Appendix D to the Environmental Assessment for Amendment to the Fishery Management Plan for Fish Resources of the Arctic Management Area

Proposed amendment to the Arctic FMP- amendment text for updating EFH description and non-fishing impacts to EFH (EFH Omnibus Amendment)

Make the following changes to the Fishery Management Plan for Fish Resources of the Arctic Management Area. When edits to existing sections are proposed, words indicated with strikeout (e.g., ~~strikeout~~) should be deleted from the FMP, and words that are underlined (e.g., underlined) should be inserted into the FMP. Instructions are italicized and highlighted. Note, instructions reference two supplemental files: Appendix A, B, and C; and Appendix F.

1. In the Executive Summary, Section E.S. 1.3, Organization of the FMP, revise the text as follows:

This FMP is organized into seven chapters. Chapter 1 contains an introduction to the FMP, and Chapter 2 describes the policy and management objectives of the FMP.

Chapter 3 contains the conservation and management measures for Arctic fishery management. Sections 3.1 through 3.7 outline the procedures for determining potential target species and maximum sustainable yield and optimum yield specifications. Sections 3.8 and 3.9 describe overfishing criteria and procedures for setting acceptable biological catch (ABC) and TAC, respectively. Sections 3.10 to 3.14 contain accountability measures, and permit and participation, gear, time and area, and catch restrictions information. A description of the bycatch reduction and incentive program is in Section 3.15. No share-based programs are established for the Arctic Management Area (Section 3.16). Measures that allow flexible management authority are addressed in Section 3.17, Section 3.18 designates monitoring and reporting requirements, and Section 3.19 describes management and enforcement considerations. Section 3.20 describes the schedule and procedures for review of the FMP or FMP components, and Section 3.21 describes the process for setting research priorities.

Chapter 4 sections 4.1 and 4.2 ~~contains~~ contain a description of the Arctic's fish resources and their habitat ~~(including essential fish habitat definitions)~~, including essential fish habitat (EFH), current fishing activities, the economic and socioeconomic characteristics of current fisheries and communities, and ecosystem characteristics. Additional descriptive information ~~also~~ is also contained in the appendices. Section 4.3 provides a description of the Arctic ecosystem and interrelationships among the physical and biological components. It includes a discussion of potential climate change effects on the Arctic region. Chapter 5 specifies the relationship of the FMP with applicable law and other fisheries. Chapter 6 provides a fishery impact statement. Chapter 7 references additional sources of material about the Arctic, and includes the bibliography.

Appendices to the FMP include supplemental information. Appendix A contains EFH text descriptions ~~of essential fish habitat (EFH)~~ for target species. Appendix B contains EFH maps ~~of EFH~~ for target species. Additional information about the Arctic Management Area, including its fish, bird, and marine mammal species, and an ecosystem description, are provided in the February 2009 Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis (EA/RIR/IRFA) for this

FMP. Appendix C provides a description of non-fishing effects on EFH in the Arctic Region, Appendix D provides supplemental ecosystem component species habitat descriptions, ~~and~~ Appendix E provides supplemental ecosystem component species habitat maps, and Appendix F provides EFH research and information needs.

2. In the Executive Summary, Section 1.4, Amendments to the FMP, insert the following description of this amendment in sequential order:

Update EFH content, descriptions, and maps based on the 5-year Review.

3. In Chapter 4, Description of Habitat, Fisheries, and Ecosystem, Section 4.1.3, Essential Fish Habitat, revise the text where indicated and reorder the subsections as follows based on the order of the ten EFH components of FMPs:

4.1.3 Essential Fish Habitat

In 1996, the Sustainable Fisheries Act amended the Magnuson-Stevens Act to require the description and identification of essential fish habitat (EFH) in FMPs, evaluate adverse impacts on EFH, and identify actions to conserve and enhance EFH. Guidelines were developed by NMFS to assist fishery management councils in fulfilling the requirements set forth by the MSA.

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat: "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.

The EFH Final Rule lists the mandatory contents of an FMP (50 CFR 600.815(a)). These requirements are summarized in the following sections and in Appendices A, B, ~~and~~ C, and F as they apply to the Arctic Management Area and the fisheries and non-fishing activities currently in this area. Because this FMP prohibits commercial fishing in the Arctic Management Area for managed species, no impacts on EFH are expected from fishing; therefore, no cumulative impacts on EFH are expected. In addition, the prohibition on commercial fishing ensures no effects on prey resources for FMP managed species. At the time this FMP may be amended to authorize a commercial fishery in the Arctic Management Area, the cumulative effects on EFH and the effects on prey resources for FMP managed species will be addressed in any FMP amendments.

4.1.3.1 EFH Text and Map Descriptions

FMPs must describe EFH in text, including reference to the geographic location or extent of EFH using boundaries such as longitude and latitude, isotherms, isobaths, political boundaries, and major landmarks. If differences exist among the descriptions of EFH in text, maps, and tables, the textual description is ultimately determinative of the limits of EFH.

The vastness of Alaska and the large number of individual fish species managed by FMPs make it challenging to describe EFH by text using static boundaries. To address this challenge, NMFS refers to the boundaries as defined by a Fishery Management Area (FMA) for the FMP and the target fisheries within the FMA as the fishery management unit (FMU). EFH must be described for the FMU. The Arctic FMP FMA is the Arctic Management Area, which is described as all marine waters in the EEZ of the Chukchi and Beaufort Seas from 3 nautical miles offshore the coast of Alaska to 200 nautical miles offshore, north of Bering Strait (from Cape Prince of Wales to Cape Dezhneva) and westward to the 1990 United States/Russia maritime boundary line and eastward to the United States/Canada maritime boundary. The fisheries within this unit are those listed in the target species category in Table 3-3.

FMPs must also include maps that display, within the constraints of available information, the geographic location of EFH or the geographic boundaries within which EFH for each species and life stage is found. A geographical information system (GIS) was used to delineate EFH map descriptions for the FMP. EFH descriptive maps depict, and are complimentary to, each life history EFH text description, if known.

EFH ~~Text and Map Descriptions~~ text and map descriptions for the target species are in Appendices A and B. Appendix D contains supplemental habitat information for several ecosystem component species, and Appendix E provides supplemental ecosystem component species habitat maps. This supplemental habitat information is provided to assist the Council in its ecosystem-based approach to management in the Arctic Management Area.

~~Appendix C provides information on non-fishing effects on EFH in the Arctic Management Area.~~

4.1.3.2 Fishing and Non-fishing Activities Affecting the Stocks or EFH

Non-fishing activities that may affect EFH are in Appendix C of the FMP. The FMP initially prohibits commercial fishing in the Arctic Management Area; therefore, the potential cumulative impacts to EFH consist of potential impacts of non-fishing activities, as analyzed in Appendix C. Absent more detailed information on the potential timing and location of the non-fishing activities discussed in Appendix C, a more robust analysis of how fishing and non-fishing activities affect the function of EFH on an ecosystem scale is not currently feasible or practicable. This section describes the MSA and non-MSA fishing activities that may affect EFH.

There are no known Indian treaty fishing rights for fish, shellfish, or other fish resources in the Arctic Management Area; therefore, no known effects on EFH are expected from Indian Treaty fishing.

4.1.3.2.1 Commercial Fishery

No commercial fishing occurs in the Arctic except for several small fisheries that occur solely in state waters and are managed by the State. These include a small commercial fishery for chum salmon, although other fish species are incidentally harvested, in the Kotzebue Sound region. Fished from coastal set nets, salmon are sold locally; some are shipped to other markets outside the region. A commercial fishery for whitefish occurs in the delta waters of the Colville River that flows into the central Beaufort Sea. This fishery is for Arctic and least cisco, and a few other species are harvested incidentally. The market for these fish is local, although some whitefish have been marketed in the Barrow and Fairbanks areas.

4.1.3.2.2 Subsistence Fishery

Subsistence fishing is an important part of the economic, nutritional, and cultural lifestyle of local residents of the Arctic. Subsistence fishing occurs throughout the coastal region of the Arctic Management Area by residents of villages in this region. Fishing activities occur near human settlements of Wainwright, Barrow, Nuiqsut, and Kaktovik, but also occur in all nearshore areas during open water seasons. Some activities occur to a limited extent in this area during winter. In winter, fishing is generally conducted by gill nets threaded through holes in the ice or by jigging. In summer, rod and reel, gill net, and jigging are techniques used to capture fish. Species harvested for subsistence purposes include Pacific herring, Dolly Varden char, whitefishes, Arctic and saffron cod, and sculpins. No data are available to determine the trends in landings for subsistence fisheries in the Arctic Management Area.

4.1.3.2.3 Recreational Fishery

At this time, there are few recreational fisheries in the Arctic Management Area, including no catch and release fishery management programs. Personal use fisheries may occur on a variety of species, occasionally in EEZ waters, but little data are available and these probably occur on a very small scale. Personal use fisheries may more accurately be described as subsistence fisheries, although there may be

some level of "sport" fishing activity near Kotzebue or Barrow. Most recreational catch in the Arctic likely would occur in state waters and thus fall under the classification of sport, subsistence, or personal use fisheries, these fisheries are regulated by Alaska state law. No data are available to determine the trends in landings, including species targeted, in recreational fisheries in the Arctic Management Area.

4.1.3.2.4 Economic and Socioeconomic Characteristics of the Fishery

No commercial fisheries occur in the Arctic Management Area except for fisheries that occur solely in state waters, as described above. Coastal communities in the Arctic Management Area may have residents that participate in fisheries, primarily for subsistence or personal use, with some fish harvested through recreational use. These fisheries are almost exclusively in inland lakes and streams, or along the coast or in river delta waters, and thus would be under management authority of the State of Alaska. Barrow and Kotzebue are regional commerce centers where government, commerce, and transportation support for regional communities are located. Fish resource surveys and harvest monitoring are generally managed from either Barrow or Kotzebue. The North Slope Borough maintains an extensive and multifaceted fish and wildlife research and management group, the Department of Wildlife Management.

4.1.3.3 Essential Fish Habitat Conservation

In order to protect EFH, certain EFH habitat conservation areas may be designated. A habitat conservation area is an area where fishing restrictions are implemented for the purposes of habitat conservation. No EFH habitat conservation areas have been designated in the Arctic Management Area. If commercial fishing is authorized, EFH habitat conservation measures may be included in the amended FMP.

4.1.3.4 Habitat Areas of Particular Concern

Habitat areas of particular concern (HAPCs) are specific sites within EFH that are of particular ecological importance to the long-term sustainability of managed species, are of a rare type, or are especially susceptible to degradation or development. HAPCs are meant to provide for greater focus of conservation and management efforts and may require additional protection from adverse effects. 50 CFR 600.815(a)(8) provides guidance to the regional fishery management councils in identifying HAPCs.

> FMPs should identify specific types or areas of habitat within EFH as habitat areas of particular concern based on one or more of the following considerations:
>
> (i) the importance of the ecological function provided by the habitat;
>
> (ii) the extent to which the habitat is sensitive to human-induced environmental degradation;
>
> (iii) whether, and to what extent, development activities are, or will be, stressing the habitat type; or
>
> (iv) the rarity of the habitat type.

4.1.3.4.1 HAPC Process

The Council may designate specific sites as HAPCs and may develop management measures to protect habitat features within HAPCs.

50 CFR 600.815(a)(8) provides guidance to the regional fishery management council in identifying HAPCs. FMPs should identify specific types or areas of habitat within EFH as habitat areas of particular concern based on one or more of the HAPC considerations.

Further, the Council's policy is that any proposed HAPCs (as identified on a map) must meet at least two of the four considerations established in 50 CFR 600.815(a)(8), and rarity of the habitat is a mandatory criterion. HAPCs may be developed to address identified problems for FMP species, and they must meet clear, specific, and adaptive management objectives.

The Council will initiate the HAPC process by setting priorities and issuing a request for HAPC proposals. Any member of the public may submit a HAPC proposal. HAPC proposals may be solicited every 5 years, to coincide with the EFH 5-year review, or may be initiated at any time by the Council. The Council may periodically review existing HAPCs for efficacy and considerations based on new scientific research.

Criteria to evaluate the HAPC proposals will be reviewed by the Council and the SSC prior to the request for proposals. The Council will establish a process to review the proposals and may establish HAPCs and conservation measures.

4.1.3.4.2 HAPC Conservation and Designation

In order to protect HAPCs, certain habitat protection areas and habitat conservation zones may be designated. A habitat protection area is an area of special, rare habitat features where fishing activities that may adversely affect the habitat are restricted. A habitat conservation zone is a subset of a habitat conservation area used to protect EFH, in which additional restrictions are imposed on fishing beyond those established for the conservation area, in order to protect specific habitat features.

Habitat areas or types, that meet the HAPC considerations, could be considered as candidates for HAPC. Habitat-type mapping is scarce and very little information exists to determine sensitive habitat areas within Arctic waters. No specific HAPCs currently are identified in the FMP because no HAPC has been identified through the process described in Section ~~4.1.3.4~~ 4.1.3.4.1.

