Essential Fish Habitat (EFH)

5-year Review for 2010

Summary Report

FINAL

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North Pacific Fishery Management Council
National Marine Fisheries Service, Alaska Region

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1 Introduction

The Magnuson-Stevens Fishery Conservation and Management Act includes provisions concerning the identification and conservation of Essential Fish Habitat (EFH). The Magnuson-Stevens Act 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 (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. Councils also have the authority to comment on federal or state agency actions that would adversely affect the habitat, including EFH, of managed species.

Each FMP contains the following 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 any locations
8. HAPC identification
9. Research and Information needs
10. Review EFH every 5 years

As clarification for component 10, the EFH Final Rule requires 'a review and revision of EFH components' be completed every 5 years, and EFH provisions be revised or amended, as warranted, based on available information. The EFH Final Rule continues that the review should also evaluate:

- published scientific literature
- unpublished scientific reports
- information solicited from interested parties
- previously unavailable or inaccessible data.

The report documents the 5-year EFH review for the Council. Based on this report, the Council will decide whether revisions to or re-evaluations of EFH, and EFH mitigation measures, are called for. If so, the Council will accordingly initiate FMP amendments, to revise EFH components or management measures within the FMPs.

1.1 Background

The Council last amended five of its FMPs (Bering Sea/Aleutian Islands [BSAI] Groundfish FMP, Gulf of Alaska [GOA] Groundfish FMP, BSAI Crab FMP, Scallop FMP, and Salmon FMP) in 2005, to address the EFH requirements (Table 1). The Council and NMFS developed an environmental impact statement evaluating alternatives and environmental consequences for three actions: (1) describing and identifying EFH for fisheries managed by the Council; (2) adopting an approach for the Council to identify Habitat Areas of Particular Concern within EFH; and (3) minimizing to the extent practicable the adverse effects of Council-managed fishing on EFH. The Council used an extensive public process to develop the alternatives for the EIS, including numerous public meetings of the Council and its EFH

Committee. The analysis indicated that there are long-term effects of fishing on benthic habitat features off Alaska, and acknowledged that considerable scientific uncertainty remains regarding the consequences of such habitat changes for the sustained productivity of managed species. Nevertheless, based on the best available scientific information, the EIS concluded that the effects on EFH are minimal because the analysis found no indication that continued fishing activities at the current rate and intensity would alter the capacity of EFH to support healthy populations of managed species over the long term. The analysis concluded that no Council-managed fishing activities have more than minimal and temporary adverse effects on EFH, which is the regulatory standard requiring action to minimize adverse effects under the Magnuson-Stevens Act. Importantly, the Council initiated a variety of practicable management actions and precautionary measures to conserve and protect EFH.

The actions the Council and NMFS took in association with this EIS resulted in FMP amendments to modify the existing EFH and HAPC designations and to implement additional measures to reduce the effects of fishing on EFH. The amendments are Amendment 78 to the FMP for the Groundfish Fishery of the BSAI Area, Amendment 73 to the FMP for Groundfish of the GOA, Amendment 16 to the FMP for BSAI King and Tanner Crabs, Amendment 9 to the FMP for the Scallop Fishery off Alaska, and Amendment 7 to the FMP for the Salmon Fisheries in the Exclusive Economic Zone (EEZ) off the Coast of Alaska. Specific regulations and associated conservation areas are located at http://www.fakr.noaa.gov/habitat/efh.htm.

The Council now also has a sixth FMP, as a new FMP for Fish Resources of the Arctic was approved by the Secretary of Commerce in August 2009 (Table 1). A thorough assessment of EFH was included in the Arctic FMP. Consequently, this FMP will not be addressed in this 5-year review report.

Table 1 List of Council Fishery Management Plans, and status of EFH review

Fishery Management Plan	EFH Last Updated	Current Review Status or Comments
Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI Groundfish)	2005	NPFMC review in 2009-10 (including Plan Team)
Groundfish of the Gulf of Alaska (GOA Groundfish)	2005	NPFMC review in 2009-10 (including Plan Team)
Bering Sea/ Aleutian Islands King and Tanner Crabs (BSAI Crab)	2005	NPFMC review in 2010 (including Plan Team)
Scallop Fishery off Alaska (Scallop)	2005	NPFMC review in 2010 (including Plan Team)
Salmon Fisheries in the EEZ off the Coast of Alaska (Salmon)	2005	NPFMC review in 2010 No salmon plan team, so review will be provided by NMFS salmon experts.
Fish Resources of the Arctic (Arctic)	FMP implemented in August 2009	NPFMC review completed in 2009 with adoption of FMP

2 Approach

The result of the 2010 5-year EFH review is documented in this summary report for the Council. The review included evaluating new information on EFH, identifying whether any revisions to EFH are needed or suggested, and assessing information gaps and research needs. The review fulfills the FMP requirement to complete a 5-year review of EFH. This summary report will be released to the public and presented to the SSC, AP, and Council. If the Council chooses to update its FMP(s) to revise EFH text or management measures, FMP amendments will be prepared, along with the appropriate analytical documents.

This is the first time the 5-year review is being conducted, and the approach to the review and any subsequent revisions is being developed for this report. It is anticipated that this review will establish a process applicable for future 5-year reviews.

The following steps have been used to complete and document the EFH review:

1. Evaluate new information, available since the last EFH review, and review the text in the Council's 5 FMPs (BSAI groundfish, GOA groundfish, BSAI King and Tanner crab, Scallop, Salmon) relating to the 10 EFH components. Note areas where changes to the EFH components may be warranted.
    a. Stock assessment authors are the lead reviewers for EFH text relating to the species or species complex which they assess.
    b. Other components will be reviewed by NMFS Habitat Division staff, or other qualified NMFS, Council, or other staff.
2. Consult with the Plan Teams with respect to the stock assessment authors' review of EFH text, and other EFH review components, if appropriate[1]. Plan Teams are invited to provide recommendations to the SSC and the Council as to whether the individual species reviews are accurate and complete, and whether the available new information warrants revisions to EFH text in the FMPs, or to Council management measures to protect and conserve EFH.
3. Prepare EFH 5-year review summary report for Council. Include recommendations of whether changes to the FMPs are warranted. Report should be made available in advance to the public. Contents of Council summary report will include:
    a. Review of 10 EFH components, documenting how the review was conducted, what new information is available relating to each component, and whether it agrees or disagrees with the information that is currently in the FMP.
    b. Possible changes to the 10 EFH components in the five FMPs under review.
4. If the Council decides to initiate FMP amendments, prepare amendments and any associated analysis to update EFH components in FMPs. Note, any change to the FMP text (which includes all 10 EFH components) must be implemented through an FMP amendment. The degree of analysis require to implement the change will vary based on whether the proposed amendment is a substantive change (e.g., a change in the EFH description), or a technical one (e.g., minor changes to the life history information).

For the most part, the review will be conducted by agency staff using new information available in the five years since the completion of the EFH EIS, the last time such an evaluation was conducted. Staff will use information from published or unpublished scientific literature or scientific data, as directed in the

[1] Note, as there is no Salmon Plan Team, the review will rely on the expertise of NMFS staff to review and provide recommendations on changes to the Salmon FMP.

EFH Final Rule, assuming the information meets acceptable standards of scientific review. Staff have also noted, as part of their review, unpublished studies that are currently underway or whose results are under review, which may provide further insight on EFH in the future. The summary report that is presented to the Council will also be distributed in advance to the public, and the public and any interested parties are invited to provide input on or information pertaining to the EFH review before the Council decides whether revisions to EFH are warranted.

2.1 Specific approach to each component

A description of the review for each of the ten EFH components listed in the FMPs is included in Table 2.

Table 2 Review plan for each of the ten EFH components

EFH FMP Component	Plan for review
1. EFH Descriptions and Identification	Identify and evaluate new scientific literature, and information from other relevant sources, to see whether species-specific EFH description and identification, as written in the FMPs, is correct. Edit the FMP text if appropriate. Stock assessment authors will be the lead reviewers on this component.
2. Fishing activities that may adversely affect EFH	An update of the fishing effects model is not planned as part of the 5-year review. Instead, the review will evaluate the various inputs to the model to see how they compare with the model inputs from 2004 (a. distribution of the trawl fisheries, b. species recovery rates, c. gear changes in the fisheries that may affect habitat). This should demonstrate whether the impacts analysis from the 2005 EIS is likely to still be valid, or whether it warrants revision. Note, the model also uses species' EFH descriptions as an input, so if major changes to the EFH descriptions are implemented by the Council, this component may need to be reevaluated.
3. Non-Magnuson-Stevens Act fishing activities that may adversely affect EFH	Review whether there have been changes in current halibut and State water fisheries, compared to EFH analysis. Identify sources of new information that may shed light on analysis of the impact of these fishing activities.
4. Non-Fishing activities that may adversely affect EFH	Review whether there have been changes to non-fishing activities affecting habitat since the EFH analysis. Identify sources of new information that may shed light on analysis of the impact of non-fishing activities.
5. Cumulative impacts analysis	Review cumulative impacts discussion in FMPs, and evaluate against new information.
6. EFH Conservation and Enhancement Recommendations	Review EFH recommendations for fishing and non-fishing activities, and evaluate against new information to see whether updates are warranted.
7. Prey species list and any locations	Based on review of new information in Component 1, review prey species information, and determine whether updates are warranted.
8. HAPC identification	Review will summarize Council's current progress in establishing HAPC priorities. As appropriate, based on species-specific review of EFH, stock assessment authors or Plan Teams may suggest candidate HAPC areas that could be considered by the Council in the next HAPC priority cycle.
9. Research and Information needs.	Based on review of new information in Component 1, review research and information needs, and determine whether updates to EFH research needs identified in the FMPs are warranted.
10. Review EFH every 5 years.	Summary report represents EFH 5-year review.

2.2 Revision of EFH text and management measures, if warranted

The Council's role with respect to the EFH 5-year review is to receive a report on the review, and decide whether any of the new information from the last 5 years, highlighted in the review, warrants change to management (i.e., amendments to the FMPs). The Council will be considering all ten EFH components

for each FMP, including individual species EFH descriptions, EFH conservation and enhancement recommendations for fishing and non-fishing effects on EFH, and identification of HAPCs. Any change to the FMP text, no matter how minor, requires an FMP amendment.

Based on the summary report, the Council may decide to initiate FMP amendments to revise one or more EFH components within any of the five FMPs under review. The level of analysis (environmental assessment, environmental impact statement, categorical exclusion) that is required to support that amendment will vary depending on the impacts of the change. The 2005 EFH EIS provided a comprehensive discussion of EFH in the five Council FMPs. It can be difficult to assess the impacts of changes to available habitat, whether due to fishing pressure, non-fishing anthropogenic activities, or the effects of changing climate or physical conditions, because the linkages between habitat preferences and abundance of managed species is largely unknown. The analysis of any new amendments initiated by the Council would be likely to rely heavily on the 2005 EFH EIS, where these unknowns were discussed and characterized. This could either be accomplished through environmental assessments tiering off the EFH EIS, or by issuing a supplement to the EFH EIS, addressing the new amendments.

Of the types of recommended changes that may emerge from the EFH 5-year review, there are some potential amendments that may be of higher priority to the Council than others. For example, while much of the EFH material in the FMPs is descriptive in nature, there are nonetheless certain sections that may have the potential to affect how EFH for a species is impacted by fishing and non-fishing activities. Examples of some of these recommended changes that may be of higher priority are listed below.

EFH text and map descriptions

The EFH text description, by life history stage, represents the legal EFH description for each of the managed species. In the Council FMPs, that text description is also portrayed graphically on a map. It is on the basis of these descriptions that evaluations are made by the agency about whether an activity is likely to impact EFH. The lead stock assessment authors have all been asked to evaluate their species' EFH descriptions, based on new information, and decide whether changes are warranted. In turn, the Plan Teams have also provided recommendations to the SSC and the Council with respect to these descriptions. If the Council decides that such changes warrant revision to the FMP, amendments will be initiated to implement these changes. Recommended changes could include:

- Change to the EFH text description of map of EFH for each species, or change to the available level of habitat information for species' life history stages
- Changes to the management of species within a complex, which may result in a new EFH description

Adverse effects on EFH from fishing or non-fishing activities

The EFH EIS reviewed the effects of fishing at the then-existing rate and intensity, and concluded that fishing would not affect the capacity of EFH to support the life history processes of any species. In other words, the effects of fishing on EFH were concluded to be no more than minimal. Since the analysis in the EFH EIS, the Council has taken management actions that may have changed the distribution or intensity of fishing, including a suite of mitigation measures adopted by the Council to provide additional protection to EFH. The 5-year review has evaluated changes to fishing distribution since the EFH EIS analysis, and stock assessment authors have reviewed changes in fishing activities and whether any such changes are likely to impact the conclusions of the EFH EIS for their species. If a change to the conclusions of the evaluation of fishing effects is indicated, this may be a higher priority action item for the Council.

Potential adverse impacts from non-fishing activities on EFH were also evaluated in the EFH EIS, and EFH Conservation Recommendations were described that span a diverse range of anthropogenic activities that may have adverse effects on EFH. Example activities include: oil and gas exploration and development; vessel casualties that result in physical damage to living habitats or spill of toxic substances (i.e., oil spill); introduction of exotic species; depositional fill; marine dredging; mineral extraction; and waste water discharges. These conservation recommendations are included in the FMPs, and they have been reviewed by the staff of the NMFS Habitat Conservation Division. These recommendations are used by NMFS staff when consulting on effects to EFH by other agencies, and updating the FMPs to reflect the most recent recommendations may be a higher priority amendment for the Council to consider.

In summary, some of the recommended changes that might be indicate a higher priority response from the Council could be the following:

- Recent changes in fishing activities that may affect the EFH EIS conclusion that no adverse effects of fishing on EFH are more than minimal and not temporary
- New recommendations to avoid, minimize, or compensate for adverse effects on EFH caused by activities other than fishing

2.3 Timeline for review and possible subsequent amendments

The following provides an overview of the timeline for completing the review in 2009 and 2010.

2009	**Overall tasks for 2009:** • Assess information gaps and new information • Stock expert review • Plan Team feedback	
February 19	Scallop Plan Team meeting	Brief PT on plans for EFH 5-year review, get input on new habitat information on scallops
March-October		Prepare review of other 9 EFH components, including fishing and non-fishing effects on habitat, and cumulative impacts review
March 30-April 1	Council meeting	Review methodology for EFH 5-year review with Council's SSC
April-June		Prepare template for stock assessment author review. Template should include (a) current FMP EFH text, (b) worksheet identifying any new or inconsistent habitat information (since the 2005 EFH EIS) and any considerations for HAPC or EFH conservation recommendations
July-October		Distribute template and worksheets to groundfish stock assessment authors, authors review and edit FMP text and worksheets
September 16	Joint Crab and Groundfish Plan Teams meeting	Discussion of EFH review requirements and PT approach for November and March. Discussion of HAPC process criteria.
September-February 2010		Distribute template and worksheets to crab and scallop stock assessment authors, authors review and edit FMP text and worksheets
October-December		Prepare Preliminary Summary Report for Groundfish Plan Team and Council.
November 16-20	Groundfish Plan Team meetings	PTs to (a) review any proposed changes to FMP EFH text, based on stock assessment author review, and (b) provide input on review of other EFH components (including HAPC and EFH conservation recommendations). PTs will recommend whether Council should consider changes to EFH descriptions and identification, or other amendments to EFH FMP text and management.
December 7-15	Council meeting	Preliminary Summary Report for Council Review. Will not include crab, scallop, and salmon reviews. Solicit public input on habitat information. Update Council on progress with EFH review, provide indication as to whether FMP amendments are likely to be required (based on PT recommendations and other comments/review)

2010	**Overall tasks for 2010:** • SSC, AP, and Council review • Final Council decision • Implement any changes through FMP amendment *Note: all changes to the FMP text, however minor, must be implemented through an FMP amendment.*	
February 8-15	Council meeting	SSC review of Preliminary Summary Report.
March 4-5	Scallop Plan Team meeting	PTs to (a) review any proposed changes to FMP EFH text, based on stock assessment author review, and (b) provide input on review of other EFH components (including HAPC and EFH conservation recommendations). PTs will recommend whether Council should consider changes to EFH descriptions and identification, or other amendments to EFH FMP text and management.
March 29-April 2	Crab Plan Team meeting	PTs to (a) review any proposed changes to FMP EFH text, based on stock assessment author review, and (b) provide input on review of other EFH components (including HAPC and EFH conservation recommendations). PTs will recommend whether Council should consider changes to EFH descriptions and identification, or other amendments to EFH FMP text and management.
April 6-14	Council meeting	Summary Report for Council Review. Will include crab and scallop reviews. Council to decide whether changes to EFH are required, and initiate FMP amendments accordingly (based on PT recommendations and other comments/review). Council will also decide whether to initiate a HAPC process by setting HAPC priorities and calling for proposals.
April – December		*If necessary, prepare amendments required to change FMP EFH text for any of Council's 5 FMPs. Determine level of analysis required to support FMP amendments.*
September	*Joint Groundfish Plan Team meeting, Crab PT meeting*	*Opportunity for PTs to review proposed FMP amendments, if necessary/ appropriate*
October	*Council meeting*	*Initial review of FMP amendments to change EFH FMP text*
December	*Council meeting*	*Final action on FMP amendments to change EFH FMP text*

3 Roadmap to ten EFH components

Although the ten EFH components are all addressed in each of the Council's FMPs, some components vary by FMP, and some are general across all the FMPs. Consequently, the format of the summary report is geared to minimize duplication, and groups related components together where appropriate. The following sections provide a roadmap to where, in the summary report, the review of each component may be found.

3.1 EFH descriptions and identification

The review of EFH descriptions and identification for each managed species is described in this report by FMP, in Sections 5 through 9. For each individual species, the following information is contained within the FMP, and was reviewed for this report:

- *EFH description* – in text by life history stage, and illustrated on a map, along with an indication of the level of EFH information that is known for each life history stage of the species
- *General habitat information* – life history and general distribution; habitat, biological, and predator-prey associations; trophic information; upper size limit of juvenile fish
- *Fishery information* – description of directed fishery, evaluation of fishing effects (by any fishery) on species habitat (summarized from the 2005 EFH EIS, which is incorporated by reference)
- *References* – references in the literature to learn more about species life history and habitat, persons to contact for further information

3.2 Fishing activities that may adversely affect EFH

The fishery effects model was used to evaluate fishing activities that may adversely affect EFH in the 2005 EFH EIS. In Section 10, the report identifies how the various inputs to the model used in the 2005 analysis were compared against information now available. The model inputs include, among other things, the distribution and intensity of trawl fishing activities and habitat recovery rates. This should demonstrate whether the impacts analysis from the 2005 EIS is likely to still be valid, or whether it warrants revision.

Additionally, each of the sections reviewing individual species EFH (Sections 5 through 9) includes consideration of whether the changes in fishing activity are likely to result in a change to the conclusions from the 2005 EFH EIS.

3.3 Non-Magnuson-Stevens Act fishing activities that may adversely affect EFH

The effects of non-Magnuson-Stevens Act fishing activities are covered within the discussion of fishing effects on habitat, and the review of the effects of fishing gear types on habitat species. The types of gear used by the non-Magnuson-Stevens Act fisheries in Alaska are discussed in detail in the 2005 EFH EIS, as well as their distribution.

3.4 Non-fishing activities that may adversely affect EFH

An extensive evaluation of the various non-fishing activities that may adversely affect EFH in Alaska is included in each of the FMPs, along with EFH conservation recommendations to avoid, minimize, or

compensate for adverse effects on EFH caused by activities other than fishing. Section 1 reports on the review of these FMP sections, and identifies whether any changes to the recommendations are merited based on new information.

3.5 Cumulative impacts analysis

The cumulative effects of fishing and non-fishing activities on EFH was considered in the 2005 EFH EIS was considered, but available information was not sufficient to assess how the cumulative effects of fishing and non-fishing activities influence the function of EFH on an ecosystem or watershed scale. No new information is available since the analysis in the EFH EIS to allow the magnitude of the combined effect of all of these activities to be quantified, so the level of concern remains unknown at this point.

3.6 EFH conservation and enhancement recommendations

Habitat conservation and enhancement recommendations address fishing and non-fishing threats to EFH and HAPCs. As part of the evaluation of EFH in 2005, the Council adopted a number of mitigation measures in the fisheries to provide additional protection to EFH. These measures were implemented in 2005, and include the designation of EFH habitat conservation areas and HAPC habitat conservation zones in the Gulf of Alaska and the Aleutian Islands. Additionally, in 2008, habitat conservation areas were implemented in the Bering Sea, and in October 2009 the Council adopted a gear modification for the Bering Sea non-pelagic trawl flatfish fishery in order to reduce adverse impact to bottom habitat. These fishing recommendations for EFH conservation have been implemented by the Council, and are described in Section 0. Additionally, stock assessment authors were provided the opportunity to offer EFH conservation recommendations for the Council's consideration, relevant to their species. These are found in the same section. Non-fishing EFH conservation recommendations are reviewed in Section 1.

3.7 Prey species list and any locations

The prey species of each managed species in the FMPs are reviewed in the individual species sections for each FMP, in Sections 1 through 0, and any recommended changes are highlighted in those sections.

3.8 HAPC identification

A description of the Council's HAPC identification process since the last evaluation of EFH in 2005 is described in Section 1. Additionally, stock assessment authors were provided the opportunity to offer HAPC recommendations for the Council's consideration, relevant to their species. These are also included in the same section.

3.9 Research and information needs

Section 1 describes the review of research and information needs for EFH, as well as providing research recommendations for many of the individual FMP species.

3.10 Review EFH every 5 years

The final EFH component is to review EFH every 5 years. This summary report documents the occurrence of this review.

4 Environmental and management changes since 2005 EFH EIS analysis

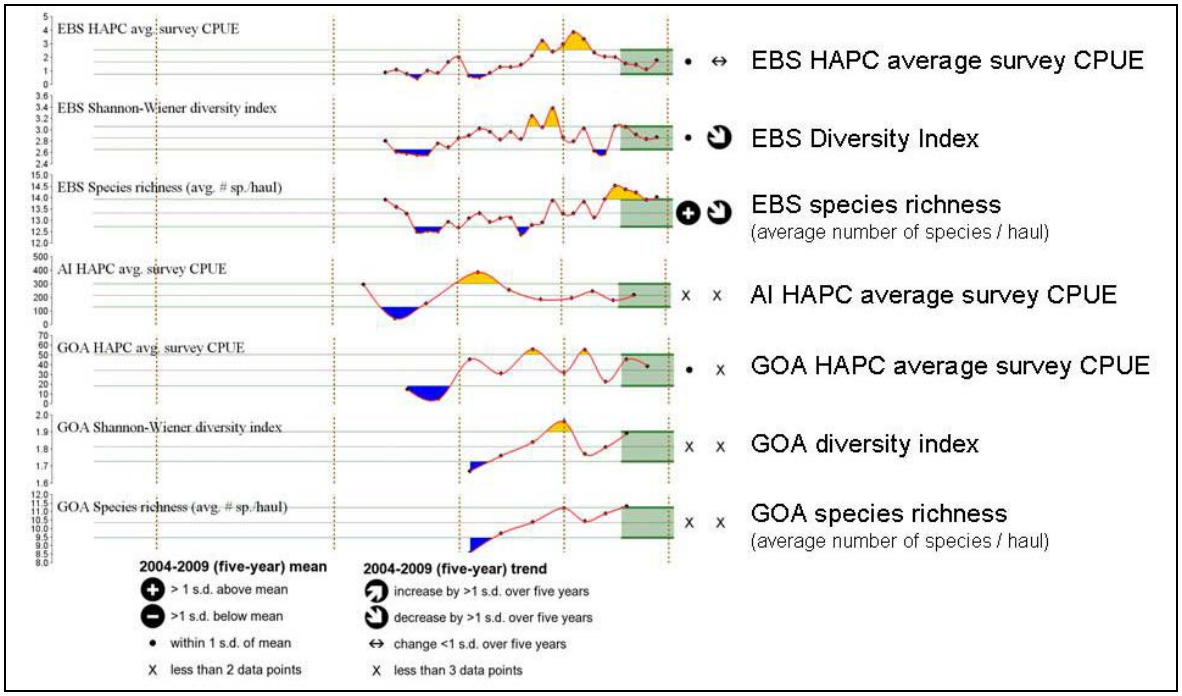
In order to better inform the five year review of EFH, this section discusses some of the changes that have occurred both in the North Pacific environment and habitat (Section 4.1), our understanding of that environment and our impact upon it (Section 4.2), and in fishery management (Section 4.3) in the last five years.

4.1 Environmental and habitat changes since 2005 EFH EIS

The Council's annual Ecosystem Assessment, in the Ecosystem Considerations chapter of the SAFE report (Boldt and Zador 2009) provides a comprehensive overview of environmental conditions in the BSAI and GOA on an annual basis. A brief summary is included here, however the annual ecosystem assessment provides the basis for understanding changes in the physical environment that may affect the review of EFH that is documented in this report. With respect to climate variability, the Bering Sea cold pool has increased over the summers of 2007-2009, compared to the low values observed in 2000-2005, but is within the range of variability observed in recent decades. The cold pool size and location may affect the distribution of some fish species, and may also affect stratification, production, and community dynamics in the Bering Sea.

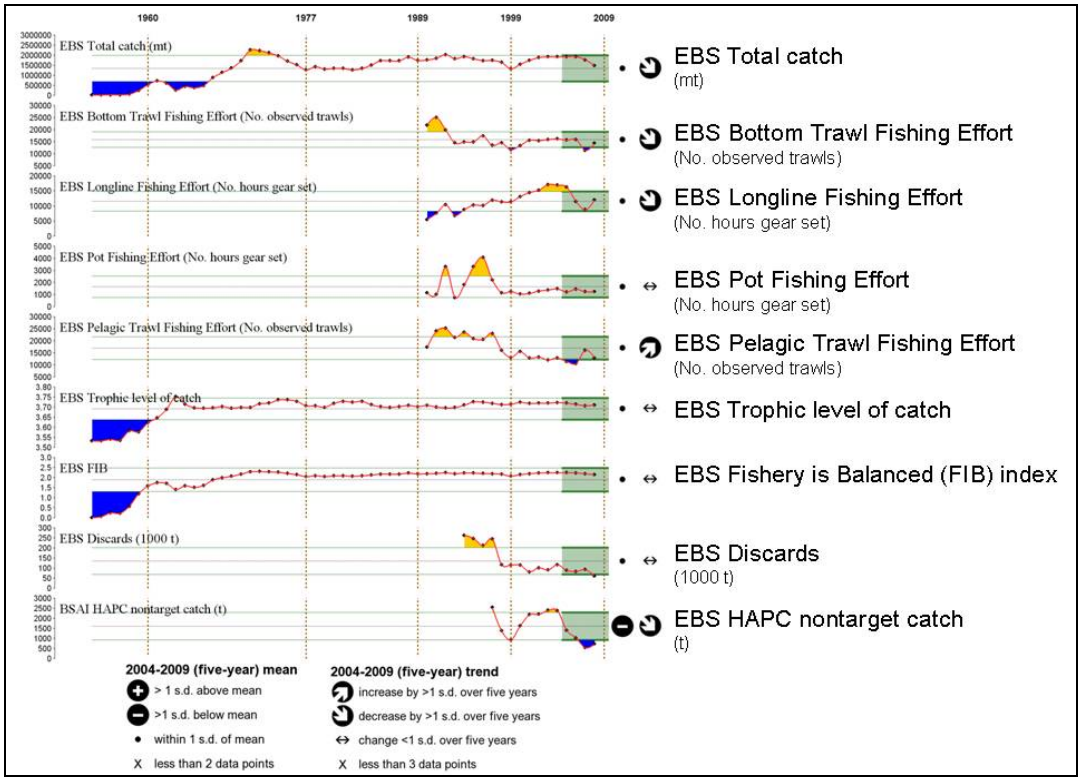
Recently, AFSC staff has developed a format for reporting various indices over time, and comparing the most recent five years against the historical record for each indicator. Figure 1 shows indices of diversity for the groundfish fishery regions. For almost all of the indices shown, the five year mean is within one standard deviation of the historical mean for the data set. This would tend to indicate that environmental conditions have not changed significantly in the last five years. The figure also shows the five year trend for the Bering Sea indicators, which are all also within one standard deviation, except for the Bering Sea size spectrum slope index. Figure 2 through Figure 4 illustrate catch, effort, and discard data sets for the eastern Bering Sea, Aleutian Islands, and Gulf of Alaska. Once again, the five year mean is within one standard deviation of the historic mean. The five year trend indicates that bottom trawl and longline effort in the Bering Sea have decreased over the time period, as has catch of HAPC biota (seapens/whips, sponges, anemones, corals, and tunicates). A more detailed discussion of changes in trawl fishing intensity is included in Section 10.1.1.

Figure 1 Comparison of 2004-2009 versus historical record of Bering Sea, Aleutian Islands, and Gulf of Alaska ecosystem diversity indices



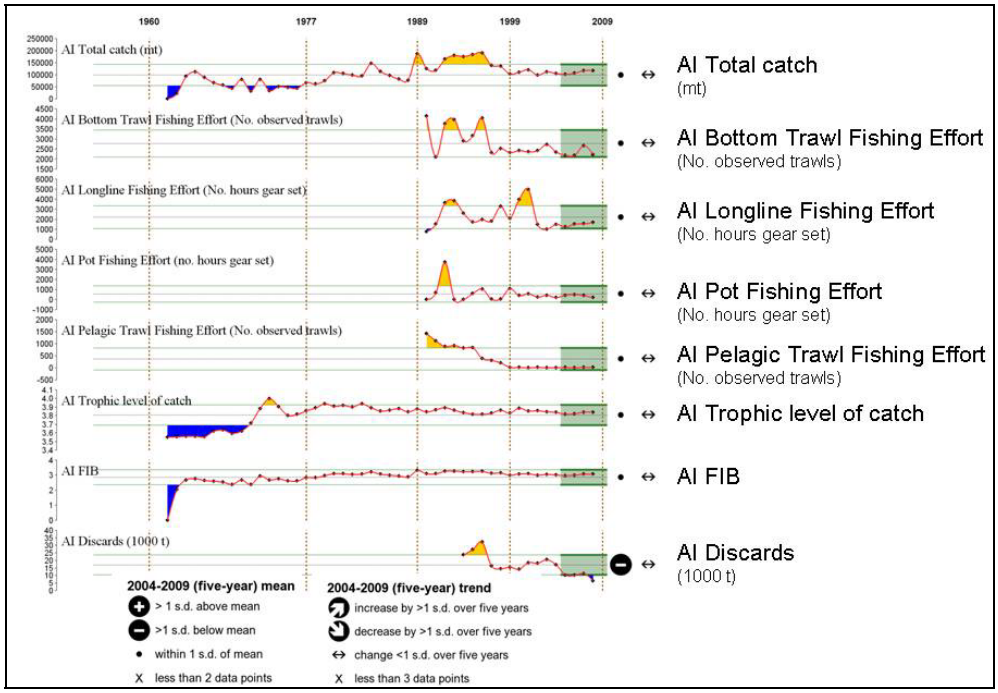
Source: S. Zador, AFSC

Figure 2 Comparison of 2004-2009 versus historical record of catch, effort, and discard indicators in the Bering Sea



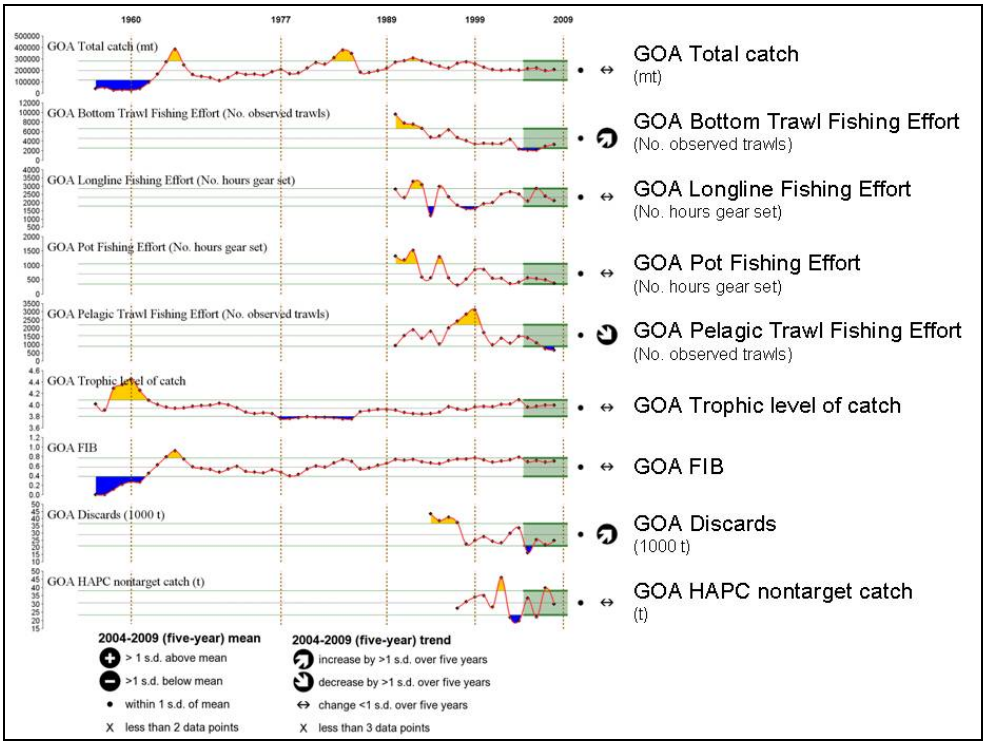
Source: S. Zador, AFSC

Figure 3 **Comparison of 2004-2009 versus historical record of catch, effort, and discard indicators in the Aleutian Islands**



Source: S. Zador, AFSC

Figure 4 **Comparison of 2004-2009 versus historical record of catch, effort, and discard indicators in the Gulf of Alaska**



Source: S. Zador, AFSC

4.2 Research since the EFH EIS

This section provides a general summary of habitat research that has been undertaken by NOAA Fisheries and the North Pacific Research Board, two of the primary research agencies for marine research in Alaska, in the last five years. Additional studies eliciting habitat information have also been documented in the individual species reviews. These research studies are documented in Appendices 1 and 2.

4.2.1 NOAA Fisheries EFH Research

EFH Research Planning is coordinated through the AFSC, the AFSC Habitat and Ecological Processes Research (HEPR) Core Team, the NPFMC, and the Alaska Region, HCD. NMFS Alaska Region has an annual EFH Research Proposal Process. In recent years, the following funding has been available for EFH research:

Year	Funded (in thousands)
2006	$478K
2007	$436K
2008	$547K
2009	$520K
2010	$450K (anticipated)

Proposals must involve habitat for species managed under an FMP. As funding is limit, the funding is currently focused on three EFH research priorities (see Section 13.2.1 for description of NMFS EFH research priorities):

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

Specific research has been done on EFH and habitat by the Alaska Fisheries Science Center since the 2005 EFH EIS, and is described below.

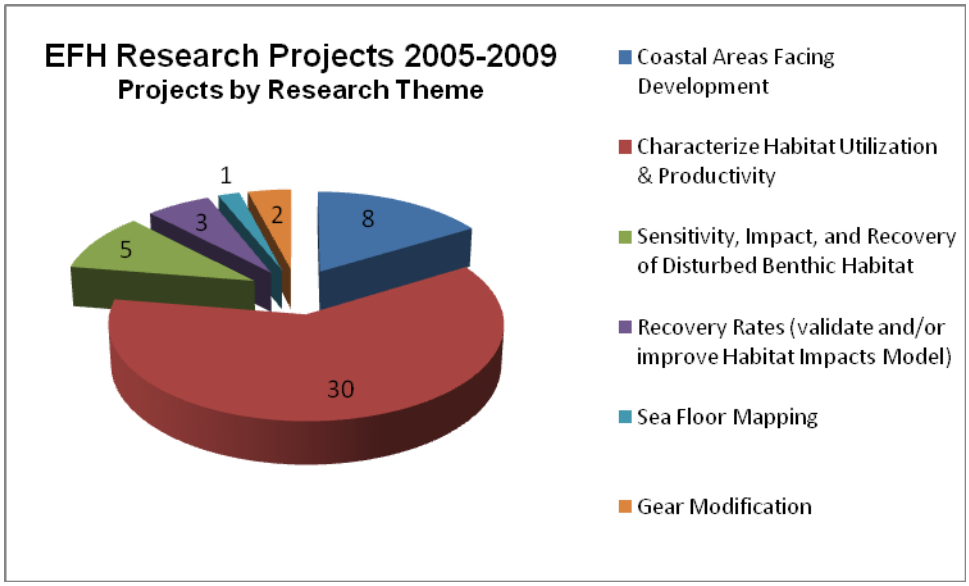
Projects funded under the EFH research plan, 2005-2009

EFH 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.

