MEMORANDUM

TO: Council, SSC and AP Members

FROM: Chris Oliver
Executive Director

DATE: April 8, 2002

SUBJECT: Essential Fish Habitat

ESTIMATED TIME
2 HOURS

ACTION REQUIRED

(a) Receive EFH committee report and summary of NMFS workshop.
(b) Review recommendation from Council/BOF Protocol Committee.

BACKGROUND

EFH committee report and summary of NMFS workshop

The Council appointed an EFH Committee in May 2001, to work with NMFS and Council staff to develop alternatives for EFH & HAPC designation, and alternatives to minimize adverse effects of fishing. The EFH Committee met on March 27 in conjunction with an EFH NMFS workshop March 25-26 at the Alaska Fisheries Science Center, Seattle. The purpose of the meeting was to review fishery descriptions, discuss potential adverse effects, discuss mitigation tools/applications, and receive a summary on the effects of fishing gear literature applicable to the Alaska region. Committee minutes, including the draft reports, are attached as Item C-8(a)(1). The Committee established workgroups to: 1) discuss the concept of rationalization as a tool for EFH mitigation, and 2) to develop a methodology to identify potential adverse effects. Reports from these workgroups will be made at the next Committee meeting.

At its next meeting May 15-17 in Sitka, the Committee will finalize fishery descriptions, receive reports from the workgroups, review detailed descriptions of EFH designation alternatives, and discuss potential HAPC sites and types.

Council/BOF Protocol Committee

The Council/BOF Protocol Committee is schedule to meet on April 17 to discuss interactions between EFH Development and MPA development. A report from the Committee could be reviewed by the Council at its June meeting.

DRAFT EFH Committee Minutes
AFSC Building 9 A/B
Seattle, WA March 27, 2002

Committee Members present: Linda Behnken (chair), Stosh Anderson (vice-chair), Heather McCarty, Scott Smiley, Ben Enticknap, Ted Meyers, John Gauvin, Gordon Blue, Earl Krygier, Glenn Reed.

Agency staff present: Cathy Coon (NPFMC), David Witherell (NPFMC), Cindy Hartmann (NMFC-HCD), John Lepore (NOAA-GC), Matthew Eagleton (NMFS-HCD), John Olson, Nina Mollett (NMFS-SF), Denby Lloyd (ADF&G), Chris Rooper (NMFS), Craig Rose (NMFS), Jack Turnock (NMFS), Tim Lohrer (IPHC).

Public Comment: Thorn Smith, Julie Bonney, Susan Robinson, Brent Payne, Joe Childers, Paul MacGregor.

The EFH Committee met on March 27 in Seattle. This meeting followed the EFH workshop held on March 25-26th in Seattle to complete fishery descriptions pertaining to the analysis on the EFH EIS, to review the criteria for minimal and temporary, and to discuss tools for mitigation. The next committee meeting will be May 15-17 in Sitka. The intent of the next meeting will be to finalize fishery descriptions, receive reports from the workgroups, review detailed descriptions of EFH designation alternatives, and discuss potential HAPC sites and types

The chair introduced new member Ted Meyers who is the NMFS- Habitat Conservation Division director.

The agenda was slightly modified to best utilize the time and to allow for a fuller discussion on mitigation tools and criteria for minimal and temporary, as well as planning for the May meeting.

Draft Fishery Descriptions:

Fishery Descriptions were compiled from the workshop break out groups on March 26, 2002. In lieu of reviewing a draft document the committee agreed to have staff polish the document and have the information made publicly available on the web on April 3. Worksheets from the workshop will need to be completed by April 15th 2002 for the final draft.

Discussion on Minimal and Temporary:

The committee discussed the criteria for minimal and temporary included in the EFH Final Rule. John Heifetz, NMFS, took a first cut and provided his suggested interpretation from a scientific standpoint of what was meant in the regulations, and how it would apply to the Alaska region.

Discussion for the 'temporary' concept detailed the concept of recovery. If recovery can occur before the next fishing season effects would be considered temporary. The committee was concerned over the temporal concept of 'temporary'- is it intended to be on an annual basis, a seasonal one (i.e. pollock {A,B,C,D} seasons), or a longer time frame? The difficulty with the 'minimal' concept is that all activities may have some sort of measurable effect (either great or small). If any imprint would be an effect, then all fisheries would fail the minimal test. Specific questions arose in defining the environment effected: Is it a discrete location as in a HAPC, or a more broad EFH area? Do we take into account intensity of the fisheries?

A discussion also ensued that it is difficult to start the process of evaluating fishing effects given the fact we don't have designations set. David Witherell presented his matrix idea to analyze this information with the updated status quo alternative. It ranked all the substrates and fisheries on temporary and minimal axises. He indicated that this would allow managers a conceptual way to understand different effects of different fisheries. It would also be useful for evaluating cumulative impacts on different substrates.

