NOAA Essential Fish Habitat
Research Implementation Plan for Alaska for FY 2007 – 2011
21 August 2006, Table 2 updated 3 July 2008

Introduction

Provisions of the 1996 amendment to the Magnuson-Stevens Fisheries Conservation and Management Act (MSFCMA) require NOAA Fisheries to describe and identify Essential Fish Habitat (EFH), to minimize adverse effects of fishing, and to identify other non-fishing effects on EFH. Further, the MSFCMA requires Federal agencies to consult NOAA Fisheries when undergoing, funding, or authorizing actions that may adversely affect EFH. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". EFH management requires identification and characterization, analysis of potential impacts from human activities, and development of possible actions to ensure conservation and restoration.

Alaska has more than 50% of the U.S. coastline and leads the Nation in fish habitat area and value of fish harvested, yet large gaps exist in our knowledge of EFH in Alaska. Major research needs are: 1) identify habitats that contribute most to the survival, growth, and productivity of managed fish and shellfish species (Table 1); and 2) determine how to best manage and protect these habitats from human disturbance and environmental change. Information is needed on the ecological significance of habitats important to all life stages of managed species and on the quantity and quality of these habitats present in Alaska. Habitats that need to be surveyed and mapped include coastal shorelines, estuaries, salt marsh wetlands, anadromous streams, riparian zones, submerged aquatic vegetation (e.g., eelgrass), coral and sponge beds, pinnacles, seamounts, and soft-bottom and hard-bottom fishing grounds on the continental shelf and slope.

Research is needed to understand the effects of fishing, as well as non-fishing activities such as oil and gas development, logging, mining, urbanization, and contaminants, so managers can protect and conserve fish habitat. Habitat protection and conservation must also keep pace with habitat changes resulting from climate change and population growth through monitoring of trends of species composition and abundance and the areal extent of key habitat types (e.g., eelgrass). Monitoring also is needed in areas altered by human activities, such as navigation dredging, to determine whether these activities have adversely affected EFH or have recovered following disturbance.

The plan is organized into four sections:

- Research themes
- Research priorities
- Allocation of resources
- Example research projects

The plan was written with input and review by Alaska Fisheries Science Center (AFSC) scientists, the AFSC Habitat and Ecological Processes Research (HEPR) Core Team, and the Alaska Region, Habitat Conservation Division.

Research Themes

Habitat characterization - Characterize, census, and map habitat features including offshore habitats susceptible to disturbance from fishing gear (e.g., corals) and coastal habitats susceptible to disturbance from non-fishing activities.

Habitat utilization - Evaluate habitat use for managed species to assess the strength of associations with different habitat features.

Habitat productivity - Investigate the relative productivity of different habitats for managed fish species, including disturbed and undisturbed habitats; studies describe whether certain habitat types provide greater support for important life history functions (e.g., growth, reproduction, and feeding).

Recovery rates - Measure habitat impact rates, sensitivity of habitat features to disturbance and recovery rates following disturbance, which could be used to indicate the persistence of effects from fishing gear or coastal development and population-level consequences for managed species.

Reduce impacts – Conduct research that could lead to significant reductions in habitat disturbance resulting from fishing and other human activities.

Research Priorities

The marine ecosystem off Alaska is large and complex. Our overarching priority is research on habitats most affected by human activities, including habitats with frequent human activity as well as habitats sensitive to disturbance where human activity is infrequent. Priority habitats include offshore habitats susceptible to disturbance from fishing gear and coastal habitats susceptible to disturbance from non-fishing activities.

Coastal areas 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, and contaminants. The research approach includes coastal habitat mapping (ShoreZone) 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 (Table 1) and facing development pressure (Table 2).

Characterize habitat utilization and productivity – This priority focuses on understanding the relationship between habitat type, patterns of use by species, and differences between habitats in productivity of managed species. Our approach is to support integrated research projects that combine measurements of habitat characteristics, habitat utilization, and habitat productivity in one study, and also combine laboratory experiments, controlled field manipulations, and field observations. Our approach also includes conducting studies that would support refining the description and identification of EFH in Fishery Management Plans based on relevant

information. Focal species are studied for multiple years to accumulate enough information for understanding. At least one rockfish species will be studied, presuming that rockfish are dependent on benthic structure that is sensitive to human activity.

