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Alaska Essential Fish Habitat Research Plan

A Research Plan for the National Marine Fisheries Service's Alaska Fisheries Science Center and Alaska Regional Office

NOAA FISHERIES

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by:
Jodi L. Pirtle[1]
James T. Thorson[2]
Skylar R. Bayer[1]
Thomas P. Hurst[2]
Mary Elizabeth Matta[2]
Margaret C. Siple[2]

[1]National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Alaska Region, Habitat Conservation Division
P.O. Box 21668 709 W. 9th Street
Juneau, Alaska 99802

[2]National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Alaska Fisheries Science Center
7600 Sand Point Way NE
Seattle, Washington 98115

For Assistance with this Document

Hard copies may be obtained by contacting: Jodi.Pirtle@noaa.gov.

Suggested changes, additions, or questions should be directed to Jodi.Pirtle@noaa.gov for consideration in updating this document.

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Introduction

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) includes provisions concerning the identification and conservation of essential fish habitat (EFH). The MSA defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The National Marine Fisheries Service (NMFS) and regional fishery management councils must describe and identify EFH in fishery management plans (FMPs), minimize to the extent practicable the adverse effects of fishing on EFH, and identify other actions to encourage the conservation and enhancement of EFH. Federal agencies that authorize, fund, or undertake actions that may adversely affect EFH must consult with NMFS, and NMFS must provide conservation recommendations to federal and state agencies regarding actions that would adversely affect EFH. EFH consultations occur for both fishing and non-fishing activities. The National Standard guidelines of the MSA facilitate the incorporation of ecosystem-based fishery management into federal fishery management. National Standard 2 requires NMFS to conserve and manage fishery resources based upon the best available scientific information. To meet these mandates, NMFS research must identify habitats that contribute most to the survival, growth, and productivity of managed fish species and determine science-based measures to best manage and conserve these habitats from adverse effects of human activities.

Section 303(a)(7) of the MSA requires that FMPs describe and identify EFH based on the guidelines established by the Secretary of Commerce under section 305(b)(1)(A) of the MSA. Federal regulations at 50 CFR 600.815 require that each FMP contains the following 10 EFH components:

1. EFH descriptions and identification
2. Fishing activities that may adversely affect EFH
3. Non-Magnuson-Stevens Act fishing activities that may adversely affect EFH
4. Non-fishing activities that may adversely affect EFH
5. Cumulative impacts analysis
6. EFH conservation and enhancement recommendations
7. Prey species list and habitat locations
8. Habitat Areas of Particular Concern (HAPC) identification
9. Research and information needs
10. Review and revision of EFH every 5 years

Component 1 (descriptions and identification of EFH) consists of maps, written descriptions, and tables in the FMPs and their appendices. The EFH regulations provide an approach to organize the information necessary to describe and identify EFH (50 CFR 600.815(a)(1)(iii)). When designating EFH, the Council and NMFS should strive to describe and identify EFH information at the highest level possible (50 CFR 600.815(a)(1)(iii)(B))—

- 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 of the species within habitats are available.
- Level 4: Production rates of the species by habitat are available.

See Appendix A for more details. In Alaska, EFH information for most FMP species is Level 2 or Level 1. Level 3 information is available for a subset of groundfish species' life stages based on temperature-dependent vital rates. Level 4 information has not been designated for any species' life stages at this time. EFH research is conducted in part to elevate the EFH level for the studied species.

In the following, we first update the five long-term research goals that have been included in Alaska EFH Research Plans since 2005 (e.g., Sigler et al. 2017). We then outline three objectives that require particular emphasis over the coming years. This document revises and supersedes these earlier plans and guides the next five years of EFH research. Revisions of the Research Plan are timed to match the required EFH 5-year Reviews by the North Pacific Fishery Management Council (Council).

Long-term Research Goals

Previous EFH research plans for Alaska have included five long-term research goals (Sigler et al. 2017; Appendix B). We provide small updates to the wording of these goals while largely maintaining their intent to now read:

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;
5. Assess coastal and marine habitats facing human development.