~~4.1.4 Habitat Conservation and Enhancement Recommendations for Fishing and Non-fishing Threats to Essential Fish Habitat~~

~~Because no commercial fishing for species managed under the FMP is conducted and the gear types and magnitude of other fisheries are not likely to impact EFH (Section 4.1.6), no actions are necessary to minimize the effects of MSA fishing on EFH. Non-fishing impacts and recommendations to minimize or compensate for the potential adverse effects of non-fishing activities on EFH are described in detail in Appendix C.~~

4.1.4.1 EFH Research and Information Needs ~~Research Efforts in Support of EFH~~

~~See Section 3.21. EFH research needs are prepared through a collaborative proposal process overseen by Habitat and Ecological Process Research (HEPR) Team at the AFSC. The process includes recommendations for regional EFH management needs by the NMFS Alaska Regional Office Habitat Conservation Division. Major research needs are (1) to identify habitats that contribute most to the survival, growth, and productivity of managed fish and shellfish species; and (2) to determine how to best manage and protect these habitats from human disturbance and environmental change. Further information can be found at http://www.afsc.noaa.gov/HEPR/efh.htm.~~

EFH research and information needs are a required component of FMPs. Each FMP should contain recommendations for research that the Council and NMFS views as necessary to improve upon the description and identification of EFH, the identification of threats to EFH from fishing and other activities, and the development of conservation and enhancement measures for EFH.

The Council considers revising or updating EFH research and information needs during the 5-year Review process (Harrington et al. 2023), as well as during the Council's research priorities process (section 3.21). EFH research recommendations were informed during the 2023 EFH 5-year Review by contributing researchers, stock assessment scientists, and the Council and advisory bodies. EFH research and information needs for the Arctic Management Area are in Appendix F.

4. In Chapter 7, References, Section 7.1.3.3, EIS for Essential Fish Habitat Identification and Conservation in Alaska, insert the following new paragraphs at the end of the section:

In 2009–2010, the Council undertook a 5-year review of EFH for the Council's managed species, which was documented in the Final EFH 5-year Review Summary Report published in April 2010 (NPFMC and

NMFS 2010). The review evaluated new information on EFH, including EFH descriptions and identification, and fishing and non-fishing activities that may adversely affect EFH. The review also assessed information gaps and research needs, and identified whether any revisions to EFH are needed or suggested. The Council identified various elements of the EFH descriptions meriting revision, and approved omnibus amendments 98/90/40/15/11 to the BSAI Groundfish FMP, the GOA Groundfish FMP, the BSAI King and Tanner Crab FMP, the Scallop FMP, and the Salmon FMP, respectively, in 2011.
From 2014 through 2017, the Council undertook a 5-year review of EFH for the Council's managed species, which was documented in the Final EFH 5-year Review Summary Report (Simpson et al. 2017). The review evaluated new information on EFH, including EFH descriptions and identification, and fishing and non-fishing activities that may adversely affect EFH. The review also assessed information gaps and research needs, and identified whether any revisions to EFH are needed or suggested. The Council identified various elements of the EFH descriptions meriting revision, and recommended omnibus amendments 115/105/49/13/2 to the BSAI Groundfish FMP, the GOA Groundfish FMP, the BSAI King and Tanner Crab FMP, Arctic FMP, and the Salmon FMP, respectively, in 2018.

From 2019 to 2023, the Council reviewed information provided by NMFS for the EFH 5-year Review for the Council's managed species, which was documented in the draft Essential Fish Habitat 5-year Review Summary Report (Harrington et al. 2023). The review evaluated new information on EFH, including EFH descriptions and identification, new species distribution models and maps, fishing and non-fishing activities that may adversely affect EFH, and research priorities. The Council recognized the new information that these updates provide, and recommended omnibus amendments to the BSAI Groundfish FMP, the GOA Groundfish FMP, the BSAI King and Tanner Crab FMP, and the Arctic FMP, respectively, in 2023. The Council should note that the Salmon FMP is being updated with EFH maps from Echave et al. (2012), and that EFH maps and text descriptions for the Salmon FMP were not produced for the 2023 EFH Review.

5. In Chapter 7, References, Section 7.2, Literature Cited, insert the following references in alphabetical order:

Echave, K., M. Eagleton, E. Farley, and J. Orsi. 2012. A refined description of essential fish habitat for Pacific salmon within the U.S. Exclusive Economic Zone in Alaska. U.S. De. Commer., NOAA Tech. Memo. NMFS-AFSC-236, 104 p.

Harrington, G. A., J. L. Pirtle, M. Zaleski, C. Felkley, S. Rheinsmith, and J. T. Thorson. Essential Fish Habitat 2023 5-year Review Summary Report. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/AKR-31, 135 p. https://doi.org/10.25923/ve1v-ns96

Simpson, S. C., Eagleton, M. P., Olson, J. V., Harrington, G. A., and S. R. Kelly. 2017. Final Essential Fish Habitat (EFH) 5-year Review, Summary Report: 2010 through 2015. U.S. Dep. Commer., NOAA Tech Memo. NMFS-F/AKR-15, 118p. https://doi.org/10.7289/V5/TM-F/AKR-15

6. Replace Appendix A, EFH Text Descriptions, with the revised Appendix A in the attached file.
7. Replace Appendix B, EFH Map Descriptions, with the revised Appendix B in the attached file.
8. Replace Appendix C, Non-fishing Effects on EFH in the Arctic, with the revised Appendix C in the attached file.
9. Add Appendix F, EFH Research and Information Needs, with the attached file.
10. Update the Table of Contents for the FMP.

Appendix A Essential Fish Habitat Text Descriptions

This appendix contains essential fish habitat (EFH) text descriptions for fish species within the fishery management unit (FMU).

A.1 Essential Fish Habitat Definitions

EFH is defined in the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." EFH for groundfish species is described for FMP-managed species by life stage. General distribution is a subset of a species' total population distribution, and is identified as the distribution of 95 percent of the species population, for a particular life stage, if life history data are available for the species. Where information is insufficient and a suitable proxy cannot be inferred, EFH is not described. General distribution is used to describe EFH for all stock conditions whether or not higher levels of information exist, because the available higher level data are not sufficiently comprehensive to account for changes in stock distribution (and thus habitat use) over time.

EFH is described for FMP-managed species by life stage as general distribution using guidance from the EFH Final Rule (50 CFR 600.815), including the EFH Level of Information definitions. New analytical tools are used and recent scientific information is incorporated for each life history stage from updated scientific habitat assessment reports (NMFS 2005, NPFMC and NMFS 2010, Simpson et al. 2017, Harrington et al. 2023). EFH descriptions include both text (Appendix A) and maps (Appendix B) if information is available for a species' particular life stage. These descriptions are risk averse, supported by scientific rationale, and account for changing oceanographic conditions, regime shifts, and the seasonality of migrating fish stocks.

EFH descriptions are interpretations of the best scientific information. In support of this information, a thorough review of FMP species is contained in the Environmental Impact Statement for Essential Fish Habitat Identification and Conservation (NMFS 2005) in Section 3.2.1, Biology, Habitat Usage, and Status of Magnuson-Stevens Act Managed Species and detailed by life history stage in Appendix F: EFH Habitat Assessment Reports. This EIS was supplemented in 2010, 2017, and 2023 by the 5-year review cycle, which periodically re-evaluates EFH descriptions and fishing and non-fishing impacts on EFH in light of new information (NPFMC and NMFS 2010, Simpson et al. 2017, Harrington et al. 2023).

Arctic FMP EFH descriptions consist of text descriptions and maps for the three target species, Arctic cod, saffron cod, and snow crab. Table A-1 lists the levels of EFH information available as a result of the 2023 EFH Review for species in the Arctic FMP.

Table A-1 EFH information levels available by species and life history stage for species in the Arctic FMP based on the 2023 Review.

Species	Life Stage				
	Egg	Larvae	Early Juvenile (age-0, immature)	Juvenile (adolescent female, adolescent male)	Adult (mature female, mature male)
Arctic cod	1	1	3	3	1
Saffron cod	1	1	1	3	1
Snow crab	inferred	0	1	1	1

A.2 Arctic Species EFH Text Descriptions

A.2.1 Arctic Cod (Boreogadus saida)

Eggs
EFH for Arctic cod eggs is the general distribution area for this life stage, located in near surface waters over the continental shelf of the Chukchi and Beaufort Seas (Logerwell et al. 2015). Arctic cod spawning is associated with sea ice. Barrow Canyon and the Beaufort Sea shelf break are EFH core areas and hotspots for Arctic cod eggs (Marsh et al. *In review*).

Larvae
EFH for Arctic cod larvae is the general distribution area for this life stage, located in near surface waters over the continental shelf of the Chukchi and Beaufort Seas (Logerwell et al. 2015). Larval Arctic cod EFH core areas and hotspots are mainly concentrated in the northeast Chukchi Sea to the coast, including Barrow Canyon, and in the western Beaufort Sea from the shelf break to the coast (Marsh et al. *In review*).

Age-0 Early Juveniles
The general distribution area for this life stage is located in near surface and pelagic waters along the continental shelf (0 to 200 m depth) and upper slope (200 to 500 m depth) in the Chukchi Sea and western Beaufort Sea (Logerwell et al. 2015). Age-0 early juvenile Arctic cod EFH core areas and hotspots are mainly concentrated in the northeast Chukchi Sea to the coast, including Barrow Canyon, and in the western Beaufort Sea from the shelf break to the coast (Marsh et al. *In review*).

Juveniles
The general distribution areas for this life stage is located in pelagic waters from the nearshore to offshore areas along the entire continental shelf (0 to 200 m depth) and upper slope (200 to 500 m depth) throughout Arctic waters and often associated with ice floes which may occur in deeper waters (Logerwell et al. 2015). Juvenile Arctic cod tend to occur deeper in the water column or on the bottom. Juvenile Arctic cod EFH area increases with ontogeny for Arctic cod, moving offshore in the Beaufort Sea (Marsh et al. *In review*).

Mature
The general distribution area for this life stage is located in pelagic waters from the nearshore to offshore areas along the entire continental shelf (0 to 200 m depth) and upper slope (200 to 500 m depth) throughout Arctic waters and often associated with ice floes which may occur in deeper waters (Logerwell et al. 2015). Mature Arctic cod tend to occur deeper in the water column or on the bottom. EFH area increases with ontogeny for Arctic cod, moving offshore in the Beaufort Sea (Marsh et al. *In review*).

A.2.2 Saffron Cod (Eleginus gracilis)

Eggs
EFH for saffron cod eggs is the general distribution area for this life stage, located in pelagic waters over the continental shelf of the Chukchi and Beaufort Seas (Logerwell et al. 2015).

Larvae
EFH for Arctic cod larvae is the general distribution area for this life stage, located in pelagic waters over the continental shelf of the Chukchi and Beaufort Seas (Logerwell et al. 2015). Larval saffron cod EFH core areas and hotspots mainly occur in the Beaufort Sea and northern Chukchi Sea (Marsh et al. *In review*).

Age-0 Early Juveniles
EFH for age-0 early juvenile saffron cod is the general distribution area for this life stage, located in pelagic waters along the coastline, within nearshore bays, and under ice along the inner (0 to 50 m depth) continental shelf throughout Arctic waters and wherever there are substrates consisting of sand and gravel. Age-0 early juvenile saffron cod EFH core areas and hotspots mainly occur in nearshore waters of the Chukchi Sea and Beaufort Sea and extend offshore in the Chukchi Sea (Marsh et al. *In review*).

Juveniles
EFH for subadult Saffron cod is the general distribution area for this life stage, located in pelagic waters along the coastline, within nearshore bays, and under ice along the inner (0 to 50 m depth) continental shelf throughout Arctic waters and wherever there are substrates consisting of sand and gravel. Juvenile saffron cod EFH core areas and hotspots mainly occur in nearshore waters of Chukchi Sea and Beaufort Sea and extend offshore in the Chukchi Sea (Marsh et al. *In review*).

Mature
EFH for adult Saffron cod is the general distribution area for this life stage, located in pelagic waters along the coastline, within nearshore bays, and under ice along the inner (0 to 50 m depth) continental shelf throughout Arctic waters and wherever there are substrates consisting of sand and gravel. Mature saffron cod EFH core areas and hotspots mainly occur in nearshore waters of Chukchi Sea and Beaufort Sea and extend offshore in the Chukchi Sea (Marsh et al. *In review*). Kotzebue Sound is an EFH hotspot for mature saffron cod.

A.2.3 Snow Crab (Chionoecetes opilio)

Eggs
EFH of snow crab eggs is inferred from the general distribution of egg-bearing female crab (see mature females).

Larvae
Insufficient information is available to determine EFH for snow crab larvae.

Immature
EFH for immature snow crab is the general distribution area for this life stage, located in bottom habitats along the inner (0 to 50 m depth) and middle (50 to 100 m depth) continental shelf in Arctic waters south

of Cape Lisburne, wherever there are substrates consisting mainly of mud. Immature snow crab EFH core areas and hotspots occur throughout the Chukchi Sea (Marsh et al. *In review*).

Adolescent females
EFH for adolescent female snow crab is the general distribution area for this life stage, located in bottom habitats along the inner (0 to 50 m depth) and middle (50 to 100 m depth) continental shelf in Arctic waters south of Cape Lisburne, wherever there are substrates consisting mainly of mud. Adolescent female snow crab EFH core areas and hotspots occur throughout the Chukchi Sea (Marsh et al. *In review*).

Adolescent males
EFH for late juvenile snow crab is the general distribution area for this life stage, located in bottom habitats along the inner (0 to 50 m depth) and middle (50 to 100 m depth) continental shelf in Arctic waters south of Cape Lisburne, wherever there are substrates consisting mainly of mud. Adolescent male snow crab EFH core areas and hotspots occur throughout the Chukchi Sea and along the Beaufort Sea outer continental shelf and upper slope (Marsh et al. *In review*).

Mature females
EFH for adult snow crab is the general distribution area for this life stage, located in bottom habitats along the inner (0 to 50 m depth) and middle (50 to 100 m depth) continental shelf in Arctic waters, wherever there are substrates consisting mainly of mud. Mature female snow crab EFH core areas and hotspots occur throughout the Chukchi Sea and along the Beaufort Sea outer continental shelf and upper slope (Marsh et al. *In review*). Barrow Canyon is an EFH hotspot for mature female snow crab.