The committee liked the matrix concept but wanted additional details and changes. Dave noted that we will need to have a methodology to present to the Council (SSC review) for the June meeting to begin our full effects analysis this summer. The committee agreed that a standardized methodology would be ideal since we have limited data on the effects of fixed gear on habitats. The methodology would require some professional judgement in scoring. Committee members were concerned about the process being subjective. Relying on professional judgement alone has a lot of subjectivity on scale factors in determining impacts, since we can't compare scales between gear. Committee members suggested modifying the temporary effects with a factor that accounts for the probability of a location within a box being revisited prior to fish habitat recovery. The chair appointed a workgroup of David Witherell, Jack Tagart, Scott Smiley, Linda Behnken to discuss the subject in fuller detail and report back to the committee in May.

The committee asked for input from Jon Kurland EFH national coordinator on the Alaska regions progress. Kurland discussed the reason for ambiguity, stressing the fact that regions need to have these types of discussion for each fishery. NMFS HQ is not planning on providing on any more guidance.

The committee expressed concern that without additional National guidance we may potentially encounter legal difficulties if the other regions take a different course of action. Ted Meyers indicated that there is going to be a national EFH workshop end of April that Council staff and agency staff will attend. The intent of the National workshop is to address EFH EIS issues, and provide a forum for each region to present and discuss it's methodology and difficulties in the EFH analysis.

Mitigation Tools:

In addition to those tools outlined by Dr. Jeff Fujioka in Monday's presentation the chair asked if there were additional items or tools to be considered. The chair asked Council staff for a review of materials that are due for the Council at the October 2002 meeting. David Witherell noted that in October the Council may select a preliminary preferred alternative for EFH designation, a process and set of HAPC sites and types, and review mitigation alternatives. Discussion occurred on whether the selection of a preliminary preferred alternative would limit full range of all alternatives for the entire EIS, and not comply with NEPA standards. Staff indicated that it would not limit the full EIS analysis but provide working fodder for the effects analysis being carried out this fall.

The committee noted one of the areas missed in the agencies tools for mitigation white paper was the concept of rationalization as a way of reducing the fishing intensity, reducing bycatch, less loss of gear, overall combined to create less impacts to habitat. The committee created a workgroup to report on the concept of rationalization as a mitigation tool to be reviewed at the May committee meeting. Members of the work group are: Heather McCarty, John Gauvin, Gordon Blue, and Linda Behnken.

The committee also discussed the concept of restricted open areas, where specific fishing is restricted to specified areas. In essence this reserves areas that have been historically fished with high CPUE and removes the possibility of displacement of effort into more sensitive habitat. David Witherell noted that the rationale of this concept was developed within the DPSEIS for the flatfish trawl fisheries where the high

CPUE is taken in the shortest amount of trawl time (and hence least benthic impacts) possible. Scott Smiley noted that the problem with open areas is that fish may move out of the area designated.

The group addressed the concept of an adaptative management approach, to test the feasability of the mitigation tools under real conditions, and have the ability to change management measures which are not effective. Ben Enticknap wanted to note that research closures are a valuable tool but these areas need a certain amount of recovery time and not open an area that has been closed to fishing. Staff advised the group to create motions to depict their intent.

The committee discussed the need for having the full EFH designation alternatives and the full fishery descriptions to review in April prior to the May meeting. Mitigation tools will be evaluated with the completed fishery descriptions between now and the end of August. Preliminary mitigation alternatives may be discussed during the May committee meeting and finalized at the September meeting. Specific HAPC sites need to be discussed fully prior to September.

Motions:

1. Linda Behnken motioned: The EFH committee recommends to Council to urge the analysts to use to the extent possible all available data (reference to sablefish logbooks, state data), and make the process and assumptions for analyzing the effects as transparent as possible.

Motion carries

2. Linda Behnken motioned: Establish a small workgroup to more fully flesh out the minimal and temporary grid/ matrix and assumptions generating the factors. Scott Smiley, Jon Heifetz, Craig Rose, David Witherell, and Jack Tagart were appointed to the workgroup. Cindy Hartmann volunteered to have NMFS-HCD representation.

Motion carries

3. Scott Smiley motioned: In regards to adaptive management, the EFH committee requests that the Council endorse the view of the EFH committee that where applicable, mitigation measures be viewed as tentative until experimental analysis validates their effectiveness, i.e. adaptive management be an integral component of enacting these measures with experimental designs to account for long and short term changes.

Motion carries

4. Scott Smiley motioned: The EFH committee recommends that the Council write letters to North Pacific Research Board, PCCC and NMFS endorsing adaptive management research as a funding priority, asking them to consider incorporating such studies relevant to their research objective.

Motion carries

5. Linda Behnken motioned: The EFH committee recommends that the Council write letters to North Pacific Research Board, PCCC and NMFS emphasizing EFH as a pressing fishing management issues, in particular prioritize habitat mapping and substrate classification as well as gear impact analysis.
The following are areas importance for gear impact analysis:

1- Pelagic gear effects on habitat
2- Follow up on the coral trawl study in Southeast
3- Encourage the current proposed assessment on the longline fishery (Heifetz- ABL)
4- Encourage an assessment on the pot fishery for habitat information

Motion passes (John Gauvin abstains due to NPRB affiliation)

The committee also requests that a workgroup of Heather McCarty, John Gauvin, Gordon Blue, and Linda Behnken (with information from others) prepare a discussion paper for the May committee meeting on the issues of rationalization reducing the effects of fisheries on habitat.