See Appendix B for full descriptions of each. 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, we emphasize the complementary role and equal importance of (1) targeted field and laboratory experiments, (2) long-term monitoring, and (3) analytical work 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. We also note that EFH research does not typically support long-term monitoring directly. Instead, EFH research in Alaska typically leverages long-term monitoring that is conducted to support other research activities (e.g., biological surveys developed for use in stock assessments). However, EFH funding in Alaska could support development and operational testing (i.e., pilot experiments) for new approaches to long-term monitoring, focusing in particular on those approaches that are likely to also be applicable to other Alaska fisheries research and are therefore likely to meet other management information needs after their potential has been demonstrated.

Timely Objectives

In addition to the five long-term research goals, we also identify three objectives that we emphasize as important for research progress and preparation for the next EFH 5-year Review. These objectives have been informed by Council bodies, stock assessment scientists, and researchers affiliated with AFSC and AKRO who provided recommendations during the most recent EFH 5-year Review cycle. We recommend that available funding for EFH research be targeted to achieve the following three objectives, while also being consistent with the five long-term goals.

Objective 1: Improve EFH information for targeted species and life stages

Our 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.

We specifically envision the following paths to improving EFH information:

1. *Additional field data*: We recommend 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. We emphasize the importance of alternative gear types including longlines, pots, small-mesh and pelagic trawls focusing on under-sampled life stages and habitats. We also encourage the application of alternative data sources such as predator stomach contents and fishery-dependent catch and effort data. 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*: We recommend research focused on identifying processes that drive shifts in habitat use and productivity. 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. We envision that this will require some methodological development and testing, and that it would be focused on a few case-study species or life stages that are likely to be shifting substantially, for consideration during the next 5-year Review.

3. *Improved methods to integrate both monitoring and process research*: We recommend continued development of new analytical methods to integrate process research 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

Our second objective addresses the ongoing need to develop and improve methods to assess fishing impacts on habitat utilization and productivity (EFH component 2). We specifically envision several potential research pathways:

1. *Additional methods to assess fishing impacts*: It is often helpful to compare results from a variety of analytical methods and approaches, and we recommend both extending the existing "Fishing effects" model (Smeltz et al. 2019[1]) as well as developing new models that address other potential impacts of fishing.

2. *Cumulative effects*: Similarly, we recommend method development 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

Our 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. We specifically envision the following paths for research:

1. *Nearshore habitat*: We recommend 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

[1] Smeltz, T.S., Harris, B., Olson, J., and Sethi, S. 2019. A seascape-scale habitat model to support management of fishing impacts on benthic ecosystems. Canadian Journal of Fisheries and Aquatic Sciences 76(10): 1836-1844 https://doi.org/10.1139/cjfas-2018-0243

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 (Grüss et al. 2021[2]), but there remains substantial work to scale these methods to more species and within geographic areas of specific interest.

2. *Prey species*: We also recommend increased efforts 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 (herring, eulachon, sand lance, etc.), juvenile stages of numerically abundant species (pollock, Pacific cod, salmonids), as well as invertebrates (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).

Research Funding Plan

The EFH Request for Proposals (RFP) has supported $350,000 in EFH research annually, and is expected to continue for the foreseeable future. During the previous EFH Research Plan, the RFP has invited both single and multi-year projects. We envision continuing the same single- and multi-year RFP process until the next EFH update (see Appendix C for the proposal format). Funded projects are also required to submit an annual progress report (see Appendix D for progress report format) until the project deliverables are all completed.