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 fishing intensity, sensitivity, and recovery rates are applied in habitat impacts models to understand the effects of fishing. Likewise, estimates of habitat impacts, sensitivity, and recovery rates are necessary to understand the effects of non-fishing activities. Recovery rates are defined as the rate of change of impacted habitat back to un-impacted habitat following disturbance. Sensitivity is defined as the susceptibility of habitat to degradation – for fishing, it is the proportion of habitat in the path of the fishing gear that is impacted by one pass of the gear. Little specific information is available on recovery rates and sensitivity.

To estimate sensitivity and recovery rates our priority is to measure damage, survival, growth, and recovery of habitat features before and after (both immediately and up to several years following) disturbance. Attention to species that are short to moderately long-lived and faster-growing is warranted because they have the potential to recover within one or two decades and specific estimates of recovery rate are needed for habitat impacts modeling. For very slow-growing species, their slow growth implies recovery will take several decades or more and more detailed information is not as high a priority for habitat impacts modeling.

Dominant habitat-forming species in Gulf of Alaska hard-bottom habitat include *Primnoa* sp., black corals, hexactinellid sponges (2 species), and demosponges (1 species), in Gulf of Alaska and Bering Sea (canyon) soft-bottom habitat, the pennatulacean *Halipteris willemoesi*, in Bering Sea pebble/sand, the tunicate *Boltenia* sp. and the soft-coral *Gersemia* sp., and in the Aleutians, *Primnoa* sp., *Paragorgia* sp., bamboo corals, and the gorgonians *Fanellia* sp., *Plumarella* sp., and *Thourella* sp. and several species of hexactinnelid sponges and demosponges. Candidate species for study because they are shorter-lived or faster-growing include demosponges, *Boltenia* sp., *Gersemia* sp., bamboo corals, *Fanellia* sp., *Plumarella* sp., and *Thourella* sp.

In addition, coastal areas often are affected by non-fishing impacts. Recovery and monitoring studies of impacted coastal areas, such as log transfer facility (LTF) sites and marine ports, are needed to determine if these sites have returned to their pre-utilization state following facility closure or development.

Validate and improve habitat impacts model – A Center for Independent Experts (CIE) panel reviewed the habitat impacts model used to estimate effects of fishing. The panel found that the model was well conceived and useful in providing estimates of the possible effect of fishing on benthic habitat, but that the parameter estimates were not well resolved and had a high degree of uncertainty and there was no attempt to validate the model. Subsequently, model validation was attempted with survey data, but because of time limitations, a comprehensive model validation analysis was not completed. Model validation remains a priority because the habitat impacts model has played 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.

Seafloor mapping – Information characterizing fish habitat and utilization in Alaska is limited to coarse depth and habitat information (e.g. nautical charts) and utilization information from AFSC surveys for the adult stage of commercially important species. Missing are fine-scale depth and habitat information, as well as juvenile stage information, especially nearshore. Seafloor mapping is costly and time-consuming. Our approach is to support low cost mapping efforts with existing sampling platforms (e.g. trawl survey vessels, NOAA vessels) to reduce costs.

Allocation of Resources

This section on allocation of resources includes a subsection on FY 2007 – 2011 EFH funding, as well as subsections on other EFH-related activities not funded by EFH, such as habitat impacts modeling and analyses to meet management needs. The intent is to provide a complete picture of how resources will be allocated, both dollars and people, on habitat research by the Alaska Fisheries Science Center during FY 2007 - 2011.

FY 2007 - 2011 EFH funding –Funding is limited, so we focus EFH funding on three research priorities:

- Coastal areas facing development, including ShoreZone mapping
- Characterize habitat utilization and productivity
- Recovery rates of disturbed benthic habitat

For planning purposes, we assume FY 2007 - 2011 EFH research funding will be roughly equal to the FY 2006 level of $478 K. We plan to continue coastal mapping (ShoreZone) each year, leaving about $350 K to be competed each year. Individual project amounts of up to $150K per year will be considered. To be funded, proposals must meet the EFH research priorities listed above and involve habitat for species managed under a North Pacific Fishery Management Council FMP (Table 1). Proposals should describe complete projects. Both single and multi-year projects will be considered. A status report is required at the end of the fiscal year for every project that receives EFH funding.