Mature males
EFH for adult snow crab is the general distribution area for this life stage, located in bottom habitats along the inner (0 to 50 m depth) and middle (50 to 100 m depth) continental shelf in Arctic waters, wherever there are substrates consisting mainly of mud. Mature male snow crab EFH core areas and hotspots occur throughout the Chukchi Sea and along the Beaufort Sea outer continental shelf and upper slope (Marsh et al. *In review*). Barrow Canyon is an EFH hotspot for mature male snow crab.

A.3 References

Alaska Department of Fish and Game (ADF&G). 2007. An atlas to the catalog of waters important for spawning, rearing, or migration of anadromous fishes. ADF&G, Habitat and Restoration Division, 333 Raspberry Road, Anchorage, AK. 99518-1599.

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Appendix B Essential Fish Habitat Maps

B.1 Outline

Maps of essential fish habitat (EFH) are included in this section for the following species (life stage is indicated in parentheses) and EFH information levels (L) 1 and 3 (see Marsh et al. *In review* for mapping methods):

Figure B-1 to B-10	Arctic cod (larvae, age-0 early juvenile, juvenile, mature) • larvae summer L1 B-1, age-0 early juvenile summer L1 B-2, juvenile summer L1 B-3, mature summer L1 B-4; • larvae warm and cold years summer L1 B-5, age-0 early juvenile warm and cold years summer L1 B-6, juvenile warm and cold years summer L1 B-7, mature warm and cold years summer L1 B-8; • age-0 early juvenile summer L3 B-9; juvenile summer L3 B-10.
Figure B-11 to B-19	Saffron cod (larvae, age-0 early juvenile, juvenile, mature) • larvae summer L1 B-11, age-0 early juvenile summer L1 B-12, juvenile summer L1 B-13, mature summer L1 B-14; • larvae warm and cold years summer L1 B-15, age-0 early juvenile warm and cold years summer L1 B-16, juvenile warm and cold years summer L1 B-17, mature warm and cold years summer L1 B-18; • juvenile summer L3 B-19.
Figure B-20 to B-29	Snow crab (immature, adolescent female, adolescent male, mature female, mature male) • immature summer L1 B-20, adolescent female summer L1 B-21, adolescent male summer L1 B-22, mature female summer L1 B-23, mature male L1 B-24; • immature warm and cold years summer L1 B-25, adolescent female warm and cold years summer L1 B-26, adolescent male warm and cold years summer L1 B-27, mature female warm and cold years summer L1 B-28, mature male warm and cold years summer L1 B-29.

B.2 Arctic Species EFH Maps

The mapping requirements for EFH component 1 descriptions and identification are that some or all portions of the geographic range of the species are mapped (50 CFR 600.815(a)(1)). The EFH regulations provide an approach to organize the information necessary to describe and identify EFH, which should be designated at the highest level possible—

Level 1: Distribution data are available for some or all portions of the geographic range of the species.

Level 2: Habitat-related densities or relative abundance of the species are available.

Level 3: Growth, reproduction, or survival rates within habitats are available.

Level 4: Production rates by habitat are available. [Not available at this time.]

New maps of habitat-related species distribution from species distribution models (SDMs) were used to map EFH Level 1 information for Arctic species for the first time in 2023 EFH 5-year Review. As there are no longstanding, systemic surveys in the Arctic Management Area, biological survey data from the summer season was compiled from numerous studies conducted between 2000 and 2018 in the U.S. Chukchi and Beaufort Seas (Marsh et al. *In review*). Fish were collected nearshore and offshore, on the seafloor and throughout the water column using a variety of gear types. The study area was constrained to encompass all waters from the coastline to depths less than 1,250 m and latitudes less than 73.1° N, as biological survey data was not collected deeper than 1,250 m or north of 73.1° N. The new EFH Level 1 maps have replaced the EFH maps for species' life stages from previous EFH 5-year Reviews.

The definition of EFH area in Alaska is the area containing 95% of the occupied habitat (NMFS 2005). Occupied habitat was defined as all locations where a species' life stage had an encounter probability greater than 5%, where encounter rates were derived from the SDM predictions and used to remove locations that had low encounter probabilities from inclusion in the EFH area (Pirtle et al. 2023). For Arctic species' life stages, the cloglog probability of suitable habitat was used in place of encounter probability (Marsh et al. *In review*). The new 2023 EFH maps are presented using percentile areas containing 95%, 75%, 50%, and 25% of the occupied habitat. Each of the EFH subareas describes a more focused partition of the total EFH area. The area containing 75% of the occupied habitat based on SDM predictions is referred to as the "principal EFH area". For the fishing effects analysis (EFH component 2), the area containing 50% of the occupied habitat is termed the "core EFH area". The areas containing the top 25% of the occupied area are referred to as "EFH hot spots". Mapping habitat percentiles for EFH subareas like these helps demonstrate the heterogeneity of fish distributions over available habitat within the larger area identified as EFH.

EFH Level 1 maps were also developed separately in warm and cold years between 2000 and 2018 to compare the area of occupied habitat for Arctic species' life stages under different climate scenarios (Marsh et al. *In review*). This new climate-informed EFH mapping approach is a first step to consider climate change effects on EFH for Arctic species.

EFH Level 3 maps of habitat-related vital rates for age-0 early juvenile and juvenile Arctic cod and juvenile saffron cod were also mapped for the first time in the 2023 EFH 5-year Review by combining spatial projections of temperature dependent growth rates from published studies with the EFH Level 1 SDMs (Marsh et al. *In review*).