Citations

Sigler, M. F., M. P. Eagleton, T. E. Helser, J. V. Olson, J. L. Pirtle, C. N. Rooper, S.C. Simpson, and R. P. Stone. 2017. Alaska Essential Fish Habitat Research Plan: A Research Plan for the National Marine Fisheries Service's Alaska Fisheries Science Center and Alaska Regional Office. AFSC Processed Rep. 2015-05, 22 p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar. Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115. https://apps-afsc.fisheries.noaa.gov/Publications/ProcRpt/PR2017-05.pdf

[2] Grüss, A., J.L. Pirtle, J.T. Thorson, M.R. Lindeberg, A.D. Neff, S.G. Lewis, and T.E. Essington. 2021. Modeling nearshore fish habitats using Alaska as a regional case study. Fisheries Research 238: 105905 https://doi.org/10.1016/j.fishres.2021.105905

Appendix A: Definitions of EFH Levels

See 50 CFR § 600.815 (2002), Contents of Fishery Management Plans, 67 FR 2376. This table is repeated from Sigler et al. (2017; Appendix 1).

Level	Definition	Information necessary to describe and identify EFH
1	Distribution data are available for some or all portions of the geographic range of the species	At this level, only distribution data are available to describe the geographic range of a species (or life stage). Distribution data may be derived from systematic presence/absence sampling and/or may include information on species and life stages collected opportunistically. In the event that distribution data are available only for portions of the geographic area occupied by a particular life stage of a species, habitat use 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. Habitat use may also be inferred, if appropriate, based on information on a similar species or another life stage.
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 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.
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 stage. The habitats contributing the most to productivity should be those that support the highest growth, reproduction, and survival of the species (or life stage).
4	Production rates by habitat are available	At this level, data are available that directly relate the production rates of a species or life 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.

Appendix B: Long-term research goals

We list here the five long-term goals of Alaska EFH research. The wording has been updated somewhat since the previous research plan (Sigler et al. 2017), but intent of these five goals is largely consistent across all previous EFH research plans:

1. **Characterize habitat utilization and productivity at regional scales** – The EFH research plan supports studies that refine the description and identification of EFH in FMPs. This priority focuses on understanding the relationship between habitat type, patterns of use by species, and differences in productivity between habitats of managed fish and invertebrate species. Our approach includes supporting integrated research projects that combine measurements of habitat characteristics, habitat utilization, and/or habitat productivity, and also combine laboratory experiments, controlled field manipulations, and field observations. We also intend that information from these studies can be extended to other fishery management on-ramps such as stock assessment and addressing climate change in the context of EBFM.
2. **Assess sensitivity, impact, and recovery of disturbed benthic habitat** – Habitat-forming biota such as corals and sponges often are sensitive to human activity and may take many years to recover from disturbance. Some managed fish and shellfish species use this habitat for protection and camouflage. Estimates of habitat impacts, sensitivity, and recovery, in both areal extent and temporal rates, are necessary to understand the effects of human activities. Recovery rates are defined as the rate of change of impacted habitat back to undisturbed habitat following disturbance. Sensitivity is defined as the susceptibility of habitat to degradation. Habitat may be affected by fishing, and studies of sensitivity to and recovery from these effects are a priority. In addition, coastal areas often are affected by non-fishing impacts. Recovery and monitoring studies of impacted coastal areas, such as marine ports, are needed to determine if these sites have returned to their pre-utilization state following facility closure or development. Finally, benthic invertebrate species may be impacted by fishing gear and coastal development, and human impacts on forage species may impact habitat suitability and productivity. Studies measuring recovery rates after human impacts remain a high priority for EFH research.
3. **Improve modeling and validation of human impacts on marine habitat** – A habitat impacts model has been used to estimate effects of fishing in Alaska, but the parameter estimates are not well resolved and have a high degree of uncertainty. Similarly, models currently do not include taxon- or category-specific impact or recovery at a given location. Model validation remains a priority because the habitat impacts model plays a key role in evaluating the effects of fishing and deciding on measures to conserve and protect habitat areas from fishing gear impacts (i.e., closure areas).
4. **Improve information regarding habitat characteristics** – Information characterizing fish habitat utilization in Alaska comes from a wide range of sources, including monitoring surveys, targeted observations using alternative sampling (e.g., camera sampling and environmental DNA), measurements of physiological status (e.g., bioenergetics, condition), tagging, and many other sources. This wide range of information can be interpreted best using detailed information about seafloor and environmental characteristics available over a regional spatial domain and where appropriate spatial resolution depends upon study intent. Seafloor mapping is costly and