Proposals will be rated based on relevance to the EFH research priorities, scientific merit and probability of success and equal weight will be given to each factor. Scoring: Excellent (5), Very Good (4), Good (3), Fair (2), Poor (1). Proposals will be discussed jointly by the HEPR Core Team and Alaska Regional Office, Habitat Conservation Division staff. Separate recommendations will be prepared. The HEPR Core Team recommendation will consist of a ranked list of proposals. The HEPR Program Leader and Assistant Regional Administrator for Habitat Conservation will subsequently prepare a consolidated recommendation for the Science Director and Regional Administrator final decision.

Date	Activity
By September 30	Request for Proposals released
October 31	Proposal deadline
By November 30	Proposal review
By December 15	Prioritized list of proposals released
When amount of EFH funds is certain	Final funding decision

Habitat Modeling Team - A major criticism of the Center for Independent Experts (CIE) Panel that reviewed the draft Essential Fish Habitat Environmental Impacts Statement was that the habitat impacts model was not validated. In addition, the Panel recommended exploration of alternative models that incorporate spatially explicit parameters other than abundance (e.g. growth). Our approach is to support formation of a habitat modeling team to meet the need to validate and improve the habitat impacts model. An economics component also may be added to the habitat impacts model to broaden the model's utility. Likely members of this cross-Divisional team include a habitat modeler, an economist, a habitat biologist, and a stock assessment biologist. Additional expertise is available from the Alaska Region, Habitat Conservation Division. The AFSC currently allocates significant modeling resources to stock assessment and ecosystems modeling because of their importance for informing management. Initiation of a habitat modeling team seems appropriate given the similar importance of habitat research and management. Further, improvement of the habitat impacts model will prepare the tools necessary to evaluate future habitat-related management proposals. Adding an economics component to the model will provide additional outputs useful for proposal evaluation. The following analyses are needed to meet the outcome: Validate and improve the habitat impacts model.

Outcome and Projects for 2007 - 2011	FTE needs by fiscal year				
Outcome. Validate and improve habitat impacts model.	*2007*	*2008*	*2009*	*2010*	*2011*
Project. Validate the habitat impacts model by comparing habitat impacts model output to empirical data.	1	1	0	0	0
Project. Incorporate spatially-explicit productivity data into habitat impacts model.	0	1	1	1	0
Project. Incorporate economic data into habitat impacts model.	0	0	1	1	1
Project. Determine likely efficacy of research closures to validate estimates of fishing effects.	1	0	0	0	0

Seafloor mapping – Currently the AFSC and collaborators expend significant effort developing acoustic systems for characterizing soft-bottom substrates. Another approach has been deployment of single-beam echo sounders on existing platforms (trawl survey vessels), but the limited effort has been unsuccessful so far. One challenge has been the lack of a commonly agreed acoustic system for habitat mapping, mostly because of the difficulty of balancing coverage and resolution. Three workgroups are expected to recommend methods for remote mapping with sound in 2006. These groups are the NOAA Fisheries Advanced Technology Working Group (habitat mapping workshop), an ICES working group, and an NPRB-funded group.

Dedicated seafloor mapping is costly and time consuming. Given the high cost of seafloor mapping, using scarce EFH funds for seafloor mapping would leave little for other EFH research priorities. Thus, we do not plan to allocate EFH funds for seafloor mapping.

Our approach is to support industry-government collaboration for seafloor mapping of selected, small areas and for development of alternative methods of habitat identification. For example, three Gulf of Alaska slope areas (Figure 1) were nominated for protection by fishing industry groups where their expert anecdotal information supported the HAPC (Habitat Areas of Particular Concern) considerations and Council priorities for high-relief coral and rockfish habitat information. In these areas, research information is needed to supplement local knowledge that suggests abundance of high-relief corals. In addition, industry has proposed testing fishermen's knowledge to type habitats, as a means of reducing costs of habitat mapping. Two potential collaborators are the Marine Conservation Alliance Foundation and the Alaska Fisheries Development Foundation.