Research projects are selected through a competitive AFSC request for proposal process based on research priorities from the EFH Research Implementation Plan for Alaska. Annually, approximately $500,000 is spent annually on EFH research projects. Funded projects address major research themes (Figure 5 and Table 3). Project results are described in annual reports and the peer-reviewed literature (http://www.afsc.noaa.gov/HEPR/efh.htm). Study results contribute to existing Essential Fish Habitat data sets.

Figure 5 **EFH Research Project Summary by Theme, (a) number of projects by theme, (b) costs by theme (projects may address more than one theme).**

(a)



(b)

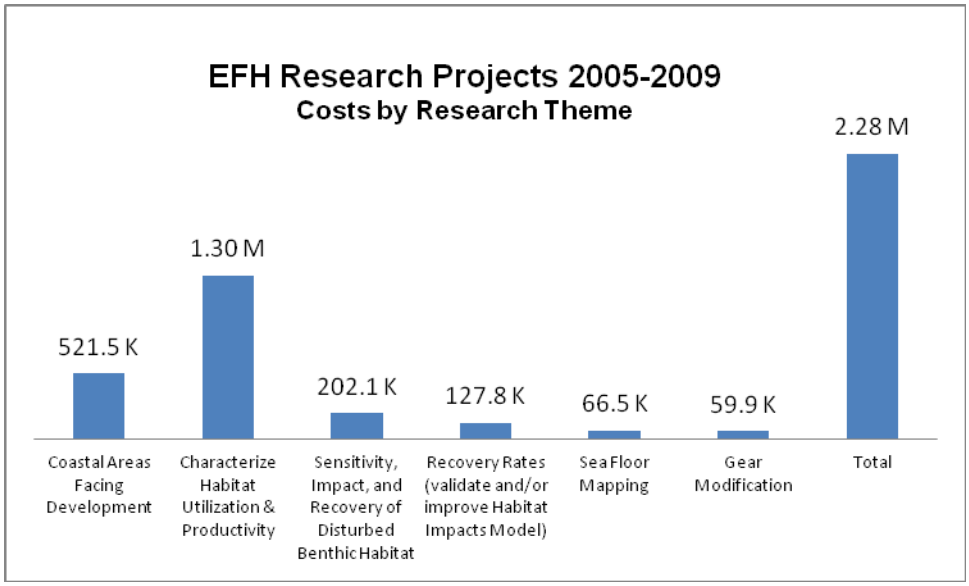


Table 3 **NMFS-funded EFH Research Projects, 2005-2009**
Note, this table, including a column summarizing the findings of each project, is available online at http://www.fakr.noaa.gov/habitat/efh.htm.

Funding Year	EFH Proposal #	Project Title	EFH Research Priority				
			Coastal Areas Facing Development	Characterize Habitat Utilization & Productivity	Sensitivity, Impact, and Recovery of Disturbed Benthic Habitat	Recovery Rates	Sea Floor Mapping
2005	1	Interannual and habitat-specific growth rates of northern rock sole		1	1		
2005	2	Trawl sweep and footrope modifications to reduce seafloor effects	Gear modification				
2005	3	Nearshore EFH: fish use, mapping, GIS database	1	1			
2005	4	Mapping and function of eelgrass beds	1	1	1		
2005	5	Video analysis of flatfish nursery habitat and gear impacts		1	1		
2005	6	Atka mackerel spawning and nesting in the Aleutians		1			
2005	7	Submersible evaluation of eastern GOA corals		1	1		
2006	1	Mapping long term equilibrium impacts of fishing and evaluation of impacts of fishing on fish condition, fish distribution, and fish diet			1	1	
2006	2	Modify trawls to reduce fishing impacts / Better characterize fishing's footprint[2]	Gear modification				
2006	3	Assessment of critical habitats for juvenile Pacific cod		1			
2006	5	Habitat effects on growth and condition of northern rock sole		1			
2006	8	Essential Fish Habitat requirements For skate nurseries		1			
2006	11	Convene a workshop to plan for the development of a habitat data inventory system for the AFSC	Workshop				
2006	12	Essential Fish Habitat - Overwinter habitat use and energy dynamics of juvenile capelin, eulachon, and Pacific herring		1			
2006	14	Juvenile rockfish habitat utilization		1			
2006	16	Nearshore essential fish habitat-seasonal fish use, mapping, GIS database	1	1			
2006	18	Food habits and small scale habitat utilization of Atka mackerel in the Aleutian Islands, Alaska		1	1		
2006	20	Log transfer facilities	1				
2007	2	Habitat effects on growth and condition of northern rock sole		1			
2007	5	Habitat specific production of Pacific ocean perch in the Aleutian Islands		1			
2007	6	Recovery of a sessile invertebrate of the Bering Sea shelf from trawling			1	1	
2007	7	Temporal dynamics of habitat use in juvenile Pacific cod		1			
2007	9	Mapping and fish utilization of coastal habitats vulnerable to disturbance from development and climate change	1	1			
2007	10	Juvenile Pacific ocean perch habitat utilization		1			
2007	12	Habitat influence on rearing condition and overwinter survival of juvenile capelin (Mallotus villosus)		1			
2007	11 A	Biological parameters to estimate the recovery of disturbed benthic habitat in Alaska, study A: Coral growth			1	1	
2007	11 C	Biological parameters to estimate the recovery of disturbed benthic habitat in Alaska, study C: Coral genetics		1	1		
2008	1	Nearshore Fish and Habitat Assessment	1	1			
2008	2	Productivity, habitat utilization and recruitment dynamics of Pacific cod		1			
2008	3	Contrasting predation intensity and distribution in two rock sole nursery areas		1	1		
2008	4	Physical and temporal aspects of pollock spawning habitat utilization		1			
2008	5	Habitat characterization and utilization of early benthic phase red king crab		1			
2008	6	Habitat influence on rearing condition and overwinter survival of juvenile capelin		1			

[2] Met 2006 priority of "fishing gear impacts to reduce impacts of fishing"

Funding Year	EFH Proposal #	Project Title	EFH Research Priority				
			Coastal Areas Facing Development	Characterize Habitat Utilization & Productivity	Sensitivity, Impact, and Recovery of Disturbed Benthic Habitat	Recovery Rates	Sea Floor Mapping
2008	7	Rockfish abundance and diurnal habitat associations on isolated rocky habitat in the eastern Bering Sea		1			
2008	8	Characterization of benthic infauna community for modeling essential fish habitat in the eastern Bering Sea		1			1
2008	9	Juvenile slope rockfish habitat distribution		1			
2009	20	Recovery of deep water sponges and sea whips from bottom trawling			1	1	
2009	8	Invertebrate colonization of PMEL moorings			1	1	
2009	22	Recruitment and response to damage of an Alaskan gorgonian coral			1	1	
2009	12	Nearshore Fish Assemblages in the Arctic: Establishment of Monitoring Sites in a Rapidly Changing Environment from Energy Development and Climate Change	1	1			
2009	4	Contrasting predation intensity and distribution in 2 rock sole nursery areas: a principle factor controlling nursery productivity - Component A		1			
2009	17	Characterization of Benthic Infauna Community for Modeling Essential Fish Habitat in the Eastern Bering Sea - Reduced plan		1	1		
2009	11	Year 2: Assessing the physical and temporal aspects of pollock spawning habitat utilization in Shelikof Strait, Gulf of Alaska		1			
2009	5	Productivity, habitat utilization and recruitment dynamics of Pacific cod		1			
2009	1	Characterize habitat utilization and productivity for rockfish species		1			
2009	16	Natural and man-made disturbance of eelgrass beds in northern southeastern Alaska: damage and recovery	1	1			
2009	4	Contrasting predation intensity and distribution in 2 rock sole nursery areas: a principle factor controlling nursery productivity - Component B		1	1		
2009	21	Utilization of nearshore habitat by fishes in Nushagak and Togiak Bays (Bristol Bay)		1			
2009	13	Nearshore Fish Assemblages in Coastal Areas Facing Development in Southcentral Alaska	1	1			

Essential Fish Habitats benefit from research directed to address effects from fishing and other anthropogenic activities. The EFH Research Implementation Plan and project review by AFSC HEPR allows EFH research to undergo peer-review scrutiny, a process implemented only in Alaska. EFH research struggles from a lack of adequate funding to address enormous unknowns, such as seafloor mapping and marine habitat delineations on the Alaska scale. However, this deficiency should not overshadow the exceptional research EFH has funded. A few highlights include:

- A better understanding of Atka mackerel spawning behaviors
- Bering Sea seafloor substrate mapping
- Coral recovery and growth studies
- Gear modification research
- Shoreline mapping and fish distributions

Further information specifically on how EFH research has been used to validate and or improve the habitat impact recovery model is described in detail in Section 10.1 of this report.

The next 5 years of EFH research will be guided by and conceptualized in the 2012-2016 EFH Research Plan. The new plan will consider research needs identified in this EFH 5-Year Review Summary Report, as listed in Section 13.

Response to recommendations from the CIE review of the EFH EIS

The Center for Independent Experts (CIE) completed an independent peer review of the technical aspects and assessment methodology used by the National Marine Fisheries Service (NMFS) to evaluate the effects of fishing on Essential Fish Habitat (EFH) in Alaska. Specifically, the reviewers focused on two broad issues: 1) the fishing effects model used to assess the impact of fishing on different habitat types, and 2) the analytical approach employed to evaluate the effects of fishing on EFH, particularly the use of stock abundance relative to the Minimum Stock Size Threshold (MSST) to assess possible influence of habitat degradation on the productivity of fish stocks. Many of the panel's comments, criticisms, and concerns are provided in the panel chair's summary report and are embodied as a succinct set of short-term and long-term recommendations (http://www.fakr.noaa.gov/habitat/cie/review.htm). NMFS' response (available on the same website) to many of the technical recommendations raised by the CIE review panel provide additional points of clarification and propose additional analyses and activities. Issues of a policy nature (e.g., the appropriate level of precaution; inclusion of the opinions, information and data of stakeholders; etc.) were outside the scope of this technical response.

The CIE panel's reports included the following findings:

- The model was well conceived and is useful in providing estimates of the possible effects of fishing on benthic habitat. However, as acknowledged in the DEIS, the parameters estimates are not well resolved and have high uncertainty due in large part to a paucity of data. Results must be viewed as rough estimates only.
- Validation of the model using data from Alaskan waters as well as other regions is essential to confirm the usefulness of the model. A hindcast using the model would also help to clarify how existing conditions relate to historical patterns.
- The use of stock status relative to the Minimum Stock Size Threshold to assess possible influence of habitat degradation on fish stocks is inappropriate. MSST is not a sufficiently responsive indicator and provides no spatial information about areas with potential adverse effects. Instead, the approach should include examination of time series indices such as size-at-age, population size structure, fecundity, gut fullness, spatial patterns in fish stocks relative to fishing effort, and the history of stock abundance.
- The analysis may underestimate the recovery rate of sponge habitat, and should incorporate more information about the rate of destruction of hard corals and sponges.
- Use the precautionary approach especially where data are unclear, recovery times are long (e.g., coral and sponge), or habitat reduction is high, even if stock abundance levels are above MSST.
- The analysis did not give adequate consideration to localized (versus population level) habitat impacts.
- The evaluations for effects on individual species should include clearer standards for incorporating professional judgment, and should be supplemented with information from stakeholders.
- The conclusion that effects of fishing on EFH are no more than minimal is premature.

NMFS has continued to advance the status of the LEI model with work done both within and outside the ASFC. Specific instances of improvements and studies can be found in this section and in Section 10.1.1, Fishing Effects on EFH, where fishing intensity, habitat categorization, modeling methods, sensitivity, recovery, and corals are discussed relative to the effects model.

Gear modification research

Since 2005, the AFSC's Conservation Engineering Project has collaborated with the Bering Sea bottom trawl fleet, represented by The Groundfish Forum and the Best Use Cooperative, to identify modifications of trawl gear that reduce damage to seafloor habitat. Research during this initial phase focused on the sweeps, cables that connect the doors to the net, which cover the vast majority of the area affected by bottom trawling, especially when targeting flatfish. Widely spaced elevating devices were developed that raised sweeps 2-4 inches above the seafloor with very little direct contact, instead of the continuous contact along the length of conventional sweeps. Cooperative research demonstrated reductions in effects on living structure animals on sand/mud substrates, while maintaining effective herding and capture of groundfish. The modification was also shown to substantially reduce mortality rates of Tanner, snow and red king crabs that encounter trawl sweeps. Field tests and workshops were conducted to develop practical implementation of these modifications, to identify related costs and handling issues and to propose useful definitions and enforcement measures. At their October 2009 meeting, the North Pacific Fisheries Management Council adopted measures to require such modifications for all trawlers targeting flatfish in the Bering Sea. Implementing regulations are scheduled to go into effect for the 2011 season. Further research to reduce effects of other trawl components is underway.

EFH data inventory

A recent Alaska-specific EFH data inventory publication offers summaries of EFH work and available data sets (see McConnaughy et al 2009, or http://www.afsc.noaa.gov/Publications/ProcRpt/PR2009-01.pdf).

Data source / project	**Region**
Habitat Areas of Particular Concern: a case study of EFH habitat data	GOA
Delta submarine video archiving	GOA, BS, AI
Estuaries database	GOA
Essential Fish Habitat requirements for skate nurseries	BS
Alaska coastal mapping / Nearshore Fish Atlas of Alaska	GOA, BS, AI, Arctic
Effect of light intensity on vertical and spatial distribution of fish and their availability to bottom trawl and acoustic surveys	GOA, BS, AI
Nearshore habitat use in juvenile Pacific cod	GOA
Flatfish nursery function	GOA
Atka mackerel EFH	AI, GOA
Habitat influence on rearing condition and overwinter survival of juvenile capelin	GOA
Bristol Bay reconnaissance	BS
Bering Sea echosounder survey	BS
EBSSED sediment database	BS
2006 FISHPAC experiment	BS
1996 TRAWLEX experiment	BS
1997 TRAWLEX experiment	BS
TRAWLEX BACI experiment	BS
Trawl-effect reduction tests	BS
Multibeam habitat mapping in the Alaska region	GOA, BS, AI
Trawlability - AFSC survey single-beams.	GOA
usSEABED	GOA, BS, AI, Arctic
Pacific ocean perch (*Sebastes alutus*) habitats	AI
Aleutian Islands cooperative acoustic survey study	AI
Kodiak fishery interactions and fisheries oceanography studies	GOA
Atka mackerel tag release and recovery	AI
Pacific cod Cape Sarichef localized depletion experiment	BS
Down to 50 m bathymetry	GOA, BS, AI

4.2.2 North Pacific Research Board (NPRB)-funded Research Projects

The NPRB was created by Congress to fund research activities related to fisheries and marine ecosystems. The NPRB sets research priorities, guided by a comprehensive science plan, to specifically address pressing fishery management needs in the North Pacific Ocean, Bering Sea, and Arctic Ocean. The NPRB employs a highly competitive funding proposal process to engage scientists. Annually, peer-reviewed research projects are funded to further investigate data gaps.

A guiding principle of the NPRB is to avoid duplication of research efforts. The NOAA Fisheries EFH program annually reviews NPRB research priorities, to ensure each program complements the other. In this manner, research benefits by program collaboration and cost sharing. Often times it is this cooperative approach that makes a project viable.

To date (since 2002), the NPRB has funded 228 projects totaling over 37 million dollars. These projects share common EFH research objectives and needs. However, the NPRB process is more diverse, as the research program comprises other components of the marine ecosystem, such as marine mammals, seabirds, and socio-economic considerations. Thus not all NPRB projects are applicable to EFH research needs. The following table lists NPRB studies by year and name that have furthered knowledge of EFH or EFH-related management. An overview of each project is described in a reference document under the 5-year review section of the NMFS EFH website, http://www.fakr.noaa.gov/habitat/efh.htm, or visit http://www.nprb.org/ for more detailed information.

North Pacific Research Board Studies and EFH

NPRB 2004	401	Forage fish
	402	Ocean circulation model
	404	Ocean infoformation GIS
	406	SEAK biology & oceanography
	410	BS biophysical mooring observations
	415	Skates
	416	Juvenile rockfish
	417	Atka mackerel
	418	Sharks –dogfish
	419	Groundfish multi-species
	420	Pacific ocean perch young of the year

NPRB 2005	502	Ecological Indicators
	503	Salmon programs
	505	EBS pollock
	506	Pollock tagging
	507	Pribilof blue king crab
	508	EBS Snow crab
	509	red king crab
	510	Skates
	511	Sharks – dogfish
	512	Pacific ocean perch - phase 2
	522	Atka mackerel biology
	523	Pollok recruitment
	524	Capelin and pollock productivity
	525	Groundfish modeling
	529	Habitat Closure Valuation
	530	Ecosystem
	536	Plankton survey North Pacific and southern BS

NPRB 2006	601	Plankton in North Pacific and southern BS
	602	Changes in BS
	603	GOA long term observations
	604	Norton Sound benthic fauna
	605	Early life stage modeling p cod
	607	Lower trophic changes to climate change
	610	Pollock larvae adaptation to climate changes
	612	NP Meso-Marine Ecosystem
	614	Coastal ecosystem health and change
	615	Marine Mapping workshop
	616	Chiswell ridge
	618	Pacific cod spatial patterns
	619	EBS Greenland halibut (turbots)
	620	Pacific cod movements
	621	Skates
	622	Groundfish prey
	623	Tanner crab
	624	Larval snow crab
	625	BSAI RKC
	627	Squid life histories
	628	BS large ecosystems for sculpins
	629	Adult female POP
	630	AI forage fish distributions
	642	Forage fish distributions and habitat use
	645	Rockfish local and subsistence harvests

NPRB 2007	701	Eco-system changes on BS shelf
	704	AK Marine Information System
	709	Flatfish EBS
	710	Trawl impact on flatfish nurseries
	711	BSAI crab effects from trawling
	713	Predicting snow crab growth
	714	Red king crab and Snow crab biological reference points
	715	Skate life history information
	716	Squid assessments
	719	BS oceanographic information
	726	benthic habitat characterization
	728	Herring spawning areas
	729	Copper rockfish in PWS
	730	Pollock biomass to manage fisheries and SSL
	731	Commercial fleet temperature data collection to reduce bycatch

NPRB 2008	805	Meso-zooplankton populations GOA and BS
	806	Euphausia in GOA
	808	Skate habitat mapping EBS
	809	Rockfish survey patchiness
	810	Rockfish assessment in untrawlable areas using advanced technologies
	811	Red king crab enumeration
	812	Snow crab behavior and structure preferences
	813	Uncertainty in snow crab recruitment using management
	814	EBS Tanner crab recruitment
	815	Pacific cod movements using mark-recapture
	817	Pacific cod genetics: investigating ecological barriers
	823	Copper River salmon biology
	825	Bristol Bay red king crab management

4.3 Management changes

Since the 2005 EFH EIS, there have been various management changes which have affected the effects of fishing on habitat, or the consideration of habitat impacts by managers. These changes are described in the sections that follow.

4.3.1 EFH conservation actions taken in conjunction with or following on from the 2005 EFH EIS

Gulf of Alaska and Aleutian Islands habitat conservation measures – implemented in August 2006

EFH mitigation actions

In February 2005, the Council adopted several new closure areas to conserve EFH. To minimize the effects of fishing on EFH, and more specifically to address concerns about the impacts of bottom trawling on benthic habitat (particularly on coral communities) in the Aleutian Islands, the Council took action to prohibit all bottom trawling in the Aleutians, except in small discrete “open” areas. Over 95% of the management area is closed to bottom trawling (277,100 nm^2). Additionally, six Habitat Conservation Zones with especially high density coral and sponge habitat were closed to all bottom-contact fishing gear (longlines, pots, trawls). These “coral garden” areas, which total 110 nm^2, are essentially marine reserves. To improve monitoring and enforcement of the Aleutian Island closures, a vessel monitoring system is required for all fishing vessels in the Aleutian management area.

In the Gulf of Alaska, bottom trawling for all groundfish species is also prohibited in 10 designated areas along the continental shelf. The GOA Slope Habitat Conservation Areas, which are thought to contain high relief bottom and coral communities, total 2,086 nm^2.

Habitat Areas of Particular Concern - HAPC

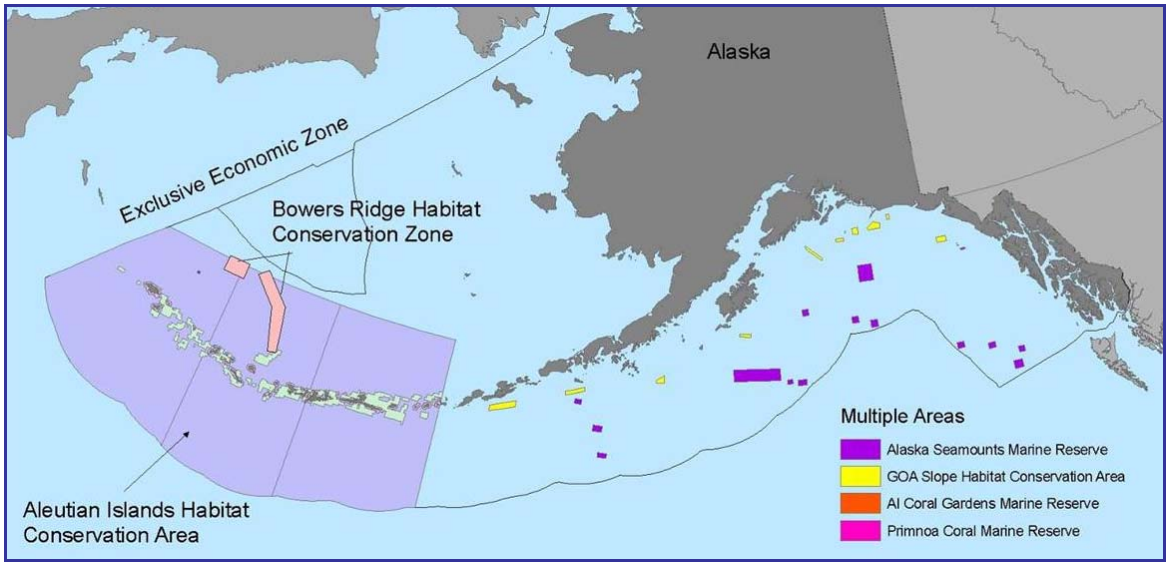
The Council formally revised its approach to designate HAPCs by adopting a site-based approach in 2005. The process begins with the Council identifying priorities and then initiating a public call for HAPC nominations, using a proposal process scheduled by the Council. Proposed sites are reviewed by the Plan Teams and staff for ecological merit, socioeconomic, management, and enforcement impacts. Based on this combined review, the Council may advance various HAPC proposals for further analysis. The Council may then design specific management measures, if needed, for each HAPC.

In February 2005, the Council adopted several new HAPCs. Twenty sites in the Gulf of Alaska and Aleutian Islands, consisting of seamounts and high density coral areas, were identified as HAPCs. To protect these sites and eliminate environmental impacts due to fishing, the Council prohibited fishing in these areas by gear types that contact the bottom. These sites and measures became effective in June 2006 (Figure 6).

> The Alaska Seamount Habitat Protection Area encompasses all 16 seamounts in Federal waters off Alaska, named on NOAA charts (Bowers, Brown, Chirkikof, Marchand, Dall, Denson, Derickson, Dickins, Giacomini, Kodiak, Odessey, Patton, Quinn, Sirius, Unimak, and Welker). Bottom-contact fishing is prohibited in all of these HAPCs, an area which totals 5,329 nm^2.
>
> In Southeast Alaska, three sites with large aggregations ("thickets") of long-lived Primnoa coral are also identified as HAPCs. These sites, in the vicinity of Cape Ommaney and Fairweather grounds, total 67 nm^2. The Gulf of Alaska Coral Habitat Protection Area designates five zones within these sites where submersible observations have been made, totaling 13.5 nm^2. All bottom-contact gear (longlines, trawls, pots, dinglebar gear, etc.) is prohibited in this area.
>
> In the Aleutian Islands region, the relatively unexplored Bowers Ridge was also identified as a HAPC. As a precautionary measure, the Council acted to prohibit mobile fishing gear that contacts the bottom within this 5,286 nm^2 area.

In 2007, the Council considered initiating another HAPC process. However, after taking public comment, the Council determined that there was no pressing need to set HAPC priorities at that time. Currently, the HAPC criteria (rarity, ecological importance, stress, sensitivity) are being re-assessed by a Council, Plan Team and NMFS Regional Office workgroup with oversight by a SSC subgroup, in preparation for the next call for proposals. The Council is scheduled to consider whether to set HAPC priorities in conjunction with the final EFH 5-year report. Section 1 offers a more detailed discussion of HAPCs, including the newly approved rating criteria.

Figure 6 EFH and HAPC Conservation Areas in the Gulf of Alaska and the Aleutian Islands



Bering Sea habitat conservation measures – implemented in August 2008

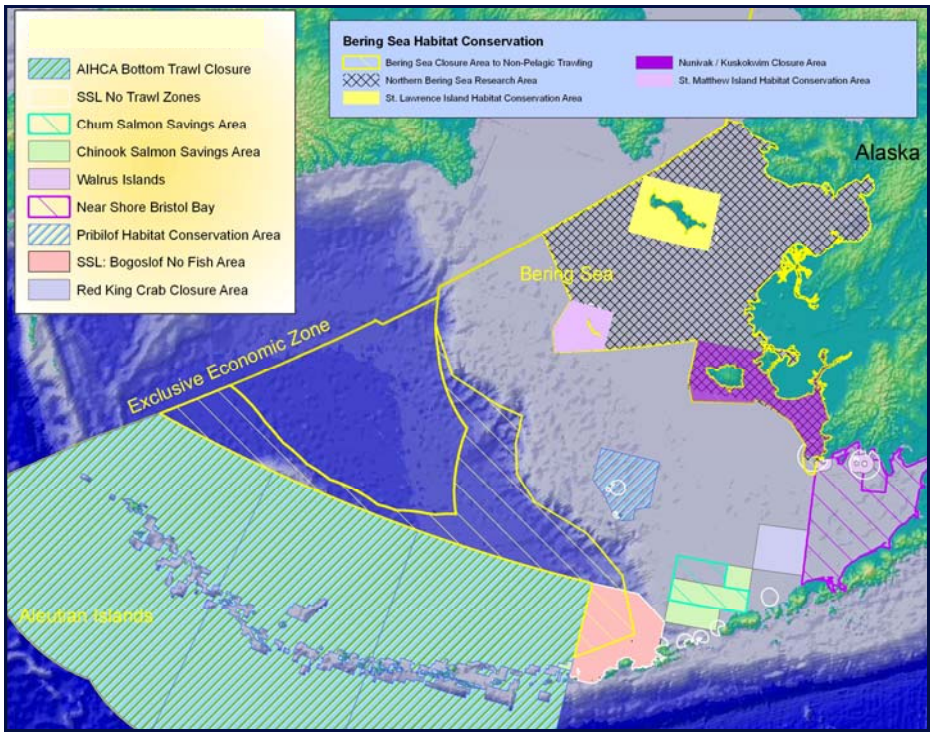
In June 2007, the Council adopted precautionary measures to conserve benthic fish habitat in the Bering Sea by "freezing the footprint" of bottom trawling by limiting trawl effort only to those areas more recently trawled (Figure 7). Implemented in 2008, the new measures prohibit bottom trawling in a deep slope and basin area (47,000 nm^2) and the Northern Bering Sea Research Area that includes the shelf waters to the north of St. Matthew Island (85,000 nm^2).

The entire Northern Bering Sea Research Area will be closed to bottom trawling while a research plan is developed. The research plan may include an adaptive management design, which could allow bottom trawling in designated areas to evaluate effects, or research using other experimental fishing approaches. Specific areas within the Northern Bering Sea Research Area, however, will always remain closed to bottom trawling. These Habitat Conservation Areas were established to conserve blue king crab habitat and other EFH where subsistence harvesting and small-scale local fisheries take place, and include the nearshore areas of Nunivak Island and Kuskokwim Bay, and around St. Lawrence and St. Matthew Islands. The research plan may also identify additional protection measures for blue king and snow crab, marine mammals, ESA-listed species, and subsistence needs for western Alaska communities in nearshore areas.

Bering Sea gear modification – Adopted by Council in 2009, will be implemented in January 2011

In October 2009 the Council adopted a gear modification for the Bering Sea non-pelagic trawl flatfish fishery in order to reduce adverse impact to bottom habitat. Any vessel targeting flatfish with nonpelagic trawl gear in the Bering Sea subarea of the BSAI management area will be required to use elevating devices on their trawl sweeps. The modification will protect habitat by reducing damage to seafloor invertebrates, including crab species. The Council recommended that this amendment become effective no sooner than the beginning of the 2011 fishing year, in order to provide sufficient time for vessels to make any modifications necessary to comply with the gear requirement. Research on the modification and its effects has been conducted over the last three years by the Alaska Fisheries Science Center, in cooperation with the flatfish industry.

Figure 7 Bering Sea Habitat Conservation Closures

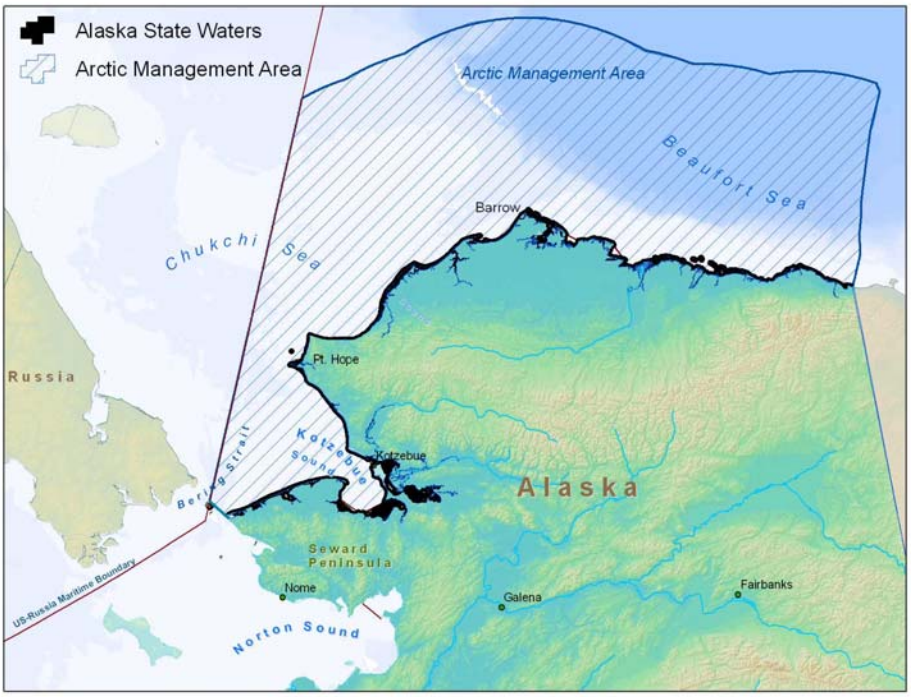


4.3.2 Other management changes

New Arctic FMP

In 2009, an Arctic Fisheries Management Plan was approved. The plan covers the Arctic waters of the United States in the Chukchi and Beaufort seas. Warming ocean temperatures, migrating fish stocks and shifting sea ice conditions from a changing climate may potentially favor the development of commercial fisheries. The plan establishes a framework for sustainably managing Arctic marine resources. It initially prohibits commercial fishing in the Arctic waters of the region until more information is available to support sustainable fisheries management (an area roughly 150, 000 sq nm^2). The plan was recommended by the North Pacific Fishery Management Council in February 2009.

Regulation (74 FR 56734, November 3, 2009) implements the Fishery Management Plan for Fish Resources of the Arctic Management Area and Amendment 29 to the Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs (Crab FMP). The Arctic FMP and Amendment 29 to the Crab FMP establish sustainable management of commercial fishing in the Arctic Management Area and move the northern boundary of the Crab FMP out of the Arctic Management Area south to Bering Strait.



Changes to the BSAI Crab FMP

In 2008, Amendment 24 to the BSAI Crab FMP was approved. Among other actions, the amendment removed twelve state-managed stocks from the FMP, for which NMFS and the Council found that the State of Alaska has a legitimate interest in their conservation and management and for which there is either no directed fishery, a limited incidental or exploratory fishery, or the majority of catch occurs in State waters. In the 2005 EFH EIS, EFH was identified for each of these species, however with their removal from the FMP, the EFH descriptions were also removed[3]. Consequently, for this 5-year review, only those species which are managed in the FMP are considered.

4.3.3 Changes in management policy and structure

Marine Fisheries Habitat Assessment Improve Plan

In 2008 and 2009, the Alaska Fisheries Science Center (AFSC) and Alaska Region (AKR) were part of a national effort to address the newly drafted Marine Fisheries Habitat Assessment Improvement Plan (HAIP). The HAIP team includes NMFS marine habitat researchers from each Science Center as well as representatives from the Office of Science and Technology and the Office Habitat Conservation. HAIP will be closely tied to improvement of stock assessments and other management strategies (such as Essential Fish Habitat designation and Integrated Ecosystem Assessments), and will be used as a funding vehicle for habitat research. The HAIP effectively addresses the common problems of inadequate resources, the absence of a research framework, and the lack of a working definition of “essential” which hinders essential fish habitat research. NMFS Alaska Regional Office of Habitat Conservation complimented the HAIP as a step in the right direction for EFH and habitat assessment.

[3] For three species, scarlet king crab, grooved Tanner crab, and triangle Tanner crab, there is some confusion as to whether the actual EFH text was deleted from the FMP. The correction of this oversight constitutes a housekeeping amendment, however, and for the purposes of this review, these species are all considered to have been removed from the FMP.

The HAIP process is still ongoing. In February 2009, the HAIP team briefed NOAA leadership as to its initial findings. The meeting re-affirmed that the HAIP establishes the framework to coordinate within NMFS programs and will assist NMFS to reach out to other line offices. HAIP discussion is scheduled to occur at the 1st National Habitat Assessment Workshop in St Petersburg, FL, May 18-20, 2010. The workshop is scheduled to follow the 11th Annual Stock Assessment Workshop, also in St Petersburg, FL, May 17-20, 2010. In this manner, many fishery stock experts can contribute and share their breadth of knowledge for the species they manage.

NMFS Alaska Regional Habitat Conservation Division

NMFS' Habitat Conservation Division (HCD) works in coordination with industries, stakeholder groups, government agencies, and private citizens to avoid, minimize, or offset the adverse effects of human activities on Essential Fish Habitat (EFH) and living marine resources in Alaska. This work includes conducting and/or reviewing environmental analyses for a large variety of activities ranging from commercial fishing to coastal development to large transportation and energy projects. HCD identifies technically and economically feasible alternatives and offers realistic recommendations for the conservation of valuable living marine resources. HCD focuses on activities in habitats used by federally managed fish species located offshore, nearshore, in estuaries, and in freshwater areas important to anadromous salmon.

HCD staff has remained relatively unchanged since 2005. Staff are located in the Juneau within the NMFS AKR Regional Office and in the Anchorage Field Office. Within HCD there are several program coordinators and subject area experts. Expertise includes: MSA/EFH experts; Federal Energy; Forestry; Habitat Restoration; Hydrology; Mining; Regulatory & Permitting; and Invasive Species. Additionally, The Anchorage Field Office harbors a NOAA Commissioned Officer (NOAA Corps) billet. The NOAA Corps Officer brings expertise in from the many different NOAA oceanic platforms served while rotating between sea and land assignments.