The committee also requests NOAA- GC (John Lepore) prepare a discussion paper for the May committee meeting on the definition of 'to the extent practicable' for use in the upcoming analysis.

<u>May 15th-17th meeting in Sitka :</u>

The committee examined the amount of work necessary to complete during the May EFH committee meeting and determined that a 2 ½ working day time slot was needed to complete the tasks. Agenda items will include:

1) Workgroup to report on minimal and temporary methodology for the effects matrix.
2) Written discussion paper from workgroup on the effects of rationalization on habitat
3) "Extent practicable" review - John Lepore
4) Review EFH alternatives
5) HAPC sites- preliminary designation
6) Finalize Fishery Descriptions

Proposed Agenda
EFH Workshop and EFH Committee Meeting
March 25-27th
in Building 9 at the NOAA Western Regional Center
7600 Sand Point Way, Seattle, Washington

March 18 Scientist's and staff reports sent to committee members and others, including the scientists who were recommended by committee members to review the documents. The following reports will be made available:

- Criteria on what is a minimal and what is a temporary impact on EFH.
- Review of the scientific studies on gear for information applicable to Alaska fisheries and habitats.
- Discussion of set of tools for mitigating adverse impacts and to what situations they apply.
- Description of fisheries.

March 25 (1- 5 pm) Dr.'s Jon Heifetz and Craig Rose will lead discussion and Q&A

Receive overview of reports from scientists on : criteria for a Minimal and Temporary impact: review of scientific studies on gear impacts pertinent to Alaska fisheries, and initial discussion of mitigation tools and to what situations they apply.

March 26 (8am-5pm)

Break out into 4 Workgroups - Crab and Scallops, BSAI Groundfish, GOA Groundfish, Salmon (and sub workgroups if necessary).

The Primary task of break out groups is to Revise Fishery Descriptions
If time allows secondary tasks include:

1. Discuss Potential Adverse Effects of their specific fisheries and
2. Discuss mitigation tools and their application to their fisheries

March 27 (8am-5pm)
EFH Committee meets to:

1. Review fishery descriptions
2. Discuss potential mitigation tools from each subgroup and any other group products.
3. Develop Committee recommendations for the April Council meeting.
4. Plan for future Committee tasks and meetings.

Essential Fish Habitat (EFH) Workshop & EFH Committee Meeting
March 25 - 27, 2002

Attendees:

North Pacific Fisheries Management Council (NPFMC)
Chris Oliver, Executive Director
David Witherell, BSAI Plan Coordinator
Cathy Coon, Analyst

National Marine Fisheries Service (NMFS)

NMFS, Habitat Conservation
Ted Meyers, Assistant Regional Administrator, HCD, Juneau
Cindy Hartmann, EFH Coordinator, HCD, Juneau
Susan Walker, HCD, Juneau
Matthew Eagelton, HCD, Anchorage
John Olson, HCD, Anchorage
Jon Kurland, OHC, Silver Spring, MD

NMFS, Sustainable Fisheries (SF)
Nina Mollett, SF, Juneau

NMFS, Alaska Fisheries Science Center (AFSC)
Dr. Jon Heifetz, AFSC, ABL, Juneau (Monday only)
Dr. Jeff Fujioka, AFSC, ABL Juneau (Monday and Tuesday)
Dr. Craig Rose, AFSC, RACE, Seattle (2 ½ days)
Dr. Robert McConnaughey, AFSC, RACE, Seattle
Dr. Chris Rooper, AFSC, RACE, Seattle
Dr. Gary Stauffer, AFSC, Director RACE Division, Seattle
Dr. Robert Otto, AFSC, RACE, Kodiak Lab Director (2 ½ days)
Dr. Pat Livingston, AFSC, REFM, Seattle
Rebecca Reuter - AFSC, REFM, Seattle
Jack Turnock, AFSC, REFM, Seattle
Paul Spencer, AFSC, REFM, Seattle
Dr. Doug DeMaster, Director AFSC
Dr. Jim Coe, Deputy Director, AFSC

Other NMFS Scientists
Mary Yoklavich - NMFS Santa Cruz Lab
Waldo Wakefield

NMFS, Northwest Region
Steve Copps (attending Monday afternoon only)
Lisa Wooninck (Monday afternoon only)
Jerry Norton (attending Monday afternoon only) jnorton@upwell.pfeg.noaa.gov
Jim Glock - Portland

National Oceanic and Atmospheric Administration (NOAA)
General Counsel (GC)
John Lepore

United States Coast Guard (USCG)
Phil Thorne 907 463-2057 pthorne@cgalaska.uscg.mil

International Pacific Halibut Commission (IPHC)
Dr. Tim Loher Tim@iphc.washington.edu, crab/scallop work group

Pacific States Marine Fish Commission (PSMFC)
Fran Recht

Alaska Department of Fish and Game (ADF&G)
Earl Krygier, Extended Jurisdiction
Denby Loyd, Western Region Supervisor

Washington Department of Fish and Wildlife
Jack Tagart

Others Scientists:
Les Watling, Professor of Oceanography and Pew Fellow in Marine Conservation, Darling Marine Center, University of Maine, Walpole, ME 04573
(207) 563-3146 x 248, FAX (207) 563-3119 watling@maine.edu