B.3 References

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B.4 Figures

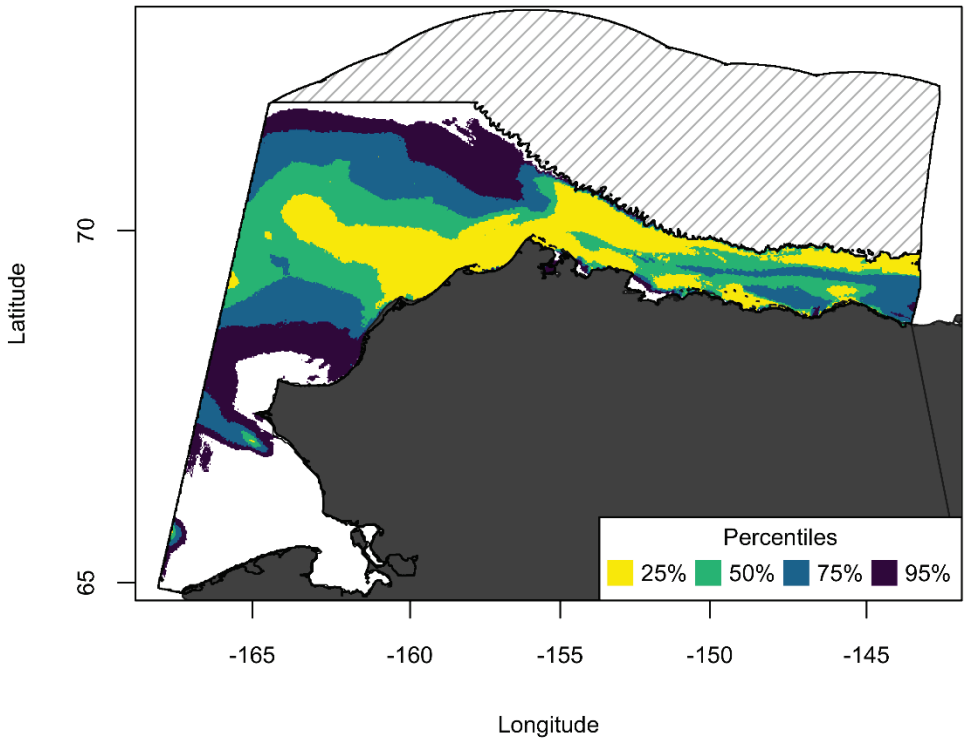

Figure B-1 EFH area of Arctic cod larvae, summer

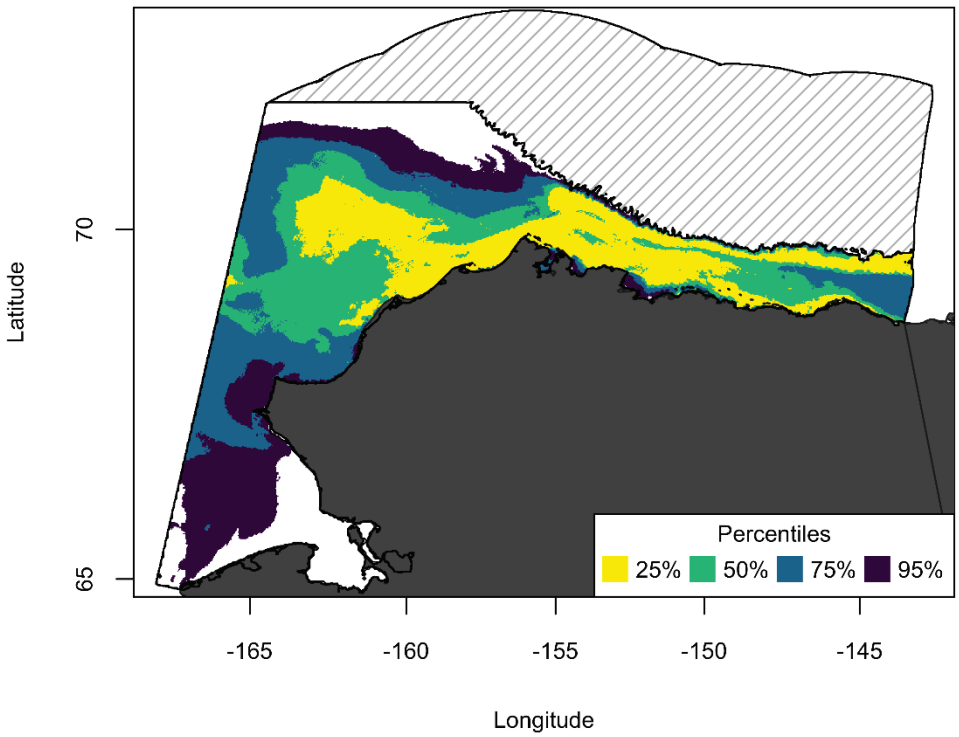

Figure B-2 EFH area of age-0 early juvenile Arctic cod, summer

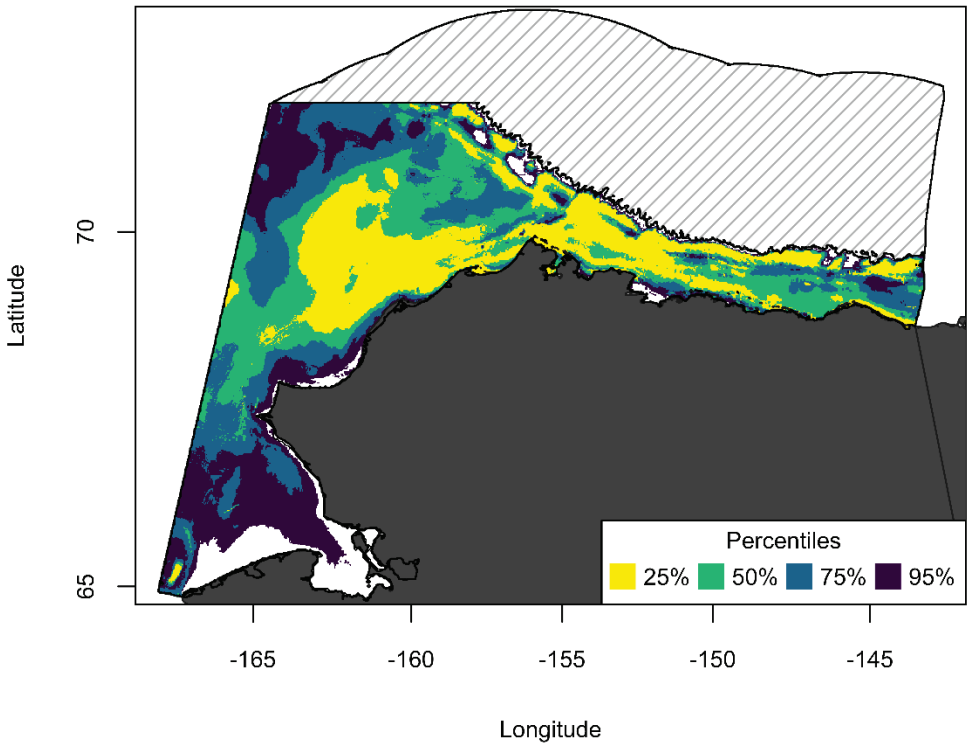

Figure B-3 EFH area of juvenile Arctic cod, summer

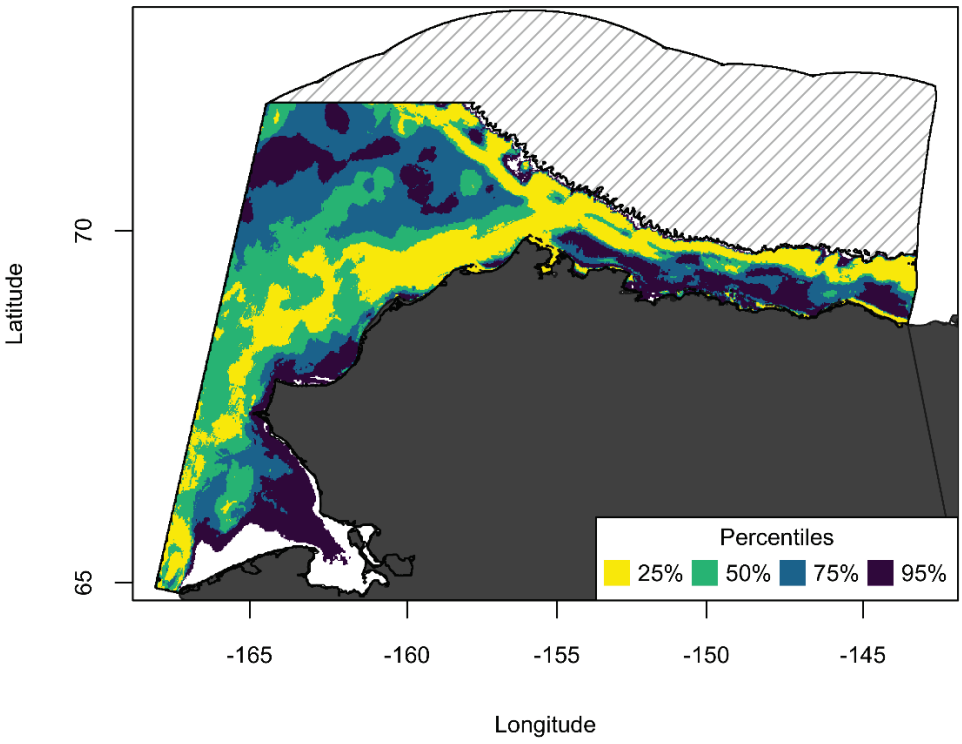

Figure B-4 EFH area of mature Arctic cod, summer

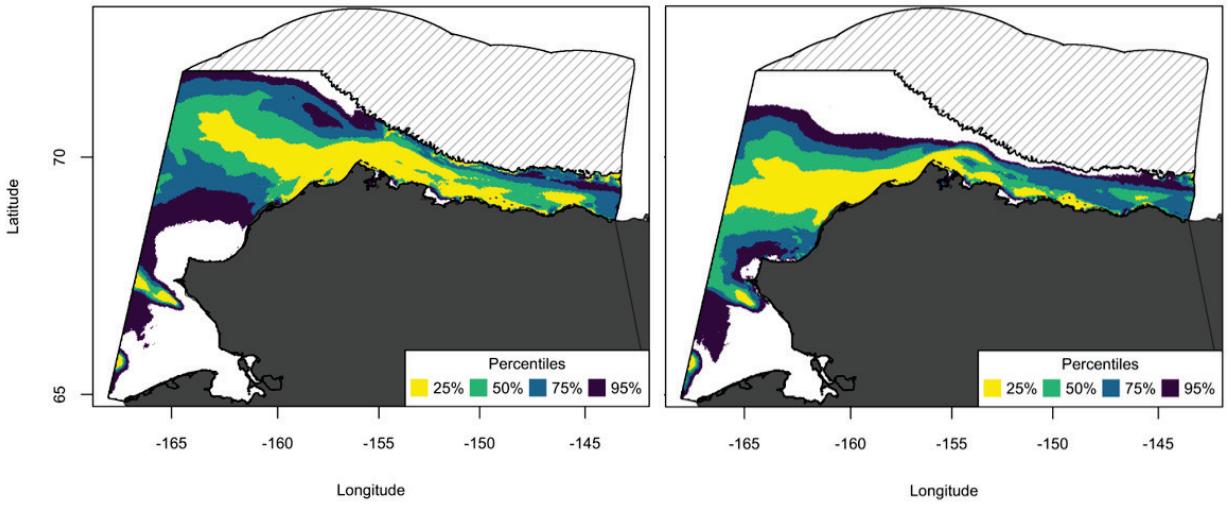

Figure B-5 EFH area of Arctic cod larvae in warm years (left panel) and cold years (right panel), summer

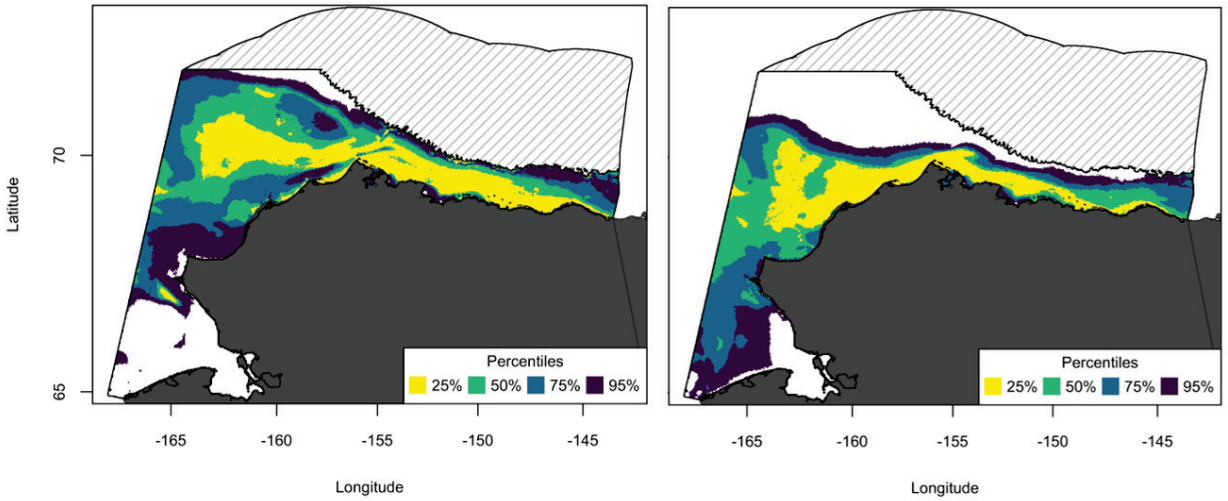

Figure B-6 EFH area of age-0 early juvenile Arctic cod in warm years (left panel) and cold years (right panel), summer

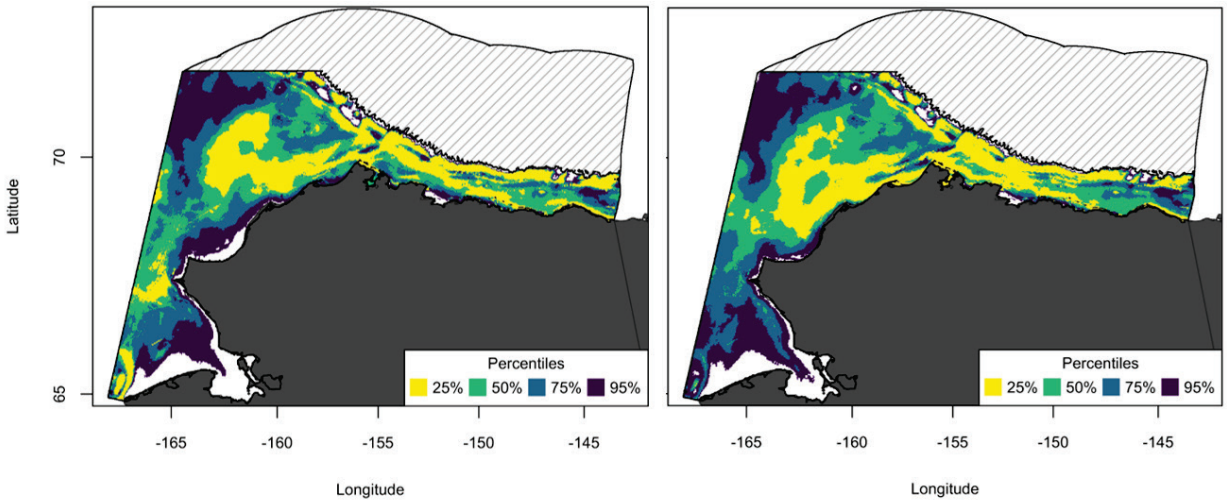

Figure B-7 EFH area of juvenile Arctic cod in warm years (left panel) and cold years (right panel), summer

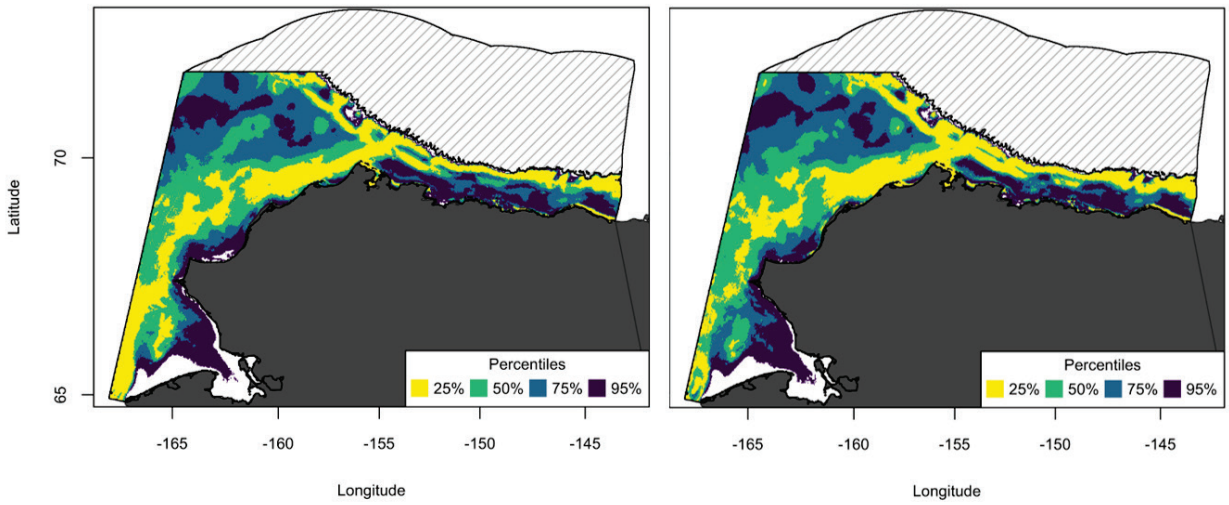

Figure B-8 EFH area of mature Arctic cod in warm years (left panel) and cold years (right panel), summer

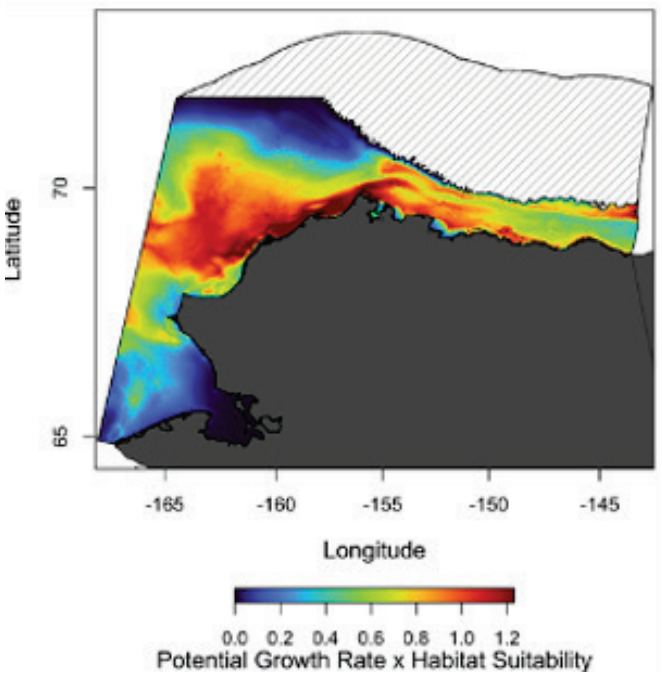

Figure B-9 EFH area of age-0 early juvenile Arctic cod, habitat-related growth potential, summer

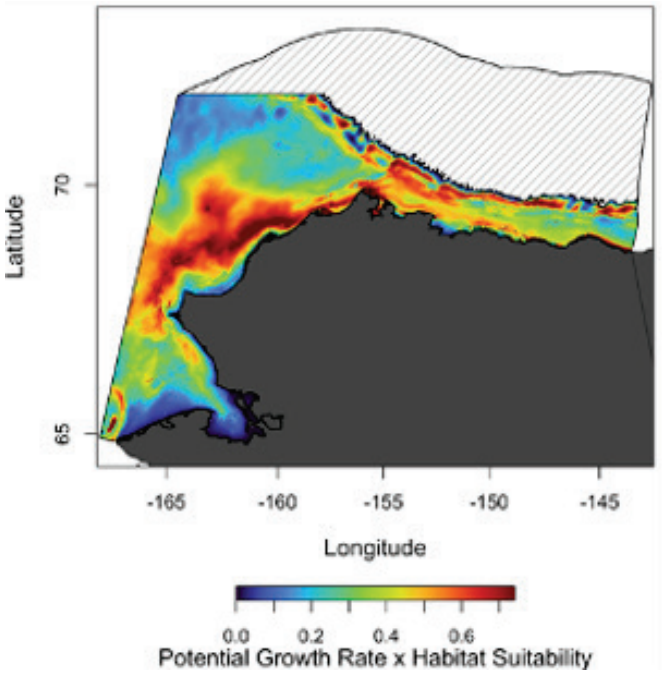

Figure B-10 EFH area of juvenile Arctic cod, habitat-related growth potential, summer