Management-based analyses – Analyses to meet habitat management needs, such as the Bering Sea Fishing Impacts Analysis, are a continuing need. These analyses typically are completed by Council, Alaska Region, and AFSC staff. The following analyses are needed to meet the outcome: Complete management-based analyses.

Outcome and Projects for 2007 - 2011	**FTE needs by fiscal year**				
Outcome. Complete management-based analyses.	*2007*	*2008*	*2009*	*2010*	*2011*
Project. Refine EFH definition for marine salmon.	1	0	0	0	0
Project. Refine EFH definition for forage species.	0	0	1	0	0
Project. Identify candidate HAPCs.	1	0	0	0	0
Project. Bering Sea Fishing Impacts Analysis.	1	0	0	0	0
Project. Calculate historical fishing effort.	0	1	0	0	0
Project. Offshore pinnacle inventory.	0	1	0	0	0

Nearshore mitigation of impacted coastal areas –Alaska-specific studies or monitoring are needed to evaluate the effectiveness of nearshore mitigation projects such as artificial reefs. Our approach is to solicit funding for these projects through the NOAA Restoration Center or other avenues.

Gear modification research – Research on gear modification has the potential to reduce habitat impact rates on habitat-forming biota. Reduce gear impacts research has been supported by EFH funding in previous years, as well as cooperative research funding and industry-government collaboration. Given limited EFH funds and the identified EFH research priorities, AFSC management plans to replace EFH funding of gear modification research with cooperative research funding.

Examples of Possible Research Projects

Mapping and Fish Utilization of Coastal Habitats Facing Shoreline Development and Climate Change

Research Priority: Coastal areas facing development.

Justification: Shallow, nearshore waters are some of the most productive habitats in Alaska; many FMP species use nearshore habitats at some point in their life cycle. Alaska has more than 50% of the U.S. coastline, most is pristine, but all of it is vulnerable to increasing stress from shoreline development and changing climate. Habitat utilization and productivity information is not available for many areas of Alaska. The lack of nearshore habitat information prevents description of EFH, including sensitive or critical juvenile or larval life stages of fish. This study will map and collect fish utilization and productivity information in coastal areas where development is most likely to occur. This information will be used by NOAA Fisheries to describe EFH for unknowns and assist the assessment of Federal actions that may adversely affect EFH.

Study Description: The mapping approach is *ShoreZone*, which is low-altitude aerial imagery of intertidal and shallow subtidal habitats. Habitat type is identified in the imagery based on shoreline geomorphic and biotic characteristics. Biological sampling is conducted to verify a representative subset of the aerial mapping and to measure productivity (e.g., eelgrass, kelp forests, fish abundance and energetics) and relative importance of utilized habitats. Other goals are to examine seasonality of habitat utilization and productivity, and to establish monitoring sites that will periodically be resampled. Fish sampling gears include beach seine, purse seine, bottom trawl, ROV and jigging. Laboratory processing of fish includes proximate composition for energy content and allocation and RNA/DNA analysis for protein synthesis and growth. An anticipated product is an interactive website with *ShoreZone* imagery of Alaska, and fish distribution and habitat use data as layers.

Required Resources: EFH funding for two sampling trips per year: vessel charter $50 K, fish energetics $35 K, overtime and travel $15 K. 5 FTE.

Expected Products (anticipated manuscript, model parameter, GIS coverages):

References:

Morris, M., J.R. Harper, P.D. Reimer, H.R Frith, and D.E. Howes. 1995. Coastal biotic mapping system using aerial video imagery. In: Proceedings of the Third Thematic Conference on Remote Sensing for Marine and Coastal Environments. Seattle, WA. Pages 200-210.

Johnson, S. W., A. D. Neff, and J. F. Thedinga. 2005. An atlas on the distribution and habitat of common fishes in shallow nearshore waters of southeastern Alaska. NOAA Tech. Memo. NMFS-AFSC-157.