5 EFH descriptions for BSAI Groundfish species

5.1 What are the BSAI groundfish species?

Table 4 lists the species and species complexes for which EFH is currently identified in the BSAI Groundfish FMP, and compares them to the species or species complexes that are assessed in the 2009 SAFE report. In a few cases, there are discrepancies. Shortraker and rougheye rockfish were managed as a complex in 2005, but are now managed separately (in fact, rougheye rockfish is managed as a complex with blackspotted rockfish). The habitat description currently in the FMP for rock sole is actually for southern rock sole, when in fact it is northern rock sole that is assessed in the SAFE report. Addressing these discrepancies is an area of recommended change resulting from this 5-year review.

Table 4 Species or species complexes for which EFH is currently identified in the FMP, compared to species or species complexes that are assessed in the 2009 SAFE report

	Species or complexes for which EFH was identified in BSAI Groundfish FMP in 2005	**Species or complexes which are assessed in the 2009 SAFE report**
Pollock	pollock	pollock (EBS, AI, Bogoslof)
Pacific cod	pacific cod	pacific cod
Sablefish	sablefish	sablefish
Flatfish	yellowfin sole	yellowfin sole
	greenland turbot	greenland turbot
	arrowtooth flounder	arrowtooth flounder
	rock sole	Northern rock sole
	flathead sole	flathead sole
	alaska plaice	alaska plaice
	rex sole dover sole	other flatfish
Rockfish	Pacific ocean perch	Pacific ocean perch
	northern rockfish	northern rockfish
	shortraker/ rougheye rockfish	shortraker rockfish blackspotted/ rougheye rockfish
	yelloweye rockfish dusky rockfish thornyhead rockfish	other rockfish
Atka mackerel	atka mackerel	atka mackerel
Squid	squid	squid
Other species	octopus	octopus
	sharks	sharks
	sculpins	sculpins
	skates	skates
Forage fish	forage fish complex	
Unspecified species		grenadiers

5.2 Summary of EFH review for individual species changes

Each stock assessment author was asked to review the current FMP text relating to EFH for the assessed species or species complex, based on new information that has become available in the five years since EFH was last evaluated. The author completed a worksheet with some general questions about new habitat information available since the 2005 EFH EIS, and recommendations on potential HAPC or EFH conservation recommendations. The author also revised the existing FMP text with recommended

changes or updates. The authors' review for each species is included in Appendix 1, which is available online at www.alaskafisheries.noaa.gov/npfmc. There are several components in the FMP that relate to EFH for each species:

- EFH description by life history stage, in text and in maps, including an indicator for how much habitat information is known about each life history stage
  - This is the legal description of EFH, based on which EFH consultations for fishing and non-fishing effects on EFH are held as directed by the Magnuson-Stevens Act
- General information about the life history and distribution of the species/complex, the fishery, relevant trophic information, and habitat and biological associations
- A literature section that cites references of where habitat information on the species/complex can be found, and a section listing contact people for more information on the species
- Conclusions from the evaluation of fishing effects on EFH for the species, summarized from the 2005 EFH EIS

Table 5 provides an overall summary of the EFH reviews by species. "Yes" indicates that the author has suggested a substantive change to the text in the identified section. Where the "yes" is combined with shading, this is to indicate that the recommended change has the potential to be a higher priority for the Council. Changes are identified as higher priority if the proposed change has the potential to affect management of the species (for example, there is a change to the EFH description for one or more life history stages, or new information indicates that the evaluation of fishing effects on the species' EFH may merit consideration – see additional discussion in Section 2.2). Low priority changes are those that are relatively minor, and are not likely to affect management of the species at this time (for example, they update general information about the species).

To further explain the summary table, the major changes recommended to the EFH text for each species are detailed in bulleted form in Section 5.3. The new literature on which the review of EFH is based is captured within the edited FMP text for each species, in Appendix 1 to this document. The authors also incorporated relevant findings from the EFH research projects described in Section 4.2 in their individual species reviews, and reviewed the change in fishing intensity maps described in Section 10.1.1. Research needs for individual species are identified in Section 13.3. Finally, if any EFH or HAPC conservation recommendations were identified, for consideration by the Council, these are included in Sections 0 and 12.3, respectively.

The BSAI Groundfish Plan Team also reviewed the stock assessment authors' recommended changes during their November 2009 Plan Team meeting, and provided recommendations for the SSC and the Council. The Plan Team recommends that amendments be initiated to update the EFH description for all species in the BSAI Groundfish FMP for which the authors have proposed changes. The relative priority to be given to each individual species amendment is indicated on the summary table (Table 5) with shading. A more detailed summary of the Plan Team's comments on each species is captured in Section 5.3, for each species.

Table 5 EFH review of BSAI Groundfish species, with recommended changes to the existing EFH FMP text

KEY: yes = author has recommended an update to the existing FMP text, based on new information
e/c = author has recommended editorial changes or clarifications to the existing FMP text
"–" = no changes to the existing text have been recommended
shading = indicates that the BSAI Plan Team recommended amendments to the EFH descriptions for these species to be of moderate priority (versus low priority for the other species)

Species	Recommended changes to the FMP text											Worksheet recommendations		Plan Team: priority recom-mend-dation
	EFH description			General information							2005 evaluation of fishing effects on EFH			
	text	map	available level of information	tables of associations	life history, gen. distribution	trophic information	biological/ habitat associations	literature	contact person	description of fishery		HAPC[4]	EFH conservation and enhancement	
pollock	e/c	–	–	yes	yes	–	–	yes	–	yes	–	–	–	low
pacific cod	e/c	–	–	–	yes	–	–	yes	yes	yes	–	–	–	low
sablefish	yes	–	–	yes	yes	yes	–	yes	–	yes	–	yes	yes	medium[5]
yellowfin sole	–	–	–	–	–	–	–	yes	–	–	e/c	–	–	low
greenland turbot	–	–	–	–	e/c	–	–	yes	–	–	–	–	–	low
arrowtooth flounder	–	–	–	–	yes	–	–	yes	–	–	e/c	–	–	low
northern rock sole[6]	e/c	–	–	–	yes	–	–	yes	–	–	e/c	–	–	low
flathead sole	–	yes	–	yes	yes	–	yes	yes	–	–	e/c	–	–	low
alaska plaice	–	–	–	–	–	–	–	yes	–	–	e/c	–	–	low
rex sole	–	–	–	yes	yes	–	yes	yes	–	–	(not in FMP)	–	–	low
dover sole[7]	–	–	–	–	–	–	–	–	–	–	–	–	–	see comments
Pacific ocean perch	–	–	–	yes	yes	–	yes	yes	–	yes	–	–	–	low
northern rockfish	yes	–	yes	yes	yes	e/c	–	yes	–	yes	–	–	–	low
shortraker rockfish[8]	yes	yes	yes	yes	yes	yes	yes	yes	–	yes	yes	–	–	low
blackspotted / rougheye rockfish	yes	yes	yes	yes	yes	yes	yes	yes	–	yes	yes	–	–	low
yelloweye rockfish	Author recommends deleting this EFH description from the BSAI FMP.													see comments
dusky rockfish	–	–	–	–	e/c	e/c	–	–	e/c	e/c	–	–	–	low

[4] HAPC and EFH conservation recommendations are described in detail for individual species in Sections 12.3 and 0.
[5] The Plan Team identified sablefish as a medium priority based not on the sablefish EFH description, but on the author and Plan Team recommendations for sablefish HAPC and EFH conservation considerations. These recommendations are addressed in Sections 12.3 and 0.
[6] EFH is currently described for rock sole, not northern rock sole, as assessed in the SAFE report and recommended by this review
[7] The stock assessment author for dover sole originally recommended removing these EFH descriptions from the FMP. Following discussion at the Plan Team meeting, the Team recommended that the EFH description should still be included in the FMP.
[8] EFH is currently described for shortraker/ rougheye rockfish, not shortraker rockfish and blackspotted/ rougheye rockfish, as assessed in the SAFE report, and recommended by this review

Species	Recommended changes to the FMP text											Worksheet recommendations		Plan Team: priority recom-mend-dation
	EFH description			General information							2005 evaluation of fishing effects on EFH			
	text	map	available level of information	tables of associations	life history, gen. distribution	trophic information	biological/ habitat associations	literature	contact person	description of fishery		HAPC[4]	EFH conservation and enhancement	
thornyhead rockfish	–	–	–	–	e/c	e/c		–	–	yes	–	–	–	low
atka mackerel	yes	–	yes	yes	yes	yes	yes	yes	–	yes	e/c	–	–	medium
squid	–	–	–	–	–	–	–	–	yes	–	–	–	–	low
octopus	–	(not in FMP)	–	–	yes	yes	yes	yes	yes	yes	e/c	–	–	low
sharks	–	(not in FMP)	–	yes	yes	yes	yes	–	–	yes	–	–	–	low
sculpins	–	–	–	–	yes	–	–	yes	yes	yes	–	–	–	low
skates	yes	–	yes	yes	–	–	–	yes	yes	–	yes	yes	–	medium
forage fish complex	–	(not in FMP)	–	–	–	–	–	yes	yes	–	–	–	–	low

5.3 Description of recommendations for EFH text for individual species

A description of the recommendations that are captured in the summary table (Table 6) is provided below for each individual species or species complex for which EFH is defined in the GOA Groundfish FMP. The complete review for each species may be found in Appendix 1 to this document (which is posted online at www.alaskafisheries.noaa.gov/npfmc). The authors' recommendations, if any, for EFH and HAPC conservation measures, and research needs, may be found in subsequent sections of this report (Sections 0, 12.3, and 13.3, respectively).

Pollock

- clarifications but no substantive changes to EFH description
- update to age at 50% maturity, and general life history
- updated with recent fishery info
- new literature references added
- ongoing research: BSIERP should provide more information for future EFH reviews
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Pacific cod

- editorial clarifications to the text in various places
- updates to natural mortality, maturity, and maximum age information
- update to description of the fishery
- updated literature section
- relevant ongoing studies identified: one EFH project and three NPRB projects, studying productivity, habitat utilization, and recruitment dynamics of Pacific cod; climate change and the

match-mismatch hypothesis in terms of Pacific cod larval survival; spatio-temporal spawning patterns of Pacific cod; and spawning and migration through a mark-recapture experiment.
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Sablefish

- information added to the EFH description for early juveniles, but no changes to the finding of no EFH description determined
- additions to the BSAI general information sections to make consistent with the more comprehensive GOA sections
- minor updates to the timing of the spawning season
- updates to reflect recent fishery information
- updated literature section
- ongoing studies identified: Tagging juvenile sablefish in southeast Alaska with time/depth recording tags to track movements from shallow inshore waters to deeper areas on the slope. Revisited lightly trawled shelf habitat in SE AK to estimate recovery rates of benthic habitat organisms. Mounted substrate nearby corals and sponges to examine recolonization of benthic organisms in SE AK. Examining the distribution of juvenile sablefish in AFSC trawl surveys (1977-present).
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, as a medium priority, based on the proposed changes to the EFH description. The Team also concurred with the author's recommendations for HAPC and EFH conservation (see Sections 0 and 12.3), and that additional research on the recovery rates of sensitive habitat features, and their role in the survival and growth of the early juvenile life stage of sablefish and other species is particularly important given recent stock trends for sablefish, and concerns with sablefish recruitment.

Yellowfin sole

- literature section updated
- fishing effects: change in trawling noted in recent period (increase in nearshore where spawning occurs and early juveniles reside, decrease in mid-shelf), although conclusion is same
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Greenland turbot

- editorial clarifications to the text
- literature section updated
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Arrowtooth flounder

- update to fecundity information
- literature section updated
- fishing effects: change in trawling noted in recent period (increase in nearshore where early juveniles reside, decrease in mid-shelf), although conclusion is same
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Northern rock sole

- update to life history section (*and EFH description also?*) to indicate northern rock sole (northern is over 95% of BS population)
- literature section updated
- fishing effects: change in trawling noted in recent period (increase in nearshore where early juveniles reside, decrease in mid-shelf), although conclusion is same
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Flathead sole

- author suggests map of distribution of larvae should be updated with the latest information from the EcoFOCI Ichthyoplankton Information System (IIS)
- updates to age at 50% maturity, spawning behavior, size at metamorphosis
- literature section updated
- fishing effects: updated with SAFE reference, recent stock abundance trajectory
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Alaska plaice

- literature section updated
- fishing effects: updated SAFE reference
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Rex sole

- updated age and length at 50% maturity, larval timing
- literature section updated
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Dover sole

- author's original recommendation was to delete the dover sole EFH description from the FMP, as it is not a key species in the BSAI, and there is no directed targeting
- Plan Team comments: did not concur with the author recommendation, and recommended that the EFH description be updated with new information

Pacific ocean perch

- associations table: updated depth association, spawning season
- updates to natural mortality, maximum age
- recent fishery information added
- updated to note associations of juvenile POP with habitat structures
- literature section updated
- ongoing studies identified: EFH projects on juvenile POP habitat utilization, juvenile rockfish habitat utilization, juvenile slope rockfish habitat utilization, habitat specific production of POP in the AI, rockfish abundance and diurnal habitat associations in isolated rocky habitat in the EBS

- note included on fishing effects: that the POP fishery in the AI is spread out more throughout the year. It is not clear how this affects that spatial footprint of the fishery, or how it would affect the impact of fishing upon the habitat
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Northern rockfish

- new information for late juvenile associations
- associations table: updated depth associations, spawning season
- updates to natural mortality, maximum age, upper size limit of juveniles
- recent fishery information added
- updated to note associations of juvenile POP with habitat structures
- literature section updated
- ongoing studies identified: EFH projects on juvenile rockfish habitat utilization, juvenile slope rockfish habitat utilization
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Shortraker rockfish

- new EFH descriptions as shortraker split out from rougheye; new maps needed, information level on larval life history stage downgraded
- associations table: revised depth and substrate associations, spawning season
- new life history information, trophic information, and habitat / biological associations sections rewritten
- recent fishery information added
- literature section updated
- ongoing studies: several studies on rockfish, but none focused on shortraker
- fishing effects: the POP fishery in the AI is spread out more throughout the year, and this affects the manner in which shortraker are harvested as bycatch. It is not clear how this affects that spatial footprint of the fishery, or how it would affect the impact of fishing upon the habitat.
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Blackspotted/rougheye rockfish

- new EFH descriptions as shortraker split out from rougheye; new maps needed, information level on larval life history stage downgraded
- associations table: revised depth and substrate associations, spawning season
- new life history information, trophic information, and habitat / biological associations sections rewritten
- recent fishery information added
- literature section updated
- ongoing studies: several studies on rockfish, but none focused on blackspotted/rougheye
- fishing effects: the POP fishery in the AI is spread out more throughout the year, and this affects the manner in which blackspotted/rougheye are harvested as bycatch. It is not clear how this affects that spatial footprint of the fishery, or how it would affect the impact of fishing upon the habitat. If hard coral provides important habitat, damage to these corals may have negative impact on blackspotted/rougheye.

- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Yelloweye rockfish

- author recommends deleting; yelloweye rockfish is not a key species in the BSAI, there is no commercial targeting on this species, and the BSAI is not the center of its distribution
- Plan Team comments: discussed author recommendations, but made no clear recommendation

Dusky rockfish

- clarification to indicate was once called light dusky rockfish
- editorial clarifications to the text in various places
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Thornyhead rockfish

- editorial clarifications to the text in various places
- recent fishery information added
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Atka mackerel

- new information available on the distribution of eggs in the Aleutian Islands (limited, not general, distribution data)
- updates to habitat, biological, and prey associations for various life history stages (depths, substrate, location in water column, community and temperature associations, reproductive traits)
- update to age at 50% maturity, prey information
- recent fishery information added
- literature references added
- minor change to evaluation of fishing effects text to indicate that stock no longer at peak spawning biomass, although biomass is still relatively high
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, as a medium priority, based on new information about the distribution of nesting sites.

Squid

- contact person updated
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Octopus

- new general distribution maps available for individual species, but the scale of these maps is not sufficient for determination of EFH
- updates to predator prey associations
- new life history information, trophic information, and habitat / biological associations sections rewritten
- recent fishery information added

- literature section updated
- ongoing studies identified: doctoral research with E. dofleini growth and development; NPRB project on field studies to document reproductive seasons of E dofleini in Alaska and to develop octopus pot gear and tagging methods; ongoing observer program special project to collect individual weights and sex of octopus; for 2009, will also be testing vitality key for possible discard mortality; proposals for octopus discard mortality studies
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Sharks

- updates to depth range, age at 50% maturity, maximum age, spawning season, and predator and prey species (in tables and sections)
- recent fishery information added
- ongoing studies identified: habitat use of spiny dogfish from satellite data
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Sculpins

- deleted red irish lord and butterfly as part of complex, added warty sculpins – life history updated
- recent fishery information added
- literature section and contact person updated
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Skates

- new information available on location of skate nurseries, affects level of information available on skate egg life history stage
- update to depth association for eggs in table
- recent fishery information added
- updates to literature section, contact person
- evaluation of the effects of fishing has not been done on skate nursery sites; fishing gear that touches the bottom has the potential to impact, but areas are small
- ongoing studies identified: NPRB project on habitat mapping and production estimate of skate nursery sites in the eastern Bering Sea; AFSC tagging of Alaska skates in the EBS to better understand their movement
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, as a medium priority, based on new information about skate nurseries. The Team also concurred with the consideration of skate nursery areas as candidates for HAPC.

Forage fish

- some progress on forage fish distribution and habitat, but not sufficient yet to formally describe EFH for forage fishes. One exception is that nearshore areas throughout the BSAI are almost certainly EFH for some forage species, but insufficient data as yet to support that.
- literature section and contact person updated

- ongoing studies identified: AFSC nearshore survey in northern Bristol Bay (capelin and rainbow smelt), but too limited in scope to provide comprehensive EFH information; UAF researchers in Dillingham also working on nearshore projects; BSIERP contains some forage components
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

6 EFH descriptions for GOA Groundfish species

6.1 What are the GOA groundfish species?

Table 6 lists the species and species complexes for which EFH is currently identified in the GOA Groundfish FMP, and compares them to the species or species complexes that are assessed in the 2009 SAFE report. In a few cases, there are discrepancies. Shortraker and rougheye rockfish were managed as a complex in 2005, but are now managed separately (in fact, rougheye rockfish is managed as a complex with blackspotted rockfish). The habitat description currently in the FMP for rock sole is actually for southern rock sole, and in fact both northern and southern rock sole are the major species in the shallow water flatfish complex that is assessed in the SAFE report. Addressing these discrepancies is an area of recommended change resulting from this 5-year review.

Table 6 Species or species complexes for which EFH is currently identified in the FMP, compared to species or species complexes that are assessed in the 2009 SAFE report

	Species or complexes for which EFH was identified in GOA Groundfish FMP in 2005	Species or complexes which are assessed in 2009 SAFE report
Pollock	pollock	pollock
Pacific cod	pacific cod	pacific cod
Sablefish	sablefish	sablefish
Flatfish	yellowfin sole rock sole Alaska plaice	shallow water flatfish
	dover sole greenland turbot	deep water flatfish
	rex sole	rex sole
	arrowtooth flounder	arrowtooth flounder
	flathead sole	flathead sole
Rockfish	Pacific ocean perch	Pacific ocean perch
	northern rockfish	northern rockfish
	shortraker/ rougheye rockfish	shortraker/ other slope rockfish blackspotted and rougheye rockfish
	dusky rockfish	pelagic shelf rockfish
	yelloweye rockfish	demersal shelf rockfish
	thornyhead rockfish	thornyhead rockfish
Atka mackerel	atka mackerel	atka mackerel
Skates	skates	skates
Other species	squid	squid
	octopus	octopus
	sharks	sharks
	sculpins	sculpins
Forage fish	forage fish complex	
Unspecified species		grenadiers

6.2 Summary of EFH review for individual species changes

Each stock assessment author was asked to review the current FMP text relating to EFH for the assessed species or species complex, based on new information that has become available in the five years since EFH was last evaluated. The author completed a worksheet with some general questions about new habitat information available since the 2005 EFH EIS, and recommendations on potential HAPC or EFH

conservation recommendations. The author also revised the existing FMP text with recommended changes or updates. The authors' review for each species is included in Appendix 2, which is available online at www.alaskafisheries.noaa.gov/npfmc. There are several components in the FMP that relate to EFH for each species:

- EFH description by life history stage, in text and in maps, including an indicator for how much habitat information is known about each life history stage
  - This is the legal description of EFH, based on which EFH consultations for fishing and non-fishing effects on EFH are held as directed by the Magnuson-Stevens Act
- General information about the life history and distribution of the species/complex, the fishery, relevant trophic information, and habitat and biological associations
- A literature section that cites references of where habitat information on the species/complex can be found, and a section listing contact people for more information on the species
- Conclusions from the evaluation of fishing effects on EFH for the species, summarized from the 2005 EFH EIS

Table 7 provides an overall summary of the EFH reviews by species. "Yes" indicates that the author has suggested a substantive change to the text in the identified section. Where the "yes" is combined with shading, this is to indicate that the recommended change has the potential to be a higher priority for the Council. Changes are identified as higher priority if the proposed change has the potential to affect management of the species (for example, there is a change to the EFH description for one or more life history stages, or new information indicates that the evaluation of fishing effects on the species' EFH may merit consideration – see additional discussion in Section 2.2). Low priority changes are those that are relatively minor, and are not likely to affect management of the species at this time (for example, they update general information about the species).

To further explain the summary table, the major changes recommended to the EFH text for each species are detailed in bulleted form in Section 6.3. The new literature on which the review of EFH is based is captured within the edited FMP text for each species, in Appendix 2 to this document. The authors also incorporated relevant findings from the EFH research projects described in Section 4.2 in their individual species reviews, and reviewed the change in fishing intensity maps described in Section 10.1.1. Research needs for individual species are identified in Section 13.3. Finally, if any EFH or HAPC conservation recommendations were identified, for consideration by the Council, these are included in Sections 0 and 12.3, respectively.
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The GOA Groundfish Plan Team also reviewed the stock assessment authors' recommended changes during their November 2009 Plan Team meeting, and provided recommendations for the SSC and the Council. The Plan Team recommends that amendments be initiated to update the EFH description for all species in the BSAI Groundfish FMP for which the authors have proposed changes. The relative priority to be given to each individual species amendment is indicated on the summary table (Table 7) with shading. A more detailed summary of the Plan Team's comments on each species are captured in Section 6.3, for each species.

Table 7 EFH review of GOA Groundfish species, with recommended changes to the existing EFH FMP text

KEY: yes = author has recommended an update to the existing FMP text, based on new information
e/c = author has recommended editorial changes or clarifications to the existing FMP text
"–" = no changes to the existing text have been recommended
shading = indicates that the GOA Plan Team recommended amendments to the EFH descriptions for these species to be of moderate or higher priority (versus low priority for the other species)

Species	Recommended changes to the FMP text											Worksheet recommendations		Plan Team: priority recom-mend-dation
	EFH description			General information							2005 evaluation of fishing effects on EFH			
	text	map	available level of information	tables of associations	life history, gen. distribution	trophic information	biological/ habitat associations	literature	contact person	description of fishery		HAPC	EFH conservation and enhancement	
pollock	e/c	–	–	no	e/c	–	–	yes	–	yes	–	–	–	low
pacific cod	–	–	–	–	yes	–	–	yes	–	yes	–	–	–	low
sablefish	yes	–	–	yes	e/c	yes	–	yes	yes	yes	e/c	yes	yes	high[9]
yellowfin sole[10]	–	–	–	–	yes	–	yes	–	(not in FMP)	yes	–	–	–	high
Northern rock sole[11]	e/c	–	–	–	yes	–	–	yes	(not in FMP)	yes	–	–	–	see comments
Southern rock sole	e/c	–	–	–	yes	e/c	yes	yes	(not in FMP)	yes	–	–	–	see comments
Alaska plaice[12]	–	–	–	yes	yes	–	–	–	(not in FMP)	yes	–	–	–	high
dover sole	–	yes	–	yes	yes	yes	yes	yes	–	–	–	–	–	moderate
Greenland turbot	Author recommends deleting this EFH description from the GOA Groundfish FMP.													see comments
rex sole	–	yes	–	yes	yes	yes	yes	yes	–	–	–	–	–	moderate
arrowtooth flounder	–	–	–	–	yes	–	–	yes	(not in FMP)	–	e/c	–	–	low
flathead sole	–	yes	–	yes	yes	yes	yes	yes	–	yes	–	–	–	moderate
Pacific ocean perch	–	–	–	yes	yes	–	yes	yes	–	yes	–	–	–	low
northern rockfish	yes	–	yes	yes	yes	yes	yes	yes	e/c	yes	e/c	–	–	low
shortraker rockfish[13]	yes	–	yes	yes	yes	yes	yes	yes	–	yes	yes	–	–	high
blackspotted/ rougheye rockfish	yes	yes	yes	yes	yes	yes	yes	yes	–	yes	e/c	–	–	high

[9] The Plan Team identified sablefish as a high priority based not on the sablefish EFH description, but on the author and Plan Team recommendations for sablefish HAPC and EFH conservation considerations. These recommendations are addressed in Sections 12.3 and 0.
[10] The stock assessment authors for yellowfin sole and Alaska plaice originally recommended removing these EFH descriptions from the FMP. Following discussion at the Plan Team meeting, the Team recommended that the EFH descriptions should still be included in the FMP, and the author subsequently provided reviews of the FMP text. The authors' recommendations have not been reviewed by the Plan Team.
[11] EFH is currently described for rock sole, not northern rock sole, as assessed in the SAFE report and recommended by this review.
[12] See above
[13] EFH is currently described for shortraker/ rougheye rockfish, not shortraker rockfish and blackspotted/ rougheye rockfish, as assessed in the SAFE report, and recommended by this review

Species	Recommended changes to the FMP text											Worksheet recommendations		Plan Team: priority recom-mend-dation
	EFH description			General information							2005 evaluation of fishing effects on EFH			
	text	map	available level of information	tables of associations	life history, gen. distribution	trophic information	biological/ habitat associations	literature	contact person	description of fishery		HAPC	EFH conservation and enhancement	
dusky rockfish	–	–	–	e/c	e/c	–	–	yes	–	yes	–	–	–	low
yelloweye rockfish	yes	yes	yes	yes	yes	–	yes	yes	–	e/c	(not in FMP)	–	–	low
thornyhead rockfish	yes	–	yes	yes	yes	yes	yes	yes	–	yes	–	–	–	low
atka mackerel	yes	–	yes	yes	yes	yes	yes	yes	–	yes	e/c	–	–	high
skates	–	–	–	–	yes	–	e/c	yes	yes	yes	–	–	–	low
octopus	–	(not in FMP)	–	yes	yes	yes	yes	yes	yes	yes	e/c	–	–	moderate
sharks	–	(not in FMP)	–	yes	yes	yes	yes	yes	–	yes	–	–	–	high
sculpins	–	–	–	–	–	–	–	yes	yes	yes	–	–	–	low
squid	–	–	–	–	–	–	–	–	yes	–	–	–	–	low
forage fish complex	–	(not in FMP)	–	–	–	–	–	yes	yes	yes	–	–	–	moderate

6.3 Description of recommendations for EFH text for individual species

A description of the recommendations that are captured in the summary table (Table 7) is provided below for each individual species or species complex for which EFH is defined in the GOA Groundfish FMP. The complete review for each species may be found in Appendix 2 to this document (which is posted online at www.alaskafisheries.noaa.gov/npfmc). The authors' recommendations, if any, for EFH and HAPC conservation measures, and research needs, may be found in subsequent sections of this report (Sections , 12.3, and 13.3, respectively).

Pollock

- clarifications but no substantive changes to EFH description
- update to age at 50% maturity, and general life history
- updated with recent fishery info
- new literature references added
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority, concurred with author-recommended research priority (see Section 13.3)

Pacific cod

- editorial clarifications to the text in various places
- updates to natural mortality, maturity, and maximum age information
- update to description of the fishery

- updated literature section
- relevant ongoing studies identified: one EFH project and three NPRB projects, studying productivity, habitat utilization, and recruitment dynamics of Pacific cod; climate change and the match-mismatch hypothesis in terms of Pacific cod larval survival; spatio-temporal spawning patterns of Pacific cod; and spawning and migration through a mark-recapture experiment.
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Sablefish

- information added to the EFH description for early juveniles, but no changes to the finding of no EFH description determined
- additions to the BSAI general information sections to make consistent with the more comprehensive GOA sections
- minor updates to the timing of the spawning season
- updates to reflect recent fishery information
- updated literature section
- ongoing studies identified: Tagging juvenile sablefish in southeast Alaska with time/depth recording tags to track movements from shallow inshore waters to deeper areas on the slope. Revisited lightly trawled shelf habitat in SE AK to estimate recovery rates of benthic habitat organisms. Mounted substrate nearby corals and sponges to examine recolonization of benthic organisms in SE AK. Examining the distribution of juvenile sablefish in AFSC trawl surveys (1977-present).
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, as a high priority, based on the proposed changes to the EFH description. The Teams also concurred with the author's recommendations for HAPC and EFH conservation (see Sections 0 and 12.3), and that additional research on the recovery rates of sensitive habitat features, and their role in the survival and growth of the early juvenile life stage of sablefish and other species is particularly important given recent stock trends for sablefish, and concerns with sablefish recruitment.

Yellowfin sole

- author's original recommendation was to delete description from FMP as yellowfin sole is not a key species in the BSAI, no directed targeting on this species in the GOA, and the GOA is not the center of its distribution
- Plan Team comments: received verbal update only, and did not concur with the author recommendation to remove the EFH description from the FMP. The Team noted that yellowfin sole was previous an abundant component of the shallow water flatfish complex, which is now in a declining trend. The Team recommended that the EFH description be updated with new information, and that the Council initiate amendment to update FMP, as a high priority.
- author subsequently revised FMP text (but this was not reviewed by the Plan Team)
- updated general distribution and depth preferences, fishery information

Rock sole (northern and southern)

- EFH information currently written for rock sole generically; revision separates into two distinct EFH descriptions, to distinguish northern and southern rock sole
- EFH text descriptions referring to the combined rock sole species is still relevant for substrate preference by life history stage, also diet information
- updated life history information including distribution, spawning depth, age at 50% maturity

- updated fishery description to reflect GOA catch locations
- spawning information added for southern rock sole
- literature references updated
- editorial changes to the EFH text descriptions to distinguish northern or southern species
- Plan Team comments: received verbal update only, but concurred with author recommendations that the EFH description be split out to reflect the two rock sole species. The Team suggested Council initiate amendment to update FMP accordingly.

Alaska plaice

- author's original recommendation was to delete description from FMP as Alaska plaice is not a key species in the GOA, it is not a direct target, main center of distribution is the Bering Sea
- Plan Team comments: received verbal update only, did not concur with the author recommendation to remove the EFH description from the FMP. The Team recommended that the EFH description be updated with new information. The Team recommended that the EFH description be updated with new information, and that the Council initiate amendment to update FMP, as a high priority.
- author subsequently revised FMP text (but this was not reviewed by the Plan Team)
- updated predator information, distribution, and fishery information

Dover sole

- author suggests map of distribution of larvae should be updated with the latest information from the EcoFOCI Ichthyoplankton Information System (IIS)
- updates to biological and predator-prey associations for dover sole life history stages (female age at 50% and 100% maturity, spawning season, predators, prey) in tables and sections
- literature references updated
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, as a moderate priority, based on new information regarding larval distribution

Greenland turbot

- author recommends deleting; Greenland turbot is not a key species in the GOA, it is not a direct target, main center of distribution is the Bering Sea
- Plan Team comments: concurred with author recommendation to delete this EFH description from the GOA Groundfish FMP, because it is sporadically present in the GOA and at the edge of its range

Rex sole

- author suggests map of distribution of larvae should be updated with the latest information from the EcoFOCI Ichthyoplankton Information System (IIS)
- updates to prey association table and revised trophic information section
- update to life history and general distribution information (spawning season, larval duration, female maturity, natural mortality rate
- literature references updated
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, as a moderate priority, based on new information regarding larval distribution

Arrowtooth flounder

- updates to natural mortality
- literature references updated (also in fishing effects section)
- Plan Team comments: received verbal update only, but concurred with author recommendations that seemed to indicate proposed changes would be minor and of low priority

Flathead sole

- author suggests map of distribution of larvae should be updated with the latest information from the EcoFOCI Ichthyoplankton Information System (IIS)
- updates to habitat, biological, and predator-prey associations for flathead sole life history stages (substrate, female age at 50% maturity, spawning season, predators, prey) in tables and sections
- description of fishery updated
- literature references updated
- acknowledgment that more information on early juvenile distribution exists in the GOA than in the BSAI, but insufficient to change level of information for this life stage from "insufficient" to "sufficient"
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, as a moderate priority, based on new information regarding larval distribution

Pacific ocean perch

- updates to depth, substrate, age at female 100% maturity, predator and prey species in tables and sections
- recent fishery information added
- literature references added
- fishing effects: no change required; the Central GOA Rockfish Pilot program has the potential effect of spreading effort in time and space and the increase in pelagic trawling will likely decrease effects of fishing
- ongoing studies identified: EFH habitat studies being conducted at Little Port Walter Field station on POP juveniles; several submarine dive studies that will be published in the future related to Pacific ocean perch habitat and catchability
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Northern rockfish

- clarifications to EFH descriptions, and refinement of depths for adult life history stage
- updates to spawning season, predator in tables
- update to life history information, including size at 50% maturity, maximum age; tropic information; and larval and juvenile associations
- recent fishery information added
- literature references added
- fishing effects: no change required, although the spatial distribution of the fishery has changed since the original analysis. When the original EFH EIS for GOA northern rockfish was prepared, fishery catches were described as being particularly concentrated in one relatively small area, the “Snakehead” south of Kodiak Island. More recent catch data show this area no longer produces large catches and that localized depletion likely occurred here as a result of the heavy fishing effort in the 1990s. Fishing is now more dispersed over other fishing grounds, which is probably beneficial to the habitat of these fish. In addition, the Central GOA Rockfish Pilot Program,

which includes northern rockfish, has the potential effect of spreading effort in space and time and also will likely decrease the effects of fishing.

- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Shortraker rockfish

- new EFH descriptions as shortraker split out from rougheye; new maps needed, information level on larval life history stage downgraded as, in comparison with rougheye, much less is known about juvenile shortrakers
- associations table: rewritten for depth, water column, substrate associations, spawning season
- new life history information, trophic information, and habitat / biological associations sections rewritten
- recent fishery information added
- literature references added
- fishing effects: the Rockfish Pilot Program appears to have spread fishery effort in space and time, and this will likely decrease the effects of fishing on the bottom. Section edited to excise rougheye.
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, as a high priority, based on the changes to the species complex

Rougheye/blackspotted rockfish

- new EFH descriptions as shortraker removed and two distinct species of rougheye identified; maps for larvae ok, but new adult map needed; information level on larval life history stage downgraded as, in comparison with rougheye, much less is known about juvenile shortrakers
- associations table: rewritten for depth, water column, substrate associations, age at 50% maturity, spawning season, predator and prey
- new life history information, trophic information, and habitat / biological associations sections rewritten
- recent fishery information added
- literature references added
- ongoing studies: larval rougheye rockfish identification; 2009 NMFS trawl survey collected data on both rougheye and blackspotted rockfish to evaluate new identification techniques and potential population distribution differences
- fishing effects: the Rockfish Pilot Program has the potential effect of spreading fishery effort in space and time, and the increase in pelagic trawling will likely decrease the effects of fishing. Section edited to excise shortraker and add blackspotted.
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, as a high priority, based on the changes to the species complex

Dusky rockfish

- update to life history information, including size at 50% maturity, maximum age; tropic information; and larval and juvenile associations
- editorial clarifications in table to remove ‘light’ before dusky; implementation date of dark rockfish removal corrected
- recent fishery information added
- literature references added
- fishing effects: the Rockfish Pilot Program has the potential effect of spreading fishery effort in space and time, and the increase in pelagic trawling will likely decrease the effects of fishing.

- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Yelloweye rockfish

- EFH description for early juveniles added, and information level updated
- update to larval map recommended to indicate presence of larval rockfish in 640 and 650
- updates to depth, substrate, structure, community associations; age at 50% maturity, maximum age, egg development, prey in tables and sections
- editorial clarifications to fishery text
- literature references added
- ongoing studies identified: ADFG research for collecting density information for the DSR stock assessment; also NMFS studies on rockfish larvae
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Thornyhead rockfish

- EFH description for early juveniles added, and information level updated
- update to substrate, age at 50% maturity, fertilization, spawning season, predator and prey in tables and sections
- recent fishery information added
- literature references added
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Atka mackerel

- new information available on the distribution of eggs in the GOA (limited, not general, distribution data)
- updates to habitat, biological, and prey associations for various life history stages (depths, substrate, location in water column, community and temperature associations, reproductive traits)
- update to age at 50% maturity, prey information
- recent fishery information added
- literature references added
- minor change to evaluation of fishing effects text to indicate that stock no longer at peak spawning biomass, although biomass is still relatively high
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, as a high priority, based on new information on nesting sites.

Skates

- added depth distribution information for skate species in life history section
- recent fishery information added
- updated SAFE reference
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Octopus

- new general distribution maps available for individual species, but the scale of these maps is not sufficient for determination of EFH

- updates to predator prey associations
- new life history information, trophic information, and habitat / biological associations sections rewritten
- recent fishery information added
- literature section updated
- ongoing studies identified: doctoral research with E. dofleini growth and development; NPRB project on field studies to document reproductive seasons of E dofleini in Alaska and to develop octopus pot gear and tagging methods; ongoing observer program special project to collect individual weights and sex of octopus; for 2009, will also be testing vitality key for possible discard mortality; proposals for octopus discard mortality studies
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, as a moderate priority, based on new distributional information

Sharks

- updates to depth range, age at 50% maturity, maximum age, spawning season, and predator and prey species (in tables and sections)
- recent fishery information added
- ongoing studies identified: habitat use of spiny dogfish from satellite data
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, as a high priority, given that distributional information may be sufficient to define EFH for this species complex.

Sculpins

- recent fishery information added
- literature section and contact person updated
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Squid

- contact person updated
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, but as a low priority

Forage fish

- some progress on forage fish distribution and habitat (more than in the BSAI), but not sufficient yet to formally describe EFH for forage fishes. Nearshore areas in general are likely to be EFH for some forage species for at least part of the year.
- Recent fishery information for eulachon added
- literature section and contact person updated
- ongoing studies identified: there is a lot of interest in GOA forage fishes. The NPRB is currently creating a GOA integrated ecosystem research project, and forage species will be a primary focus of this work. The project is slated to run from 2010-2014 and will probably yield some useful results for the next 5-year review
- Plan Team comments: concurred with author recommendations, suggested Council initiate amendment to update FMP, as a moderate priority, based on new distributional information

7 EFH descriptions for BSAI king and Tanner crab species

7.1 What are the BSAI crab species?

Since the 2005 EFH EIS, an FMP amendment has removed certain crab species from the BSAI Crab FMP (further described in Section 4.3)[14]. The managed species currently identified in the BSAI Crab FMP, and which were reviewed as part of this process, are the following:

- red king crab
- blue king crab
- golden king crab
- Tanner crab
- Snow crab

7.2 Summary of EFH review for individual species changes

Each stock assessment author was asked to review the current FMP text relating to EFH for the assessed species or species complex, based on new information that has become available in the five years since EFH was last evaluated. The author completed a worksheet with some general questions about new habitat information available since the 2005 EFH EIS, and recommendations on potential HAPC or EFH conservation recommendations. The author also revised the existing FMP text with recommended changes or updates. There are several components in the FMP that relate to EFH for each species:

- EFH description by life history stage, in text and in maps, including an indicator for how much habitat information is known about each life history stage
  - This is the legal description of EFH, based on which EFH consultations for fishing and non-fishing effects on EFH are held as directed by the Magnuson-Stevens Act
- General information about the life history and distribution of the species/complex, the fishery, relevant trophic information, and habitat and biological associations
- A literature section that cites references of where habitat information on the species/complex can be found, and a section listing contact people for more information on the species
- Conclusions from the evaluation of fishing effects on EFH for the species, summarized from the 2005 EFH EIS

Table 8 provides an overall summary of the EFH reviews by species. To further explain the summary table, the major changes recommended to the EFH text for each species are detailed in bulleted form in Section 7.3. The detailed changes to the FMP text for each species, as suggested by the authors, are included in Appendix 3 to this document (which is posted online at www.alaskafisheries.noaa.gov/npfmc). The authors incorporated relevant findings from the EFH research projects described in Section 4.2, as well as other new information available on crab habitat (also detailed in Appendix 3) in their individual species reviews, and reviewed the change in fishing intensity maps described in Section 10.1.1.

[14] Note, there is some discrepancy as to whether EFH text relating to scarlet king crab, Grooved tanner crab, and Triangle tanner crab is still intended to be in the FMP, even though these species were clearly removed under Amendment 24. The removal of this EFH text would constitute a housekeeping amendment to the FMP, however, and these species were not evaluated as part of this 5-year review.

The BSAI Crab Plan Team reviewed the stock assessment authors' recommended changes during their March 2010 Plan Team meeting, and provide recommendations for the SSC and the Council. Table 8 incorporates the changes that were recommended coming out of the Plan Team meeting. The Plan Team also had recommendations about a suggested HAPC priority for Council consideration (see Section 12.3), and EFH research for crab species (see Section 13.3).

Overall, the Plan Team recommended that further analysis should be undertaken to evaluate fishing effects on crab stocks, and determine whether the conclusions in the FMP are valid. Consequently, the Plan Team identified that their EFH recommendations for the Council should be considered a high priority for Council action. Distribution of crab stocks, particularly red king crab, has changed since the analysis in the 2005 EFH EIS. Additionally, the methodology used in the 2005 effects of fishing analysis may not adequately capture actual impacts of fishing on crab populations. Other parameters may need to be considered for crab stocks, such as the importance of spawning and larval distribution relative to oceanographic currents (pelagic habitat) for crab settlement. This is applicable to the assessment of all crab stocks. Also, the conclusions in the 2005 EFH EIS imply that more is known about the effects of fishing on the habitat needs and life history stages of crab (especially growth to maturity) than can be substantiated, based on research-to-date. Therefore the Crab Plan Team recommends further evaluation of the effects of fishing be undertaken.

Table 8 EFH review of BSAI crab species, with recommended changes to the existing EFH FMP text

KEY: yes = Plan Team has recommended updates to the existing FMP text, based on new information
e/c = author has recommended editorial changes or clarifications to the existing FMP text
"–" = no changes to the existing text have been recommended

Species	Recommended changes to the FMP text										Worksheet recommendations		Plan Team: priority recom-mend-dation
	EFH description			General information						2005 evaluation of fishing effects on EFH			
	text	map	available level of information	tables of associations	life history, gen. distribution	trophic information	biological/ habitat associations	literature	description of fishery		HAPC[15]	EFH conservation and enhancement	
Red king crab	-	-	-	yes	yes	yes	-	-	yes	yes	yes	-	high
Blue king crab	-	-	-	yes	e/c	yes	e/c	-	e/c	yes	-	-	high
Golden king crab	-	-	-	yes	yes	yes	yes	yes	yes	yes	-	-	high
Tanner crab	e/c	-	-	yes	yes	yes	yes	yes	yes	yes	-	-	high
Snow crab	-	-	-	yes	yes	yes	yes	yes	yes	yes	-	-	high

7.3 Description of recommendations for EFH text for individual species

A description of the recommendations that are captured in the summary table (Table 8) is provided below for each individual species or species complex for which EFH is defined in the BSAI Crab FMP. The complete review for each species may be found in Appendix 3 to this document (which is posted online at www.alaskafisheries.noaa.gov/npfmc).

Red king crab

- updates to prey associations, natural mortality, recent fishery information
- author suggests change to evaluation of fishing effects; effects of fishing on spawning and breeding may be more than minimal and not less than temporary in southern Bristol Bay, specifically. The area is an important spawning ground for red king crab and also subject to high trawling intensity, which may greatly impact crab spawning success. Most of the distribution of red king crab was north and east of the high intensity fishing areas, however a high density of mature female crab were found in the area during 2008-2009, and it appears that mature female crab may have moved back to this historical important spawning ground. Given this current overlap, professional judgment indicates that trawling fisheries have currently adversely affect the EFH of red king crab. Beyond southern Bristol Bay, other fishing may have minimum impacts on red king crab EFH.
- Plan Team comments: agreed with the author that there is evidence that the effect of fishing on spawning/ breeding populations could be substantial. As per the general recommendation above, further evaluation is required to determine whether a change to the FMP's conclusions is warranted. The Plan Team also recommended the Council consider red king crab spawning habitat as a HAPC priority type.

Blue king crab

- updates to age at maturity, editorial clarifications
- author suggests that insufficient information is available to determine EFH for late juvenile and adult life stages
- author recommends changing determination of effect of fishing on growth to maturity to "unknown"
- Plan Team comments: disagreed with author's recommendation to change EFH information from Level 1 (information is available to describe EFH) to Unknown, based on the clarification that EFH has been defined by the Council as the general distribution of the species. Recommended that this clarification be explicitly added to the FMP text. Agreed with author's modification of the effects of fishing on growth to maturity from MT (minimal and not more than temporary) to unknown. No available studies are available on growth to maturity, such that a conclusion of MT could be supported.

Golden king crab

- author suggests that insufficient information is available to determine EFH for late juvenile and adult life stages; current EFH distribution for these species is equivalent to stock distribution
- updates to size at sexual maturity, reproductive cycle, depth associations by life history stage
- recent fishery information updated
- literature references added
- author recommends changing determination of effect of fishing on spawning/breeding to "unknown", however notes that there is no information suggesting that overall fishing effects on golden king crab EFH are beyond minimal and temporary
- Plan Team comments: as with blue king crab, disagreed with author's recommendation to change the status of available EFH information, but recommended that appropriate clarification be added to the document to note that EFH is defined based on general distribution. A minor edit was recommended to the water column association for larvae, to replace pelagic with unknown. For the evaluation of fishing effects, the CPT recommended that the MT conclusion be provisionally retained for spawning and breeding (consistent with the rationale for blue king crab, some

information is available on the number of breeding crab caught as bycatch in fishing operations). The Team supported 'unknown' for the other conclusions.

Tanner crab

- editorial clarifications to EFH text description and evaluation of fishing effects summary
- updates to size and age at maturity, natural mortality, fecundity, reproduction, and predator and prey associations
- substantial clarifications and additions to life history and general distribution, and fishery description
- literature references added
- Plan Team comments: disagreed with the author's proposed change to the EFH text description for eggs based on the clarification that the rationale for this determination is that egg distribution can be reasonably inferred from adult distribution. Recommended that the fishing effects evaluation conclusions be modified to 'unknown' for consistency with the approach used to evaluate other species.

Snow crab

- updates to prey associations, natural mortality, molting and mating cycle, recent fishery information
- literature reference added
- Plan Team comments: As with Tanner crab, recommended modifying the fishing effects conclusions to 'unknown' to be consistent with other reviews. The Team noted that the summary text for this species should also be edited to include this rationale.

8 EFH descriptions for Scallop FMP species

8.1 What are the Scallop FMP species?

All scallop stocks off the coast of Alaska are covered under the Scallop FMP, including weathervane scallops (*Patinopecten caurinus*), rock scallops (*Crassadoma gigantean*), pink scallops (*Chlamys rubida*), and spiny scallops (*C. hastata*, *C. behringiana*, and *C. albida*). Only weathervane scallops are commercially harvested in Alaska, and it is the only scallop species for which EFH is described.

8.2 Summary of EFH review for individual species changes

The weathervane scallop stock assessment author was asked to review the current FMP text relating to EFH for the assessed species or species complex, based on new information that has become available in the five years since EFH was last evaluated. The author completed a worksheet with some general questions about new habitat information available since the 2005 EFH EIS, and recommendations on potential HAPC or EFH conservation recommendations. The author also revised the existing FMP text with recommended changes or updates. There are several components in the FMP that relate to EFH for each species:

- EFH description by life history stage, in text and in maps, including an indicator for how much habitat information is known about each life history stage
  - This is the legal description of EFH, based on which EFH consultations for fishing and non-fishing effects on EFH are held as directed by the Magnuson-Stevens Act
- General information about the life history and distribution of the species/complex, the fishery, relevant trophic information, and habitat and biological associations
- A literature section that cites references of where habitat information on the species/complex can be found, and a section listing contact people for more information on the species
- Conclusions from the evaluation of fishing effects on EFH for the species, summarized from the 2005 EFH EIS

Table 9 provides an overall summary of the EFH review for weathervane scallop. “Yes” indicates that the author and Plan Team have suggested a substantive change to the text in the identified section. To provide further detail on the summary table, the major changes recommended to the EFH text are detailed in bulleted form below the table. The new literature on which the review of EFH is based is included in Appendix 4 to this document (which is posted online at www.alaskafisheries.noaa.gov/npfmc).

The Scallop Plan Team reviewed the author’s recommended changes during their March 2010 meeting, and provided recommendations to the SSC and Council. The Plan Team recommends that an amendment be initiated to update the EFH description for weathervane scallop.

Table 9 EFH review of Weathervane Scallop, with recommended changes to the existing EFH FMP text

KEY: yes = author and Plan Team have recommended updates to the existing FMP text, based on new information
e/c = author and Plan Team have recommended editorial changes or clarifications to the existing FMP text
"–" = no changes to the existing text have been recommended

Species	Recommended changes to the FMP text										Worksheet recommendations		Plan Team: priority recom-mend-dation
	EFH description			General information						2005 evaluation of fishing effects on EFH			
	text	map	available level of information	tables of associations	life history, gen. distribution	trophic information	biological/ habitat associations	literature	description of fishery		HAPC[16]	EFH conservation and enhancement	
Weathervane Scallop	yes	yes	–	e/c	e/c	–	e/c	yes	–	–	–	–	yes

Weathervane Scallop

- Maps of weathervane scallop EFH distribution should be updated to include bays and inshore areas that are important scallop habitat, based on NMFS and ADF&G trawl survey data. These include, but may not be limited to, bays on the east side of Kodiak Island and south of the Alaska Peninsula between Chignik and Unimak Pass; also Kachemak Bay, and bays in Prince William Sound such as Orca Bay. The EFH distribution should also be reviewed against areas where scallops are no longer fished commercially, but may still constitute important scallop habitat (although any such changes should be based on reliable and fairly recent data).
- If necessary, based on changes to the maps, the scallop EFH text description should be updated to include inner shelf waters (<50m) where scallops are generally distributed.
- No changes to the evaluation of fishing effects are required. While there may be changes to the EFH distribution for scallop, the new areas that would be included are primarily nearshore, and not subject to intensive trawl fishing. Overall the intensity of trawl fishing has decreased since the 2005 evaluation, and the localized areas of increased intensity do not appear to be in areas that are important to scallop habitat.
- Plan Team comments: concurred with author recommendations regarding the need to adjust the map of EFH distribution to include inshore areas. The Team suggested the Council initiate an amendment to update the FMP accordingly. The Team also suggested that editorial and other updates to the life history description of scallops in the FMP text could be incorporated in such an amendment, and that there may be other updates to biological and habitat associations that could be made at the same time. The Team requested that they have the opportunity to review the final distribution map again during the amendment process.

9 EFH descriptions for Salmon FMP species

9.1 What are the Salmon FMP species?

The managed species identified in the Salmon FMP are the following:

- Chinook salmon
- Chum salmon
- Coho salmon
- Pink salmon
- Sockeye salmon

9.2 Summary of EFH review for individual species changes

Because management of salmon is deferred to the State of Alaska, and there is no Council Salmon Plan Team, NMFS salmon experts were asked to provide the EFH review for salmon. They were asked to review the current FMP text relating to EFH for the assessed species or species complex, based on new information that has become available in the five years since EFH was last evaluated. The authors were asked to complete a worksheet with some general questions about new habitat information available since the 2005 EFH EIS, and recommendations on potential HAPC or EFH conservation recommendations. The authors also revised the existing FMP text with recommended changes or updates. There are several components in the FMP that relate to EFH for each species:

- EFH description by life history stage, in text and in maps, including an indicator for how much habitat information is known about each life history stage
  - This is the legal description of EFH, based on which EFH consultations for fishing and non-fishing effects on EFH are held as directed by the Magnuson-Stevens Act
- General information about the life history and distribution of the species/complex, the fishery, relevant trophic information, and habitat and biological associations
- A literature section that cites references of where habitat information on the species/complex can be found, and a section listing contact people for more information on the species
- Conclusions from the evaluation of fishing effects on EFH for the species, summarized from the 2005 EFH EIS

In their December 2009 review, the Ecosystem Committee recommended that the State of Alaska be given the opportunity to participate in the EFH review, given the joint management that exists for this FMP. The State has been made aware of the ongoing review, however given that EFH is out of their normal purview, and given the short time frame of the current review document, State researchers are unlikely to participate directly in the current review. Should the Council decide to pursue any changes to EFH for the salmon species, however, the State will once again be included in any developments.

Table 9 provides an overall summary of the EFH review for salmon species. “Yes” indicates that the author has suggested a substantive change to the text in the identified section. To provide further detail on the summary table, the major changes recommended to the EFH text are detailed in bulleted form below the table. The new literature on which the review of EFH is based is included in Appendix 5 to this document (which is posted online at www.alaskafisheries.noaa.gov/npfmc).

Table 10 EFH review of salmon species, with recommended changes to the existing EFH FMP text

KEY: yes = author has recommended updates to the existing FMP text, based on new information
e/c = author has recommended editorial changes or clarifications to the existing FMP text
"–" = no changes to the existing text have been recommended

Species	Recommended changes to the FMP text										Worksheet recommendations	
	EFH description			General information						2005 evaluation of fishing effects on EFH		
	text	map	available level of information	tables of associations	life history, gen. distribution	trophic information	biological/ habitat associations	literature	description of fishery		HAPC[17]	EFH conservation and enhancement
Chinook salmon	-	yes	-	-	e/c	-	-	yes	yes	yes	-	-
Chum salmon	-	-	--	e/c	e/c	-	e/c	yes	e/c	-	-	-
Coho salmon	-	-	-	yes	e/c	yes	yes	yes	e/c	-	-	-
Pink salmon	-	-	-	-	e/c	-	-	yes	e/c	-	yes	-
Sockeye salmon	-	yes	-	yes	e/c	-	yes	yes	-	-	yes	-

Chinook Salmon

- Several changes in text are needed to update current knowledge of Chinook EFH-related issues.
- Chinook salmon EFH maps for SE Alaska and Arctic Areas. I.e., the SE AK map does not include several 20-30 year old runs of hatchery stocks.
- Increased occurrence of adult Chinook salmon along the Arctic coast.
- Habitat disruptions, especially in the Pacific Northwest, may affect Chinook salmon stocks in Alaska EEZ waters.
- Research is needed for stock origins and potential impacts of bycatch of Chinook salmon in certain GOA and BSAI groundfish fisheries.
- Chinook salmon bycatch in some groundfish fisheries may be having adverse impacts on certain stocks requiring management changes in some fisheries.
- Significant changes in fishing activities involving Chinook salmon are required under the new salmon treaty accords with Canada. Management changes need to involve new Chinook salmon protocols for treaty fisheries in Southeast Alaska. Also, under the treaty-related Yukon River Salmon Agreement, management changes need to assess poor status of stocks resulting from in-river fisheries and in BSAI groundfish fisheries.

Chum salmon

- More recent data suggests the trend in smaller size of mature fish has changed. Hatchery production of chum salmon in Alaska is large, particularly in Southeast Alaska, where enhanced fish accounted for 85% of the chum salmon catch. Current research in Alaska and the Pacific Northwest is addressing the impacts of enhancement on chum salmon populations.

- Recent temperature increases in the Arctic could lead to a significant change in salmon distribution in the future. Currently, higher salmon catches may indicate an increase in the number of salmon moving through the northern Chukchi Sea.
- There are large and valuable directed fisheries occurring on chum salmon, primarily those from hatchery production in Southeast Alaska, due at least in part to the development of better markets for both the flesh and eggs of chum salmon.
- Chum salmon bycatch in trawl fisheries has been an area of concern addressed by the management council and thru directed research to identify stock composition and attempt to mitigate such bycatch.
- Chum salmon populations are particularly vulnerable to natural or development cased perturbations to stream hydrology.

Coho salmon

- Habitat associations should be updated with the information provided.
- Alaska continental shelf, stock-specific migrations have identified Alaska and non-Alaska stocks of juvenile coho to migrating as far north and west as Kodiak Island during their first summer at sea.
- Koski (2009) identifies this late summer and fall estuarine habitat as important for coho nomad fry that spend several months in estuaries then reinvade freshwater just prior to winter. Therefore, ensuring connective-ness in wetland habitats among coho natal streams and adjacent non-natal over wintering freshwater habitats is important.
- New data in three SE Alaska coho systems identifies "summer" coho stocks and are characterized as "limited" by Halupka et al. (2003). Summer run stocks enter lake systems early in the year, hold in the lake for months, and then move upstream to spawn. It is uncertain as to the extent this occurs throughout Alaska.

Pink Salmon

- More open ocean research, especially during the winter period, is a high priority need to better understand the causes of variable year class strength and high fluctuations in marine survival of pink salmon. Recent development of reasonably accurate forecasts on pink salmon run strength have been developed for southeast Alaska based on marine life period just prior to when juveniles enter the open ocean environment. This forecast model, however, does not account for how fluctuations in variable oceanic conditions affect juvenile pink salmon. [The need for similar oceanic research focused on a broad array of biophysical metrics [ecosystem approach] also applies to other salmon species.]
- In recent years a significant proportion of Alaska's pink salmon harvest comes from hatchery programs, especially in Prince William Sound. In 2007 for example pink salmon represented 53% by weight of the total commercial Alaska salmon catch with 43% of this amount originating from hatcheries.
- HAPC (intertidal pink spawning areas) - Remaining pockets of Exxon Valdez oil in PWS may have residual effects on wild pink salmon populations, especially in intertidal areas.

Sockeye salmon

- Several changes in text are needed to update current knowledge of Sockeye salmon EFH-related issues. The Sockeye salmon distribution maps are currently being updated by life history stage.
- Previous data gap on the distribution of western Alaska sockeye salmon in the Western Bering Sea has been addressed by Bugaev and Myers 2009 as a result of BASIS research
- The eastern Bering Sea shelf is a rearing habitat for juvenile western Alaska sockeye salmon. Current oil and gas lease sales in the North Aleutian Basin have the potential to adversely impact the juvenile salmon rearing habitat if an oil spill or other human caused catastrophe occurs in the lease area.
- Habitat disruptions and climate change, especially in the Pacific Northwest are continuing to impact Sockeye salmon stocks throughout Alaska EEZ waters.

9.3 Plans for revising marine salmon EFH

A new methodology to refine the geographic scope of EFH for Pacific salmon in marine waters off Alaska is being developed by the AFSC. When the North Pacific Fishery Management Council first identified EFH in 1998 it designated all marine waters including the entire Exclusive Economic Zone (0 to 200nm from shore) as EFH for each of the five species of Pacific salmon. In 2005, the Council recommended an improved analytical approach to identify EFH for most species of groundfish, crabs, and scallop, resulting in more refined EFH descriptions, but no changes were proposed to the existing description of marine salmon EFH as including the entire EEZ. Salmon EFH was identified broadly because (1) no systematic marine salmon survey exists off Alaska, (2) salmon are observed infrequently in offshore commercial fisheries for other species, and (3) the Alaska Fisheries Science Center (AFSC) did not have the resources to analyze various data sources to determine whether it is possible to better define offshore salmon distributions and relative abundance.

NOAA Fisheries has been criticized repeatedly for the breadth of EFH designations. EFH for salmon in marine waters is particularly broad, not only off Alaska[18] but also off the west coast[19] and New England[20]. Identifying EFH so broadly greatly reduces the potential utility of EFH designations for management purposes, and also reduces the credibility of the EFH program nationwide. Developing a methodology to refine the way salmon EFH is designated off Alaska would enable the North Pacific Council to amend its salmon fishery management plan accordingly. This approach may also be applicable for other regions identifying EFH for salmon or other highly migratory species.

Methodology

The AFSC Auke Bay Laboratories has begun to examine all available pertinent data sets for the Bering Sea and Gulf of Alaska, including: Ocean Carrying Capacity transect and station data, Southeast Alaska Coastal Monitoring data, coded wire tag data [Regional Mark Information System (RMIS), http://www.rmpc.org/], GLOBEC GAK line work data, Japanese Maru data, Canadian Fisheries and Oceans salmon data, AFSC Fish Atlas, groundfish survey data, and NORPAC fisheries observer data. A frequency of occurrence analysis of distribution data will highlight the areas most commonly used by salmon. For data sets that include information on relative abundance of salmon, the data will be analyzed as cumulative probability distributions in relation to habitat variables such as depth, temperature, and salinity, following methods detailed in Perry and Smith (1994). The methodology for data analysis will

[18] www.alaskafisheries.noaa.gov/habitat/seis/final/appd_3_5.pdf
[19] www.pcouncil.org/habitat/habback.html#salmon
[20] www.nero.noaa.gov/hcd/salmon.pdf

be documented to ensure a repeatable approach that could potentially be applied to data sets for other salmon populations on the west coast or in New England.

AFSC has employed a temporary data analyst/GIS specialist to work with permanent personnel to test the ability of the existing time series to support analyses that would refine existing EFH descriptions. AFSC will then work with Alaska Regional Office personnel to develop new map and text descriptions of EFH. The methodology and resulting draft EFH descriptions and maps will be presented at the annual Alaska Marine Science Symposium in a special session designed to obtain peer review. The project will be coordinated between the Alaska Regional EFH Coordinator, Regional EFH Analytical Expert, and Salmon Program leaders of the AFSC Auke Bay Laboratories, with input from the Alaska Department of Fish & Game. Information from the Canadian Department of Fisheries and Oceans will also be incorporated as appropriate (CDFO; Marc Trudel).

The investigators fully anticipate that the existing broad marine salmon EFH descriptions can be refined in a scientifically defensible way and made geographically smaller, although it is possible that after completing this project the data may not support narrower EFH descriptions. This project has national application, insofar as the methodology developed here could be applied to data sets for other salmon stocks or other migratory species.

Progress to date

Preliminary work on this project was presented at the January 2010 Alaska Marine Science Symposium in Anchorage, Alaska, and is described below (from Echave et al 2010). To date, the researchers have been examining catch, maturity, salinity, temperature, and station depth data for the Bering Sea and Gulf of Alaska from multiple data sources, however not all the data sets identified in the methodology have yet been included.

Following the methodology of Perry and Smith (1994), work to date has identified associations between environmental conditions and the distributions of Pacific salmon in marine waters. Emphasis has been on the influence of salinity, temperature, and bottom depth on the distribution of each of the five species of salmonids during juvenile, immature, and mature life history stages. Juveniles of all species except sockeye salmon displayed a significant association ($P < 0.01$ for all) with specific salinity conditions, and all juveniles except Chinook salmon displayed a significant association with temperature ($P < 0.01$ for all). Juveniles of all five species displayed a tolerance for a broader range of salinity conditions than mature or immature salmon yet showed less tolerance for extreme temperature ranges. In all life history stages, chum salmon were found to occupy areas with the deepest waters, sockeye salmon were found to tolerate the smallest range of temperatures, and Chinook salmon occupied the coldest and broadest range of temperatures. When compared to the other life history stages, the distribution of juvenile salmon for all five species off the coast of Western Alaska extended the farthest north. Immature salmon were generally found farther offshore and had a more southerly distribution, with 75 percent distributed west of 165.4° W. In general, the distribution of sockeye salmon extended farther south than the other four species, with 75 percent of the catch occurring south of 58.5° N, while the distributions of all life history stages of chum salmon were more northerly, with the majority reaching at least 64° N.

10 Fishing effects on EFH

10.1 Compilation of new information affecting input parameters to the analysis of fishing effects on EFH

In the 2005 EFH EIS, analysis of the effects of fishing on EFH included application of a numerical model that provided spatial distributions of an index of the effects of fishing on several classes of habitat features, such as infauna prey and shelter created by living organisms. The specific index (Fujioka 2006), termed the Long-term Effect Index (LEI), estimated the eventual proportional reduction of habitat features from a theoretical unaffected habitat state, should the recent pattern of fishing intensities be continued indefinitely. Distributions of LEIs for each class of habitat feature were provided to experts on each managed species, to use in their assessment of whether such effects were likely to impact life history processes in a way that indicated an adverse change to EFH. Experts were asked to assess connections between the life history functions of their species at different life stages and the classes of habitat features used in the effects-fo-fishing model. Then, considering the distribution of LEIs for each of those features, they were asked whether such effects raised concerns for their species. Experts also considered the history of the status of species stocks in their assessments.

An overview of research that has occurred since the 2005 EFH EIS analysis is included in Section 4.2. The purpose of the following section is to review this research with respect to the elements of the fishing effects evaluation from the previous analysis and to see how knowledge of any of these elements has changed. This section evaluates each of the inputs to the fishing effects model, including: the distribution of fishing intensity for each gear type, spatial habitat classifications, classification of habitat features, habitat- and feature-specific recovery rates, and gear- and habitat-specific sensitivity (proportional reduction by one gear exposure) of habitat features. A summary section discusses whether those changes might substantially affect our perception of the effects of fishing on EFH for Alaska managed species.

10.1.1 Fishing Intensity

The mapping of changes in fishing intensity presented in this section is based on NORPAC observer data over three five-year periods; 1993-1997, 1998-2002, and 2003-2007. “Intensity”, for the purposes of this analysis, is defined as the proportion of the area swept by fishing effort assigned to a block relative to the total area of that block. For example, an intensity of 1.0 represents enough fishing effort to fully cover the block once, if it was spread evenly across the block. This analysis contains only the pelagic and non-pelagic trawl fisheries because these fisheries showed the highest effect in the original EFH EIS. It is also important to note that observer coverage in the Gulf of Alaska and Aleutian Islands is less than in the Bering Sea, and this limited coverage influences the analysis.

The following plots were generated using the same fishing parameters as was used in the original EFH EIS effects–of-fishing model to convert observed hours towed to area swept. Changes in trawl width, towing speed or percent of tows observed (for trawlers under 125 ft LOA) could affect the actual area swept and such changes would not be reflected in these plots. Likewise, changes in the percentage of pelagic trawl effort that contacts the seafloor from the 44% estimate used in the analysis would change swept area. While we have no specific data indicating that these factors have changed since the previous analysis, changes in fishing gear and operations should be assessed over time.

These data were first aggregated to 100km^2 blocks. The difference between two of the time periods (for example avg 2003-2007 – avg 1998-2002) was then calculated for each block. Data were filtered for confidentiality (three or more distinct vessels engaging in fishing activity per block), values binned and

the maps created. Positive values reflect increases in trawl intensity; while negative values reflect decreases in trawl intensity. An average annual intensity was also calculated for each block.

Two sets of maps are provided in this document (see Section 1, Color figure 1 through Color figure 25). For each region (Bering Sea, Aleutian Islands, Gulf of Alaska) and gear type (non-pelagic and pelagic trawl), the first set of maps compares *change in intensity* between two five-year periods (1993-1997 versus 1998-2002 and 1998-2002 vs 2003-2007). This analysis provides a retrospective look at changes before the period originally analyzed in the 2005 EFH EIS (1998-2002), as well as a look at shifts in intensity in recent years, relative to the period included in the EFH EIS analysis. The second set of maps shows *average annual intensity* for each period, fishery, & region. These maps can be used to compare and contrast areas that may experience high levels of effort (high intensity) every year but are not indicated in the first set of maps due to a small change in effort between periods. Conversely, other areas may not appear to have high total intensity but may show a larger marginal increase or decrease in effort, which will be apparent in the first set of maps. Supplemented by the LEI maps from the EFH EIS, these maps should provide an assessment whether the direction of shifts in fishing efforts is likely to be favorable or unfavorable to a particular species.

The fishing intensity difference figures presented here represent where fishing intensity changed moderately (intensity differences of 0.25 - 1) and strongly (>1) between the periods 1993-1997, 1998 – 2002, and 2003 - 2007. These maps are different than those showing the LEIs in the 2005 EFH EIS, which represented the proportion by which a habitat feature would be reduced over the long term if subjected to a particular fishing intensity. While the spatial structure of LEI plots is due to the distribution of fishing intensity, LEI values also consider the sensitivity and recovery rates of habitat features. The data and figures provided here on the change in fishing intensity allows the evaluation of the distribution and magnitude of any significant shifts of fishing effects on habitat features without having to complete a new LEI analysis.

With the exception of Bering Sea pelagic trawl, which saw a slight increase, the number of grids (or blocks) fished during each 5-year period decreased for both the pelagic and non-pelagic trawl fisheries in each region. In all cases the total intensity (total area swept in 100 km^2 block units) decreased between periods (Table 11). This trend corresponds with decreasing or steady effort for both gear types in all regions since 1993, shown in Figure 8 and Figure 9.

Table 11 Number of grids fished within each region, Bering Sea (BS), Aleutian Islands (AI), and Gulf of Alaska (GOA), by gear type (non-pelagic trawl (NPT) or pelagic trawl (PTR)) and the overall change in intensity of fishing between five year periods.

Period	# Grids Fished	Change in Sum Intensity
AI NPT 93/97 - 98/02	293	13.44
AI NPT 98/02 - 03/07	256	-26.97
BS NPT 93/97 - 98/02	2,365	-111.85
BS NPT 98/02 - 03/07	2,142	-315.39
BS PTR 93/97 - 98/02	1,995	27.36
BS PTR 98/02 - 03/07	2,038	-86.8
GOA NPT 93/97 - 98/02	971	-14.2
GOA NPT 98/02 - 03/07	668	-88.07
GOA PTR 93/97 - 98/02	326	7.31
GOA PTR 98/02 - 03/07	276	-15.92

Figure 8 **Number of observed non-pelagic trawls in the Bering Sea (BS), Aleutian Islands (AI), and Gulf of Alaska (GOA), 1990-2008**

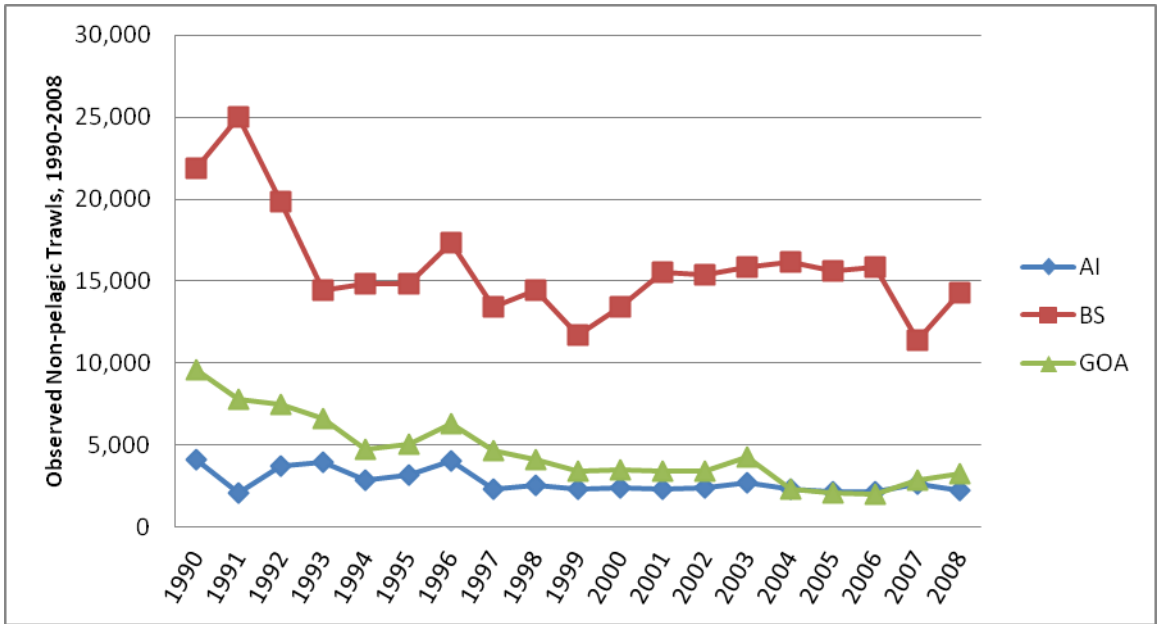
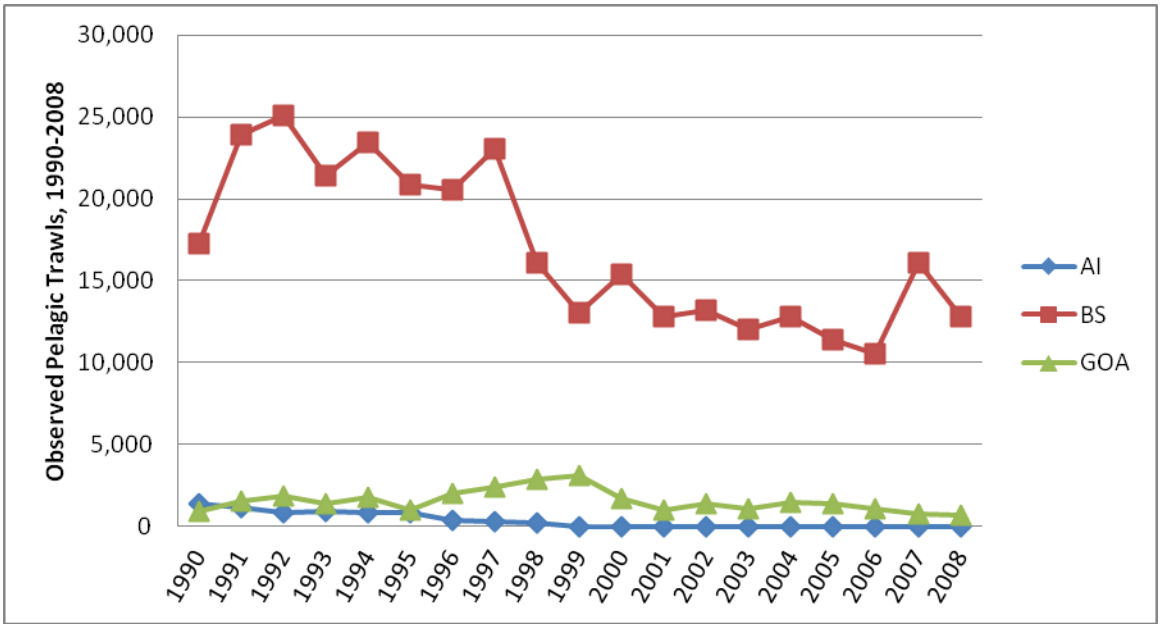


Figure 9 **Number of observed pelagic trawls in the Bering Sea (BS), Aleutian Islands (AI), and Gulf of Alaska (GOA), 1990-2008.**



The principal shifts in fishing intensity are summarized in the following paragraphs.