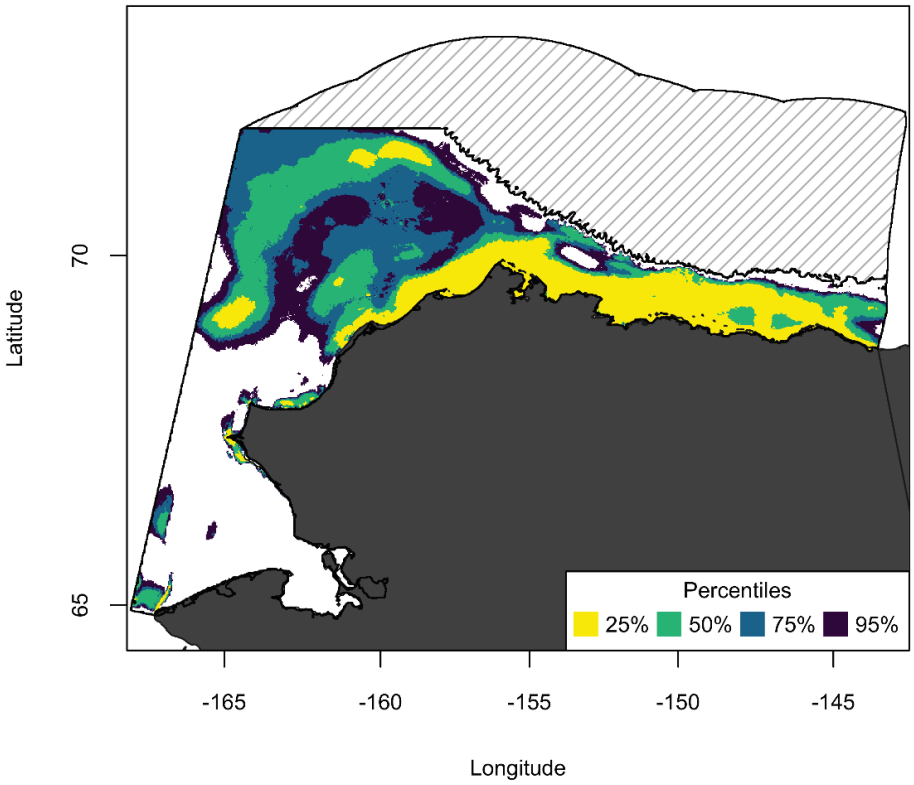

Figure B-11 EFH area of saffron cod larvae, summer

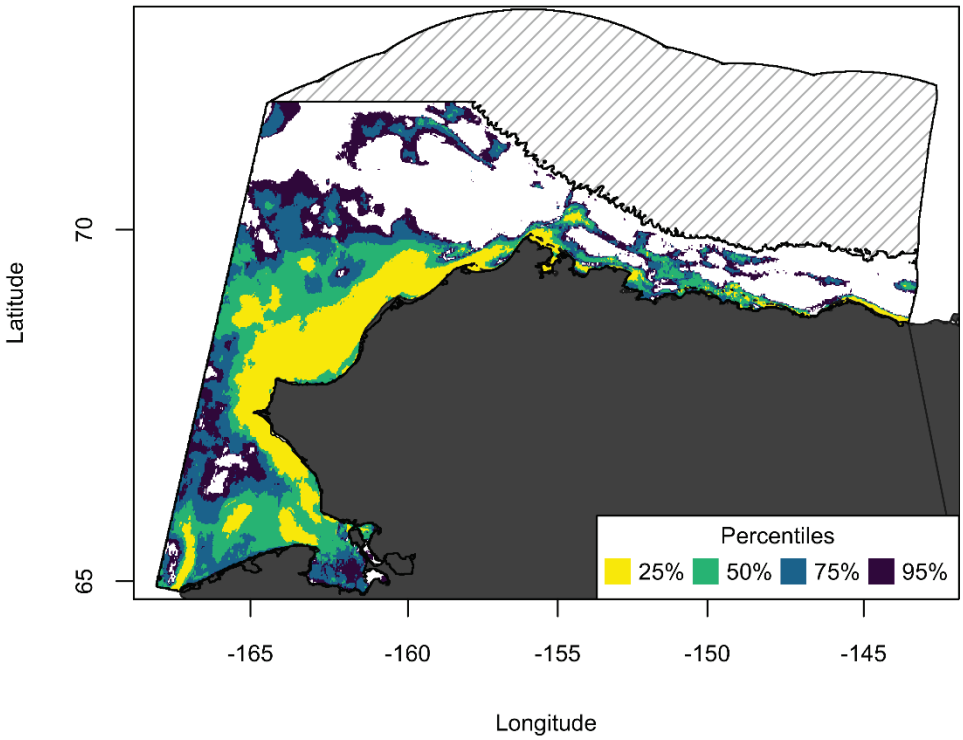

Figure B-12 EFH area of age-0 early juvenile saffron cod, summer

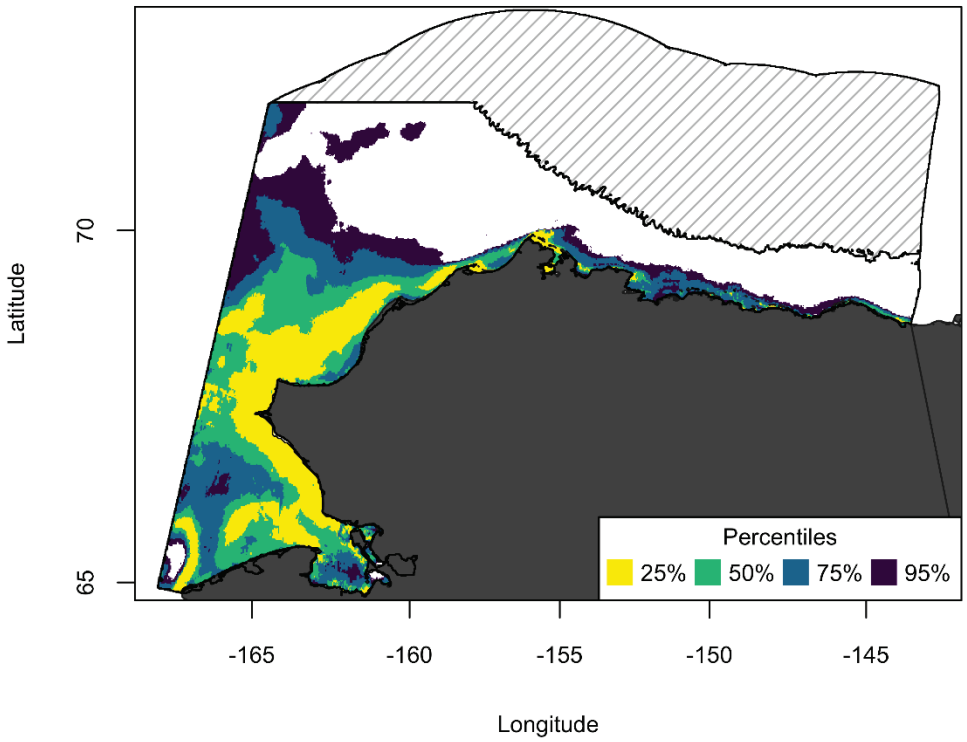

Figure B-13 EFH area of juvenile saffron cod, summer

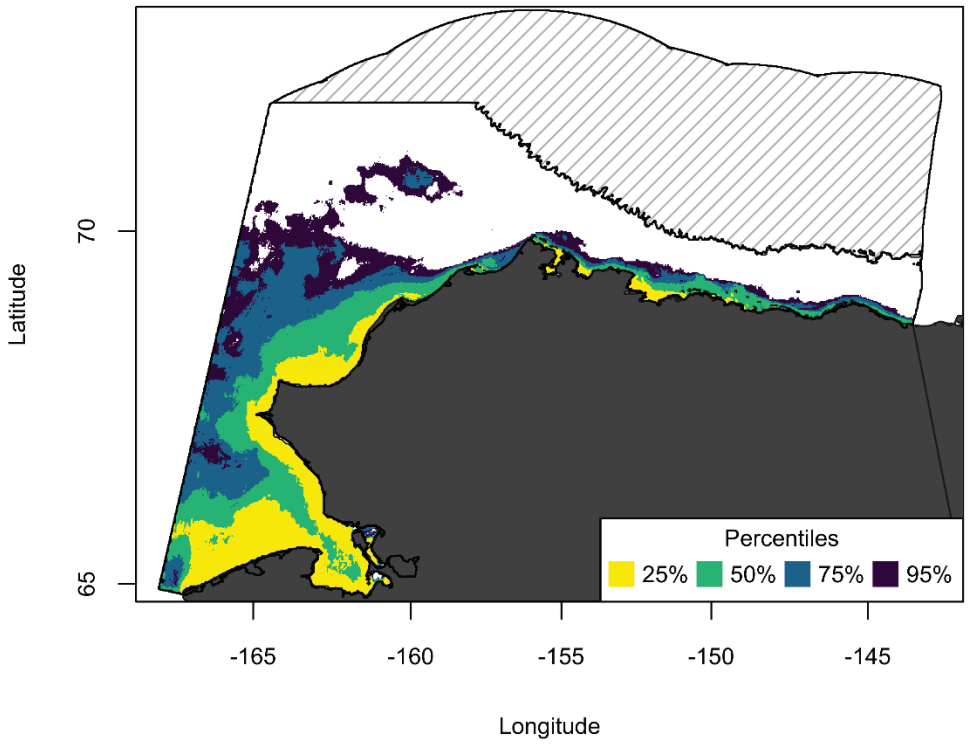

Figure B-14 EFH area of mature saffron cod, summer

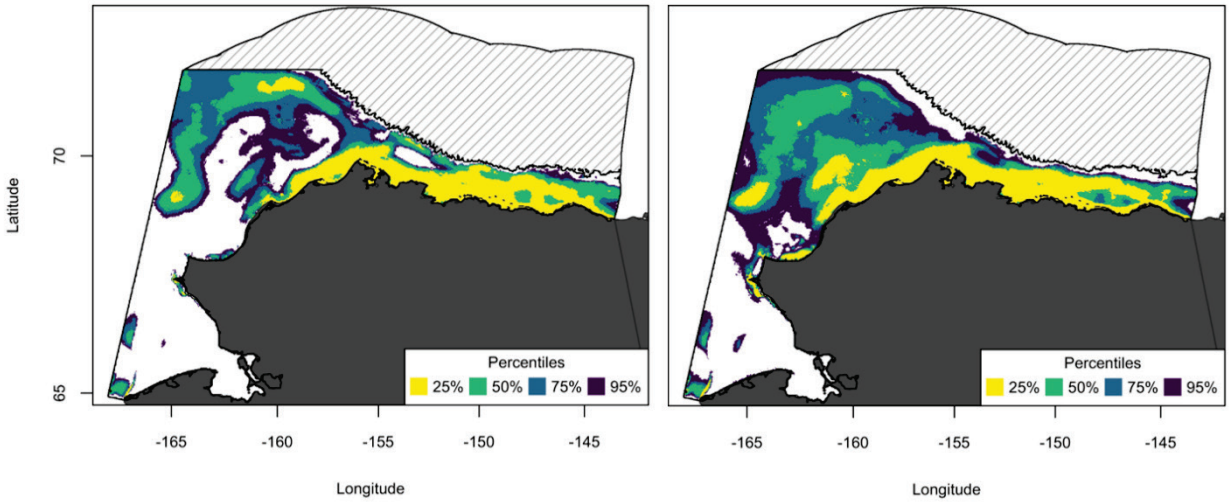

Figure B-15 EFH area of saffron cod larvae in warm years (left panel) and cold years (right panel), summer

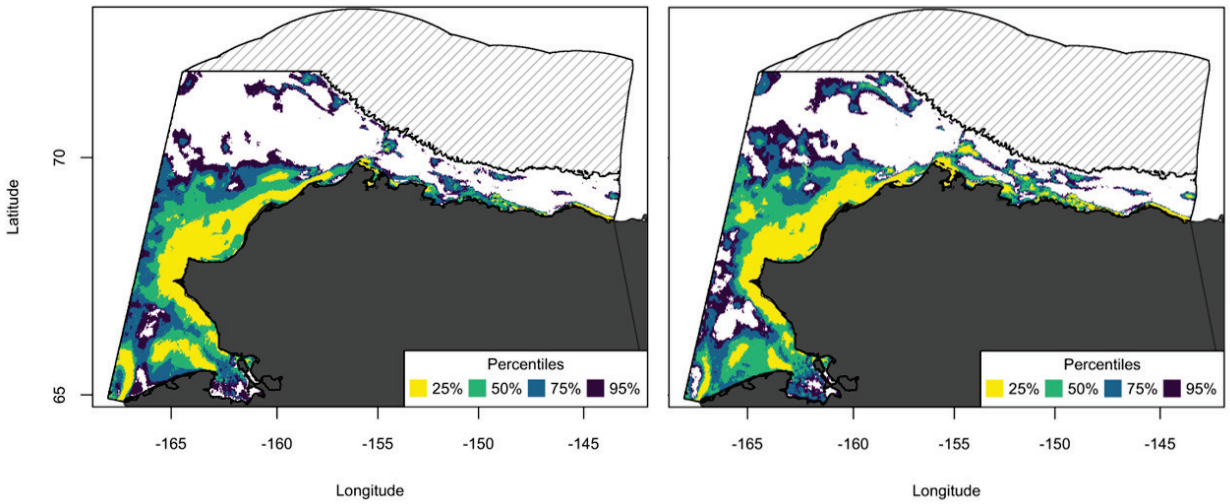

Figure B-16 EFH area of age-0 early juvenile saffron cod in warm years (left panel) and cold years (right panel), summer