Foster Wheeler Environmental Corporation (FWEC)
Dr. Ellen Hall, NEPA Coordinator and Economics/Socioeconomics Task Lead
Alan Olson, Fisheries Task Leader
Judy Brown - Tuesday only
Don Bergquist - Tuesday only
Shana Avila - Tuesday only
Jennifer O'Neal - Tuesday only

Natural Resources Consultants, Inc. (NRC)
Dr. Gregory Ruggerone - Monday and Tuesday
Jeff June - Monday and Tuesday
Dr. Lee Alverson - Monday

NPFMC, EFH Committee
Linda Behnken, Chair EFH Committee
Stosh Anderson, Vice-chair EFH Committee
Gordon Blue
Ben Enticknap
John Gauvin
Earl Krygier, ADF&G
Heather McCarty
Ted Meyers, NMFS, HCD
Glenn Reed
Scott Smiley

Public

Dave Benson - Trident Seafoods
Julie Bonney
Joe Childers
Craig Cochran
Craig Cross - Aleutian Spray Fisheries
Matt Doherty
John Gruver
Karl Haflinger
Alan Bing Henkel
Doug Hoedel
Eric Hollis - FCA
Don Iverson
Jan Jacobs
Kirsten Stahl Johnson
Mark Kandianis
Teressa Kandianis
Terry Leitzell
Paul MacGregor
Tom Minio - scallop skipper
Lance Morgan
Elias Olafson
Dave Olney
Brent Paine, United Catcher Boats
Steve Patterson
Richard Powell
Susan Robinson - Fishermen's Finest, Inc
Dick Schleitweiler - Lummi Trawl
Thorn Smith - Executive Director North Pacific Longline Association
Jay Stinson
Ken Stump
Lori Swanson - Ground Fish Forum (GFF)
Ken Tippett - Alaska Boat Co.
Arni Tomson
Phil Thorne

DRAFT

Fishery Descriptions of Principal Federal FMP Fisheries

for the analysis of

Essential Fish Habitat

April 2, 2002

Prepared by the EFH Committee

North Pacific Fishery Management Council
605 West 4th Ave, Suite 306
Anchorage, AK 99516

Sources of Information

Fishery and gear descriptions contained in this document were based on information graciously provided to the EFH Committee by numerous fisheries representatives and fishermen, as well as published sources, information provided in public testimony at Council meetings over the years, discussions at other EFH Committee meetings, unpublished information from Craig Rose (NMFS), Herman Savikko and other ADF&G staff.

Bibliography

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Fritz, L. W., Greig, A., and Reuter, R. F. 1998. Catch-per-unit-effort, length, and depth distributions of major groundfish and bycatch species in the Bering Sea, Aleutian Islands, and Gulf of Alaska regions based on groundfish fishery observer data. NOAA Technical Memorandum NMFS-AFSC-88. 179p.

Hiatt, T., R. Felthoven, and J. Terry. 2001. Economic Status of the Groundfish Fisheries off Alaska, 2000. NOAA-NMFS Seattle, WA. 97p.

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NPFMC (North Pacific Fishery Management Council). 2001. Stock Assessment and Fishery Evaluation Report for BSAI King and Tanner Crab Fisheries. North Pacific Fishery Management Council, Anchorage.

Turk, T. 2000. Distribution, Abundance, and Spatial Management of the Weathervane Scallop Fishery in Alaska. Masters Thesis, University of Washington. 231p.

Acronyms

AI	= Aleutian Islands
BSAI	= Bering Sea and Aleutian Islands
f	= fathom (equal to 6 feet)
ft	= feet (equal to 12 inches)
FMP	= fishery management plan
GOA	= Gulf of Alaska
IFQ	= individual fishing quota
LOA	= length overall
m	= meter (equal to 3.281 feet)

Alaska Scallop FMP
Alaska Weathervane Scallop Fishery ... 1

Bering Sea/Aleutian Islands King and Tanner Crab FMP
Bristol Bay Red King Crab Fishery ... 3
Norton Sound Red King Crab Fishery ... 5
Pribilof Islands Red and Blue King Crab Fishery ... 6
Saint Matthew Blue King Crab Fishery ... 6
Aleutian Islands Red King Crab Fishery ... 7
Aleutian Islands Golden King Crab Fishery ... 7
Aleutian Islands Tanner Crab Fishery ... 8
Bering Sea Tanner Crab Fishery ... 8
Bering Sea Snow Crab Fishery ... 9

Alaska Salmon FMP
Alaska Salmon Drift Gillnet Fishery ... 10
Alaska Salmon Set Gill Net Fishery ... 10
Alaska Salmon Seine Fishery ... 11
Alaska Salmon Troll Fishery ... 12
Alaska Salmon Rod and Reel Fishery ... 12
Alaska Salmon Fish Wheel Fishery (Commercial and Subsistence) ... 13
Alaska Salmon Subsistence/Personal Use Fishery ... 13