Bering Sea non-pelagic trawl

1998-2002 vs. 2003-2007 (Color figure 1): There has been no radical shift in the distribution of fishing intensity in the Bering Sea. The large area of the central Bering Sea that was subject to particularly high bottom trawl intensity in 1998 - 2002 received moderately lighter intensity from 2003 - 2007. Four principal areas were subject to increased bottom trawl intensity; 1) along the northwest border of the

Pribilof Islands Habitat Conservation Zone, 2) off of Kuskoquim Bay, 3) along the southern border of the King Crab Protection Zone and 4). Most of the increases were moderate, though 2 of 8 blocks in the 4th area along the western side of the Nushagak Peninsula (inner Bristol Bay) had strong increases. The area of high intensity effort north of Akutan Island, Unimak Pass and Unimak Island remained a high intensity area. Many of the shifts within that area registered as moderate or strong changes because of the high absolute levels of fishing intensity.

1993-1997 vs. 1998-2002 (Color figure 2): The central Bering Sea showed a pattern of higher intensity in non-pelagic trawling around a central area of lower intensity near the border of management areas 509 and 513. Decreases in fishing intensity occurred on the west side of the Nushagak Peninsula, off of Kuskoquim Bay, northeast of St George Island, and Pervenets Canyon to the far northwest. Intensity dropped in the area north of Akutan Island, Unimak Pass and Unimak Island, while there were increases on the southwest and eastern sides of that area.

Bering Sea pelagic trawl

1998-2002 vs. 2003-2007 (Color figure 6): The central Bering Sea showed a pattern of higher intensity in non-pelagic trawling around a central area of lower intensity near the border of management areas 509 and 513. Decreases in fishing intensity occurred on the west side of the Nushagak Peninsula, off of Kuskoquim Bay, northeast of St George Island, and Pervenets Canyon to the far northwest. Intensity dropped in the area north of Akutan Island, Unimak Pass and Unimak Island, while there were increases on the southwest and eastern sides of that area.

1993-1997 vs. 1998-2002 (Color figure 7): The central Bering Sea showed moderate increases in pelagic trawling intensities near the border between areas 513 and 517. The area north of Akutan Island, Unimak Pass and Unimak Island exhibited moderate to large decreases in effort.

Aleutian Islands non-pelagic trawl

1998-2002 vs. 2003-2007 (Color figure 11): There was a trend of decreases throughout the region, with moderate decreases noted in the Adreanof Islands and Petrel Bank, as well as throughout the western portions of Rat Islands. Stronger increases in intensity occurred around Buldir Island and west of Tanaga, with moderate increases found in the Near Islands.

1993-1997 vs. 1998-2002 (Color figure 12): Overall the number of blocks fished decreased by approximately one-third. These data are subject to significant gaps because of data confidentiality issues, as over half of the blocks fished are not shown on the maps due to data confidentiality. Large increases in intensity north of Amlia, on Petrel Bank, and east of Agattu Islands, with moderate increases throughout most of Andreanof Islands are shown. Relatively strong decreases were noted in effort south of Seguam Island, with moderate decreases in the Rat Islands.

Aleutian Islands pelagic trawl

Pelagic trawling in the Aleutian Islands decreased from from 416 blocks fished in the first period, mainly on the 541/518 (Bering Sea) border, to only 16 blocks fished in the most recent period. Fishing intensity for pelagic trawl fisheries in the Aleutian Islands is currently very minor. Consequently, maps are not included for Aleutian Islands pelagic trawl.

Gulf of Alaska non-pelagic trawl

1998-2002 vs. 2003-2007 (Color figure 16): Moderate decreases were seen in intensity throughout the region, with overall blocks fished decreasing by approximately 40%. Largest drops in intensity occurred near Chiniak and south of Chirikof Island with moderate increases in intensity to the northwest of Chirikiof Island and south of Ugak Island.

1993-1997 vs. 1998-2002 (Color figure 17): There was a varied pattern of increases and decreases in effort, with overall number of blocks fished decreasing by approximately 30%. Largest increases in fishing intensity occurred south of Akutan are at the shelf break/slope, while moderate decreases appeared on the shelf and centered around Kodiak Island and increases to the south of Chiniak and Chirikof, and the west end of Portlock Bank.

Gulf of Alaska pelagic trawl

1998-2002 vs. 2003-2007 (Color figure 21): Very minor changes in intensity were seen with moderate increases in Shelikof Strait, but decreases in intensity in most Kodiak nearshore waters, as well as in isolated areas of 610 and 620.

1993-1997 vs. 1998-2002 (Color figure 22): Very minor changes in intensity were seen with small increases in intensity to the north, west and south of Kodiak, as well as isolated blocks in 610 and 620. Minor decreases in intensity centered south of Ugak Bay.

Summary

Total fishing effort decreased in all regions for pelagic and non-pelagic trawling between the period analyzed in the EFH EIS (1998-2002) and the subsequent 5 years (2003-2007). These plots identify the areas affected and the distribution of significant increases or decreases in fishing intensity. It is unlikely that the assessments of fishing effects on the essential habitat of any species would be worse unless the specific areas where intensity increased were particularly important to the spawning, breeding, feeding or growth to maturity of that species and were not balanced by decreases in other similarly important areas. Plots of the distribution of fishing intensity and changes in fishing intensity were provided to the species experts to allow them to make such assessments.

10.1.2 Habitat categorization

The original analysis categorized Bering Sea habitat types primarily by sediment types – i.e., sand, mixed sand and mud, and mud. Additional categories were added for the slope below 200 m depth and the northern shelf. An analysis of invertebrate catches from the eastern Bering Sea crab/groundfish survey from 1982 to 2002 (Yeung and McConnaughey 2006) found spatial classifications based on the invertebrate data that matched fairly closely with the broad classifications used in the prior EFH analysis. While considerable interannual variation was detected, mainly due to responses of the more mobile invertebrates, this underlying pattern was persistent over years.

The ability to classify habitats in the Aleutian Islands and Gulf of Alaska was highly constrained due to the lack of comprehensive sediment distribution data,. However, some additional information has been developed in both areas since the original EFH analysis. In the Gulf of Alaska, Michael Martin and Mark Zimmerman have been analyzing the ability of the GOA bottom trawl survey to trawl at randomly selected sites and looking at the catch of invertebrates in an auxiliary net designed to sample benthic epifauna that is attached to the standard survey trawl. This study is leading toward a spatial description of the locations of rough/hard bottom through out the Gulf of Alaska and associated abundance of living

structure organisms. A multibeam sonar survey, with submarine and ROV dives for ground-truthing, along 17 strips across the Aleutian Islands (Heifetz et al. 2007) has provided new information on the proportions of different substrate types in that central Aleutians. As the sampled strips are widely spaced, they fall short of the coverage needed for comprehensive classification.

Woodby et al. (2009) also analyzed coral distributions in the Aleutian Islands to better predict their areas of concentration. They found relationships to depth, slope and roughness of the terrain, but were unable to assess other factors considered likely to affect corals, such as current flows.

10.1.3 Modeling Methods

A number of recent studies have addressed the modeling and analysis of the effects of fishing on seafloor habitats. First, Fujioka (2006) published the model used in the prior EFH analysis and that paper also addressed a number of alternative applications for the model, including ways to refine closures to limit reduced habitat benefits due to redistribution of fishing effort. Hiddink et al. (2006) developed a model that included effects of fishing on the size composition of living habitat features, as well as their abundance, and described an application of this model to the North Sea (Hiddink et al. 2007). However, requirements for both size composition and size selectivity of habitat features would make the Hiddink et al (2006) model difficult to implement for Alaska fisheries. McConnaughey et al. (2005) demonstrated size differences for Bering Sea invertebrates between adjacent untrawled and heavily-trawled areas.

The Northeast Region of the NMFS has started their 5-year EFH review. Their analysis approach was described in a draft document released in March 2009. Their methodology considers factors parallel to those considered in the Alaska EFH analysis. Key differences include: 1) all quantitative values are reduced to scores (usually 0-2 or 0-3) before being combined into overall scores, and 2) assessment of habitat requirements of managed species are combined with assessing the effects of fishing on habitat into one expert-based analysis. This second factor contrasts with the Alaska analysis, which was divided into the two stages. The first assessed the distribution of effects on habitat features in a numerical model, followed by an expert assessment of the consequences of those effects on the managed species.

10.1.4 Sensitivity

Sensitivity is the likelihood of damage to particular habitat features when exposed to specific fishing gears. While a range of sensitivity studies provided rate estimates for the EFH analysis, there was certainly need for more information that was directly relevant to the gears and environments of Alaska waters. Some work has been completed to fill that need.

The 2001-2002 TRAWLEX project was a two-year effort to evaluate the impact of bottom trawling on soft-bottom benthic habitats and to describe the recovery process (R. McConnaughey, pers. comm.). The experiment used a Before-After Control-Impact (BACI) experimental design with six pairs of experimental and control trawl corridors each 100 m wide and 21 km long, located in the Crab and Halibut Protection Zone 1 (management area 512 in Bristol Bay). The study area has strong tidal currents and a generally level and compacted mud-sand seafloor with depths ranging from 40 to 80 m. Potential impacts were studied by fishing a two-seam Aleutian combination otter trawl with a 14" diameter footrope in a previously untrawled area of Bristol Bay, making four complete passes over each experimental corridor in alternating directions. Before and after commercial trawling, epifauna were randomly sampled at preselected stations with a NMFS 83/112 bottom trawl that was modified to improve capture and retention of small macroinvertebrates.

Overall, taxon abundance (kg/ha) in the experimental corridors were not significantly different than the corresponding abundances in the control corridors in 21 of the 24 taxa examined (alpha = 0.10). The

situation was unchanged one year later, ruling out the possibility of delayed mortality. Of particular interest for the EFH analysis was the statistically significant reduction (-27%) in the dominant structure-forming invertebrate in the area, *Boltenia*. The high-profile shape of this ascidian makes it particularly vulnerable to trawl damage or removal and it should have been well sampled by the sampling trawl. Assuming removal of equal proportions of remaining animals with each trawl pass, this result yields a removal per exposure of 7.5%, which is in the lower part of the range of sensitivity rates used in the prior analysis for living structure features on soft substrates (1 – 21%, with a central estimate of 15%). It is also notable that the effect was not detectable after one year, supporting the relatively fast recovery times used in the model for those organisms.

Another relevant study was completed on cobble substrates with similar gear on Newfoundland's Grand Banks (Henry et al. 2006). They trawled an experimental corridor 12 times annually for three years. Results were summarized: "No cumulative effects from the pulsed trawling were detected, and colonial species assemblages on control and impacted lines were similar at the end of the experiment." While some of the tests for trawling effects were statistically weak, the authors concluded that it was certain that any effects were small relative to natural inter-annual change. Henry et al. made a particularly relevant comment in comparing this outcome to results from Alaska (e.g., Freese et al. 1999); "Unlike sessile epifaunal assemblages dominated by erect, rigid megabenthic sponges and corals, the colonial epifauna in the study area was dominated by flexible *Dendrobeania* spp. (Bryozoa), a small epizoic sponge, *Scypha ciliata*, and several hydroids, which may generally be less vulnerable to immediate removal than more rigid species." While their site had not been subject to trawling for 10 years, that may not have been long enough to recover to some of the later successional stages that may be present in some of the Alaska sites with cobble substrates. Increases in abundance of some sessile epifauna at control sites provided additional evidence of continuing recovery from historical trawling.

A study by AFSC Conservation Engineering to test trawl modifications to reduce effects on living-structure animals collected rates of damage for sea whips, basket stars and sponges after exposure to each component of a typical Alaska bottom trawl (C. Rose, pers. comm.). Short term seawhip damage rates, mostly seawhips uprooted and laying flat on the substrate, were 20-25% for those encountering trawl sweeps and approximately 30% for those encountering the trawl footrope. Since sweeps account for up to 90% of the area swept by bottom trawls, this puts the average damage rate marginally above 21%, which was the 75th percentile of sensitivity for living shelter animals on soft substrates from the EFH EIS literature review. Given that seawhips have the tallest profiles of such animals in that environment, this preliminary result is consistent with the sensitivity parameters used in the original analysis of fishing effects.. It is also worth noting that the sweep modifications that resulted from this research were found to decrease such damage to a range of 12 – 21%. As the NPFMC recommended requirements for use of these modifications during all Bering Sea flatfish trawling, such damage to living shelter should be reduced.

An extensive, long-term study of the effects of fishing on emergent, habitat-forming invertebrates of Australia's Great Barrier Reef (Pitcher 2008) provided a wide range of effect and recovery estimates for animals from taxonomic groups similar to those found in hard-bottom habitats off of Alaska. While sensitivity rates to trawling were not directly applicable to Alaska fisheries as the impact gear was a shrimp trawl, the overall negligible effects observed were notable.

Henry et al.(2003) found that *Gersemia*, a soft coral found on the unconsolidated sediment area covering much of the Bering Sea shelf, were not extremely sensitive to simulated trawling exposures. Colonies crushed every two weeks over two months did not behave differently than control colonies. *Gersemia* responded by immediate retraction, which limited damage.

Several reviews and meta-analyses of the effects of fishing on living habitat features have been published since the EFH analysis – e.g., Pitcher et al 2009, Lokkeborg 2005, Kaiser et al 2006. While analytical methods, specific conclusions and study emphases varied between these studies, their conclusion on sensitivity broadly support the rates used in the EFH analysis and the variation of those rates relative to gears, taxa and habitats. This is not altogether surprising as the lists of research analyzed in those reviews were very similar and nearly all of those studies were considered in the Alaska EFH analysis.

10.1.5 Recovery

Recovery rates were among the hardest parameters to find values for from the literature, particularly for the living structure animals that the EFH analysis identified as the most vulnerable habitat feature. Some progress has been made, and two research projects have been started to fill more of this gap.

Malecha and Stone (2009) studied the recovery and delayed mortality of seawhips after simulated trawling exposure. They found that essentially all seawhips that were either dislodged or had fractured axial rods lost all tissue within a year, while tissue damage to lightly abraded animals mostly healed over the same period. Surprisingly, half of the dislodged seawhips were able to right themselves quickly, however nearly all became dislodged again (The authors cite a possibility that attachment of anchors to mark individuals may have influenced this result). Interaction with predation by nudibranchs was involved in much of the tissue loss observed, as dislodgement or fracture made parts of the seawhips accessible to these predators that would not otherwise have been. Recovery due to healing was only effective for animals that remained erect. The study did not address recovery by reproduction, likely a much slower process.

Similar healing results were found for laboratory experiments that simulated crushing of *Gersimia rubiformes* by a trawl (Henry et al. 2003). Like sea whips, this soft coral is a species that is commonly found on the unconsolidated sediments of the Bering Sea shelf, where trawl intensities can be much higher than in the hard bottom habitats of most corals. Healing of damaged tissues started in weeks, with new tissue covering the wounded surface by the first month. While disturbed colonies released daughter colonies, the released polyps did not survive, so may have represented a premature release of propagules that could inhibit normal reproductive rates and hence recovery.

Scientists from the Auke Bay Laboratory aboard the chartered ADFG research vessel R/V Medeia conducted submersible operations during the period August 5 through August 14, 2009 (Pat Malecha, pers. comm.). The submersible Delta was deployed in the eastern Gulf of Alaska offshore of Salisbury Sound. Video transects were conducted on the seafloor of the continental slope to document moderate- to long-term damage and recovery of sponges and sea whips 13 years after the pass of a single trawl. Persistent evidence of trawling was observed including trawl furrows on the seafloor and damaged and displaced sponges. Video analysis is scheduled to occur this winter. This study follows up on previous work that documented immediate effects (Freese et al. 1999) and one year post-trawling effects (Freese 2003).

Scientists from the Auke Bay Laboratory aboard the chartered US Fish and Wildlife research vessel R/V Curlew conducted scuba operations during a period from August 17 through August 22, 2009 (Pat Malecha, pers. comm.). The Curlew transported scientific personnel and served as a tender vessel in Middle Arm, Kelp Bay, Southeast Alaska. This project is planned for a minimum duration of two years and will document damage, recovery, and recruitment of the gorgonian coral *Calcigorgia spiculifera*. In 2009, scuba divers installed settlement substrates designed to capture new coral recruits and subjected a selection of coral colonies to simulated trawl disturbances. Video observations of the trawled colonies were recorded pre- and post-treatment. Divers will return in the spring and late summer of 2010 to evaluate recruitment and survival and recovery of the damaged coral colonies.

An extensive, long-term study of the effects of fishing on emergent, habitat-forming invertebrates of Australia's Great Barrier Reef (Pitcher 2008) provided a wide range of effect and recovery estimates for animals from taxonomic groups similar to those found in hard-bottom habitats off of Alaska. Recovery rates varied from rapid for some soft corals and ascidians, moderate for a range of sponges, gorgonians and hard corals, to slow for some other sponges and gorgonians. While the applicability of specific rates to the very different environmental and ecological conditions from Alaska waters may be limited, the relative recovery rates of different taxa may be relevant.

10.1.6 Corals

The effects of fishing analysis noted that the LEI results required separate consideration for particularly long-lived and slow-growing living structure, exemplified by corals in hard bottom areas. Even relatively low fishing intensities still eventually reduced corals to very low levels in exposed areas. As a result, this class of living structure is being treated separately from those with faster recovery rates. Research on coral distribution and fishing impacts have moved forward, with studies by Stone (2006), expanded in Heifitz et al. (2009). Areas of highest coral density in the central Aleutian Islands were found to be deeper than most trawling effort. These studies found coral ubiquitous throughout transects across the central Aleutian Islands and damage to these correlated to the intensity of bottom trawling effort. Damage was also noted in depths with little trawling effort, where longline and pot fisheries were the only fishing effort contacting the seafloor. Damage from those gears was harder to identify and attribute due to the less continuous pattern of their effects.

These studies are consistent with the effects of fishing analysis of the EFH EIS in that bottom trawling damages corals and that the slow growth rates of coral make them particularly vulnerable. They also indicate that such damage continues in the areas left open by the Council's action to protect EFH in the Aleutians. Their observations on effects of pot and longline gear on corals are some of the only such information available. While such effects were clearly less identifiable and intensive than damage due to trawling, the slow recovery rates of coral leave them an area needing further assessment.

Evaluation of areas of high coral catch

In the development of the 2005 EFH EIS, a suggestion was made to evaluate the effects of fishing on EFH by identifying areas of high coral bycatch, or "hotspots". In response, NMFS analysts utilized the observer and survey databases to plot observed catch of corals and assess the capability of the data to support area closures based on high coral observed catch. The results of this analysis were that observer and survey data are not useful for "hotspot" analysis of coral catch for the following reasons:

1. The abundance of deep water corals is unknown in Alaska. Distribution is known primarily through observed bycatch in commercial fisheries (and supplemented with survey data), but this is only a subset of the likely total distribution of corals in Alaska.
2. "Coral", as defined by the observer database, includes both hard/stony, encrusting, and soft corals as well as bryozoans. They are not differentiated, and these species have vastly different life histories. Red Tree Coral was added as a new observer category in 2000.
3. Until 2000, spatial data from observed tows was only recorded at haulback. Capture of any "coral" species in the net could have come from any area within a radius of up to 3-4 miles from the haulback point. After 2000, set and haulback points were recorded, providing endpoints but not specific locations of bycatch from an unknown location between those points. With VMS data, the possible location points of "coral" bycatch are minimized but still could come from any point along the tow.
4. Trawl nets are not designed to catch and sample corals. Many marine invertebrates are thorny and have the characteristics to become entrained in various parts of the trawl. Even when bycatch

of "coral" species is recorded, it is very possible that those samples could have been caught on a different tow in a different location.

5. As stated on the AFSC webpage, observed fishery data "will not always provide an accurate portrayal of catches of target and non-target species by the whole fleet. Inaccuracies will be greatest for rarely-occurring species and when sample sizes are relatively small." The inclusion of these rare species in samples, which are then extrapolated to an entire haul, can lead to misleading results. The SAFE report notes similarities in the survey data: "While gorgonian and stony corals occur in a relative large number of tows, mean CPUE typically is strongly influenced by a small number of tows;" and "the biennial survey in the Aleutian Islands does not sample any of the HAPC fauna well."

The following table contains examples of the highest extrapolated values of "corals" from NORPAC database, and illustrates the effect of extrapolation of rare species (such as corals) to a whole haul. These large extrapolated values were as likely due to these specific observer samples being the few that randomly selected large amounts (or pieces) of coral as that the sampled trawl tows encountered a particularly high density of coral on the seafloor.

Sample (kg)	Extrapolated (kg)
73.5	22,630
68.6	21,011
66.6	16,105
26.5	10,343
39.9	8,220
33.8	7,166
13	5,319

NMFS and the NPFMC will continue to track coral & sponge observed catch through both observer and survey programs. This information is reported yearly in several publications, including the SAFE report, and those data made available to the public. Coral catch in trawl fisheries and surveys can provide some information regarding the distribution of coral habitat in the areas where fishing or surveys occur. It does not provide information on the distribution of corals throughout Alaska, however.

The issues with using sampling from commercial or research trawl tows to identify specific areas of coral abundance listed above have not been rectified since the 2005 EFH assessment. Furthermore, the overall rates of such observations do not flag any increase in trawl-coral interactions. Therefore, analysis of the fine spatial distribution of coral catch was not part of this 5-year review.

Observed catch of HAPC species, including corals and sponges, in both the BSAI and GOA has generally decreased since 2004. Fishing effort has also decreased or remained steady as well. Until coral and sponge habitat is better described and sampled, observed catch information is the best available science. NMFS and the Council have implemented numerous measures in the last decade designed to conserved and protect coral habitats and will continue to do so through management actions and the precautionary principle.

10.1.7 Recommended conclusions about the impact of new information on the effects of fishing analysis

While recent research provided incremental improvements to our understanding of habitat types, sensitivity and recovery of seafloor habitat features, these new results were consistent with the sensitivity and recovery parameters and distributions of habitat types used in the prior analysis of fishing effects for the EFH EIS. None of this new information revealed significant errors in the parameters used in that analysis; rather, it marginally increased support for their validity. This still leaves the effects-of-fishing model well short of a rigorously validated, predictive structure. It remains a simple lattice on which the

different components of our understanding of the relevant processes can be interconnected and examined. Future studies should continue to strengthen this understanding and may indicate flaws in that structure, but, for now, the original parameters and habitat distributions have been supported.

Without substantial changes in other components of the model, changes in the distribution of fishing intensity represent the remaining source of potential changes in the effects of fishing on habitat features. Because fishing intensity is the only component of the model with fine spatial structure, shifts in the intensity distribution were considered a reasonable proxy for shifts in expected habitat effects, relative to prior model runs. Therefore, the comparative charts of fishing intensity were provided to species analysts to allow them to consider where such effects might have changed since the last analysis in a way that raises concerns for their species.

In general, fishing intensity has decreased overall, with moderate shifts causing increases or decreases in relatively limited areas. In addition, area closures from EFH protection actions and regulations have limited the expansion of effort into areas of concern and implementation of gear regulations should further reduce effects of bottom trawling in the Bering Sea.

Recommendations for research to further test and improve understanding of fishing effects on EFH are reviewed in Section 13. Model parameters that still have particularly limited support include sensitivity of habitat features to pelagic trawls (when operated in contact with the seafloor) and recovery rates of living shelter organisms on soft substrates. Likewise, where and how often pelagic trawls are fished on the seafloor is poorly known. The growing availability of Vessel Monitoring System (VMS) data can provide a much more detailed treatment of fishing intensity, allowing better assessments of the effects of overlapping effort and distribution of effort between and within grid cells.

10.2 EFH conservation recommendations for fishing threats to EFH and HAPC

The 2005 EFH EIS concluded that fisheries do have long term effects on habitat, but these impacts were determined to be minimal and not detrimental to fish populations or their habitats. The analysis found no indication that continued fishing activities at the current rate and intensity would alter the capacity of EFH to support healthy populations of managed species over the long term. Nevertheless, the Council acknowledged that considerable scientific uncertainty remains regarding the consequences of habitat alteration for the sustained productivity of managed species. Consequently, the Council has adopted a number of management measures designed to reduce adverse impacts to habitat, both in conjunction with the 2005 EFH EIS, and more recently. These actions are described in Section 1. In this section, suggestions for EFH conservation recommendations that resulted from the EFH individual species reviews are described.

Table 12 provides recommendations for EFH conservation suggested from the individual species reviews.

Table 12 Recommendations for EFH conservation from the individual species reviews

Council FMP	Species	Recommendation
BSAI and GOA Groundfish	Sablefish	Given the intense fishing in areas of sensitive habitat features as indicated in Figure B.2-3a,b (of the EFH EIS), more research should be done to evaluate the recovery rates of these features and their role in the survival and growth of the early juvenile life stage of sablefish and other species that inhabit those areas. Note, this recommendation was originally made by the individual species authors, and forwarded by the Groundfish Plan Teams.

11 Non-fishing effects on EFH

11.1 Background

Non-fishing activities that may adversely affect EFH are diverse[21]. Example activities include harbor construction, navigation channel dredging, fill for near shore development and infrastructure, oil and gas exploration and production facilities, shoreline stabilization, exotic species introduction, and fish processing waste water. The NOAA Fisheries Alaska Region Habitat Conservation Division staff (HCD) reviewed Appendix G of the 2005 EFH FEIS. Appendix G describes non-fishing activities and offers EFH Conservation Recommendations by activity type.

11.2 Review Approach and Summary of Findings

The review of non-fishing activities review focused on EFH EIS Appendix G, which is a comprehensive document that evaluates the impacts of non-fishing activities on EFH, and identifies EFH conservation and enhancement recommendations for each of these activities. An abbreviated version of this appendix was included in each of the Council's FMPs. HCD staff reviewed each activity and offered editorial and technical changes, based on new literature and information sources. Importantly, staff suggested new EFH Conservation Recommendations (Table 13), as applicable. To document the review, staff completed two worksheets.

In the first worksheet, subject experts updated and documented new information for non-fishing impacts available since EFH was last identified. The intent of the worksheet was to capture the most recent information available. Worksheet A includes:

1. New subject matter information
2. New literature sources
3. Any unpublished data, reports or other related subject matter documents

Worksheet B asked subject experts to determine whether existing FMP text is still accurate and to review existing EFH Conservation Recommendations. Subject experts were also asked to offer new EFH Conservation Recommendations, if needed. Worksheet B topics include:

1. Research and information needs
2. Most recent and best available information
3. An effects discussion
4. Cumulative impacts
5. Changes to existing EFH Conservation Recommendations
6. New EFH Conservation Recommendations[22]

[21] Non-fishing activities (or developmental activities) information is compiled by NOAA, other Federal agencies, academia, and environmental consulting firms. The amount of this type of information as compared to information used to address fishing affects on fish habitat is extensive. Appendix G addresses those activities most likely to reduce the quantity and/or quality of EFH. It is not meant to provide a conclusive review and analysis of the impacts of all potentially detrimental activities; rather it highlights notable threats and provides information to determine if further examination of a proposed activity is necessary. Subject-specific EFH Conservation Recommendations are advisory and serve as proactive conservation measures that would help minimize and avoid adverse effects of these fishing activities on EFH. Site-specific EFH Conservation Recommendations will be prepared per activity and as necessary during EFH Consultation [see: CFR 50 Part 600 Subpart K].

[22] New EFH Conservation Recommendations supplement existing EFH Conservation Recommendations for each non-fishing activities, as appropriate.

11.3 New EFH Conservation Recommendations

For each of the non-fishing activities, staff reviewed the evaluation in Appendix G (and abbreviated in the FMPs) of the activity's potential to result in adverse impacts on EFH, and recommended conservation measures to avoid, minimize, or compensate for adverse effects on EFH, if needed. The complete review will be available in an appendix to this document, once the final report is prepared. Table 13 identifies new EFH conservation recommendations that resulted from the review. The Council may wish to consider initiating FMP amendments to add these conservation recommendations to each of the FMPs.

The following is an example of existing and new EFH Conservation Recommendations for fill placed in marine waters (*= *new EFH Ccnservation Recommendations*):

- Fill be utilized in upland areas first;
- Fill be considered for beneficial use to enhance marine habitats previously disturbed, such as artificial reef creation;
- Any in-water deposition area avoid spawning areas, areas that concentrate prey, or areas of sensitive marine aquatic vegetation (used by fish as refugia);
- Fill not disrupt juvenile or adult fish migration
- ∗ *In areas near anadromous streams, fill should be sloped to maintain shallow water, photic zone productivity; allow for unrestricted juvenile and adult salmon migration; and provide refugia for juvenile fish.*
- ∗ *In marine areas of kelp and other aquatic vegetation, fill (including artificial structure fill reefs) be designed to maximize kelp colonization and provide areas for juvenile fish acclimation to marine conditions and shelter juvenile fish from higher currents and exposure to predators.*
- ∗ *Fill materials should be tested and be within the neutral range of 7.5 to 8.4 pH. This pH range, in marine waters, will maximize colonization of marine organisms. Excessively alkaline fill material (pH>8.4) should not be used.*

Table 13 New EFH Conservation Recommendations for Non-fishing Activities

Activity	New EFH Conservation Recommendations (bullets) ***Other recommended changes to non-fishing FMP text (italics)***
Non-point Source Pollution	• Identify subsurface waterflows to ensure prevention of leakage into river/stream systems (hyproheic connections). • Research chemicals used in the area of application to prevent reactions resulting in toxic contaminants to fish or their prey. • Ensure that levels of pesticide entering waters do not surpass FDA requirements for human consumption.
Silverculture / Timber Harvest	*Existing recommendations are adequate.* *Minor editorial comments.* *New subject references and information provided.*

Activity	New EFH Conservation Recommendations (bullets) ***Other recommended changes to non-fishing FMP text (italics)***
Pesticide Application	• Incorporate integrated pest management and BMPs as part of the authorization or permitting process to ensure the reduction of pesticide contamination in EFH (Scott et al. 1999). If pesticides must be applied consider several factors including: why application is necessary (such as to eradicate an invasive plant species), area, terrain, weather, droplet size, pesticide characteristics, and other conditions to avoid or reduce effects to EFH. • Avoid the use of pesticides within 500 lineal feet and/or 1000 aerial feet of anadromous fish bearing streams. • For forestry vegetation management projects, NMFS recommends to follow the Alaska Department of Environmental Conservation measures that establish a 35 foot pesticide-free buffer area from any surface or marine water body and that pesticides not be applied within 200 feet of a public water source (http://www.dec.state.ak.us/regulations/pdfs/18%20AAC%2090.pdf). • Consider immediate weather events, as rainfall events may increase pesticide runoff into adjacent water bodies or ground conditions may inhibit intended application. This includes application when soil moisture content is at its field capacity; where soils are saturated as not to allow pesticide penetration, as applicable. • Do not apply pesticides when wind speeds exceed 10 mph, as measured with an anemometer immediately prior to application. • When applying pesticide products, begin nearest to the aquatic habitat boundary and proceed away from the aquatic habitat; do not apply towards a water body. *Re-write of recommendations to include knowledge of pesticide use near anadromous fish streams.* *Other minor editorial comments.* *New subject references and information provided.*
Urban / Suburban Development	• Install oil/water separators in areas adjacent to marine or anadromous waters. • Where feasible, remove impervious surfaces such as abandoned parking lots and buildings from hyporheic, riparian and shoreline areas; re-establish water regime, wetlands, and native vegetation.
Road Building and Maintenance	• After creating disturbance to the riparian area, re-vegetate with native vegetation to avoid colonization by non-native plant species. • Avoid storage or disposal of snow directly into waters. Snow laden with salt and ice melt chemical should not be placed in anadromous fish streams. Snow-melt disposal areas should be silt-fenced and include a collection basin. • Use Stream simulation techniques to design watered crossing structures (bridges or culverts); maintain flow, slope, and natural alignment.
Mining	• To the extent practicable, avoid mineral mining in waters, water sources and water sheds, riparian areas, hyproheic zones, and floodplains containing EFH. • Incorporate stochastic water models and include predictions to illustrate uncertainty.
Organic and Inorganic Debris	• Locate and identify type and source of debris. Determine rough timeline of foreign debris. Information should directly determine the avenue for any removal remedies and address outreach, as necessary. Provide resources and technical guidance to develop focused studies, restoration, and monitoring of the site. • Develop and implement a monitoring protocol to ensure that installed fish passage systems are working.
Dam Operation	• Develop and implement monitoring protocols for fish passage.