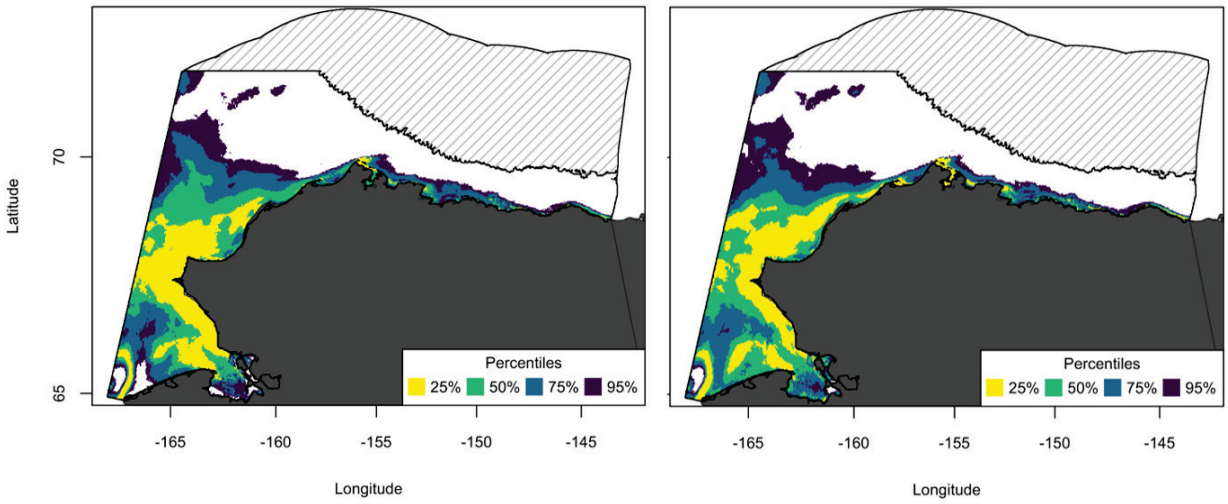

Figure B-17 EFH area of juvenile saffron cod in warm years (left panel) and cold years (right panel), summer

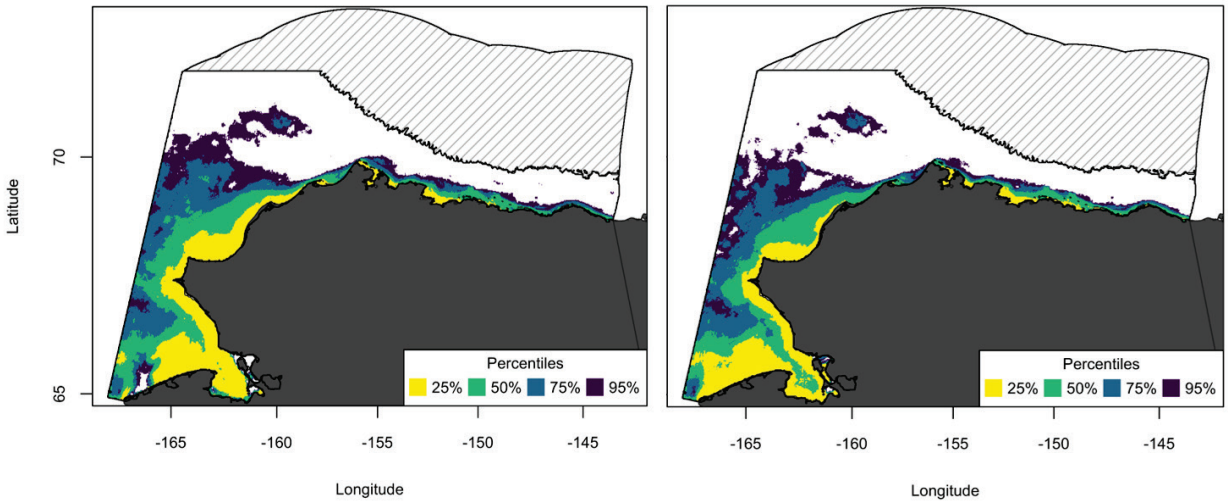

Figure B-18 EFH area of mature saffron cod in warm years (left panel) and cold years (right panel), summer

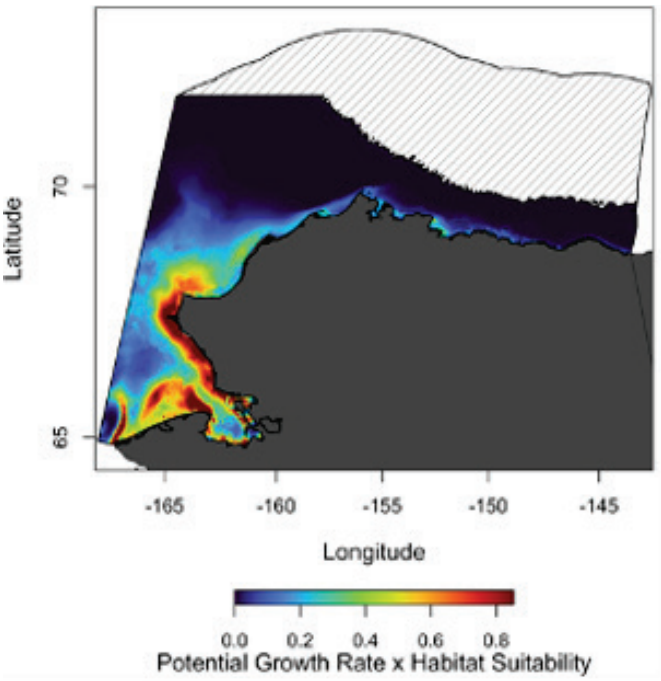

Figure B-19 EFH area of juvenile saffron cod, habitat-related growth potential, summer