Bering Sea/Aleutian Islands Groundfish FMP
Bering Sea Pollock Trawl Fishery ... 15
Aleutian Islands and Bogoslof Pollock Trawl Fishery ... 16
Bering Sea Pacific Cod Trawl Fishery ... 17
Bering Sea Rock Sole Trawl Fishery ... 18
Bering Sea Yellowfin Sole Trawl Fishery ... 19
Bering Sea Flathead Sole/Other Flatfish Trawl Fishery ... 20
Aleutian Islands POP and Northern Rockfish Trawl Fishery ... 21
Aleutian Islands Atka Mackerel Trawl Fishery ... 22
BSAI Pacific Cod Longline Fishery ... 23
BSAI Sablefish/Tubot Longline Fishery ... 24
Bering Sea Pacific Cod Jig Fishery ... 25
BSAI Pacific Cod Pot Fishery ... 26

Gulf of Alaska Groundfish FMP
GOA Pollock Trawl Fishery ... 27
GOA Pacific Cod Trawl Fishery ... 28
GOA Deepwater Flatfish Trawl Fishery ... 29
GOA Shallow Water Flatfish Trawl Fishery ... 31
GOA Slope Rockfish Trawl Fishery ... 32
GOA Sablefish Longline Fishery ... 34
GOA Southeast Demersal Shelf Rockfish Longline Fishery ... 35
GOA Pacific Cod Longline Fishery ... 35
GOA Cod Jig Fishery ... 36
GOA Pacific Cod Pot Fishery ... 37

Alaska Weathervane Scallop Fishery

Description of gear used: This fishery is prosecuted with dredges. A total of 9 vessels is allowed to participate in this fishery, with access limited by a license limitation program. In 2000 there were 5 vessels using two 15-foot dredges and 2 vessels using smaller gear. Vessels used in the fishery range in size from 60 to 124 ft LOA. Maximum horsepower is 800. Vessels fishing outside Cook Inlet are limited by regulations to a maximum of two dredges with a maximum width of 15 feet. The 15-foot dredges weigh 2,400 pounds dry weight each, consisting of a frame and a bag. The 1,900-pound frame rests on two 4" by 9" shoes. The bags weigh 500 pounds each. The shoes are changed every 4 to 5 days because they bear most of the weight. In Cook Inlet, only one dredge with a maximum width of 6' can be used. Dredges are of a standard 'New Bedford' design, with the steel dredge shoe and 4" diameter steel rings contacting the bottom during fishing. The tops of the bags are constructed of 6" stretched mesh polypropylene netting. Each dredge is attached by single steel wire cable that is operated from a deck winch.

In the past, rubber chafing gear was used to protect the links connecting rings; however, chafing gear is not used at this time. The rate of the wear on the bag depends on the bottom type that is being fished. For example, in Yakutat the bottom is more sandy and abrasive to the gear, whereas in Shelikof Strait it is a soft, muddy, less abrasive bottom. Not using chafing gear creates more wear and requires more time and effort to replace links. For example, if link wear required 1,500 pounds of replacement links with chafing gear, the link wear associated with the same amount of fishing time without chafing gear would require 3,700 pounds of replacement links, at $1.50 per pound. There are about 30 links per pound and it requires significant extra crew time to change the links. This represents less time fishing and more time repairing the gear. This extra effort is necessitated by reduced efficiency of the worn bag, causing increased effort for the area. This equals about 68,000 links per vessel, each one hand squeezed. The impression of the scallop fishermen is that the rubber chafing gear is less impactive on the bottom.

Description of fishery operations: Scallop fishing operations involve the following steps: 1) dredge setting, 2) towing for about 45 minutes on bottom at 4.3 to 4.8 knots, 3) dredge retrieval , 4) dumping the catch on deck, 5) sorting out the scallops to be retained, d 6) discarding debris, small scallops and other bycatch, and 7) repairing gear as needed . The gear is then reset or the boat moves to a different area. Retained scallops are shucked by a hand-held knife, with the adductor muscle retained and the shells and remaining tissues discarded overboard as the scallops are shucked. The yield of shucked meats is approximately 10 to 11 percent. The discarded shell serves as substrate for settling scallop spat and other marine organisms.

Habitat type where fishery occurs: Weathervane scallops occur in discrete beds in areas 60-140 m (average of about 90 m) deep over predominantly clayey silt and sandy bottoms, but are also found in areas with gravelly sand and silty sand (Turk 2000). Bottom type and depth depends on the area fished. For example, in the Bering Sea, the fishery occurs at depths of 100-120 m, but occurs at 60-85 m near Kayak Island in the eastern GOA. The fishery occurs from the panhandle out to the Aleutian Islands and the Bering Sea, with the area fished each year equaling approximately 200 nautical square miles over the entire state. Scallop fishermen tend to avoid rocky or hard bottoms in order to protect their gear. The ADF&G regional information report has not reported any corals taken as bycatch in the scallop fisheries (Barnhart and Rosenkranz, 1999. ADF&G Regional Information report #4K99-63, 1997-1998).

"Throughout their range, weathervane scallops are typically found in discrete elongated beds located in areas with high currents and moderate mixing." (Turk 2000).