time-consuming. The research approach is to support low-cost mapping efforts with existing sampling platforms (e.g., trawl survey vessels, NOAA vessels) to reduce costs, as well as reanalysis of existing data. Information regarding environmental conditions like water temperature, ocean currents, and water clarity can also be obtained from direct sampling as well as Regional Ocean Modelling Systems (ROMS) and forecasted using downscaled global climate models. Finally, forage densities can be compiled from benthic grab, beam trawl, phytoplankton, and zooplankton sampling. These characteristics of seafloor, midwater environment, and forage quality all improve our ability to interpret differences in habitat quality.

5. **Assess coastal and marine habitats facing development** – Characterization of coastal habitats susceptible to disturbance from non-fishing activities is a priority. These non-fishing activities include oil and gas development, logging, mining, urbanization, contaminants, ocean acidification, loss of sea ice, and water temperature changes. The research approach includes coastal habitat mapping and analysis (whether ShoreZone or using alternative LIDAR and drone-based technologies), as well as field surveys of a representative subset of the mapped habitats to measure fish and shellfish utilization. Priority coastal habitats for study are those utilized by managed fish and shellfish species and facing development pressure. Collaborating with coastal communities using environmental DNA or other new sampling technologies is also encouraged.

Appendix C: Template for proposals

Write complete proposals that provide sufficient information for the review panel to judge your proposal.

Limit proposal to four pages (including references, and excluding budget, any figures/tables, and Data Access and Distribution).

Review process

The Scientific Review Team (SRT) will score and rank all proposals based on:

1. *Scientific merit*, i.e., the degree to which the proposed research addresses an important, innovative, and impactful topic of scientific interest;
2. *Probability of success*, i.e., the degree to which the proposed research can be completed on time and within budget, based on the qualifications of the PIs, collaborators, and any available information about project logistics, staffing, and partnerships;
3. *Relevance to priorities*, i.e., the degree to which the project addresses the five long-term goals and three research objectives listed, including its importance relative to the required budget;
4. *Quality of presentation*, i.e., the degree to which scientific protocols, analytical methods, project logistics, and other considerations can be clearly understood by the review team.

The AKRO will also provide a Management Prioritization rank, and this will be available when Science Review scores are initially provided.

Title

Principal Investigators:

Study duration (years) (circle one): 1 2 3

> *Multi-year proposal guidance:* If multi-year, you may (but are not required to) describe what research would be completed if only one year of funding is available. To also compete for one-year funding, briefly describe the one-year project (one, additional-page limit). Indicate (also circle "1" this section) whether you also are competing for one-year funding. Multi-year proposals are required to resubmit a proposal during their second and third years of funding. Resubmissions in second and third years are evaluated on the basis of their original proposal as well as subsequent progress reports, and the review team will typically decrease the review score if progress is not being made (potentially resulting in subsequent years not being funded).

Research Priority:

Justification:

Project Description:

Required Resources: Provide details of, for example, travel, rent (charters), equipment, and supplies (fuel).

Expected Products: List the milestones to be achieved each year, the products to be delivered upon completion, and when the milestones and products will be completed. Product descriptions should include the method of dissemination (e.g., refereed publication).

Data Access and Distribution: Explain how the data will be made available (e.g., spatial data will be archived at NOAA National Centers for Environmental Information). Data should follow NOAA policy and guidance protocols.