Habitat influences on growth and recruitment of northern rock sole

Research Priority: Characterize habitat utilization and productivity.

Justification: Growth rates of early life stages of fish are mediated by biotic and abiotic factors of the nursery habitat, with rapid growth essential for survival in the face of strong size-selective mortality. An understanding of spatial and temporal variation in growth is essential to understanding population productivity of fishery resource species. Detailed maps of habitat characteristics and fish distribution are being developed for juvenile rock sole (Stoner et al. 2006). The goal of this project is to extend our understanding of habitat function from fish distribution to growth and production. Patterns of growth and survival among years and nurseries will be related to site-specific habitat characteristics.

Description: Hurst and Abookire (2006) identified significant spatial variation in growth rates of age-0 northern rock sole among nursery areas along the northeastern Kodiak coast. In this project, we will determine the stability of these site-specific differences among years. We will also extend analyses to determine the additional effects of habitat on energetic condition. Age-0 northern rock sole will be collected from three sites at monthly intervals for four consecutive years (first two years completed). Variation in thermal regimes will be described from temperature measurements made at each site. The role of thermal variation in regulating growth is accounted for through laboratory calibration of potential growth rates across temperatures. Habitat suitability maps for Kodiak nurseries (Stoner at al. 2006) will be used to develop nursery-level indices of habitat quality and examined for evidence of temporal variation in habitat characteristics (e.g., presence and extent of ephemeral worm tube mats) in relation to variation in growth.

Required Resources: EFH funding for three sampling trips per year: vessel charter $30 K, fish energetics $20 K, overtime and travel $10 K. 2 FTE.

Expected Products (anticipated manuscript, model parameter, GIS coverages):

Collaborators: Current collaboration: A. Abookire (Kodiak) & Ron Heintz (ABL)

References:

Hurst, T.P. and A.A. Abookire. 2006. Temporal and spatial variation in potential and realized growth rates of age-0 northern rock sole. J. Fish Biol. 68:905-919.

Stoner, A.W., M.L. Spence, and C.H. Ryer. 2006. Flatfish-habitat associations in Alaska nursery grounds: use of continuous video records for multi-scale spatial analysis. J. Sea Res. (in press).

Recovery of deep water sponges from bottom trawling

Research Priority: Recovery rates of habitat-forming biota.

Justification: Assessment of the long term recovery rates of damaged/removed biota provides baseline information to assess whether or what type of management measures are needed to mitigate/protect essential fish habitat from the effects of fishing.

Project Description: In 1996 Freese et al. (1999) used a bottom trawl equipped with tire gear to examine short-term effects of trawling on benthic invertebrates in the Gulf of Alaska. This gear is similar to that used in the rockfish fishery. Based on video data collected through direct observations with the *Delta* submersible there was a significant decrease in density and an increase in damage to sponges and anthozoans in trawled versus reference sites. About 70% of large sponges were damaged by a single pass of a trawl. In a follow up study, one year post-trawl no new colonization or evidence of repair or regrowth of sponges occurred (Freese 2001). Our project proposes to revisit the 1996 sites to examine recovery dynamics of sponges 10 years post trawling. Methods identical to those described by Freese et al (1999) and Freese (2001) will be used.

The study sites are representative of the hard-bottom (pebble, cobble, boulder) habitat preferred by numerous rockfish species. Taxa such as sponges form high-relief complex habitat that is generally thought to foster increased biological diversity and productivity by providing cover and food aggregations for fish, especially rockfish (e.g. Freese and Wing 2003).

Required Resources: Six day charter of *Delta* submersible to collect video transect data. Cost of charter is approximately 11.5 K per day excluding travel, overtime, and materials which will be an in kind contribution to the study. Funding Requested: 70K.

Expected Products (anticipated manuscript, model parameter, GIS coverages):

References:

Freese, J.L., P.J. Auster, J. Heifetz, and B.L. Wing. 1999. Effects of Trawling on seafloor habitat and associated invertebrate taxa in the Gulf of Alaska. Mar. Ecol. Prog. Ser. 182: 119-126.