Existing regulatory measures to mitigate effects of this fishery: Extensive areas in the North Pacific that support scallops are or were closed to scallop fishing to protect other resources. Scallop fishermen are restricted not only by trawl closure areas, but by additional areas that are closed specifically to scallop dredging. Shells are discarded as the scallops are shucked. Scallop shells that are discarded during the fishery serve as important substrate for settling scallop larvae as well as a wide variety of other invertebrates, including sponges, tunicates, and hydroids. The state regulations prohibit shell stocking and require that scallop shells be discarded at the time they are harvested, or where they are harvested, to serve as biological substrate. Soft body parts are used as food for a wide variety of organisms, including birds, fish and others.

Effort restrictions include both license limitations and the formation of cooperatives. The fishery has additional efficiency restrictions that include crew size restrictions, a ban on mechanical shucking, vessel length restrictions, gears size restrictions (including 4" ring size), limitation on dredge size (limit to 15 feet), bycatch limits (for crab bycatch caps see table [to be created]). These efficiency and effort restrictions spread the fishery in both time and area.

There are also time and area restrictions. From February 15 to July 1, scallop fishing is closed to protect molting crab in the Westward Region.

To minimize impacts, the scallop cooperative uses the Seastate reporting system, which allows real time identification and avoidance of hot spots for bycatch. Exploration of new areas is accomplished with a single dredge and limited towing time to minimize the risk of bycatch.

Bristol Bay Red King Crab Fishery

Description of gear used: This fishery is prosecuted with pots that typically measure 7 feet by 7 feet by 3 feet deep, set one pot per line. The total number of pots allowed for a given vessel is determined by a grid that includes vessel length and abundance of the stocks. Vessels participating in this fishery range from 60' to 180' long, with most being catcher vessels of medium size (80'-125' LOA). In 2000, 213 catcher vessels and 5 catcher-processors participated in the Bristol Bay red king crab fishery, and made a total of 98,694 pot lifts during a 15 day season.

Pots used in this fishery are constructed with a steel bar frame (1.25" diameter) and covered with tarred nylon mesh netting (minimum 3.5" stretched mesh). Pots are required to include escape rings or large mesh (10" stretched) to sort out sublegal size crab. Pots are also equipped with a biodegradable panel that will open at least 18 inches. Pot sizes range from 6' to 8' square, with the average vessel using 7'x7' pots.

Pots are constructed as follows: There is an outer frame consisting of "weight bars" on the bottom of the pot, typically 1½" diameter steel bar stock,; a top frame and sides, typically 1 1/8" steel bar stock, to provide the structure; and an inner frame of 5/8" "web bars" to support the mesh and separate it from the sides and bottom of the pot. Most of the initial contact with the bottom is borne by the weight bars. A rectangular "door" is hinged opposite the bridle, to allow easy unloading of catch. Each pot weighs from 500 to 700 pounds dry weight. Each pot has two tunnel openings, on opposite sides, typically 9 x 36 inches, with no dimension less than 5 inches and a perimeter of at least 36 inches.

The pot is attached with a bridle, generally constructed of 1" diameter floating polypropylene line. The bridle is attached to floats via a buoy line or warp that consists of a 30' to 60' surge line, constructed of heavy duty floating polypropylene and coils of line sufficient to reach the surface. The lower coils of line (33 fathom) are made of 3/4" floating polypropylene, and the upper coil of line is made of sinking line. The length of the floating line is not sufficient to reach the surface. The floating line keeps from fouling on the bottom and the sinking line avoids accidentally fouling in the vessel's propellers. Attached to the top coil is a plastic buoy ("bag"), with an auxiliary buoy attached on a tether (trailer) line. Pots are required to carry vessel identification by number and a state licensed serial tag on the buoy denoting the pot limit. These tags must be purchased for each season's fishery.

Description of fishery operations: Pots are baited with 1 to 2 gallons of chopped herring or other bait placed in hanging bait jars in the center of the pot. The bait jars are thoroughly riddled with small holes to provide water circulation , spreading a plume of scent down current from the pot. "Hanging bait", often consisting of whole Pacific cod, or other fish, is also put in the pot, when available. On most vessels, the pot is tipped into the sea with a pot launcher. The coils of line are thrown overboard, followed by the buoys, as the pot sinks to the bottom. The pot rests directly on the bottom. The pot remains stationary on the bottom until it is retrieved. In recent years, the fishery has lasted from 4 to 10 days. Vessels are capable of handling more gear in a day's time than allowed by current pot limits. This produces shorter "soak" times, generally about 10 to 20 hours, than had been practiced in the past.

Pots are retrieved as follows: the crewman throws a grappling hook between the buoys to get the line. The line is fed into an hydraulic hauler located on a davit, which is positioned over the starboard side of the vessel. The pot is brought to the surface and a hook is placed in the bridle. The pot and catch are then lifted aboard and placed on the pot launcher. Crabs are dumped into a sorting table or totes and are sorted. Only male king crab with 6½ inch or greater carapace width may be retained. All other crab is returned immediately to the sea. Careful handling is encouraged, and most vessels use a stream of water through a chute to carry the crab overboard with minimal loss or damage. Retained catch is placed in a hold that has circulating sea water, and is retained alive until delivery, to catcher vessels. Catcher processors process the catch and freeze it for later delivery. The pots are rebaited and reset, or are stored if they are being moved to a different area or it is the end of the season. In the highly competitive short seasons that are currently the rule, more gear is stacked and moved to different areas than is reset in the original location. This is a function of the short soak times.