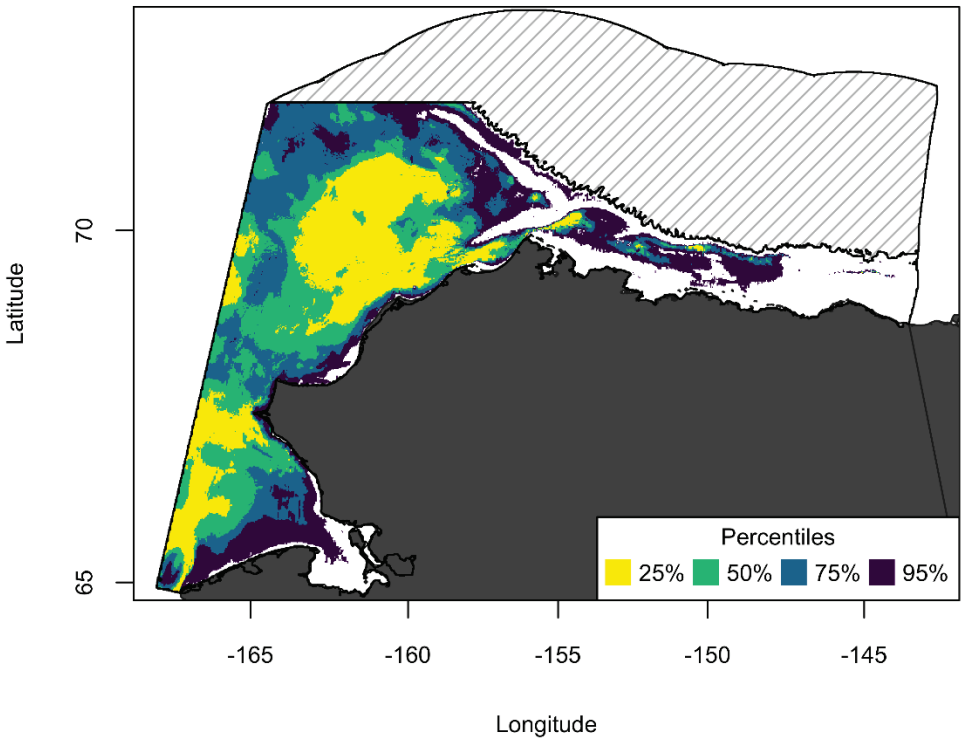

Figure B-20 EFH area of immature snow crab, summer

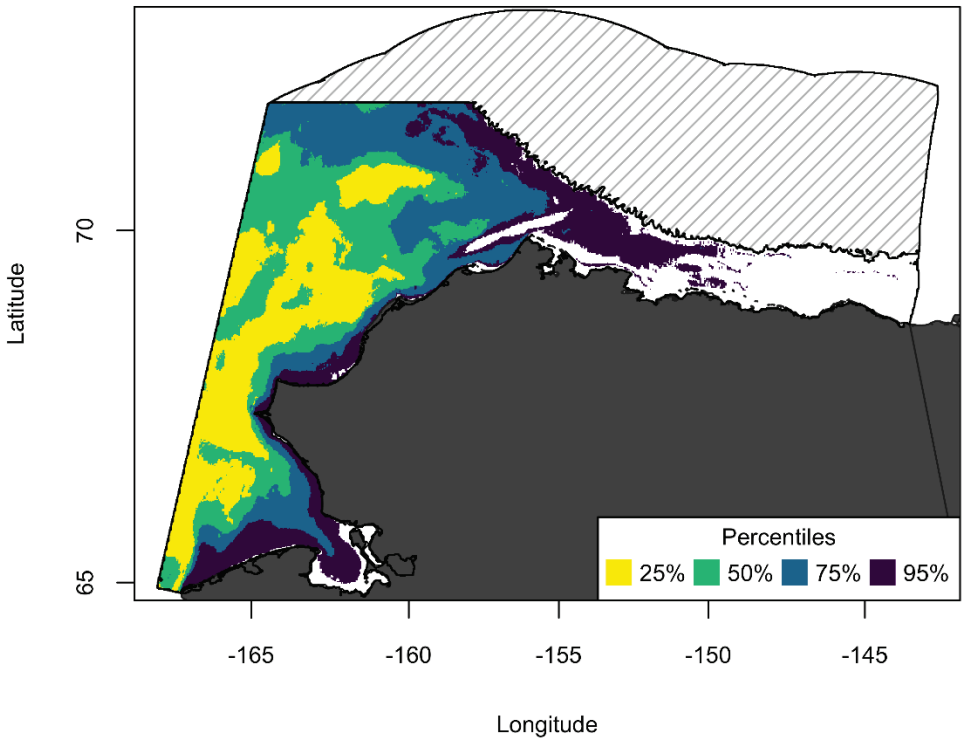

Figure B-21 EFH area of adolescent female snow crab, summer

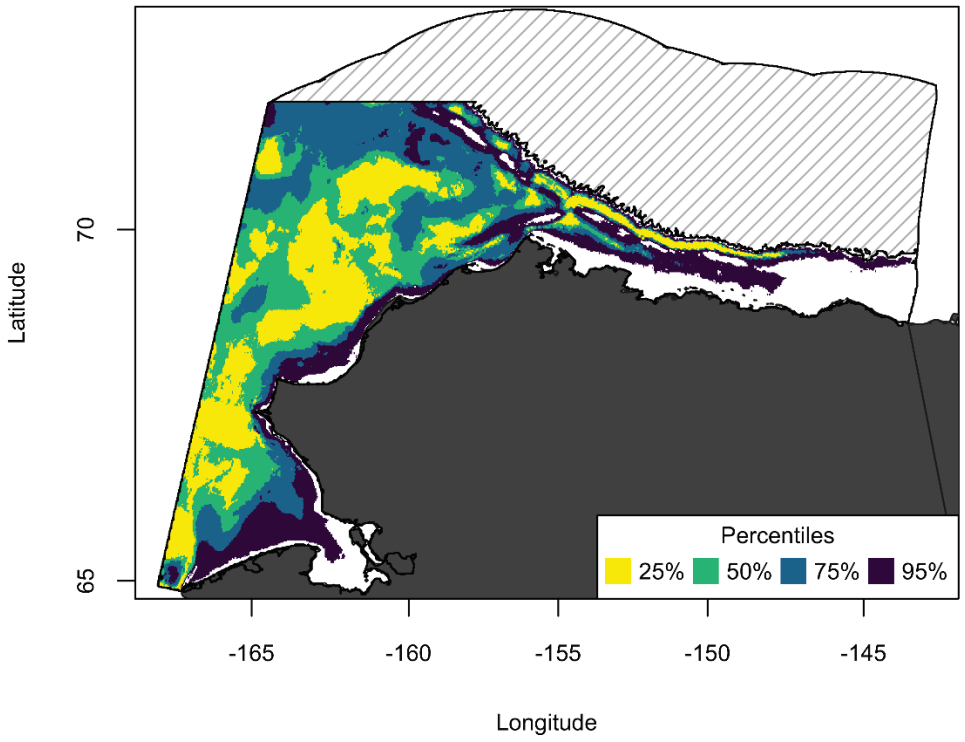

Figure B-22 EFH area of adolescent male snow crab, summer

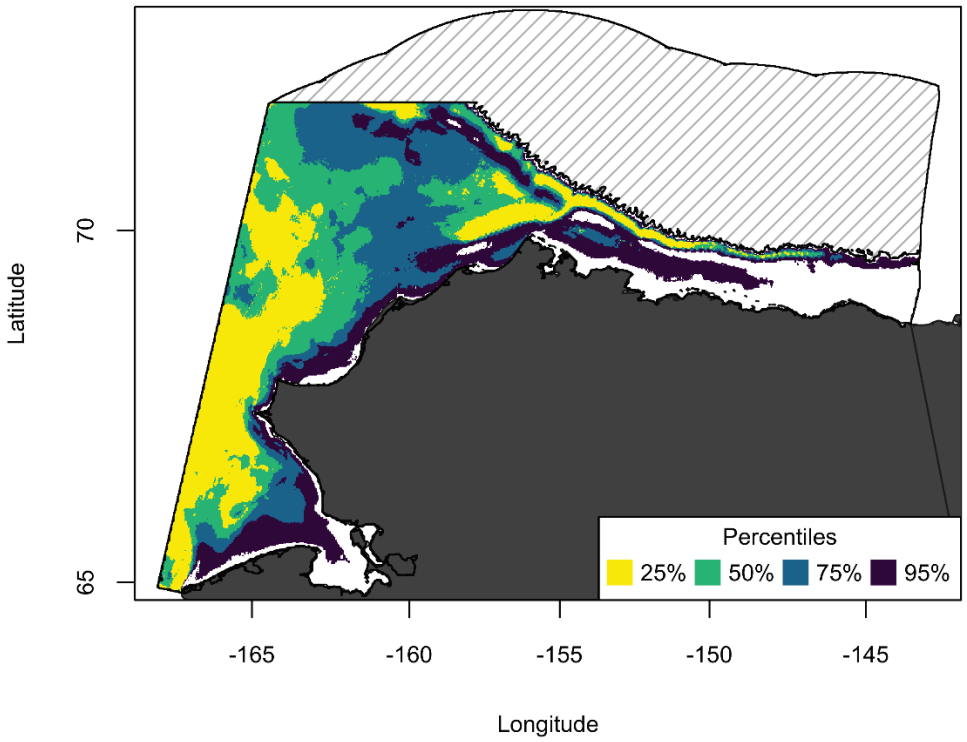

Figure B-23 EFH area of mature female snow crab, summer

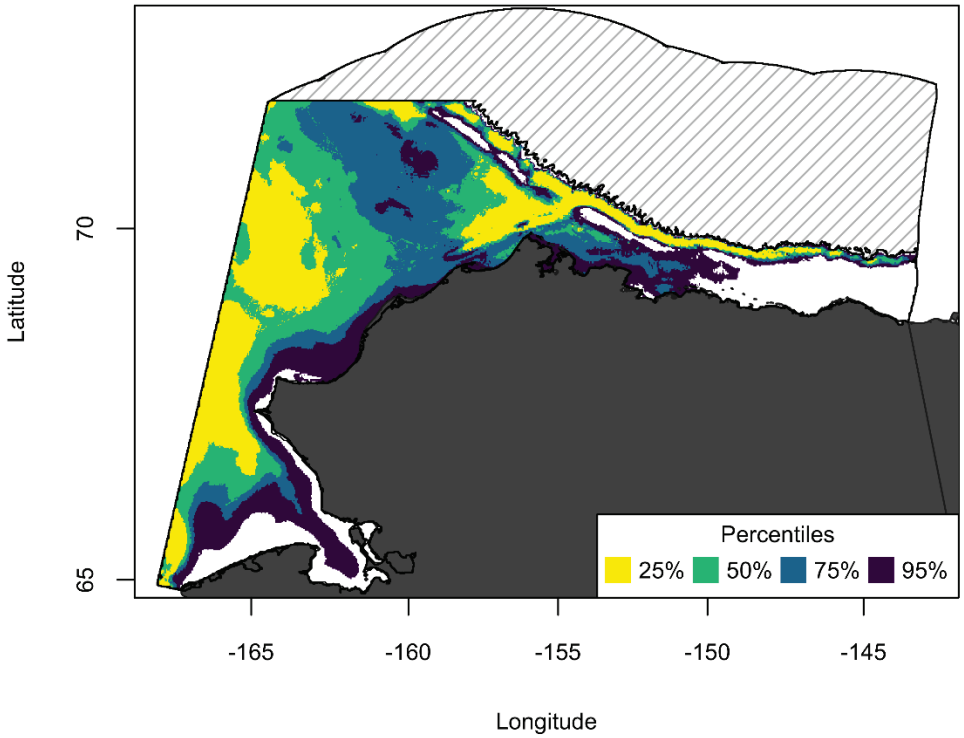

Figure B-24 EFH area of mature male snow crab, summer

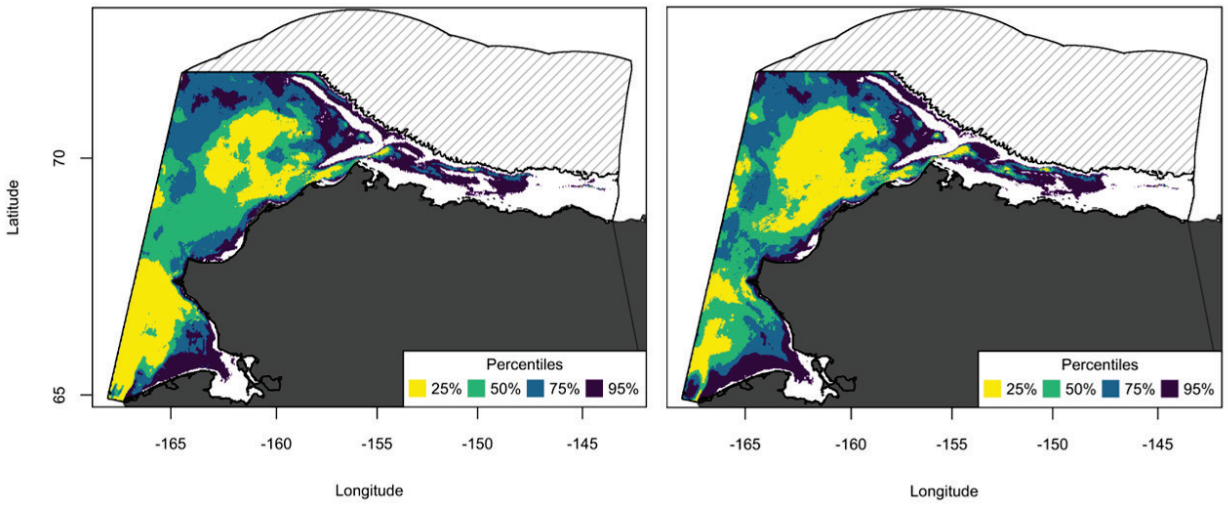

Figure B-25 EFH area of immature snow crab in warm years (left panel) and cold years (right panel), summer

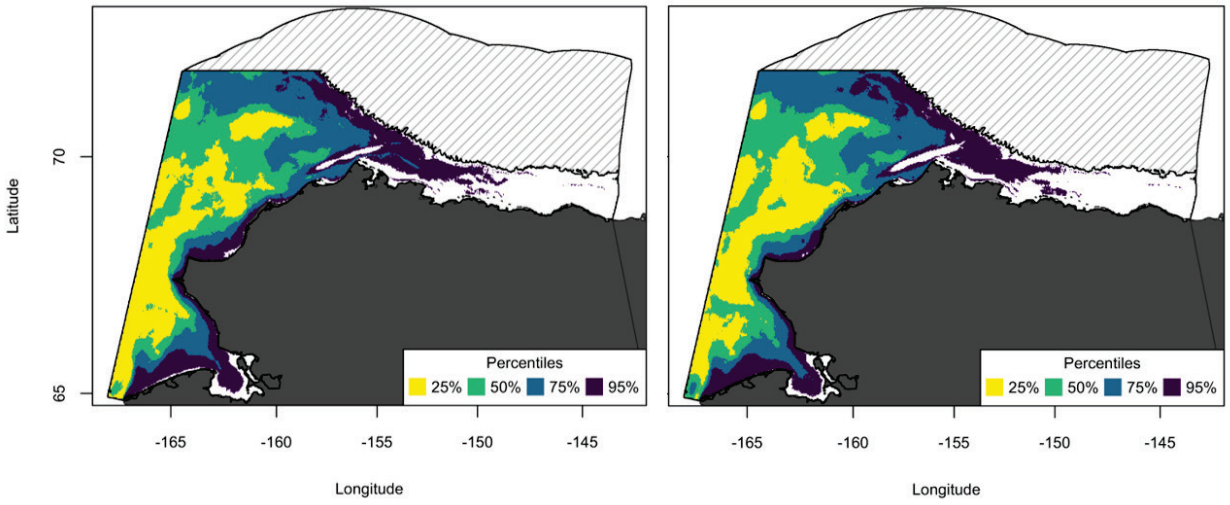

Figure B-26 EFH area of adolescent female snow crab in warm years (left panel) and cold years (right panel), summer

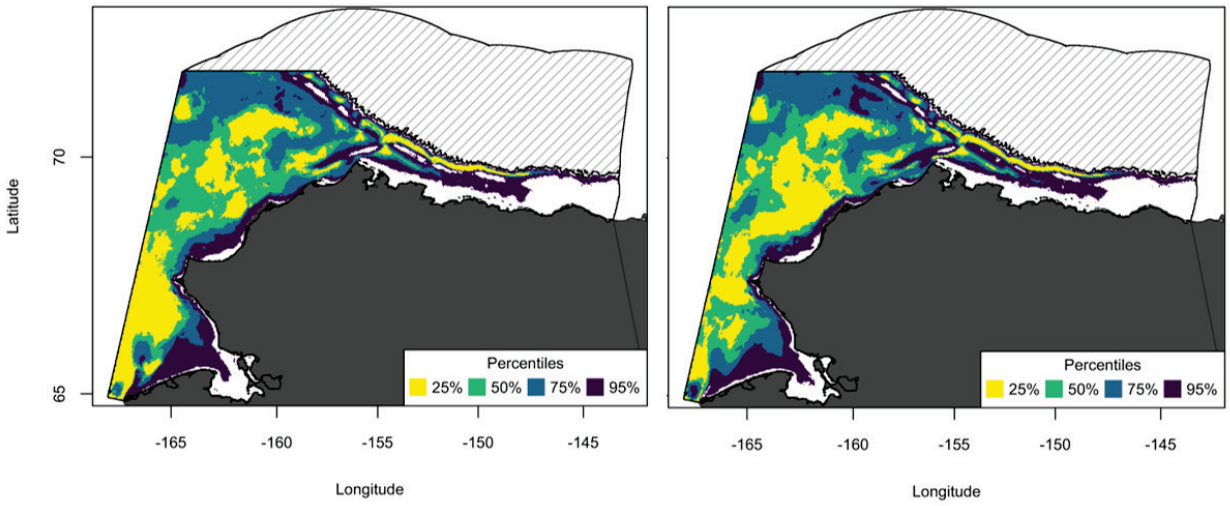

Figure B-27 EFH area of adolescent male snow crab in warm years (left panel) and cold years (right panel), summer

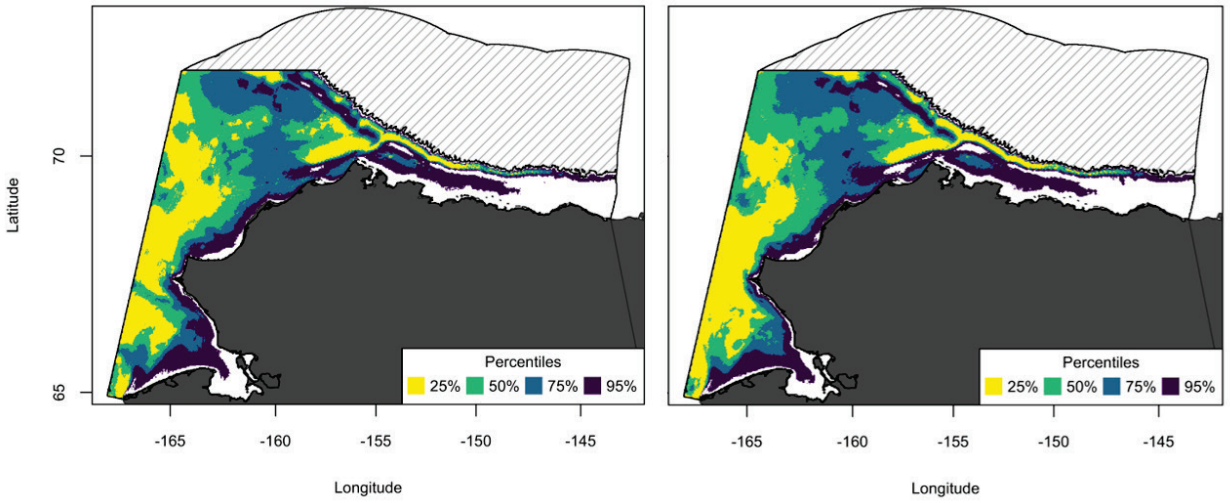

Figure B-28 EFH area of mature female snow crab in warm years (left panel) and cold years (right panel), summer

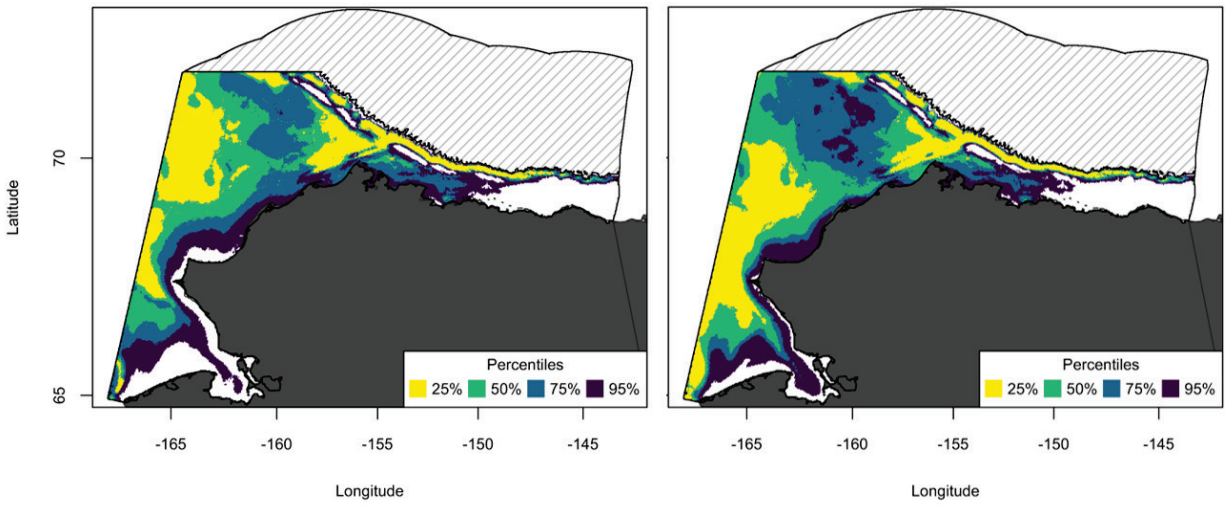

Figure B-29 EFH area of mature male snow crab in warm years (left panel) and cold years (right panel), summer

Appendix C Non-fishing Activities that May Adversely Affect Essential Fish Habitat

The waters, substrates, and ecosystem processes that support essential fish habitat (EFH) and sustainable fisheries are susceptible to a wide array of human activities and climate-related influences unrelated to the act of fishing. These activities range from easily identified, point source discharges in watersheds or nearshore coastal zones to less visible influences of changing ocean conditions, and increased variability in regional temperature or weather patterns. Broad categories of such activities include mining, dredging, fill, impoundments, water diversions, thermal additions, point source and nonpoint source pollution, sedimentation, introduction of invasive species, and the conversion of aquatic habitat that may eliminate, diminish, or disrupt the functions of EFH. For Alaska, non-fishing impacts are reviewed in the Non-Fishing Impacts Report, which NMFS updates during an EFH 5-year Review.

