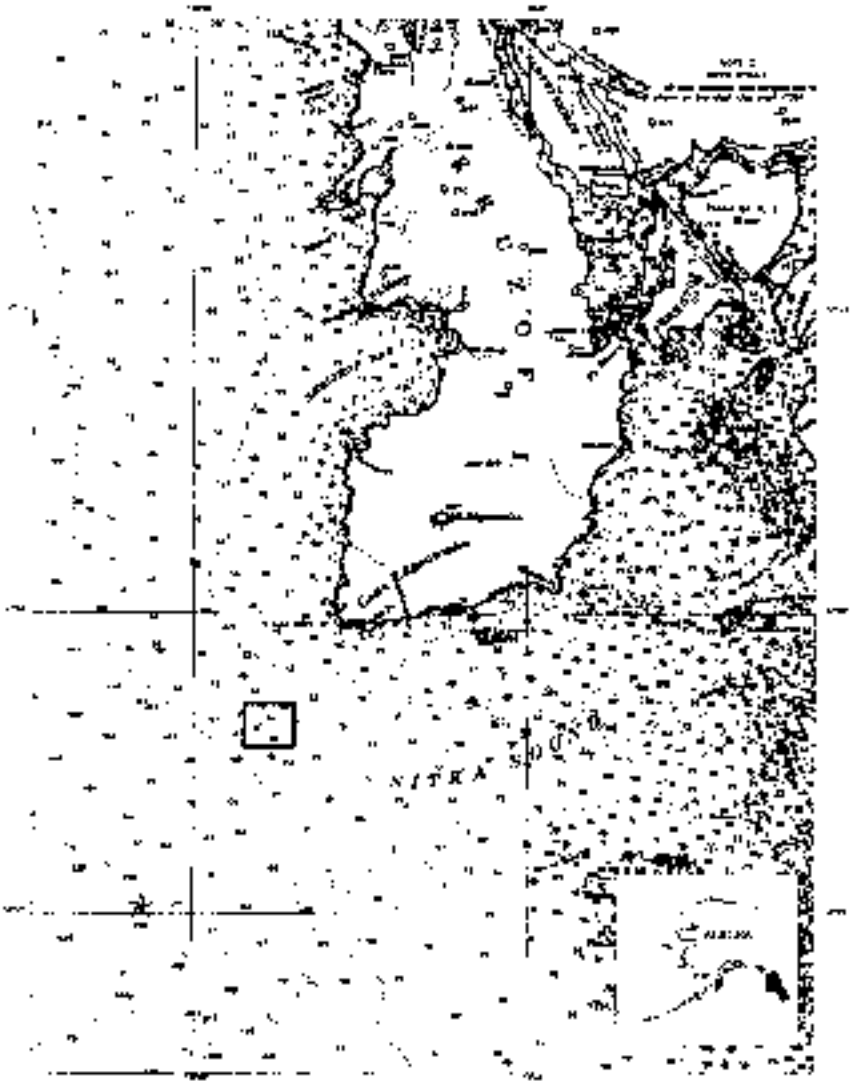

Figure 2. Cape Edgecumbe pinnacle area closure.

Figure 3. Bathymetry of pinnacles area (10 X vertical exaggeration).

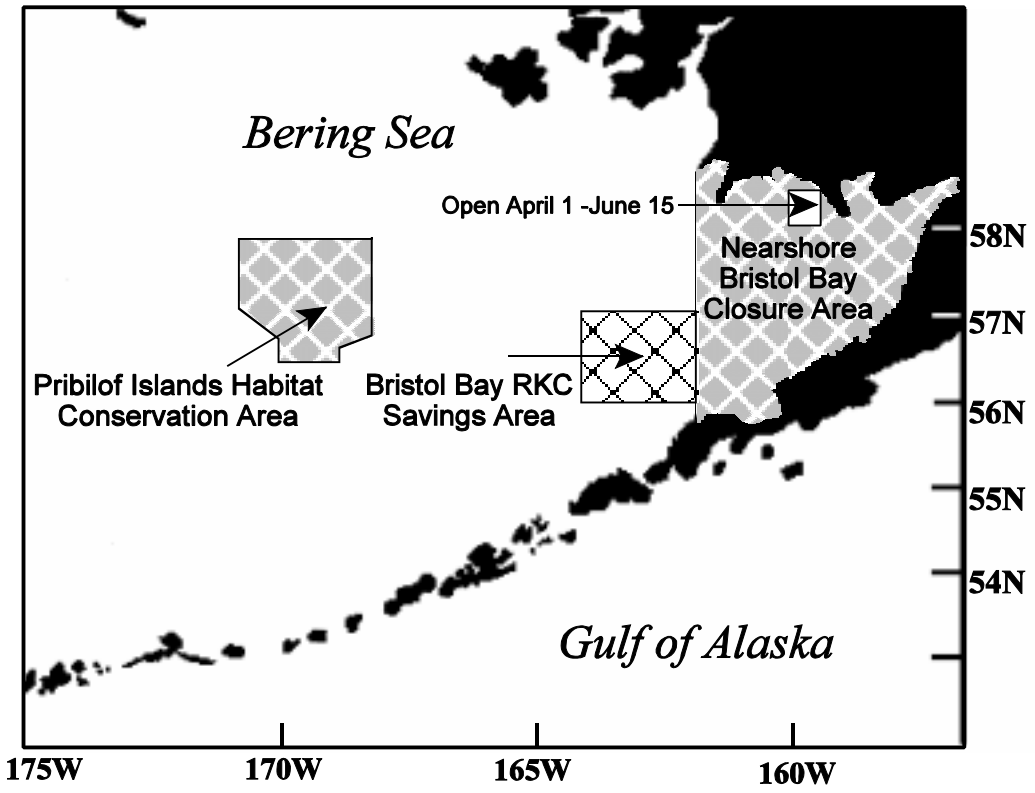

Figure 4. Location of trawl closure areas to protect red and blue king crab habitats.