The product form produced after processing is sections of legs, claws and body meat. The carapace, gills and viscera are removed and ground before discharge. Shore plants are required to have discharge permits in near shore areas, while at-sea processors disperse their discharge according to Marpol regulations.

Habitat type where fishery occurs: Red king crabs are mostly taken in areas consisting of sandy and silty bottoms at depths of 20 to 80 fathoms (120-480 ft.). This bottom is typically low relief, without marked features or steep slopes. Occasionally red king crab may be taken on shell hash, gravel, or cobble bottoms. They frequently feed on sand dollars, starfish, clams, scallops, and various marine worms in these areas.

Crabs in their first one to two years of life generally occur at depths of less than 25 fathoms on grounds characterized by cobble, rock, shell hash, and extensive epifaunal growth in the form of mussels, sponges, compound tunicates and hydroids. They may also be found in association with some species of sea stars and urchins. The commercial fishery tends to concentrate on mature stocks that have segregated themselves by size and sex. The fishery seasons generally avoid mating and molting periods, when males and females are found together.

Bristol Bay red king crab are considered a distinct genetic stock and are managed as a single unit. The area boundaries are established to accomplish this.

Existing regulatory measures to mitigate effects of this fishery:

Gear. Pots are the only legal gear type. Pots require biodegradable panels, to minimize "ghost fishing" by lost or derelict gear. Pots require escape rings and/or large mesh panels designed to permit the escape of non-target crabs. The number of pots a vessel can fish is limited by regulation to reduce accidental loss of gear, to produce efficiency controls on the fisheries, and to slow down the fishery for better management.

Fishing Seasons. The opening date and mandatory closure dates are established to avoid mating and molting periods. The season length is usually determined by quota because fisheries are closed when the quota is reached. Recently, this has occurred after fewer than 10 days of fishing. This has produced near year-round closure of these grounds to the directed fishery.

Limited Access. Beginning in 2000, the license limitation program has provided for a limit on the maximum number vessels allowed in the fishery. An analysis is currently being undertaken, aimed at further rationalization of the fishery.

Size and Sex Restrictions. A prohibition on the retention of female crabs is designed to maximize overall reproductive potential. Male size limits are set to ensure that males have at least one mating season before becoming vulnerable to the fishery. The legal size for mature males is 6½". In addition, the exploitation rate is set conservatively to assure that there are adequate males of various size classes available to meet reproductive needs.

Norton Sound Red King Crab Fishery

Description of gear used: This fishery is prosecuted with pots set on single lines. Both "square" pots similar to those of Bristol Bay, but generally no larger than 6' in largest dimension, and "conical" pots are used. Conical pots used in this fishery are constructed with a steel bar frame and covered with tarred nylon mesh netting (3.5" stretched mesh). Not all conical pots use an inner "web bar" frame. Conical pot sizes are generally 4' to 6' on the base diameter. These pots are built with a smaller diameter "top ring" and are designed to nest when stacked. Tunnels may be similar to the "square pots" or consist in a plastic collar approximately 18" in diameter and 10" high in the top of the pot. Pots may weigh from 70 to several hundred pounds. The pot is rigged with bridle and line similar to that described for the Bristol Bay red king crab fishery, although the depth fished is shallower, so the lines are shorter. Sometimes a "sash weight" is attached to the line to prevent flotation on the surface rather than using a nylon top coil.

The Norton Sound fishing fleet is unique from the other fisheries managed under the FMP. Due to the small pot limits and the super-exclusive registration area, almost all of the vessels that participate in the Norton Sound fishery are under 32 feet and are from the villages surrounding Norton Sound. The majority of the fleet is converted herring gillnet boats, many of which are skiffs that do not have wheel houses or even lights. The Norton Sound winter fishery uses snow machines instead of boats to harvest crab. Approximately 10 snow machines are permitted to harvest king crab commercially by fishing small pots through the ice. A substantial subsistence fishery in the winter also exists for Norton Sound red king crab.

Description of fishery operations: Pots are baited in a manner similar to that described for Bristol Bay, though hanging bait is less frequently used. On most vessels, the pot is set manually. The line is thrown overboard, followed by the buoys as the pot sinks to the bottom. The pot rests directly on the bottom. The pot remains stationary on the bottom until it is retrieved. Pots are retrieved with hydraulic haulers or by hand, and handled similarly to the method described for Bristol Bay.

Compared to the Bristol Bay red king crab fishery, the Norton Sound crab are held for much shorter time periods, if at all, in circulating seawater. The crab live in cold salt water on the ocean's bottom; the surface waters are frequently warmer and less saline. A fresh water lens of Yukon River water is a common feature of Norton Sound.

The near shore area in the vicinity of Nome is closed to commercial fishing in the summer time to avoid decreasing the number of crab available to the subsistence fishers.

Habitat type where fishery occurs: Norton Sound red king crabs are taken primarily in areas consisting of sandy and silty bottoms at depths of 25 fathoms or less.