C.1 Non-Fishing Impacts and 2023 EFH 5-year Review

The most recent report, *Impacts to Essential Fish Habitat from Non-Fishing Activities in Alaska* (Limpinsel et al. 2023), presents a brief history of the Magnuson-Stevens Act and the language, provisions, and purpose supporting conservation of EFH. The report emphasizes the growing importance and implementation of Ecosystem Based Fisheries Management. This iteration recognizes climate change as an anthropogenic threat influencing EFH. Chapter 2 provides a discussion on how greenhouse gas emissions are warming the Arctic and influencing the atmosphere, ocean, and fisheries across Alaska. Chapters 3, 4 and 5 of this report address watersheds, estuaries and nearshore zones, and offshore zones, starting by highlighting the more commonly recognized physical, chemical, and biological processes that make each zone distinct. Each chapter discusses ecosystem processes, EFH attributes, sources of anthropogenic impacts that could compromise EFH, and proposes conservation recommendations to reduce the severity of those impacts. This report reflects the best available science.

C.2 Regulatory Alignment

The purpose of this report is to assist in the identification of activities that may adversely impact EFH and provide general EFH conservation recommendations to avoid or minimize adverse impacts. Section 305(b) of the Magnuson-Stevens Act requires Federal agencies to consult with NMFS on any action that they authorize, fund, or undertake, or propose to authorize, fund, or undertake, that may adversely affect EFH. Each Council shall comment on and make recommendations to the Secretary of Commerce, through NMFS, and any Federal or State agency concerning any such activity that, in the view of the Council, is likely to substantially affect the habitat, including EFH, of an anadromous fishery resource under its authority. If NMFS or the Council determines that an action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by any State or Federal agency would adversely affect any EFH, NMFS shall recommend to the agency measures that can be taken to conserve EFH. Within 30 days after receiving EFH conservation recommendations from NMFS, a Federal agency shall provide a detailed response in writing regarding the matter. If the response is inconsistent with NMFS's recommendations, the Federal agency shall explain its reasons for not following the recommendations.

EFH conservation recommendations are non-binding to Federal and state agencies. EFH consultations do not supersede regulations or jurisdictions of Federal or state agencies. NMFS has no authority to issue permits for projects or mandate measures to minimize impacts of non-fishing activities. Most non-fishing activities identified in this report are subject to numerous Federal, state, and local environmental laws and regulations designed to minimize and mitigate impacts to fish, wildlife and habitat.

C.3 Cumulative Effects

This section summarizes the cumulative effects of non-fishing activities on EFH. Cumulative impacts analysis is Component 5 of the ten EFH components. The cumulative effects of non-fishing activities on EFH were considered in the 2005 EFH EIS, but insufficient information existed to accurately assess how the cumulative effects of fishing and non-fishing activities influence ecosystem processes and EFH. The 2017 5-year Review reevaluated potential impacts of fishing and non-fishing activities on EFH using recent technologies and literature, and the current understanding of marine and freshwater fisheries science, ecosystem processes, and population dynamics (Simpson et al. 2017). Cumulative impacts analysis was not a component of focus for the 2023 EFH 5-year Review. The 2017 evaluation is summarized below with updated reference for the new non-fishing effects report.

The cumulative effects from multiple non-fishing anthropogenic sources are increasingly recognized as having synergistic effects that may degrade EFH and associated ecosystem processes that support sustainable fisheries. Non-fishing activities may have potential long term cumulative impacts due to the long term additive and chronic nature of the activities combined with climate change (Limpinsel et al. 2023). However, the magnitude of the effects of non-fishing activities cannot currently be quantified with available information. NMFS does not have regulatory authority over non-fishing activities, but frequently provides recommendations to other agencies to avoid, minimize, or otherwise mitigate the effects of these activities.

Each type of non-fishing activity alone may or may not significantly affect the function of EFH. The synergistic effect of the combination of all of these activities may also be a cause for concern. Unfortunately, available information is not sufficient to assess how the cumulative effects of non-fishing activities influence the function of EFH on an ecosystem or watershed scale. The magnitude of the combined effect of all of these activities cannot be quantified, so the 2017 EFH 5-year Review concluded that the cumulative level of concern is unknown.

C.4 References

Limpinsel, D., S. McDermott, C. Felkley, E. Ammann, S. Coxe, G. A. Harrington, S. Kelly, J. L. Pirtle, L. Shaw, and M. Zaleski. 2023. Impacts to Essential Fish Habitat from Non-Fishing Activities in Alaska: EFH 5-year review from 2018-2023. National Marine Fisheries Service, Alaska Region, Juneau, Alaska. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-F/AKR-30, 226 p. https://doi: 10.25923/9z4h-n860

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Appendix F Research Needs

F.1 Essential Fish Habitat Research and Information Needs

One of the required components of the EFH provisions of each FMP is to include research and information needs. Each FMP should contain recommendations for research efforts that the Councils and NMFS view as necessary to improve upon the description and identification of EFH, the identification of threats to EFH from fishing and other activities, and the development of conservation and enhancement measures for EFH.

F.2 Alaska EFH Research Plan

A new Alaska EFH Research Plan that revises and supersedes earlier plans will guide research to support the next EFH 5-year Review and other fishery management information needs where advancements in habitat science are helpful (Pirtle et al. 2023). The Alaska EFH Research Plans have included five long term research goals that remain consistent with minor, meaningful updates since 2005. EFH research recommendations were informed during the 2023 EFH 5-year Review by contributing researchers, stock assessment scientists, and Council advisory bodies. These recommendations were summarized as three objectives for the new Alaska EFH Research Plan.
In addition, as part of the 2023 EFH 5-year Review, each stock assessment author provided a stock-specific evaluation of EFH research needs. These research needs also contributed to the research objectives in the revised Alaska EFH Research Plan.
These long term research goals, timely objectives, and species specific recommendations are informative as updates to the EFH research recommendations in the GOA Groundfish FMP.

F.2.1 EFH Research Recommendations

Five long-term research goals have been included in Alaska EFH Research Plans since 2005 (e.g., Sigler et al. 2017, Pirtle et al. 2023)—

1. Characterize habitat utilization and productivity at regional scales;
2. Assess sensitivity, impact, and recovery of disturbed benthic habitat;
3. Improve modeling and validation of human impacts on marine habitat;
4. Improve information regarding habitat and seafloor characteristics; and
5. Assess coastal and marine habitats facing human development.

These goals represent the need to understand habitat characteristics and their influence on observed habitat utilization and productivity for fishes and invertebrates. These goals also emphasize the importance of understanding human impacts on habitat (e.g., fishing, coastal development, and ongoing climate change), how these impacts in turn affect habitat utilization and productivity, and assessing the consequences of these impacts at regional scales.
To achieve these goals the complementary role and equal importance of targeted field and laboratory experiments, long-term monitoring, and analytical work should be emphasized to model and map the progressive levels of EFH information (EFH component 1) and impacts at a regional scale (EFH components 2, 4, and 5). In particular:

- Field and laboratory experiments are necessary to understand ecological mechanisms that underlie habitat association, vital rates and productivity, and how human activities (including fishing, development, and climate change) cause changes in habitat conditions and resulting

utilization and productivity. In particular, understanding causality is not possible without experimental support. Understanding ecological mechanisms (i.e., causality) is also necessary to predict the likely impact of human impacts that have not previously been observed;

- Long-term monitoring is necessary to understand habitat utilization and productivity at regional scales;
- Analysis including statistical and mathematical modeling is needed to map the geographic distribution of the area of occupied habitat (EFH) for life stages of targeted FMP species and their prey and is also necessary to identify changes in habitat utilization likely resulting from human activities and climate change.

Without these three elements, applied habitat research cannot be successful.
In addition to the five long term research goals, three objectives are emphasized as important for research progress and preparation for future EFH 5-year Reviews and are described in the Alaska EFH Research Plan (Pirtle et al. 2023). These objectives were informed by recommendations from contributing researchers, stock assessment scientists, and Council advisory bodies during the 2023 EFH 5-year Review and are written with consideration of research needs across FMPs.

Objective 1: Improve EFH information for targeted species and life stages
The first objective seeks to improve EFH information for species and life stages that were identified as requiring further research during the 2023 EFH 5-year Review, as well as other targeted FMP species that were not updated in 2023 (i.e., salmon ocean life stages and scallops) under EFH component 1. Studies should focus on methods development with practical application to improve EFH information for a select set of species life stages, where the following pathways are recommended:

1. **Additional field data:** Collecting and incorporating additional field data in the models used to identify and describe EFH, beyond the large-mesh bottom trawl summer survey data that were used primarily during the 2017 and 2023 EFH 5-year Reviews. The importance of including alternative gear types to the extent practicable is emphasized, including longlines, pots, small-mesh and pelagic trawls, focusing on under-sampled life stages and habitats. The application of alternative data sources such as predator stomach contents and fishery-dependent catch and effort data is also encouraged. Sampling may also be used to improve understanding of seasonal variation in habitat use. This will presumably involve measuring (via paired experiments) or estimating a fishing-power correction between multiple sampling gears. When analyzed properly, these additional data sources can provide complementary information to characterize habitat profiles for life stages of targeted FMP species.
2. **Demographic processes driving variation over time:** Research focused on identifying processes that drive shifts in habitat use and productivity is recommended. This may involve hindcasting and forecasting methods, including (but not limited to) fitting models with covariates that vary over time, conditioning predictions upon spatio-temporal residuals, incorporating information about trophic interactions, and separately analyzing numerical density and size information. This might also involve process research, e.g., incorporating information about individual movement from tags, behavioral and eco-physiological experiments, or other process research. This likely requires methodological development and testing and could be focused on a few case-study species or species' life stages that are likely to be shifting substantially, for consideration during the future 5-year Reviews.
3. **Improved methods to integrate both monitoring and process research:** Continued development of new analytical methods to integrate process research is recommended when identifying species habitat utilization, vital rates, and productivity. Analytical methods might include individual- and agent-based models (IBMs) that "scale up" laboratory measurements, particularly when IBM output is used as a covariate or otherwise combined with survey and other

species sampling information. This process research might include juvenile survival, growth, and movement experiments and habitat-specific observations. Ideally, these new methods would include process information and monitoring data simultaneously, rather than either a. seeking to validate an IBM via comparison with monitoring data without explicitly incorporating these data, or b. fitting to monitoring data without incorporating field or laboratory experimental data.

Objective 2: Improve fishing effects assessment
The second objective addresses the ongoing need to develop and improve methods to assess fishing impacts on habitat utilization and productivity (EFH component 2). Research pathways might include:

1. **Advance methods to assess fishing impacts:** It is often helpful to compare results from a variety of analytical methods and approaches. Advancing the existing Fishing Effects model (Smeltz et al. 2019) is recommended as well as developing new analytical approaches to address potential impacts of fishing to EFH.
2. **Cumulative effects:** Methods development is recommended to identify the cumulative effect of fishing and non-fishing human activities to EFH, including ongoing climate change (EFH component 5).

Objective 3: Improve understanding of nearshore habitat and forage species
The third objective acknowledges that additional research is needed regarding critical nearshore life stages and for the prey species that represent an important component of habitat suitability and EFH. Research may include the following pathways:

1. **Nearshore habitat:** Ongoing and expanded scientific efforts to understand habitat utilization and productivity into nearshore environments (EFH component 1). This nearshore habitat is critical for juvenile life stages of many targeted FMP species (e.g., Pacific cod, flatfishes, salmonids) and prey species (EFH component 7) and is also subject to substantial impacts from human development. Improved understanding of nearshore habitat is intended to support the EFH consultations that are done near areas with human development (urban areas as well as shipping activities) (EFH components 4 and 5). Understanding nearshore habitat may also support improved understanding of recruitment processes and population connectivity. Data are available in the Nearshore Fish Atlas of Alaska and ShoreZone, and analytical methods have already been demonstrated (e.g., Grüss et al. 2021), but there remains substantial work to scale these methods to more species and within geographic areas of specific interest.
2. **Prey species:** Increased efforts are recommended to understand habitat utilization and productivity for those species that represent the primary prey for targeted FMP species (EFH component 7). This can include pelagic forage fishes (e.g., herring, eulachon, sand lance, etc.), juvenile stages of numerically abundant species (e.g., pollock, Pacific cod, salmonids), as well as invertebrates (e.g., Euphausiids, snow crab). Improved understanding of habitat-specific densities (i.e., Level-2 EFH information) can then be used as a covariate for understanding habitat suitability for their predators (i.e., targeted FMP species).

F.1 References

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