Activity	New EFH Conservation Recommendations (bullets) *Other recommended changes to non-fishing FMP text (italics)*
Commercial and Domestic Water Use	• Design water diversion and impoundment projects to create flow conditions that provide for adequate fish passage, particularly during critical life history stages. • Avoid creating low water levels that strand juveniles and dewater redds (egg rearing habitat). • Incorporate juvenile and adult fish passage facilities on all water diversion projects (e.g., fish bypass systems). • Install screens at water diversions on anadromous fish-bearing streams, as needed. • Maintain water quality necessary to support fish populations by monitoring and adjusting water temperature, sediment loads, and pollution levels. Water temperatures should not vary or alter native fish populations. • Maintain appropriate flow velocity and water levels to support continued stream functions. • Where practicable, mitigate for unavoidable impacts to fish and their habitat. Mitigation can include water conservation measures that reduce the volume of water diverted or impounded. • Incorporate responsible water utilization planning for domestic and commercial water usage, which minimizes the affects to EFH. There are many advanced techniques and devices to help conserve water, such as greywater reuse, rainwater collection, water-conserving landscaping and irrigation practices, the installation of low-flow fixtures and appliances, and proper plumbing maintenance. • Use common-sense strategies; known as "Wise Water Use" methods. Includes taking shorter showers, wash full loads of laundry and dishes, and use of collected rainwater to water plants. *Re-write of recommendations.* *Minor editorial comments.* *New subject references and information provided.*
Dredge/Fill/Material Disposal	• In areas near anadromous streams, fill should be sloped to maintain shallow water, photic zone productivity; allow for unrestricted juvenile and adult salmon migration; and provide refugia for juvenile fish. • In marine areas of kelp and other aquatic vegetation, fill (including artificial structure fill reefs) be designed to maximize kelp colonization and provide areas for juvenile fish acclimation to marine conditions and shelter juvenile fish from higher currents and exposure to predators. • Fill materials should be tested and be within the neutral range of 7.5 to 8.4 pH. This pH range, in marine waters, will maximize colonization of marine organisms. Excessively acidic fill material (pH>8.4) should not be used.
Vessel Operations / Transportation / Navigation	• To facilitate movement of fish around breakwaters, breach gaps and construct shallow shelves to serve as “fish benches”, as appropriate. Often benches are expanded shelf features used in common toe-slope stabilization transitions within the breakwater design. Benches need to provide for unrestricted fish movement throughout all stages of local tidal condition (i.e. -3’ MLLW). • Vessel operations and shipping activities should be familiar with Alaska Geographic Response Strategies which detail environmentally sensitive areas of Alaska’s coastline. Currently, GRS’s exist for the many different regions and areas including Southeast Alaska, Southcentral Alaska, Kodiak Island, Prince William Sound, Cook Inlet, Bristol Bay, Northwest Arctic, North Slope, and the Aleutian Islands (see http://www.dec.state.ak.us/spar/perp/grs/home.htm).
Introduction of Exotic Species	• Undertake a thorough scientific review and risk assessment before any non-native species are introduced. • Identify effects of non-native species on existing native species in such areas as habitat alteration, pathology, and associated species composition.
Pile Installation and Removal	*Existing recommendations are adequate.* *Minor editorial comments.* *New subject references and information provided.*
Pile Driving	*Existing recommendations are adequate.* *Minor editorial comments.* *New subject references and information provided.*

Activity	New EFH Conservation Recommendations (bullets) ***Other recommended changes to non-fishing FMP text (italics)***
Pile Removal	*Existing recommendations are adequate.* *Minor editorial comments.* *New subject references and information provided.*
Overwater Structures	*Existing recommendations are adequate.* *Minor editorial comments.* *New subject references and information provided.*
Flood Control / Shoreline Protection	*Existing recommendations are adequate.* *Minor editorial comments.* *New subject references and information provided.*
Log Transfer Facilities / In-water Log Storage	*Existing recommendations are adequate.* *Minor editorial comments.* *New subject references and information provided.*
Utility Line / Cables / Pipeline Installation	*Existing recommendations are adequate.* *Minor editorial comments.* *New subject references and information provided.*
Commercial Utilization of Habitat	*Existing recommendations are adequate.* *Minor editorial comments.* *New subject references and information provided.*
Point Source Discharge	• Coordinate regulations/programs at Federal (EPA) and state (ADNR, ADEC) to ensure consistency.
Fish Processing Waste – Shoreside and Vessel Operation	• Incorporate most-recent technologies to minimize the impacts of nutrient overloading.
Water Intake Structures / Discharge Plumes	*Existing recommendations are adequate.* *Minor editorial comments.* *New subject references and information provided.*
Oil and Gas Exploration / Development / Production	*Existing recommendations are adequate.* *Minor editorial comments.* *New subject references and information provided.*
Habitat Restoration and Enhancement	*Existing recommendations are adequate.* *Minor editorial comments.* *New subject references and information provided.*
Marine Mining	• Deposit tailings within as small an area as possible. *Minor editorial comments.* *New subject references and information provided.*
Persistent Organic Pollutants	*Existing recommendations are adequate.* *Minor editorial comments.* *New subject references and information provided.*

11.4 Conclusions

A review by NMFS HCD staff provided new information and new EFH Conservation Recommendations for consideration. Updates to this section provide the Council, Federal agencies, the public, and NMFS staff a starting point as to those actions that may adversely affect EFH (other than fishing) and ways to avoid, minimize, or mitigate for any effects.

Appendix G will be updated. A new Non-fishing Activities and Recommended EFH Conservation Measures document will undergo public review through the Council process and be readily available online. The Council will then adopt any new EFH Conservation Measures and each FMP will be updated.

11.5 Future Considerations

Non-fishing activities that may affect EFH span a multitude of subjects. Future application to assess these types of actions could include a GIS spatial planning component linked to fish and fish habitat information, research, and management.

12 HAPC recommendations

Habitat areas of particular concern (HAPCs) are areas within essential fish habitat (EFH) that may require additional protection from adverse effects. Essential fish habitat is designated for the managed species identified in the Council's five Fishery Management Plans (BSAI and GOA groundfish, BSAI crab, Scallop, and Salmon). The EFH guidelines provide that HAPCs may be identified as specific types or areas of habitat within EFH, based on one or more of the following four considerations:

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

The Council will consider HAPCs that meet at least two of the four HAPC considerations above, and rarity will be a mandatory criterion of all HAPC proposals.

12.1 HAPC nomination processes

In 2005, the Council formally revised its approach to the designation of HAPCs by adopting a site-based approach. To date, there has been one HAPC nomination process, initiated in October 2003, which resulted in the implementation of several HAPC designations in the Gulf of Alaska and the Aleutian Islands in 2006. For the initial 2003-2004 HAPC process, the Council identified two specific priority areas for HAPC proposals:

1. Seamounts in the exclusive economic zone (EEZ), named on National Oceanic and Atmospheric Administration (NOAA) charts, that provide important habitat for managed species.
2. Largely undisturbed, high-relief, long-lived hard coral beds, with particular emphasis on those located in the Aleutian Islands, which provide habitat for life stages of rockfish or other important managed species.

Additionally, nominations were to be based on best available scientific information and include the following features:

1. Sites must have likely or documented presence of Fishery Management Plan (FMP) rockfish species.
2. Sites must be largely undisturbed and occur outside core fishing areas.

The Council received 23 HAPC proposals from six different organizations. The proposals were reviewed by the Plan Teams, and by staff to consider management, enforcement, and socioeconomic issues. Ultimately, the Council identified a range of alternatives, staff completed an analysis, and the Council established several new HAPCs. Management measures for these HAPCs were implemented in August 2006.

12.2 Recommendations currently on table for Council HAPC consideration

Since the Council last initiated a HAPC proposal cycle (in 2003-04), there have been various occasions on which the Council has considered HAPC priorities or candidate sites. In some cases, the Council has directed that these priorities or areas be brought forward for their upcoming consideration of whether to re-initiate a HAPC proposal cycle (summarized in Table 14).

During the 2003-4 HAPC proposal cycle, six proposals were received that did not meet the Council's designated priorities at that time. These identified two sites in the Bering Sea with dense aggregations of soft corals; three deepwater canyons, two in the Bering Sea and one in Prince William Sound; 54 pinnacles in the Gulf of Alaska; 82 pinnacles in the Aleutian Islands; and the Eight Fathom Pinnacle in the Gulf of Alaska. The Council minutes from April 2004 note that these proposals were removed from the current analysis, but were placed on hold for further consideration under the next HAPC cycle. The proposals would be considered "alive", and need not be re-submitted, although it was expected that the submitters would participate in updating and revising their proposals.

In 2006-2007, the Council considered whether to initiate a HAPC proposal process during discussion related to Bering Sea Habitat Conservation. There were two parts to this discussion. First, the Council reviewed the previous HAPC cycle process, and decided that a review of process was needed to address Plan Team and public concerns. Some of these concerns included: how the Council assembles proposed HAPC nominations; the need to ensure uniformity in the information provided in the proposals; and the need for better definitions of the HAPC criteria, such as the requirement for 'rarity' of candidate HAPCs. The Council formally revised the HAPC process to address many of these concerns, and asked the SSC to provide further definition of the HAPC criteria prior to the next Council call for proposals. Following discussion through an SSC, agency, and Plan Team workgroup, the Council adopted the SSC's recommended revisions to the HAPC criteria at the February 2010 Council meeting.

Secondly, in 2007, the Council considered whether to set a HAPC priority for Bering Sea skate nurseries and/or Bering Sea canyons. A summary of available research on these subjects was prepared and presented. Following public input and Plan Team and SSC review, the Council determined that it would be premature to initiate a call for proposals as there were no identified conservation concerns at that time. These habitat priority types are also brought forward for the Council's upcoming HAPC priority consideration.

In June 2009, the Council considered whether to set priorities for identifying HAPCs and resolicit for HAPC proposals. The Council opted to postpone this decision pending the completion of this five-year EFH review. The Council chose to synchronize the timing of the two actions so that the results from the five-year review can be considered in setting HAPC priorities, and the HAPC proposal cycle that might result.

Table 14 Recommendations on HAPC priorities from previous Council discussions

HAPC discussion at the Council	Priority types forwarded for consideration in 2010
2003-2004 proposal process: proposals submitted that did not meet with the Council's designated priorities at that time	dense aggregations of soft corals (2 sites identified in the Bering Sea) deepwater canyons (2 in the Bering Sea, 1 in Prince William Sound) pinnacles (54 in the Gulf of Alaska, 82 in the Aleutian Islands)
2006-2007 discussion of Bering Sea Habitat Conservation	skate nurseries (in the Bering Sea) deepwater canyons (Pribilof and Zemchug)

12.3 Recommendations on HAPCs from the 5-year review

In April 2009, the SSC recommended that the Council consider permanently changing the timeline for consideration of HAPC priorities and candidate sites to align it with the EFH 5-year review. Currently, the HAPC cycle is designated to be considered by the Council on a three-year cycle, or initiated at any time by the Council.

Additionally, Table 15 identifies recommendations on HAPC priorities that resulted from the EFH 5-year individual species reviews, for the Council's consideration in the next HAPC proposal cycle.

Table 15 Recommendations on HAPC priorities from the individual species reviews

Council FMP	Species	Recommendation
BSAI and GOA Groundfish	Sablefish	Areas of extensive and intensive bottom trawling should be of concern. An abundance of pre-recruit sablefish 1-3 yrs old were noted in the late 70s and early 80s in some areas that are currently trawled intensively. Pre-recruit sablefish have been absent or present in only much reduced numbers since. Research on the ecosystem effects from intensive trawling should be conducted. Small unobtrusive research closures would be a responsible step for NMFS in determining whether EFH is adversely affected. *Note, this recommendation was originally made by the individual species authors, and forwarded by the Groundfish Plan Teams.*
BSAI Groundfish	Skates	The Council may want to consider closing known skate nurseries to fishing activity. I know the Council has discussed this in the past; I'm not sure where things stand at the moment. *Note, this recommendation was originally made by the individual species author, and forwarded by the BSAI Groundfish Plan Team.*
BSAI Crab	Red king crab	The Council should consider identifying red king crab spawning habitat as a HAPC priority type. A specific area in southwest Bristol Bay has been identified that may provide important habitat for red king crab spawning, with direct oceanographic transport to juvenile rearing areas. Should the Council choose to move forward with this as a HAPC priority, the CPT would be prepared to put forward a proposal to the Council to nominate this area as a HAPC in the time frame the Council allows for these proposals, as it appears to meet the criteria identified by the Council for HAPCs (e.g., ecological function, rarity). *Note, this recommendation was made by the Crab Plan Team.*
Salmon	pink salmon	Intertidal spawning areas for pink salmon in Prince William Sound. Remaining pockets of Exxon Valdez oil in Prince William Sound may have residual effects on wild pink salmon populations, especially in intertidal areas. *Note, this recommendation was made by the pink salmon EFH reviewer, and was not vetted through a Plan Team (as there is no Plan Team for the Salmon FMP).*
	sockeye salmon	The eastern Bering Sea shelf is rearing habitat for juvenile western Alaska sockeye salmon. Current oil and gas lease sales in the North Aleutian Basin have the potential to adversely impact the juvenile salmon rearing habitat if an oil spill or other human-caused catastrophe occurs in the lease area. *Note, this recommendation was made by the sockeye salmon EFH reviewer, and was not vetted through a Plan Team (as there is no Plan Team for the Salmon FMP).*

13 Research and information needs

Section 13.1 identifies the EFH research plan that was outlined in the 2005 EFH EIS, and which is included in the Council's 5 FMPs. The Council may wish to consider revising or updating these research priorities, given the passage of five years.

To inform any recommendations on other EFH research priorities, Section 13.2 identifies the current habitat research priorities for NMFS and the NPFMC. Section 13.3 identifies research needs that were identified in each of the individual species reviews.

13.1 EFH research priorities

The EIS for Essential Fish Habitat Identification and Conservation (NMFS 2005) identified a research approach for EFH related to minimizing fishing impacts, including research objectives, questions, activities, and a time frame.

The four research objectives that are defined below have largely been met by the Council in the time period since the EFH EIS. With respect to the research questions, many of these are still valid, and remain to be investigated. The Council may wish to consider either deleting the objectives from the FMP, and retaining the remainder of the research priority section, or perhaps developing new objectives for EFH research.

Recommendations arising from the 5-year review:

In their December 2009 review, the Ecosystem Committee recommended that habitat research should look at species diversity in areas that are now closed to trawling, in addition to species recovery rates (a priority in NMFS' current EFH proposal funding).

The GOA Plan Team also recommended that EFH research funding should encourage further studies of habitat impacts and the linkages of habitat to species productivity. The Crab Plan Team identified that research over the next five years should be directed to allow a better definition of "essential" habitat for crab species.

The SSC identified some specific priorities that would aid the evaluation of EFH:

- There is a continuing need to validate the LEI model and to improve estimates of recovery rates, particularly for the more sensitive habitats, including coral and sponge habitats in the Aleutian Islands region, possibly addressed through comparisons of benthic communities in trawled and untrawled areas.
- There is also a continuing need to obtain high resolution mapping of benthic habitats, particularly in the on-shelf regions of the Aleutian Islands.
- Time series of maturity at age should be collected to facilitate the assessment of whether habitat conditions are suitable for growth to maturity.
- In the case of red king crab spawning habitat in southern Bristol Bay, research is needed on the current impacts of trawling on habitat in spawning areas and the relationship of female crab distribution with respect to bottom temperature.

13.1.1 EFH research priority language that is currently in the FMPs

Objectives

Reduce impacts. (1) Limit bottom trawling in the AI to areas historically fished and prevent expansion into new areas. (2) Limit bottom contact gear in specified coral garden habitat areas. (3) Restrict higher impact trawl fisheries from a portion of the GOA slope. (4) Increase monitoring for enforcement. (5) Establish a scientific research program.

Benthic habitat recovery. Allow recovery of habitat in a large area with relatively low historic effort.

Research Questions

Reduce impacts. Does the closure effectively restrict higher-impact trawl fisheries from a portion of the GOA slope? Is there increased use of alternative gears in the GOA closed areas? Does total bottom trawl effort in adjacent open areas increase as a result of effort displaced from closed areas? Do bottom trawls affect these benthic habitats more than the alternative gear types? What are the research priorities? Are fragile habitats in the AI affected by any fisheries that are not covered by the new EFH closures? Are sponge and coral essential components of the habitat supporting FMP species?

Benthic habitat recovery. Did the habitat within closed areas recover or remain unfished because of these closures? Do recovered habitats support more abundant and healthier FMP species? If FMP species are more abundant in the EFH protection areas, is there any benefit in yield for areas that are still fished without EFH protection?

Research Activities

Reduce impacts. Fishing effort data from observers and remote sensing would be used to study changes in bottom trawl and other fishing gear activity in the closed (and open) areas. First, the recent gear-specific fishing pattern must be characterized to establish a baseline for comparison with observed changes in effort after closures occur. An effective analysis of change requires comprehensive effort data with high spatial resolution, including accurate information about the tow path or setting location, as well as complete gear specifications. Effects of displaced fishing effort would have to be considered. The relative effects of bottom trawl and alternative gear/footrope designs and, thus, the efficacy of the measure should be investigated experimentally in a relatively undisturbed area that is representative of the closed areas. The basis of comparison would be changes in the structure and function of benthic communities and populations, as well as important physical features of the seabed, after comparable harvests of target species are taken with each gear type. Ultimately, there should be detectable increases in FMP species that are directly attributable to the reduced impacts on sponge and coral habitat.

Benthic habitat recovery. Monitor the structure and function of benthic communities and populations in the newly closed areas, as well as important physical features of the seabed, for changes that may indicate recovery of benthic habitat. Whether these changes constitute recovery from fishing or just natural variability/shifts requires comparison with an area that is undisturbed by fishing and otherwise comparable. A reference site would have to remain undisturbed by fishing during the entire course of the recovery experiment. Such a reference site may or may not exist, and the essential elements of comparability for identifying this area are presently unknown. Without proper reference sites, it may still be possible to deduce recovery dynamics based on changes observed in comparable newly closed areas with different histories of fishing disturbance.

Research Time Frame

Changes in fishing effort and gear types should be readily detectable. Biological recovery monitoring may require an extended period if undisturbed habitats of this type typically include large or long-lived organisms and/or high species diversity. Recovery of smaller, shorter-lived components should be apparent much sooner.

13.2 Current NMFS and NPFMC research priorities for habitat and EFH

13.2.1 NMFS EFH research themes and priorities

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. An 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 and facing development pressure.

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.

13.2.2 North Pacific Fishery Management Council

The following is an excerpt from the Council's research priorities, adopted in October 2010, as they relate to habitat research. The full research priority list is available on the Council website, at http://www.fakr.noaa.gov/npfmc/Research_priorities09.pdf.

Five-Year Research Priorities: 2010-2014

Immediate Concerns

III. Habitats

A. Evaluate habitats of particular concern:

1. Assess whether Bering Sea canyons are habitats of particular concern, by assessing the distribution and prevalence of coral and sponge habitat, and comparing marine communities within and above the canyon areas, including mid-level and apex predators (such as, short-tailed albatrosses) to neighboring shelf/slope ecosystems.
2. Assess the extent, distribution, and abundance of important skate nursery areas in the EBS, to evaluate the need for designation of new HAPCs.

B. Baseline Habitat Assessment

1. Dynamic ecosystem and environmental changes in the northern Bering Sea and Arctic are occurring on a pace not observed in recorded time . Given the potential for fishery expansion into the northern Bering Sea, as well as considerations associated with the new FMP for the Arctic, assessment of the current baseline conditions is imperative. This effort, while of great scientific importance, should not supplant the regular surveys in the BSAI and GOA, which are of critical importance to science and management.

Ongoing Needs

III. Habitat

A. Habitat Mapping

1. Improved habitat maps (especially, benthic habitats) are required to identify essential fish habitat and distributions of various substrates and habitat types, including habitat-forming biota, infauna, and epifauna.
2. Begin to develop a GIS relational database for habitat, including development of a historical time series of the spatial intensity of interactions between commercial fisheries and habitat, which will be needed to evaluate impacts of changes in EFH on the growth, reproduction, and distribution of fish and shellfish.
3. Assess the extent of the distribution of Primnoa corals in the GOA.

B. Function of Habitat

1. Evaluate relationships between, and functional importance of, habitat-forming living substrates to commercially important species, including juveniles.

2. Develop a time series of the impact of fishing on GOA, AI, and EBS habitats that could be used to assess: a) the impact of changes in management on the rate of habitat disturbance, and b) the impact of habitat disturbance on the growth, distribution, and reproductive success of managed species.
3. Evaluate effects of fishing closures on benthic habitats and fish production. There are many closures that have been in effect for various periods of time, for which evaluations have not been conducted. A recent example includes slope HAPCs designated in the western Gulf of Alaska.

13.3 EFH research priorities identified by species

Table 16 through Table 20 identify research priorities that were highlighted in the individual species reviews, by FMP. These research needs could be used by the SSC and the Council in refining the Council's research priorities which are disseminated to NPRB, NMFS, and other agencies. Additionally, these research needs will also likely be used by NMFS in developing research priorities for the 2012-2016 funding cycle.

Table 16 Research priorities identified in the individual species reviews – BSAI Groundfish

BSAI Groundfish Species	Recommendation
pollock	none
Pacific cod	The early life history stages of Pacific cod are poorly understood, as noted in several recent articles. Most of the recent work has focused on the Gulf of Alaska stock of Pacific cod.
sablefish	Little is known about the early juvenile stage distribution, habitat requirements, and interaction with other components of the ecosystem. They have been known to reside in habitat subject to potentially adverse fishing effects as indicated by high LEI values for living structure (table B.3-3 of Final EFH EIS). Research is needed on the effect of fishing on the habitat in this area, the role of habitat features on prey, predator, and competitor species in the area, and the role of these species on the growth and survival of sablefish.
yellowfin sole	Distribution of eggs, larvae and early juvenile stages is mostly unknown (undocumented).
greenland turbot	Distribution of early juvenile stages is mostly unknown (undocumented).
arrowtooth flounder	Distribution of larvae and early juvenile stages is mostly unknown (undocumented).
northern rock sole	Distribution of eggs, larvae and early juvenile stages is mostly unknown (undocumented)
flathead sole	Little to no information exists regarding early juvenile distribution and EFH requirements.
alaska plaice	Distribution of larvae and early juvenile stages is mostly unknown (undocumented).
rex sole	Distribution of early juvenile stages is mostly unknown (undocumented).
dover sole	none
Pacific ocean perch	Little information currently exists on the habitat use of various life stages of POP. The studies above are addressing this issue, but field studies are often limited to small geographical areas relative to the POP distribution in Alaska. This field work should be continued and expanded in order to better understand how stock productivity is related to habitat. Also, efforts should be made to estimate population abundance in "trawlable" and "untrawlable" habitats, and their relative trends over time. A concern with our trawl surveys is that we implicitly assume the trawlable habitats (where we have data) are equivalent to the untrawlable habitats.
northern rockfish	Little information currently exists on the habitat use of various life stages of rockfish. The studies above are addressing this issue, but field studies are often limited to small geographical areas. This field work should be continued and expanded in order to better understand how stock productivity is related to habitat. Also, efforts should be made to estimate population abundance in "trawlable" and "untrawlable" habitats, and their relative trends over time. A concern with our trawl surveys is that we implicitly assume the trawlable habitats (where we have data) are equivalent to the untrawlable habitats.

BSAI Groundfish Species	Recommendation
shortraker rockfish	Little information currently exists on the habitat use of various life stages of shortraker rockfish in the BSAI. Information on the distribution and habitat use of the various life-history stages would improve our knowledge of stock productivity and population dynamics. Also, efforts should be made to estimate population abundance in “trawlable” and “untrawlable” habitats, and their relative trends over time. A concern with our trawl surveys is that we implicitly assume the trawlable habitats (where we have data) are equivalent to the untrawlable habitats.
blackspotted/ rougheye rockfish	Little information currently exists on the habitat use of various life stages of either blackspotted or rougheye rockfish in the BSAI. A study examining fine-scale habitat partitioning would help address the question of how speciation could occur and be maintained with organisms that appear to occupy similar large-scale habitats. Also, efforts should be made to estimate population abundance in “trawlable” and “untrawlable” habitats, and their relative trends over time. A concern with our trawl surveys is that we implicitly assume the trawlable habitats (where we have data) are equivalent to the untrawlable habitats.
dusky rockfish	It is assumed that the bycatch of dusky in targeted fisheries in the Bering Sea is minimal and does not adversely impact the population or their habitat.
thornyhead rockfish	It is assumed that the bycatch of shortspine thornyheads in targeted fisheries in the Bering Sea is minimal and does not adversely impact the population or their habitat.

BSAI Groundfish Species	Recommendation
atka mackerel	o Studies to determine whether there have been any changes in life history parameters over time (e.g. maturity-at-age, fecundity, weight- and length-at-age) o Studies to determine the impacts of environmental indicators such as temperature regime on Atka mackerel o Information on Atka mackerel habitat preferences is needed to improve our understanding of Essential Fish Habitat (EFH), and improve our assessment of the impacts to habitat due to fishing o Better habitat mapping of the Gulf of Alaska would provide information for survey stratification and the extent of trawlable and untrawlable habitat. o Regional and seasonal food habits data for Gulf of Alaska Atka mackerel
squid	Squid in the BSAI are very poorly understood, so any information on distribution or habitat would be helpful. Perhaps the most important question is how the distribution of squids (and the habitat needs that drive it) overlap with seabird and marine mammal predators. This would be really useful for looking at the potential impact of squid removals on other parts of the ecosystem.
octopus	1) Life history: Because octopuses are semelparous, a better understanding of reproductive seasons and habits is needed to determine the best strategies for protecting reproductive output. Reproductive seasons and spawning habitat of E dofleini need to be identified for Alaskan waters. Life histories of other species need more information. 2) Seasonal movement: E. dofleini in Japan and off the US west coast reportedly undergo seasonal movements, but the timing and extent of migrations in Alaska is unknown. While many octopus move into shallower coastal waters for egg-laying, it is probable that at least some octopus reproduction occurs within federal waters. 3) State/Federal: The distribution of octopus biomass and extent of movement between federal and state waters is unknown and could become important if a directed state fishery develops. Tagging studies to determine seasonal and reproductive movements of octopus in Alaska would add greatly to our ability to appropriately manage commercial harvest. 4) Biomass Estimation: Fishery-independent methods for assessing biomass of the harvested size group of octopus are feasible, but would be species-specific and could not be carried out as part of existing multi-species surveys. Pot surveys are effective both for collecting biological and distribution data and as an index of abundance; mark-recapture methods have been used with octopus both to document seasonal movements and to estimate biomass and mortality rates. These methods would require either extensive industry cooperation or funding for directed field research. Factors determining year-to year patterns in octopus abundance are poorly understood. Octopus abundance is probably controlled primarily by survival at the larval stage; substantial year-to-year variations in abundance due to climate and oceanographic factors are expected. The high variability in trawl survey estimates of octopus biomass make it difficult to depend on these estimates for time-series trends; trends in CPUE from observed cod fisheries may be more useful. 5) Natural Mortality: Estimates of natural mortality rates for octopus would require species and region-specific field studies. Any stock assessment calculations would need to be based on natural mortality rates for adult octopus prior to spawning. Development of octopus-specific survey gear or tagging would be needed to perform such studies. 6) Growth: Field and laboratory studies to determine growth rates, age at maturity, and fecundity.
sharks	Estimates of bycatch from unobserved fisheries, including halibut IFQ and salmon. Identification of nursery areas and juvenile habitat use. Investigation of fishing effects on the species, such as fecundity and survival.
sculpins	there is a need for research on sculpin habitat utilization throughout their life history. This basic information is not known. It is also not known whether bottom trawling negatively impacts the habitat of adult sculpins. It would be first priority to find out what types of habitat are utilized by sculpins throughout their life history and then determine whether fishing activities negatively impact those habitats.
skates	1) Location and habitat features of skate nurseries. While some of these have been identified, further research is needed to fully characterize these areas. 2) Age-related movement and distribution of skates, particularly the Alaska skate.
forage fish complex	Basic information on distribution, seasonal movements, and habitat associations

Table 17 Research priorities identified in the individual species reviews – GOA Groundfish

GOA Groundfish Species	Recommendation
pollock	Additional research is needed on impacts of trawling using midwater nets.
pacific cod	The early life history stages of Pacific cod are poorly understood, as noted in several recent articles. Most of the recent work has focused on the Gulf of Alaska stock of Pacific cod.
sablefish	Little is known about the early juvenile stage distribution, habitat requirements, and interaction with other components of the ecosystem. They have been known to reside in habitat subject to potentially adverse fishing effects as indicated by high LEI values for living structure (table B.3-3 of Final EFH EIS). Research is needed on the effect of fishing on the habitat in this area, the role of habitat features on prey, predator, and competitor species in the area, and the role of these species on the growth and survival of sablefish.
yellowfin sole	Distribution of eggs, larvae and early juvenile stages is mostly unknown (undocumented)
Northern rock sole	Diet information differentiated between the two rock sole forms needs to be documented. This information may already exist in the AFSC database.
Southern rock sole	Diet information differentiated between the two rock sole forms needs to be documented. This information may already exist in the AFSC database.
Alaska plaice	Any spawning information such as type (batch or broadcast?) and documentation of spawning location.
dover sole	The level of information for the early juvenile life stage is inadequate to change the current level from "Unknown" to "Level 1".
rex sole	The level of information for the early juvenile life stage is inadequate to change the current level from "Unknown" to "Level 1".
arrowtooth flounder	It would be desirable to know if arrowtooth flounders are broadcast or batch spawners. It would also be informative to know there role, if any, in the pelagic zone.
flathead sole	While more information exists regarding early juvenile distribution and EFH requirements in the GOA than in the BSAI, it does not seem complete enough to change the level of information for this life stage from "Unknown" to "Level 1".
Pacific ocean perch	There is little information on larval, post-larval, or early juvenile stages slope rockfish. Habitat requirements for these stages are mostly unknown. Habitat requirements for later stage juvenile and adult fish are anecdotal or conjectural. Research needs to be done on the bottom habitat of the major fishing grounds, on what HAPC biota are found on these grounds, and on what impact bottom trawling has on these biota. Additionally, Pacific ocean perch are undersampled by the current survey design. The stock assessment would benefit from additional survey effort on the continental slope. Further research on trawl catchability and trawlable/ untrawlable grounds would be very useful.

GOA Groundfish Species	Recommendation
northern rockfish	Except for adults, there is almost no information on life history or habitat of northern rockfish in the GOA. At this time, identification of northern rockfish larvae and post-larvae is not possible, even using genetic methods. Additional genetic studies are needed to determine genetic markers that will positively identify northern rockfish to species. Few small juvenile northern rockfish have been caught in either the fishery or by surveys; studies are needed to locate and sample these young fish before their habitat requirements can be determined. Manned submersible studies on the outer shelf and upper slope have observed small red rockfish associated with corals and sponges. New studies need to be done to identify these fish to species and determine if they include northern rockfish. Although much more is known about adult fish, even their habitat requirements remain largely conjectural or based on circumstantial evidence. Research needs to be done on the bottom habitat of the major fishing grounds, on what HAPC biota are found on these grounds, and on what impact bottom trawling has on these biota.
shortraker rockfish[23]	There is very little information on larval, post-larval, or juvenile shortraker rockfish, especially juveniles, which are rarely caught in any sampling gear. Studies are needed to locate and sample these young fish before their habitat requirements can be determined. Although more is known about adult fish, the specifics of their habitat requirements need further research. For example, does a relationship exist between adult shortraker rockfish and Primnoa coral, and if so, how important is this relationship? Research needs to be done on the bottom habitat of the major fishing grounds, on what HAPC biota are found on these grounds, and on what impact bottom trawling has on these biota.
blackspotted/ rougheye rockfish	There is little information on larval, post-larval, or early juvenile stages of rougheye and blackspotted rockfish. Habitat requirements for these stages are mostly unknown. Habitat requirements for later stage juvenile and adult fish are anecdotal or conjectural. Research needs to be done on the bottom habitat of the major fishing grounds, on what HAPC biota are found on these grounds, and on what impact bottom trawling has on these biota. Additionally, the current NMFS trawl survey design should extend into deeper waters (>300 m) to cover the range of primary habitat for rougheye and blackspotted rockfish. Further research on trawl and longline catchability, trawlable/untrawlable grounds, and natural mortality would be very useful.
dusky rockfish	There is little information on larval, post-larval, or early juvenile stages slope rockfish. Habitat requirements for these stages are mostly unknown. Habitat requirements for later stage juvenile and adult fish are anecdotal or conjectural. Research needs to be done on the bottom habitat of the major fishing grounds, on what HAPC biota are found on these grounds, and on what impact bottom trawling has on these biota. Additionally, dusky rockfish are undersampled by the current survey design. The stock assessment would benefit from additional survey effort on the continental slope. Further research on trawl catchability and trawlable/untrawlable grounds would be very useful.
yelloweye rockfish	adult and juvenile fish associations with living habitats and also more can be done to identify larvae and their locations, do DSR larvae ever use eel grass beds like some other rockfish species do?
thornyhead rockfish	age and growth studies
atka mackerel	o Studies to determine whether there have been any changes in life history parameters over time (e.g. maturity-at-age, fecundity, weight- and length-at-age) o Studies to determine the impacts of environmental indicators such as temperature regime on Atka mackerel o Information on Atka mackerel habitat preferences is needed to improve our understanding of Essential Fish Habitat (EFH), and improve our assessment of the impacts to habitat due to fishing o Better habitat mapping of the Gulf of Alaska would provide information for survey stratification and the extent of trawlable and untrawlable habitat. o Regional and seasonal food habits data for Gulf of Alaska Atka mackerel
skates	Habitat needs for GOA skates have not been studied. In particular, it would be valuable to know whether there are nursery sites (where egg cases are deposited) similar to those that have been found in the BSAI. Also, we know nothing about movement of skates throughout the GOA.

[23] EFH is currently described for shortraker/ rougheye rockfish, not shortraker rockfish and blackspotted/ rougheye rockfish, as assessed in the SAFE report, and recommended by this review

GOA Groundfish Species	Recommendation
octopus	1) Life history: Because octopuses are semelparous, a better understanding of reproductive seasons and habits is needed to determine the best strategies for protecting reproductive output. Reproductive seasons and spawning habitat of E dofleini need to be identified for Alaskan waters. Life histories of other species need more information. 2) Seasonal movement: E. dofleini in Japan and off the US west coast reportedly undergo seasonal movements, but the timing and extent of migrations in Alaska is unknown. While many octopus move into shallower coastal waters for egg-laying, it is probable that at least some octopus reproduction occurs within federal waters. 3) State/Federal: The distribution of octopus biomass and extent of movement between federal and state waters is unknown and could become important if a directed state fishery develops. Tagging studies to determine seasonal and reproductive movements of octopus in Alaska would add greatly to our ability to appropriately manage commercial harvest. 4) Biomass Estimation: Fishery-independent methods for assessing biomass of the harvested size group of octopus are feasible, but would be species-specific and could not be carried out as part of existing multi-species surveys. Pot surveys are effective both for collecting biological and distribution data and as an index of abundance; mark-recapture methods have been used with octopus both to document seasonal movements and to estimate biomass and mortality rates. These methods would require either extensive industry cooperation or funding for directed field research. Factors determining year-to year patterns in octopus abundance are poorly understood. Octopus abundance is probably controlled primarily by survival at the larval stage; substantial year-to-year variations in abundance due to climate and oceanographic factors are expected. The high variability in trawl survey estimates of octopus biomass make it difficult to depend on these estimates for time-series trends; trends in CPUE from observed cod fisheries may be more useful. 5) Natural Mortality: Estimates of natural mortality rates for octopus would require species and region-specific field studies. Any stock assessment calculations would need to be based on natural mortality rates for adult octopus prior to spawning. Development of octopus-specific survey gear or tagging would be needed to perform such studies. 6) Growth: Field and laboratory studies to determine growth rates, age at maturity, and fecundity.
sharks	Estimates of bycatch from unobserved fisheries, including halibut IFQ and salmon; Identification of nursery areas and juvenile habitat use; Investigation of fishing effects on the species, such as fecundity and survival.
sculpins	sculpin habitat utilization throughout their life history. This basic information is not known. It is also not known whether bottom trawling negatively impacts the habitat of adult sculpins. It would be first priority to find out what types of habitat are utilized by sculpins throughout their life history and then determine whether fishing activities negatively impact those habitats.
squid	Squid in the GOA are very poorly understood, so any information on distribution or habitat would be helpful. Perhaps the most important question is how the distribution of squids (and the habitat needs that drive it) overlap with seabird and marine mammal predators. This would be really useful for looking at the potential impact of squid removals on other parts of the ecosystem.
forage fish complex	There are lots of little bits of information on GOA forage fishes; what is needed is a comprehensive understanding of distribution, habitat, and movement gulfwide. Hopefully the GOA IERP will yield some of this

Table 18 Research priorities identified in the individual species reviews – BSAI Crab

BSAI Crab FMP species	Recommendation
all species	Determine critical spawning grounds for all crab species. Information from this research could be used in future HAPC considerations. Research should look at substrate needs as well as pelagic habitat (e.g. the importance of oceanographic transport mechanisms) in determining critical spawning areas.
	Analyze temporal trends in spatial distribution of crab stocks to assess the current EFH descriptions. Include historical data and analyze shifts in distribution over time.
	Evaluate relationships between, and functional importance of, habitat-forming living substrates to juvenile and adult crab.
	Quantify crab habitat characteristics utilizing appropriate technology to allow increased precision of survey catch rate estimates.