Freese, J.L. 2001. Trawl-induced damage to sponges observed from a research submersible. Mar. Fish. Rev. 63(3): 7-12.

Freese, J.L. and B.L. Wing. 2003. Juvenile red rockfish associated with sponges in the Gulf of Alaska. Mar. Fish. Rev. 65(3) 38-42.

Table 1 - Species and species groups managed within Fishery Management Plans (FMP) of the Exclusive Economic Zone off Alaska. Refer to current FMP versions for more detail (http://www.fakr.noaa.gov/npfmc/fmp/fmp.htm).

Species
Walleye pollock
Pacific cod
Sablefish
Flatfish
Rockfish
Atka mackerel
Skates
Squid
Sculpins
Sharks
Octopus
Forage fish species
Pacific salmon
King crab
Tanner Crab
Weathervane scallop

Table 2 - AKRO/HCD Recommended Nearshore EFH Survey Areas.

Region	Area	Sub-area	Specific sites	Nearest Community	On Contiguous Road System	Small Boat Support	Rationale
GOA	South Central	Upper Cook Inlet	Big Susitna	Anchorage	Yes	HCD/Anchorage	Sparse information; chiefly completed by private research efforts. Alaska's largest population center. Area is known feeding area for proposed-endangered beluga whales. Possible site for LNG facility.
		Lower Cook Inlet	Iniskin Bay Area	Williamsport	No	HCD/Anchorage Possible	Area is an existing access point to service a large scale mining district (several different mines). Semi-private road (15mi) serves Lake Iliamna from Pile Bay in Cook inlet and listed in ADOT Industrial Roads Plan for AK.
		Resurrection Bay	Head of Bay and Lowell Point	Seward	Yes	HCD/Anchorage Possible	Little to no nearshore information exists. Possible site for LNG facility. Chance to partner with Sea Life Center?
	PWS	Northern PWS	Duck Flats and Lowell Point	Valdez	Yes & AK Ferry	HCD/Anchorage Possible	Information is dated (>20 years). LNG facility for Alaska Natural Gas Pipeline.
		Eastern PWS	Shepard Point and Fleming Spit	Cordova	AK Ferry	HCD/Anchorage Possible	Information is dated (>20years). Community still suffers from EXXON VALDEZ incident.
	SE	Price of Wales Is	Kassan Bay / 12 Mile Arm	Hollis	Logging Rd		Information unknown.
		Koskiusko Is	Edna Bay / Cape Pole	Klawock	Logging Rd		Information unknown.
		Heceta Is	Port Alice	Klawock	Logging Rd		Information unknown.
		Tuxecan Is	Jihni Bay / Scott Lagoon	Klawock	Logging Rd		Information unknown.
		Revillagigedo Is	Neets Bay / Naha Bay	Loring	Logging Rd		Information unknown.

BSAI	Bristol Bay to GOA	Balboa Bay	Albatross Anchorage	Sand Point	No		No information exists. Proposed GOA-side marine terminal to service Bristol Bay Region & North Aleutian Basin Oil & Gas exploration and development.
	Bristol Bay	Nushagak Bay	Telephone Pt and Near Deadman Sands	Dillingham	No		No nearshore information exists. Region faces an increase in oil & gas exploration and development.
	Norton Sound	Nearshore Area	Near Sun River and Along coast	Nome	No		No nearshore information exists. Some offshore info exists, however dated (1980's BIMA project). Area is subject to expansive recreation mining dredges operating in nearshore areas. Region faces an increase in oil & gas exploration and development.

Figure 1. Recently, ten areas of the continental slope in the Gulf of Alaska were closed to bottom trawl gear based on public comments designating these areas as high relief living habitat. Three of these areas are thought to contain high abundance of high-relief corals; only anecdotal information exists from fisherman. NOAA Fisheries must validate the presence or absence of high relief corals in these three areas within 5 years so the Council can determine whether to maintain or revoke the closures. These three areas are slope areas east of the Shumagin Islands, south of Sanak Island, and south of Unalaska Island (red circles).