References:

Budget:

Object class	Description	Amount ($)
1100	Direct Labor: Funds will not be approved for labor or benefits.	
1150	Overtime and hazard pay	
1200	Benefits: Funds will not be approved for labor or benefits.	
2100	Travel	
2200	Transportation	
2300	Rents (vessel charter)	
2400	Printing	
2500	Contracts: List name or type of contractor	
2600	Supplies and Materials: Itemize large items, group small stuff	
3100	Equipment: Itemize large items, group small stuff	
4100	Grants	
	Total	

Appendix D: Form for Annual Report of Project Status

Essential Fish Habitat Project Status Report

Reporting date:

Project number:

Title:

PIs:

Funding year:

Funding amount:

Status: Complete Incomplete, on schedule Incomplete, behind schedule

Planned completion date if incomplete:

Reporting: Have the project results been reported? If yes, state where the results were reported and attach an electronic copy of the report.

Results: What is the most important result of the study?

Additional Resources

National Marine Fisheries Service, Alaska Region, Essential Fish Habitat in Alaska. https://www.fisheries.noaa.gov/alaska/habitat-conservation/essential-fish-habitat-efh-alaska

North Pacific Fishery Management Council (NPFMC). Fishery Management Plans, Fishery Ecosystem Plans, and Amendment Summaries. https://www.npfmc.org/library/fmps-feps/

North Pacific Fishery Management Council (NPFMC). February 2023 Meeting Agenda item C4 EFH[3]. https://meetings.npfmc.org/Meeting/Details/2975

Harrington, G. A., J. L. Pirtle, M. Zaleski, C. Felkley, S. Rheinsmith, and J. T. Thorson. 2024. 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

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. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/AKR-30, 226 p. https://doi.org/10.25923/9z4h-n860

Zaleski, M., T. S. Smeltz, S. Rheinsmith, J. L. Pirtle, and G. A. Harrington. 2024. 2022 Evaluation of the Fishing Effects on Essential Fish Habitat. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/AKR-29, 205 p. https://doi.org/10.25923/c2gh-0w03

Pirtle, J. L., E. A. Laman, J. Harris, M. C. Siple, C. N. Rooper, T. P. Hurst, C. L. Conrath, J. T. Thorson, M. Zaleski, S. Rheinsmith, and G. A. Harrington. 2024. Synthesis Report: Advancing Model-Based Essential Fish Habitat Descriptions and Maps for North Pacific Species. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/AKR-28, 295 p. https://doi.org/10.25923/jvpx-ck45

Harris, J., E. A. Laman, J. L. Pirtle, M. C. Siple, C. N. Rooper, T. P. Hurst, and C. L. Conrath. 2022. Advancing model-based essential fish habitat descriptions for North Pacific species in the Aleutian Islands. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-458, 406 p. https://doi.org/10.25923/ffnc-cg42

Laman, E. A., J. L. Pirtle, J. Harris, M. C. Siple, C. N. Rooper, T. P. Hurst, and C. L. Conrath. 2022. Advancing model-based essential fish habitat descriptions for North Pacific species in the Bering Sea. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-459, 538 p. https://doi.org/10.25923/y5gc-nk42

Pirtle, J. L., Laman, E. A., Harris, J., Siple, M. C., Rooper, C. N., Hurst, T. P., Conrath, C. L., and Gibson, G. A. 2023. Advancing model-based essential fish habitat descriptions for North Pacific species in the Gulf of Alaska. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-468, 541 p. https://doi.org/10.25923/ygdf-5f65

[3] In publishing the 2024 Alaska EFH Research plan some Additional Resource documents were still in the publishing process leading up to the completion of the 2023 EFH 5-year Review. Until published (i.e., active Digital Object Identifier links), please refer to the review versions of those documents provided for agenda item C4 EFH of the NPFMC February 2023 Meeting available at https://meetings.npfmc.org/Meeting/Details/2975.

U.S. Secretary of Commerce
Gina M. Raimondo

Undersecretary of Commerce for Oceans and Atmosphere and
Administrator of National Oceanic and Atmospheric Administration
Richard W. Spinrad

Assistant Administrator for Fisheries
Janet Coit

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National Marine Fisheries Service
Alaska Region, Habitat Conservation Division
P.O. Box 21668 709 W. 9th
Street Juneau, Alaska 99802
www.alaskafisheries.noaa.gov