Table 19 Research priorities identified in the individual species reviews – Scallop

Scallop FMP species	Recommendation
weathervane scallop	Research and better technological tools are needed to classify scallop distribution and bed areas. With this information, research will need better advances and tools to assess and disseminate the enormous influx of information expected.
	Additional camera sled survey information on areas closed to scallop fishing with known scallop beds. Habitat-based assessment approach possibility for pooling camera sled research and broadscale assessment statewide for statewide biomass estimate.

Table 20 Research priorities identified in the individual species reviews – Salmon

Salmon FMP Species	Recommendation
Chinook	Research is needed for stock origins and potential impacts of bycatch of Chinook salmon in certain GOA and BSAI groundfish fisheries.
coho	The ocean life history profile describing coho seasonal abundance is not complete in the EEZ of Alaska and beyond. Little information exists on the extent of ocean distribution of juveniles in late fall, and their ensuing distribution as adults from early winter to spring
chum	Recent research and management information is increasing the understanding of what defines the habitat needs of chum salmon especially in their ocean life stages. Work currently underway will augment the current knowledge base.
pink	More open ocean research, especially during the winter period, is a high priority need to better understand the causes of variable year class strength and high fluctuations in marine survival of pink salmon. Recent development of reasonably accurate forecasts on pink salmon run strength have been developed for southeast Alaska based on marine life period just prior to when juveniles enter the open ocean environment. This forecast model, however, does not account for how fluctuations in variable oceanic conditions affect juvenile pink salmon. [The need for similar oceanic research focused on a broad array of biophysical metrics [ecosystem approach] also applies to other salmon species.]
sockeye	(none offered)

13.4 EFH research priorities identified for nonfishing impacts

Table 21 identifies research priorities that were highlighted in the individual species reviews. These research needs could be used by the SSC and the Council in refining the Council's research priorities which are disseminated to NPRB, NMFS, and other agencies. Additionally, these research needs will also likely be used by NMFS in developing research priorities for the 2012-2016 funding cycle.

Table 21 Research priorities identified during the review of nonfishing impacts on EFH

EFH Activity	Research Need
Silviculture/Timber Harvest	Determine how culverts affect fish passage.
Silviculture/Timber Harvest	Determine how cost effective remediation measures are on fish passage.
Pesticide Application	Determine how copper, organophosphates, and the mixture of pesticides affect fish.
Commercial and Domestic Water Use	Determine cumulative effects of commercial and domestic water use at the watershed level.
Fill	Determine the cumulative effects of fill, especially in developed areas, on fish species.
Vessel Operations/ Transportation/ Navigation	Determine the cumulative effects of vessel operations and port expansion, especially in developed areas, on fish species.

14 Conclusions and Council action

The 5-year EFH review has been completed and is documented in this summary report (with the exception of recommendations from the Council's BSAI Crab Plan Team, which will be provided at the April Council meeting as a supplement to this report). At this stage, the Council's primary decision point will be to determine whether, based on the new information available in the last five years, revisions to any of the Council's FMPs are warranted, which would require initiation of FMP amendments and associated analysis.

The Council also decided, in June 2009, to delay the consideration of whether to initiate a new HAPC proposal cycle until the completion of the EFH 5-year review. Consequently, another decision point for the Council is to decide whether to set HAPC priorities, thus initiating a call for proposal for specific sites to define as HAPCs. Section 12 provides some guidance to the Council on HAPC priorities that have been suggested since the last HAPC proposal cycle, both within the Council process and as part of the EFH review.

In order to provide some guidance for the Council with respect to whether to initiate FMP amendments for revising EFH, the recommendations contained within the review are summarized in Table 22. If FMP amendments are initiated, the Council will go through the normal FMP amendment process, with the development of an analysis to support the amendment (to comply with NEPA and Regulatory Flexibility Act requirements, and EO 12866 if a change to the regulations is also anticipated), and initial review and final action by the Council. The considerations before the Council can be summarized as follows:

- Do the EFH descriptions and geographical distributions for individual species warrant revising in the FMP? Should the FMPs be revised to reflect new information on their life history, biological/ habitat/ predator-prey associations, or fishery?
- Is a new evaluation of the adverse effects of fishing on EFH needed?
- Should any new conservation measures be considered to mitigate adverse effects of fishing?
- Should the conservation and enhancement recommendations for nonfishing threats to EFH be revised in the FMPs?
- Is there a need to identify new HAPC priority types, and thus initiate a call for proposals for candidate sites to be considered for special management as HAPCs?
- Does the Council want to identify new directions for EFH research for the next 5 years?

Table 22 Summary of recommended changes to the FMPs resulting from the EFH 5-year review

EFH component	Council FMP	Recommended change	Priority?
EFH descriptions of individual species	BSAI Groundfish	**Amendments are recommended for all 24 species or complexes** whose habitat is described in the FMP, to revise some aspect of the EFH description	The BSAI Plan Team provided recommendations about whether these amendments constitute low or higher priorities. • Revisions for three species are identified as moderate priority amendments that have the potential to affect management of the species (because of a change to the geographical distribution of EFH, or to the way the species is managed within a complex). • The Team recommended deleting one EFH description from the FMP.
	GOA Groundfish	**Amendments are recommended for all 24 species or complexes** whose habitat is described in the FMP, to revise some aspect of the EFH description	As above, the GOA Plan Team provided recommendations about whether these amendments constitute low or higher priorities. • Revisions for seven species are identified as high priority amendments, and five as moderate priority amendments that have the potential to affect management of the species (because of a change to the geographical distribution of EFH, or to the way the species is managed within a complex). • The Team recommended deleting one EFH description from the FMP.
	BSAI Crab	**Amendments are recommended for all 5 species or complexes** in the FMP, to revise general EFH and fishery information for each species, and to reconsider the conclusions of the effects of fishing evaluation.	The Crab Plan Team recommended, as a higher priority, that further evaluation of the conclusions regarding the effects of fishing on crab EFH be undertaken to decide whether the conclusions summarized in the FMP are valid (see also below)
	Scallop	**An amendment is recommended for the one species** whose habitat is described in the FMP, to revise aspects of the EFH description	The Scallop Plan Team recommended that this amendment be considered a higher priority, as a change to the geographical distribution of weathervane scallop EFH is proposed.
	Salmon	**Amendments are recommended for all 5 species** in the FMP, to revise some aspect of the EFH description	The proposed changes do not affect the geographical distribution of EFH for marine salmon species, therefore using the same rationale as the other Plan Teams, these may be considered to be low priority amendments.

EFH component	Council FMP	Recommended change	Priority?
Fishing activities that may adversely affect EFH	All Council FMPs	**A general re-evaluation of the effects of fishing activities on EFH is not recommended.** Recent research results are consistent with the habitat sensitivity and recovery parameters and distributions of habitat types used in the prior analysis of fishing effects for the EFH EIS. Fishing intensity has decreased overall, gear regulations have been designated to reduce habitat damage, and area closures have limited the expansion of effort into areas of concern. **For crab species, however, re-evaluation is recommended.**	The Crab Plan Team has identified concerns with the conclusions and methodology of the evaluation of effects of fishing specifically on crab stocks, and recommends that further analysis be undertaken.
Non-fishing activities that may adversely affect EFH	All Council FMPs	**Amendments are recommended to update EFH conservation recommendations for 14 of 22 nonfishing activities.**	Recommendations are used by NMFS to consult with other agencies about Federal activities affecting EFH; updating these recommendations may be important for accurate consultation.
HAPC identification	Potentially all Council FMPs	Review has provided some suggestions for HAPC priorities (see Sections 12.2 and 12.3).	The Council is not obligated to identify HAPCs, only to consider whether it is appropriate to do so.
Research and information needs	Potentially all FMPs	The Council's research priority objectives from 2005 have largely been met, however many of the research questions are still valid and remain to be investigated (see Section 13.1.1). The Council may wish to identify new objectives to guide EFH research over the next 5 years.	

14.1 Council action

The Council reviewed the summary report at the April 2010 Council meeting. Based on the review of the report, the Council opted to initiate amendments to revise EFH components in the five Council FMPs. A summary of the proposed amendments is included in Table 22.

Table 23 Council action on EFH 5-year Summary Report

EFH component	Council FMP	Recommended change
EFH descriptions of individual species	BSAI Groundfish	**Initiate amendments for all 24 species or complexes** whose habitat is described in the FMP, to revise some aspect of the EFH description, as described in the summary report
	GOA Groundfish	**Initiate amendments for all 24 species or complexes** whose habitat is described in the FMP, to revise some aspect of the EFH description, as described in the summary report
	BSAI Crab	**Initiate amendments for all 5 species or complexes** in the FMP, to revise general EFH and fishery information for each species, as described in the summary report (amendments to revise the evaluation of fishing effects conclusions are not initiated at this time, rather see discussion under evaluation of fishing effects)
	Scallop	**Initiate amendment for the one species** whose habitat is described in the FMP, to revise aspects of the EFH description, as described in the summary report
	Salmon	**Initiate amendments for all 5 species** in the FMP, to revise some aspect of the EFH description, as described in the summary report, except that the recommendation to revise the conclusions of the effects of fishing on Chinook would not be forwarded for analysis
Fishing activities that may adversely affect EFH	All Council FMPs	**A general re-evaluation of the effects of fishing activities on EFH, including re-running the model, should not be initiated at this time.** Recent research results are consistent with the habitat sensitivity and recovery parameters and distributions of habitat types used in the prior analysis of fishing effects for the EFH EIS. Fishing intensity has decreased overall, gear regulations have been designated to reduce habitat damage, and area closures have limited the expansion of effort into areas of concern. **For crab species, request a discussion paper to look at how the effects of fishing are considered for crab stocks.** The paper should include the Plan Team's comments about considering the pelagic environment and transport mechanisms and their importance for spawning and breeding populations, and should also evaluate existing closures for crab habitat to see if habitat usage by crab species has changed since the mid-1990s when these closures were put into effect. Based on this discussion paper, the Council can then decide whether further analysis of this issue should be incorporated into the overall EFH analysis and amendments.
Non-fishing activities that may adversely affect EFH	All Council FMPs	**Initiate amendments to update EFH conservation recommendations for 14 of 22 nonfishing activities.**
HAPC	All FMPs	**Initiate amendment to revise the timeline associated with the HAPC process to coincide with the EFH 5-year review.** Note, the Council also set skate nurseries as a habitat priority, and initiated a call for proposals for candidate HAPC sites. Any amendments resulting from the call for proposals will, however, be implemented through a separate process.
Research and information needs	All FMPs	**Initiate amendments to revise research priority objectives in the FMP.** The Council's research priority objectives from 2005 have largely been met, however many of the research questions are still valid and remain to be investigated (see Section 13.1.1). The Council preliminarily identified new objectives to guide EFH research over the next 5 years.

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Preparation of document

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Review of groundfish species EFH

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BSAI and GOA Groundfish Plan Teams

Review of crab species EFH

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Review of salmon species EFH

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Review of fishing effects

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Review of non-fishing effects

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17 Color figures

Bering Sea – Non-pelagic trawl

Difference in fishing intensity between periods: 2003-2007 vs. 1998-2002 ..... B
1998-2002 vs. 1993-1997 ..... B

Average fishing intensity over the five-year period: 2003-2007 C
1998-2002 C
1993-1997 ..... D

Bering Sea – Pelagic Trawl

Difference in fishing intensity between periods: 2003-2007 vs. 1998-2002 ..... E
1998-2002 vs. 1993-1997 ..... E

Average fishing intensity over the five-year period: 2003-2007 ..... F
1998-2002 ..... F
1993-1997 ..... G

Aleutian Islands – Non-pelagic trawl

Difference in fishing intensity between periods: 2003-2007 vs. 1998-2002 ..... H
1998-2002 vs. 1993-1997 ..... H

Average fishing intensity over the five-year period: 2003-2007 I
1998-2002 I
1993-1997 ..... J

Gulf of Alaska – Non-pelagic trawl

Difference in fishing intensity between periods: 2003-2007 vs. 1998-2002 ..... K
1998-2002 vs. 1993-1997 ..... K

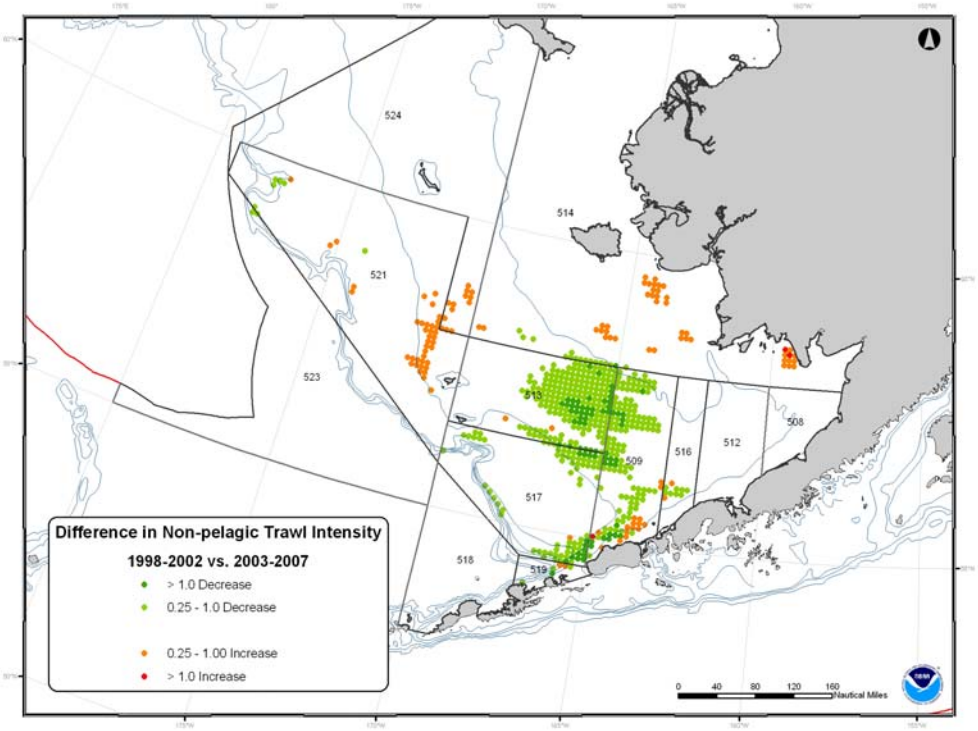
Average fishing intensity over the five-year period: 2003-2007 L
1998-2002 L
1993-1997 ..... M

Gulf of Alaska – Pelagic trawl

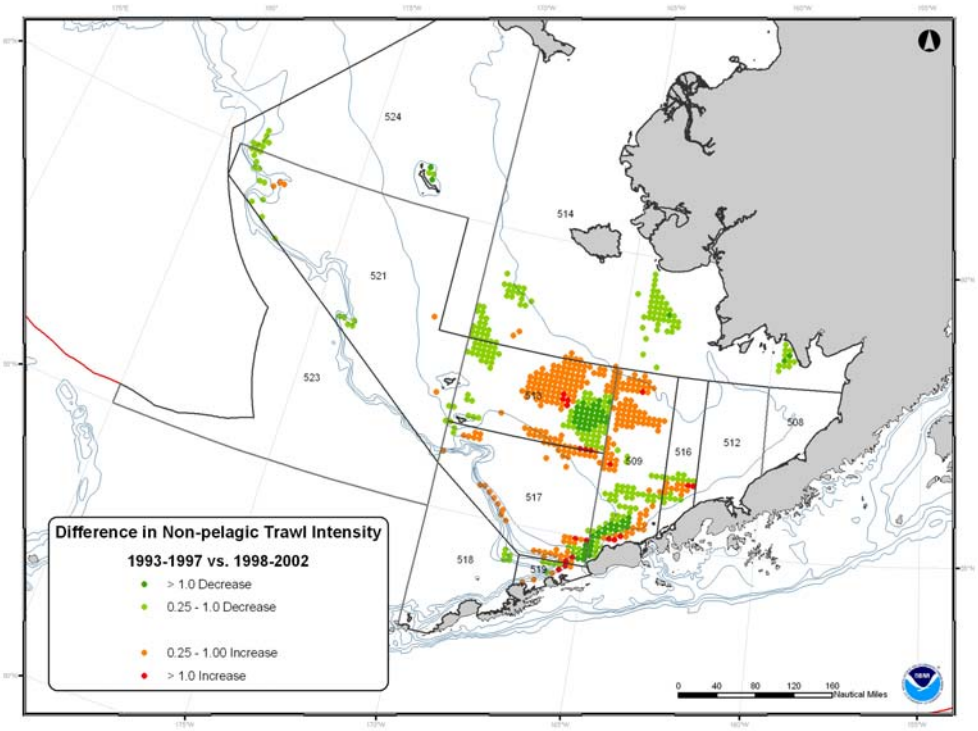
Difference in fishing intensity between periods: 2003-2007 vs. 1998-2002 ..... N
1998-2002 vs. 1993-1997 ..... N

Average fishing intensity over the five-year period: 2003-2007 ..... O
1998-2002 ..... O
1993-1997 ..... P

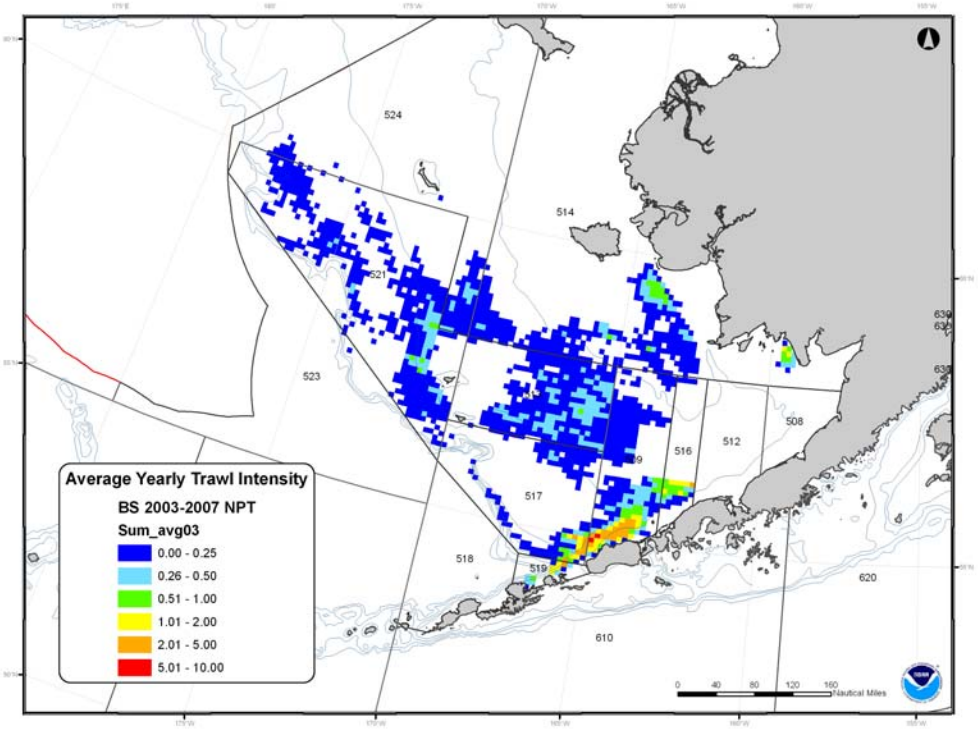
Color figure 1 **Difference in Bering Sea non-pelagic trawl intensity between the five-year period analyzed in the EFH EIS (1998-2002) and the more recent period (2003-2007)**



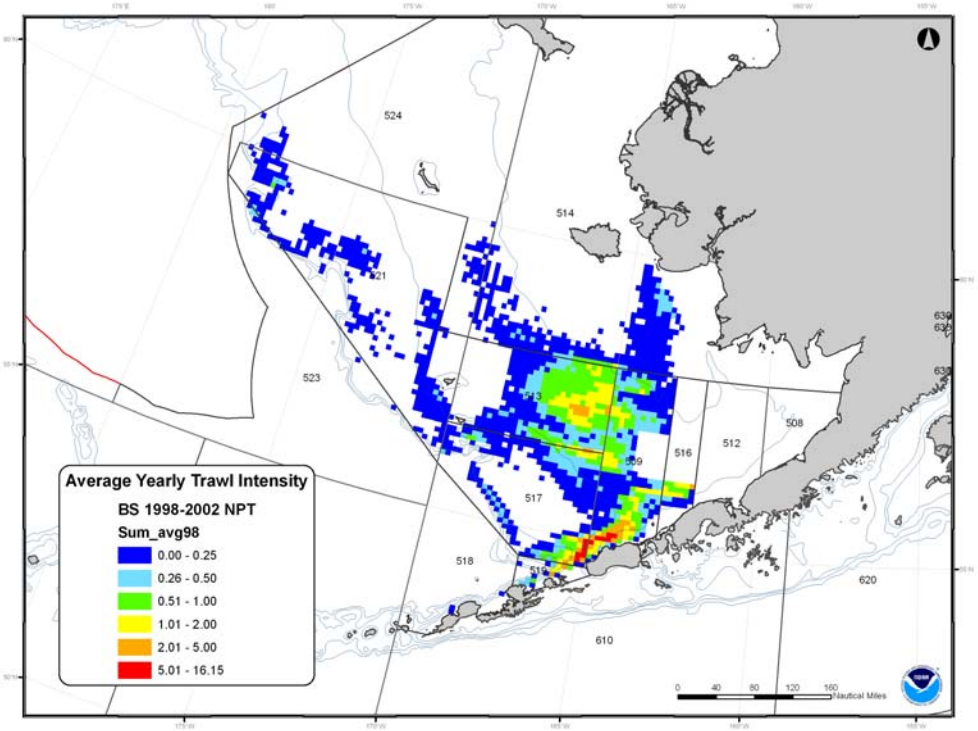
Color figure 2 **Difference in Bering Sea non-pelagic trawl intensity between the five-year period analyzed in the EFH EIS (1998-2002) and the previous period (1993-1997)**



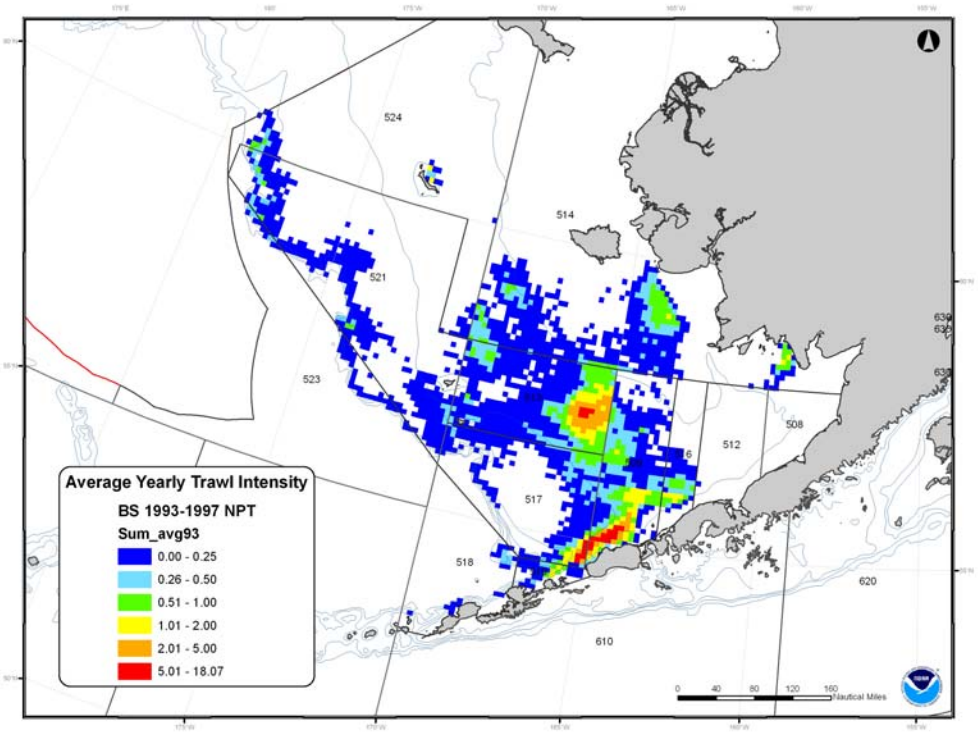
Color figure 3 **Bering Sea non-pelagic trawl average annual fishing intensity over the five-year period 2003-2007**



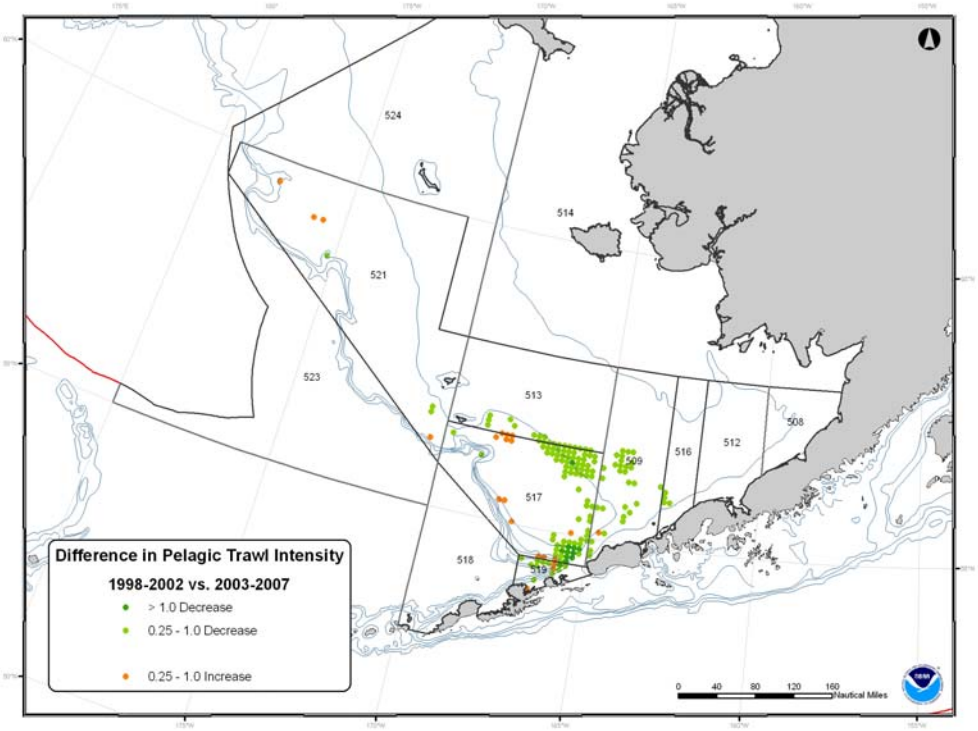
Color figure 4 **Bering Sea non-pelagic trawl average annual fishing intensity over the five-year period 1998-2002**



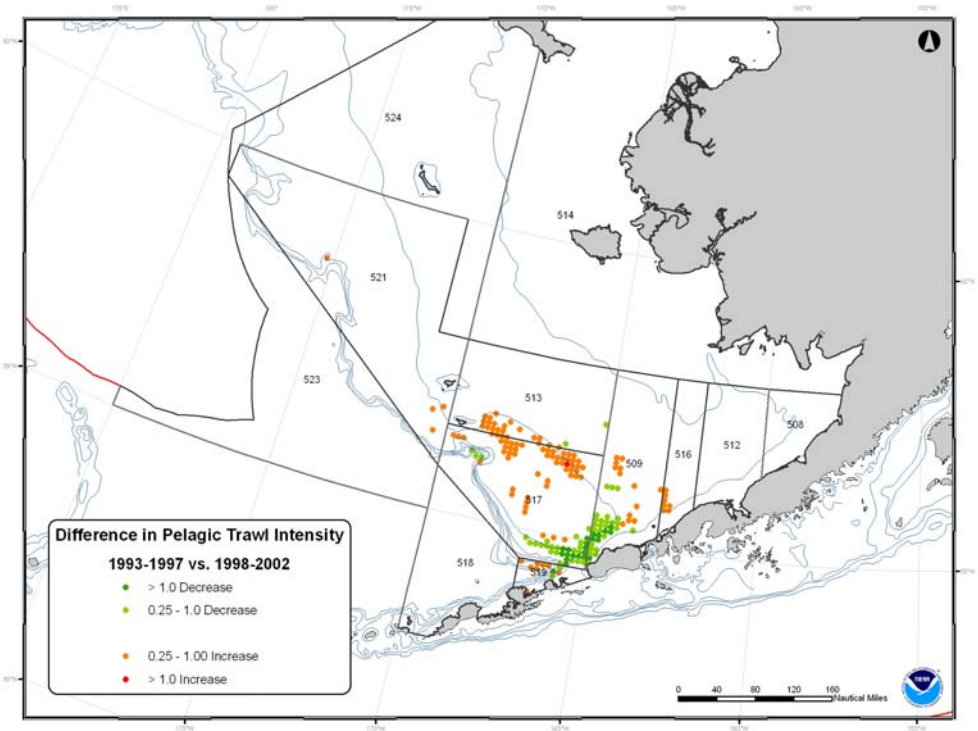
Color figure 5 **Bering Sea non-pelagic trawl average annual fishing intensity over the five-year period 1993-1997**



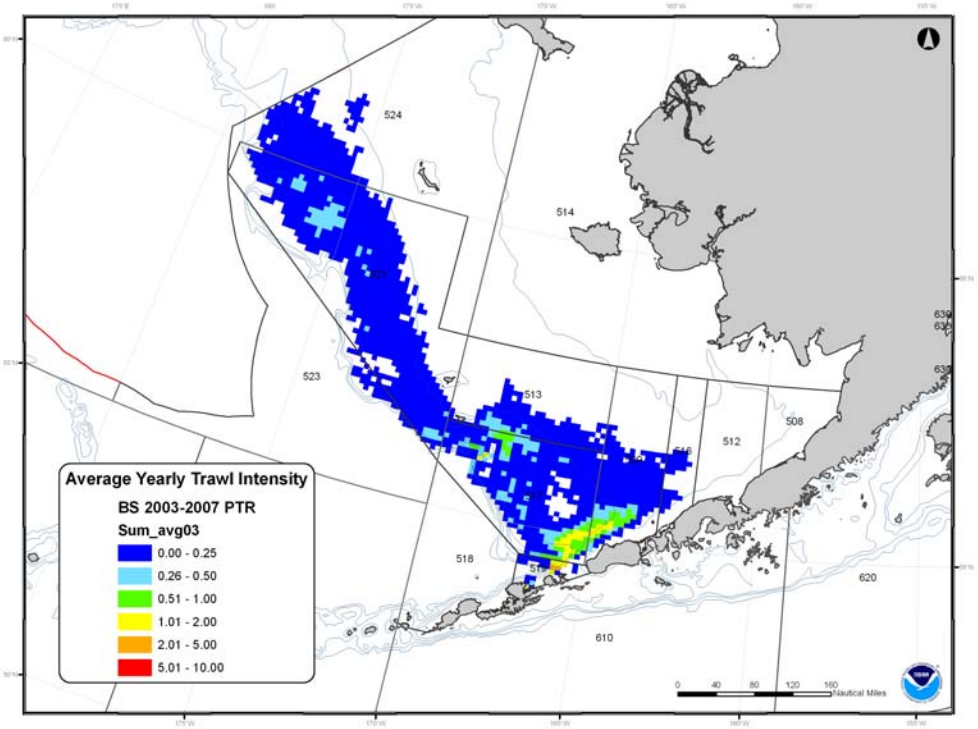
Color figure 6 **Difference in Bering Sea pelagic trawl intensity between the five-year period analyzed in the EFH EIS (1998-2002) and the more recent period (2003-2007)**



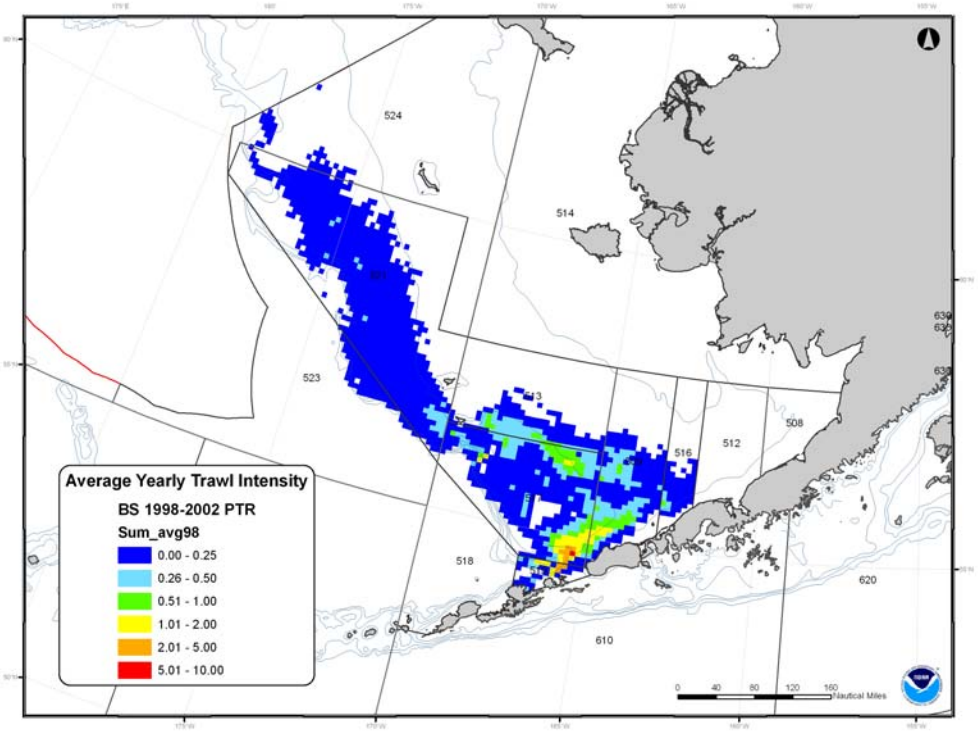
Color figure 7 **Difference in Bering Sea pelagic trawl intensity between the five-year period analyzed in the EFH EIS (1998-2002) and the previous period (1993-1997)**



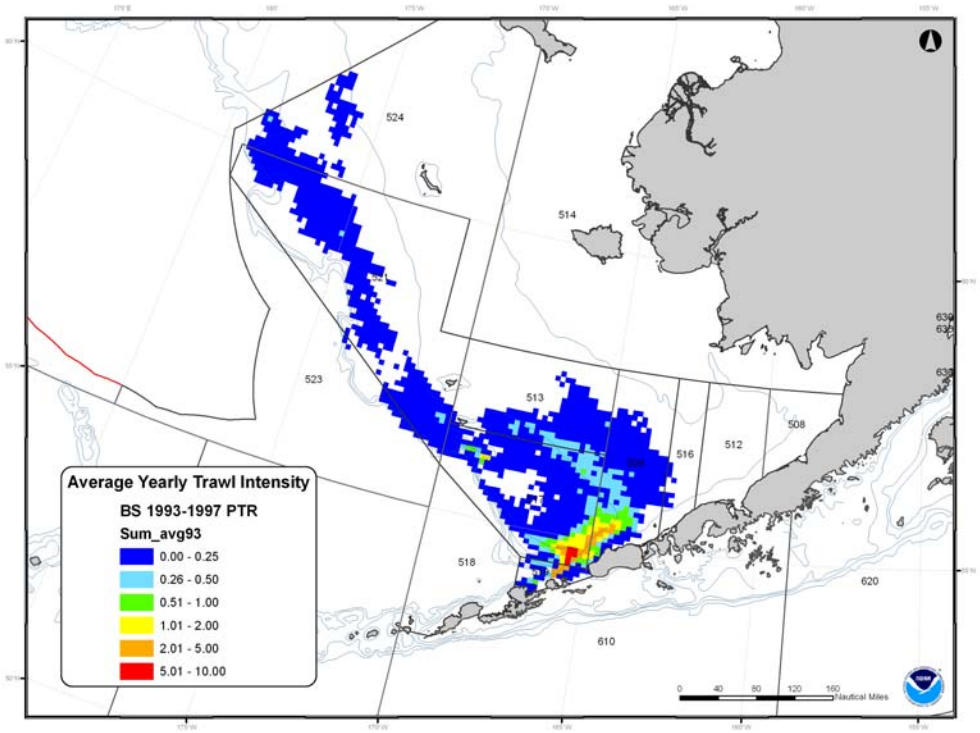
Color figure 8 **Bering Sea pelagic trawl average annual fishing intensity over the five-year period 2003-2007**



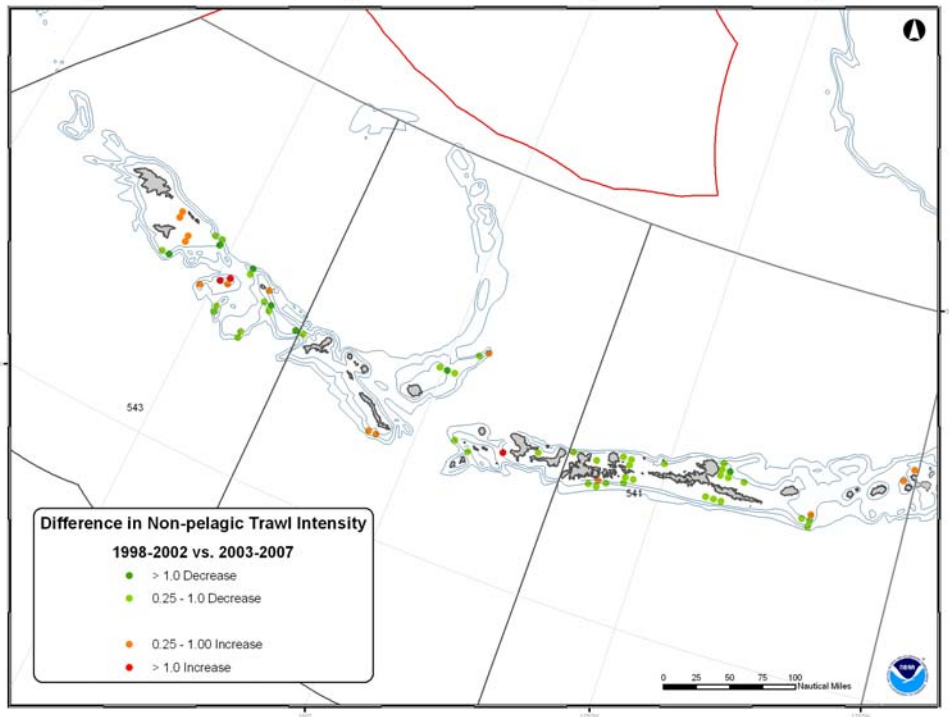
Color figure 9 **Bering Sea pelagic trawl average annual fishing intensity over the five-year period 1998-2002**



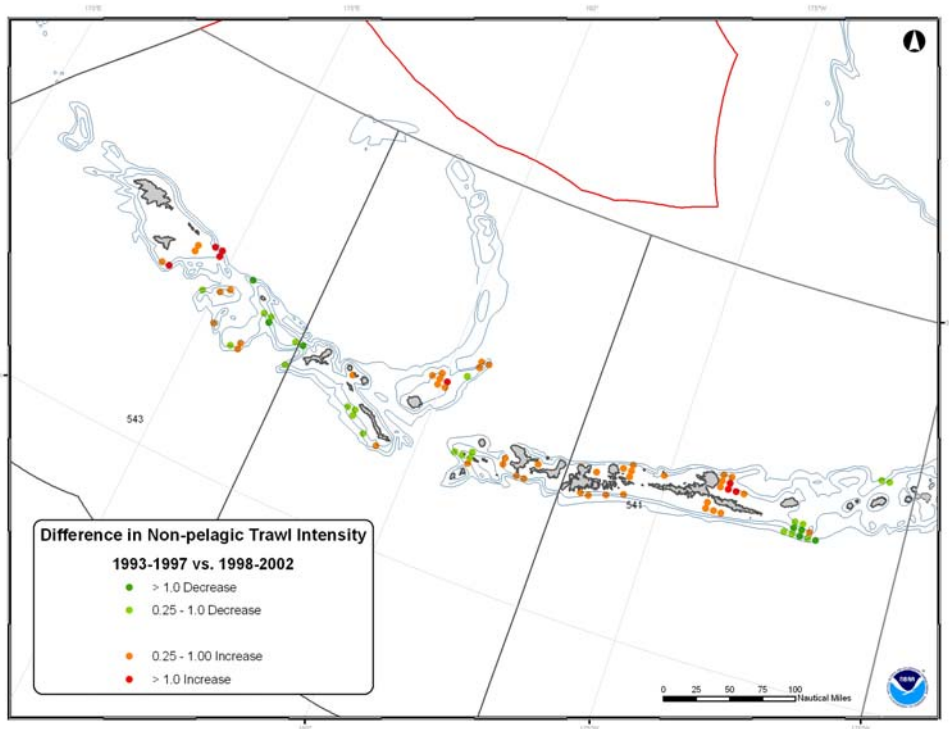
Color figure 10 Bering Sea pelagic trawl average annual fishing intensity over the five-year period 1993-1997



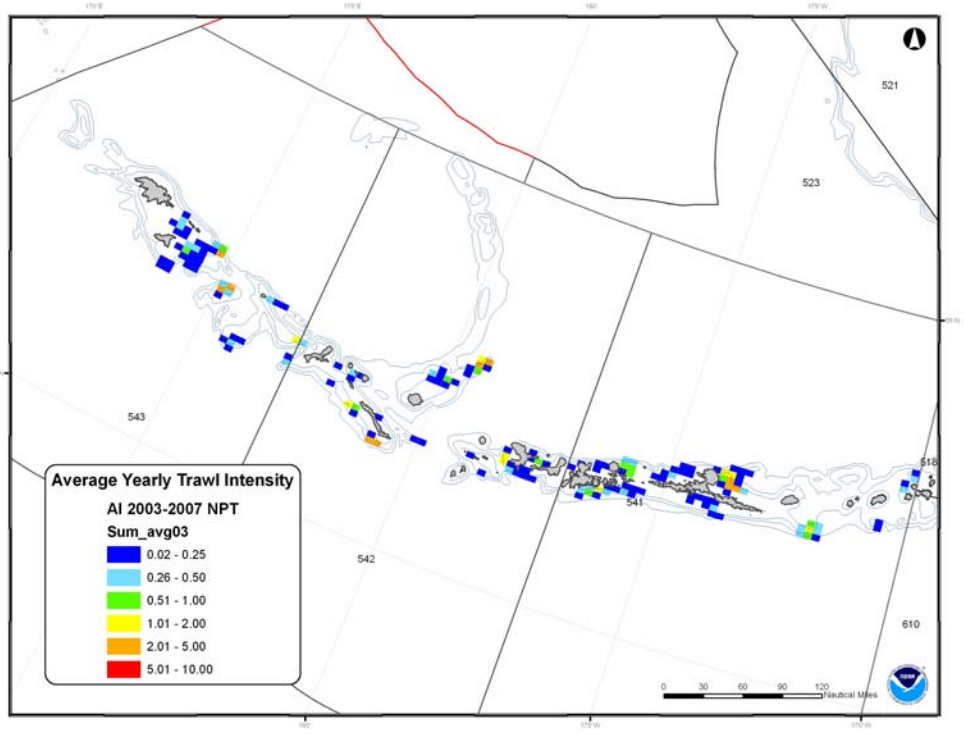
Color figure 11 **Difference in Aleutian Islands non-pelagic trawl intensity between the five-year period analyzed in the EFH EIS (1998-2002) and the recent period (2003-2007)**



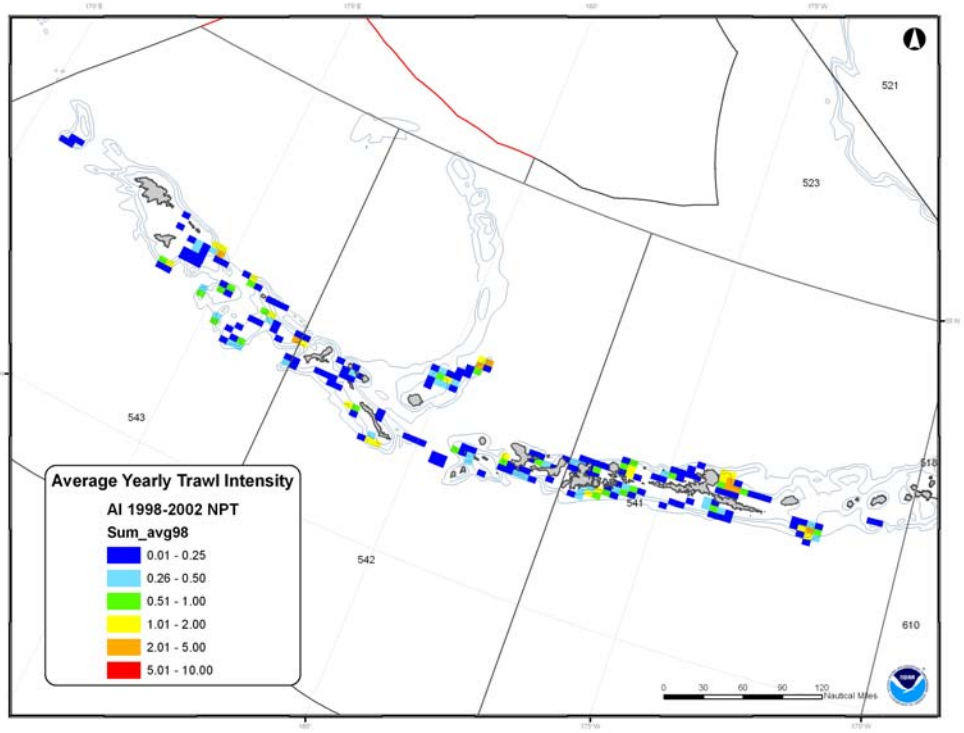
Color figure 12 **Difference in Aleutian Islands non-pelagic trawl intensity between the five-year period analyzed in the EFH EIS (1998-2002) and the previous period (1993-1997)**



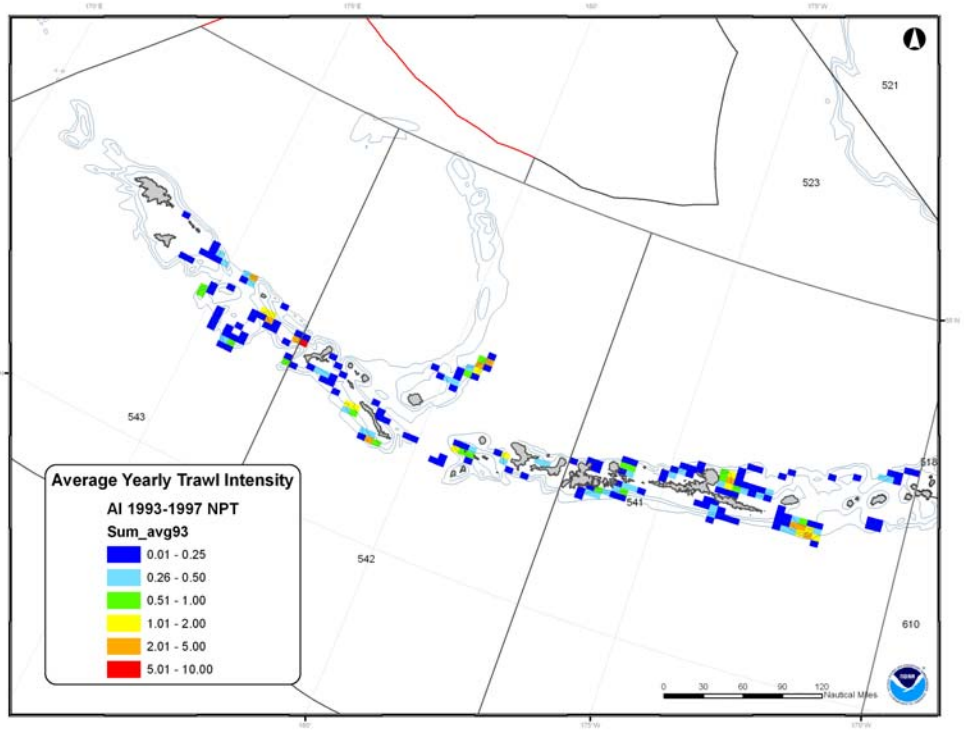
Color figure 13 **Aleutian Islands non-pelagic trawl average annual fishing intensity over the five-year period 2003-2007**



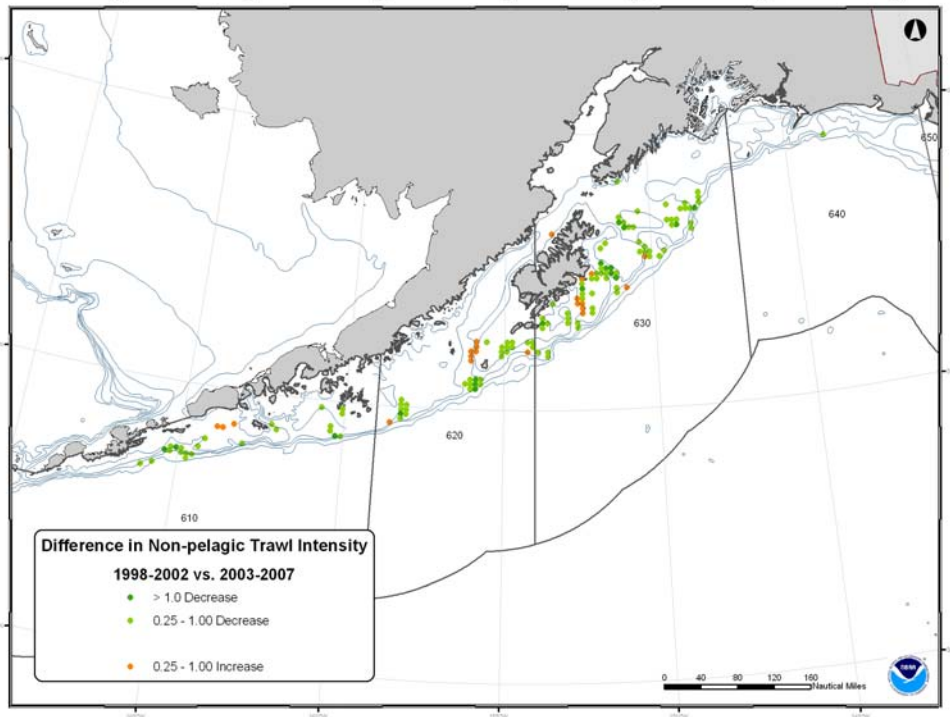
Color figure 14 **Aleutian Islands non-pelagic trawl average annual fishing intensity over the five-year period 1998-2002**



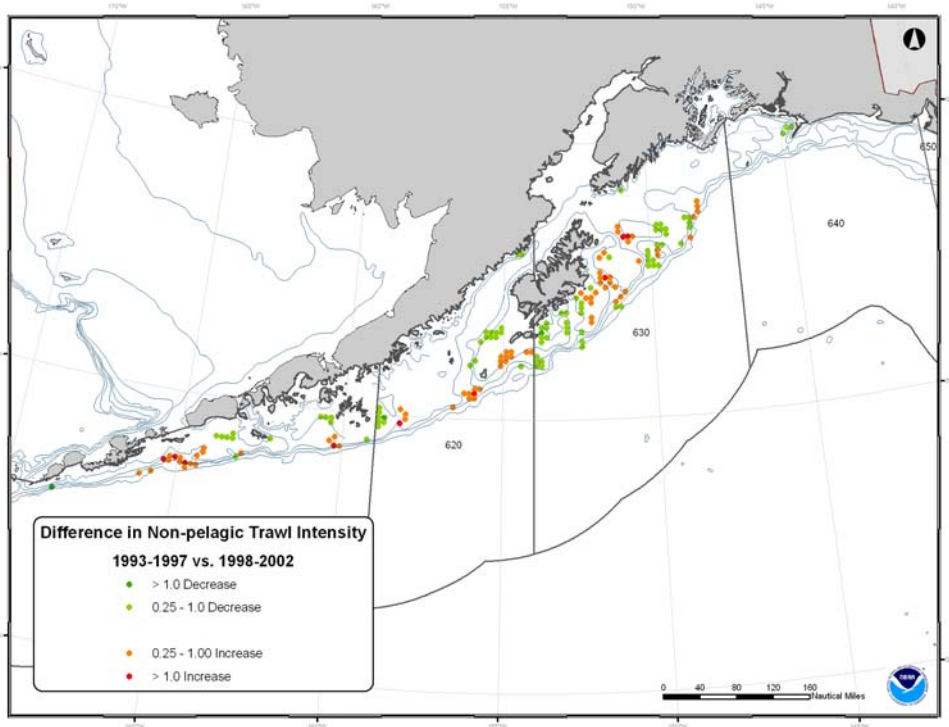
Color figure 15 Aleutian Islands non-pelagic trawl average annual fishing intensity over the five-year period 1993-1997



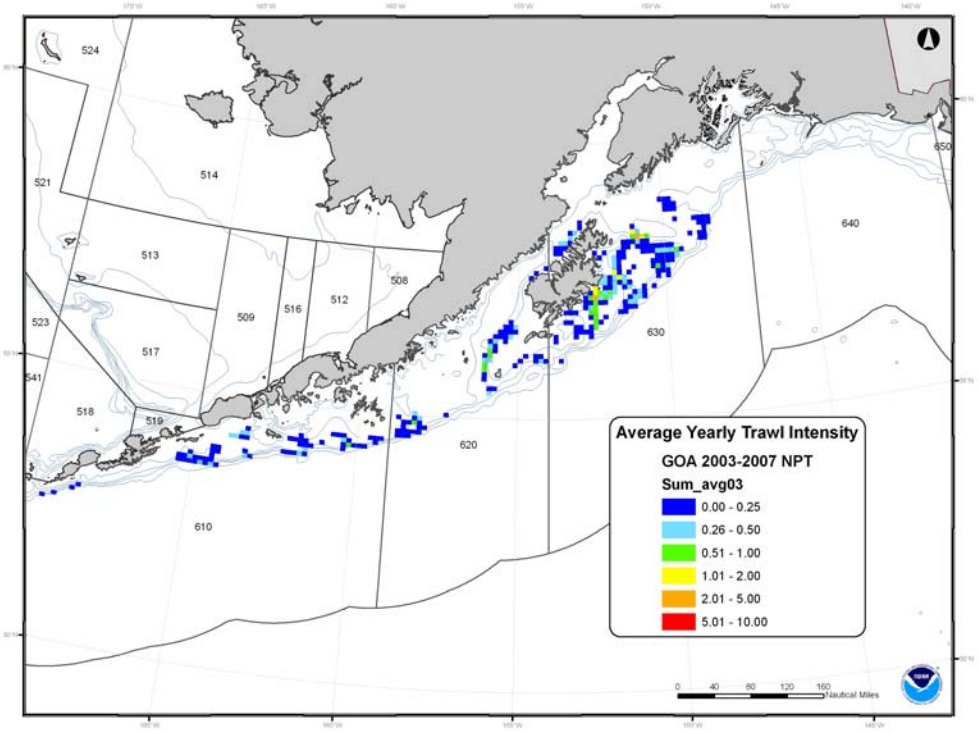
Color figure 16 **Difference in Gulf of Alaska non-pelagic trawl intensity between the five-year period analyzed in the EFH EIS (1998-2002) and the recent period (2003-2007)**



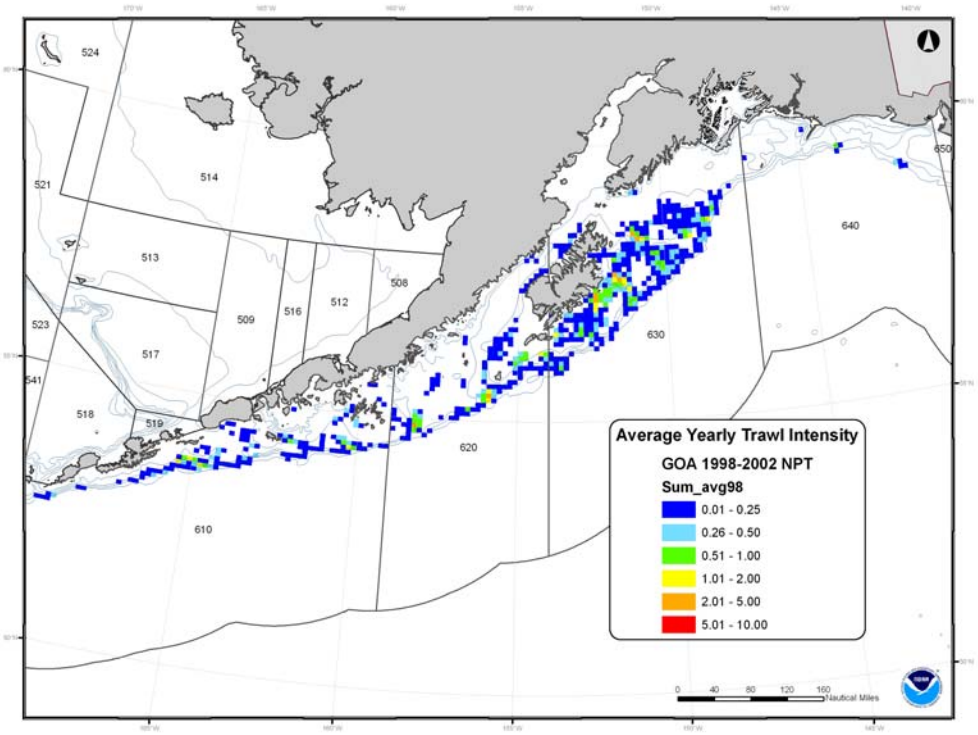
Color figure 17 **Difference in Gulf of Alaska non-pelagic trawl intensity between the five-year period analyzed in the EFH EIS (1998-2002) and the previous period (1993-1997)**



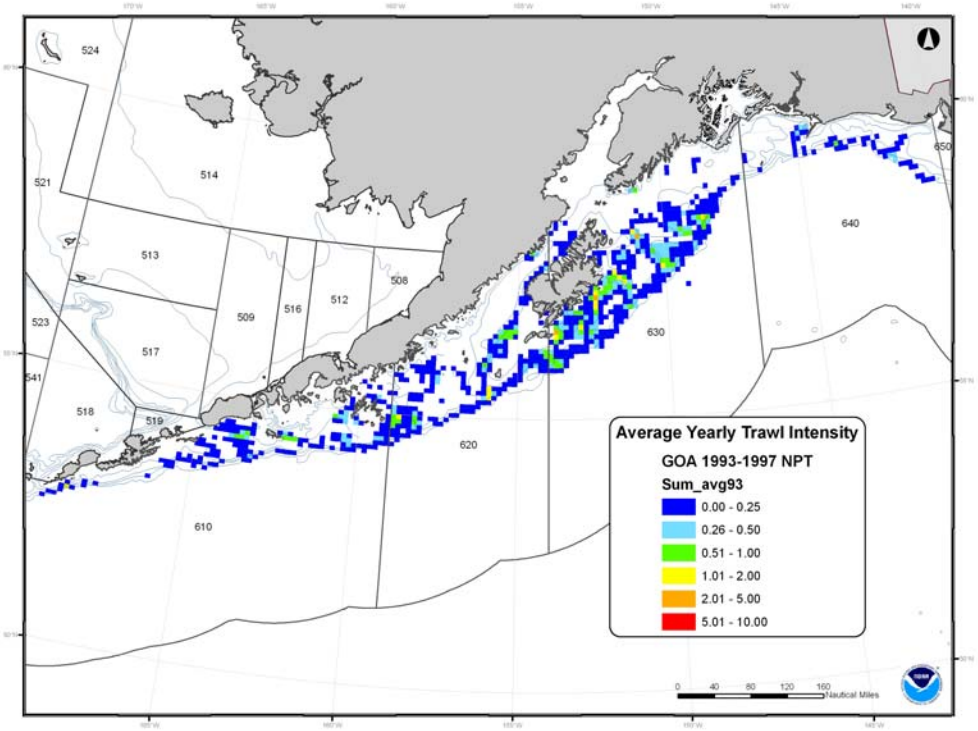
Color figure 18 **Gulf of Alaska non-pelagic trawl average annual fishing intensity over the five-year period 2003-2007**



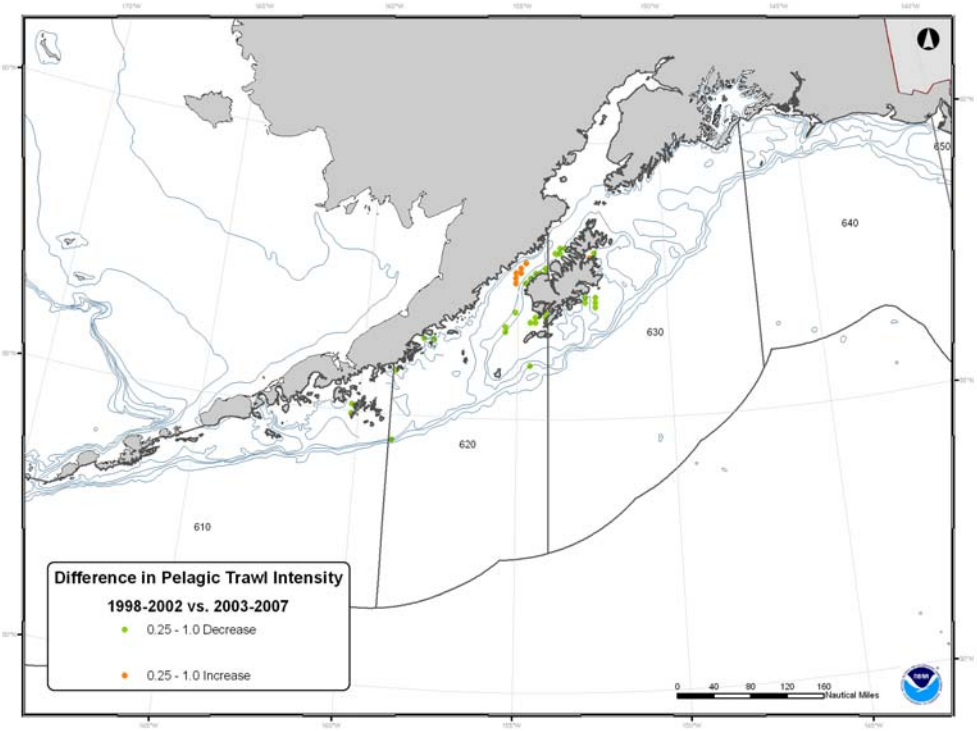
Color figure 19 **Gulf of Alaska non-pelagic trawl average annual fishing intensity over the five-year period 1998-2002**



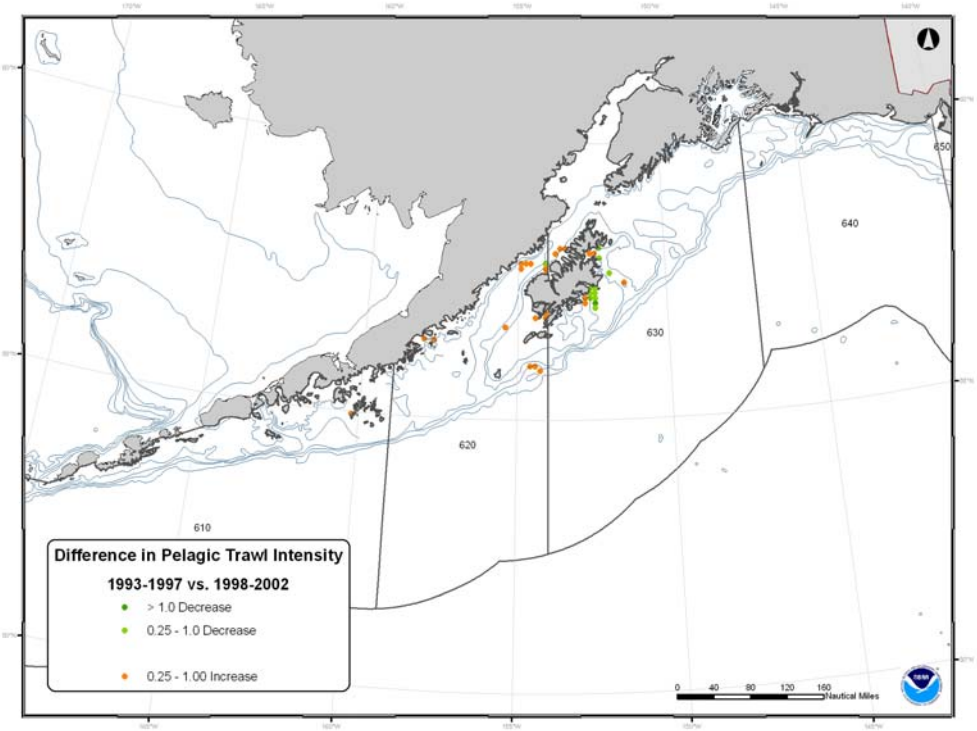
Color figure 20 Gulf of Alaska non-pelagic trawl average annual fishing intensity over the five-year period 1993-1997



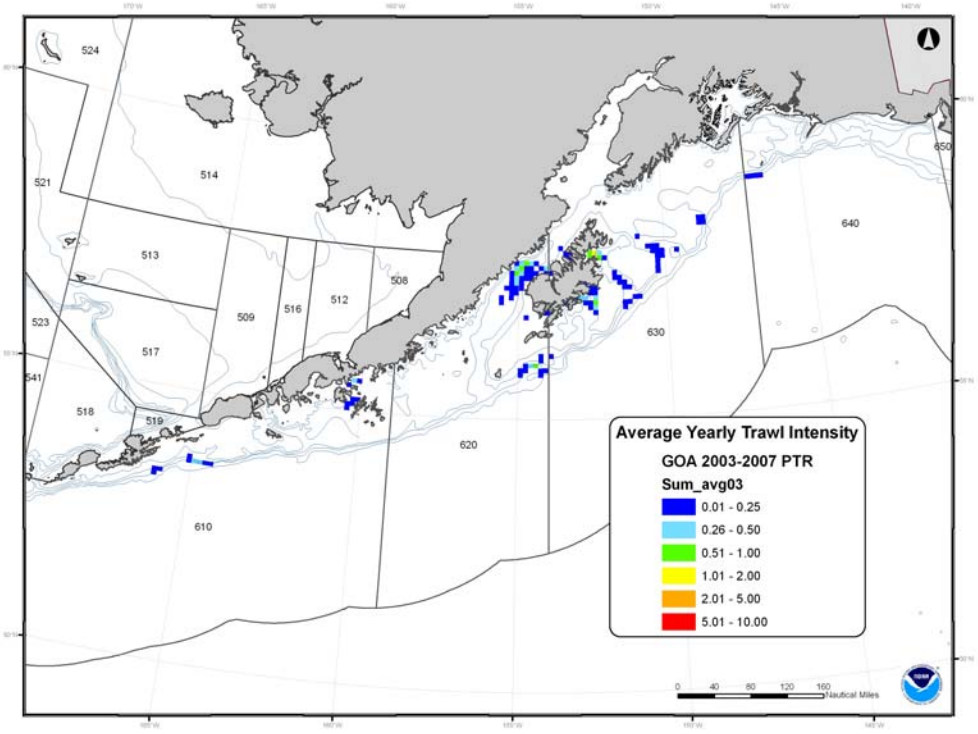
Color figure 21 **Difference in Gulf of Alaska pelagic trawl intensity between the five-year period analyzed in the EFH EIS (1998-2002) and the more recent period (2003-2007)**



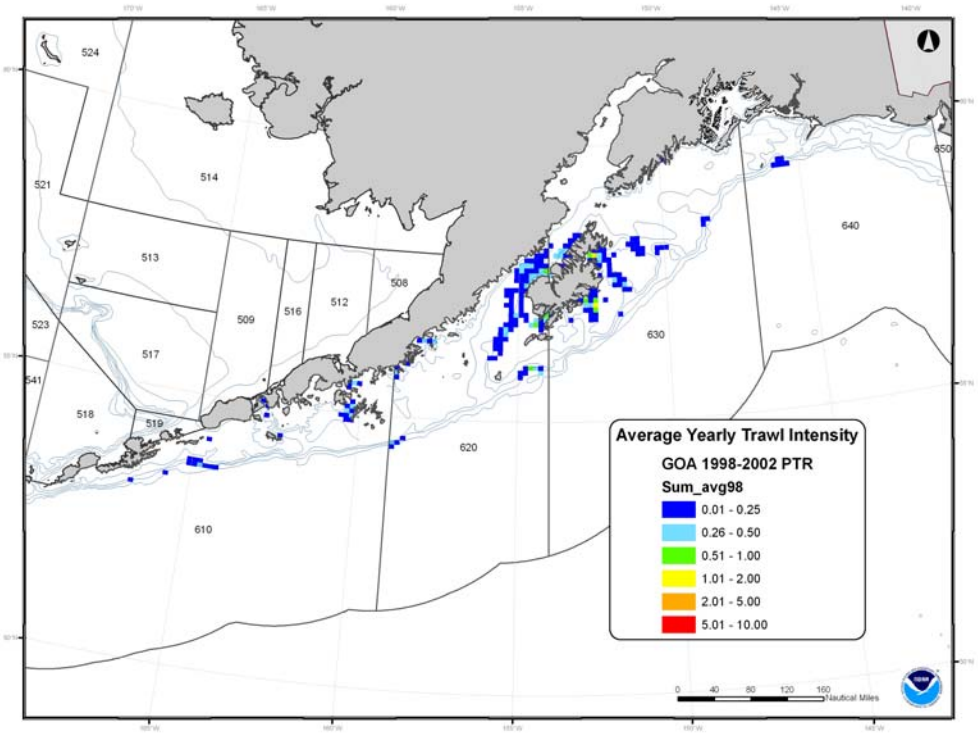
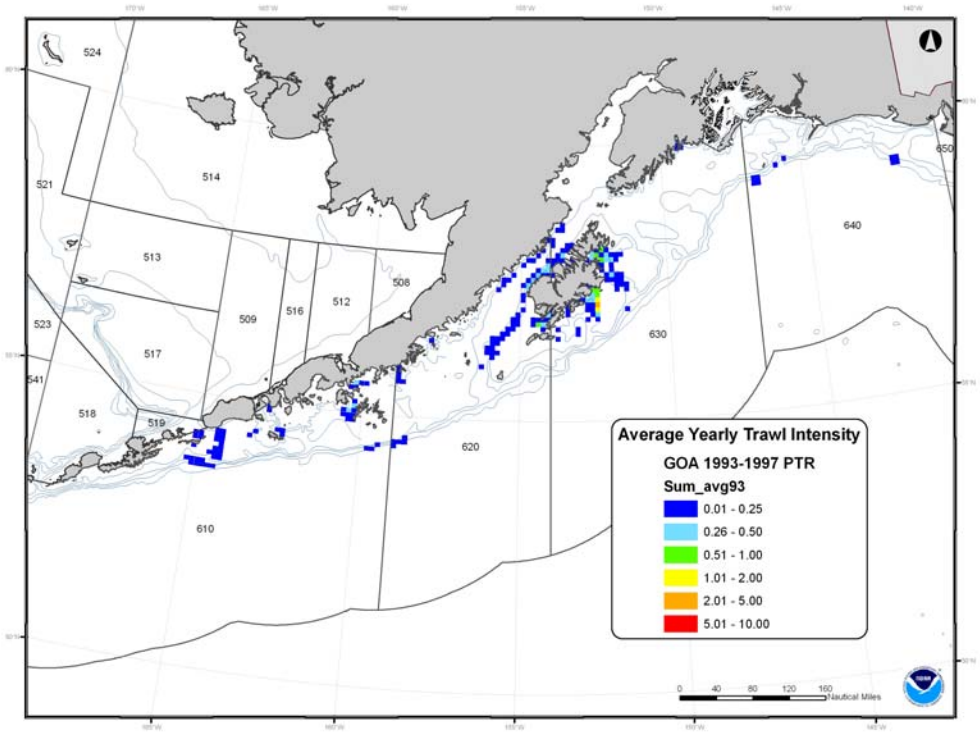
Color figure 22 **Difference in Gulf of Alaska pelagic trawl intensity between the five-year period analyzed in the EFH EIS (1998-2002) and the previous period (1993-1997)**



Color figure 23 **Gulf of Alaska pelagic trawl average annual fishing intensity over the five-year period 2003-2007**



Color figure 24 **Gulf of Alaska pelagic trawl average annual fishing intensity over the five-year period 1998-2002**



Color figure 25 Gulf of Alaska pelagic trawl average annual fishing intensity over the five-year period 1993-1997