Existing regulatory measures to mitigate effects of this fishery: In addition to the provisions described under Bristol Bay, the following apply: 1) The legal size for mature males is 4 ¾", reflecting the smaller size at maturity; 2) The fishery is managed as a "superexclusive" area. Vessels that fish in this fishery may fish in no other king crab fishery in the state. This provision protects this extremely small stock from excess fishing effort.3) The harvest strategy is developed to assure the priority of the subsistence fishery; and 4) Pot limits are more restrictive than Bristol Bay.

Pribilof Islands Red and Blue King Crab Fishery

Description of gear used: The gear used in this fishery is in every respect similar to the gear described for the Bristol Bay red king crab fishery. Compared to Bristol Bay, there are more vessels of smaller size used in this fishery. In 1998, the last year the Pribilof king crab fishery was open, 57 catcher vessels made a total of 23,381 pot lifts during the 13 day season.

Description of fishery operations: Pots are baited and fished identically to the method described for the Bristol Bay red king crab fishery.

Habitat type where fishery occurs: Red king crabs are taken in areas consisting of sandy and silty bottoms at depths of 15 to 60 fathoms (90-360 ft.). Blue king crabs are generally taken in similar depths, but are more likely found on harder bottom, including cobble, gravel and occasional rock ledges. Red and blue king crab in the Pribilof Islands are each considered a unique genetic stock. Juveniles of both species are found on shallow, hard bottom associated with epifauna. Blue crab juveniles in their first year of life are very frequently found on shell hash.

Existing regulatory measures to mitigate adverse effects of this fishery: Existing measures are the same as those described for Bristol Bay except that pot limits are lower, reflecting the relative size of the stocks. Recently, both red and blue crab stocks have to be open for either fishery to be opened in the Pribilof Islands. Additionally, the Pribilof fishery is always opened concurrent with the St. Matthew Island blue king crab fishery, to spread fishing effort. Both areas must be opened for either to be fished.

Saint Matthew Blue King Crab Fishery

Description of gear used: The gear used in this fishery is in every respect similar to that described for the Bristol Bay red king crab fishery. Vessels participating in this fishery are mostly catcher vessels 58' to125' LOA. In 1998, the last year the St. Matthew king crab fishery was open, 131 vessels made a total of 89,500 pot lifts during an 11-day season.

Description of fishery operations: Pots are baited and fished identically to the method described for the Bristol Bay red king crab fishery.

Habitat type where fishery occurs: Blue king crabs are taken at depths of 15 to 60 fathoms (90-360 ft.) on hard bottom, including cobble, gravel and occasional rock ledges near shore, and softer bottom off shore. Blue king crab in the St. Matthew Island fishery are considered a unique genetic stock. The early life history of this blue king crab is expected to be similar to the Pribilof Islands blue king crab.

Existing regulatory measures to mitigate effects of this fishery: The mitigation measures are similar to those described for Bristol Bay and the Pribilof Islands. The size limit for mature males is 5½" to reflect the smaller size of St. Matthew blue king crab at sexual maturity. There is a near shore area closed to all fishing to protect spawning stocks and habitat.

Aleutian Islands Red King Crab Fishery

Description of gear used: The gear used in this fishery is in every respect similar to that described for Bristol Bay red king crab. In 1995, 4 vessels made a total of 2,205 pot lifts. In 1998, the last year the AI red king crab fishery was open, only one vessel made landings of red king crabs. Red king crabs can also be retained in the golden king crab fishery.

Description of fishery operations: Pots are baited and fished identically to the method described for the Bristol Bay red king crab fishery. The area between 179 degrees west longitude and 179 degrees east longitude will open October 25, 2002, for 500,000 pounds GHL. There will be a pot limit of 40 pots per vessel less than 125 feet long and 50 pots for larger vessels. In addition, the Board of Fisheries has directed that in the event of a fishery, the area between 172 and 179 degrees west longitude, inside 3 nautical miles, will be restricted to harvest by vessels of 90 feet or less LOA. Probably, multiple small stocks of red king crab are spread over the Aleutians, although this region is currently managed as a single unit. Traditional areas of high abundance are: Petrel Bank, Adak/Amlia Islands and Attu Island.

Habitat type where fishery occurs: Red king crabs are taken in areas of all sediment types at depths of 20 to 100 fathoms (120-600 ft.).

Existing regulatory measures to mitigate effects of this fishery: The mitigation measures are similar to those described for Bristol Bay.

Aleutian Islands Golden King Crab Fishery

Description of gear used: This fishery is prosecuted with square pots set in strings of multiple pots. Most of the vessels participating in this fishery are catcher vessels under 125' long.. There is a single 130' catcher processor vessel currently participating. Vessels set 400 to 1,800 pots (710 pots each on average). In the 1999/2000 fishery, 17 vessels participated and made a total of 180,169 pot lifts. Pots used in this fishery are constructed with a steel bar frame and covered with nylon mesh netting.

A variety of pot sizes is used, largely depending on vessel size and area fished. Pots range from 5'3" x 5'3" x 32" high to 10' x 10' x 34" high. The leading end of the pots' outer frame bars are radiused so that they do not snag on the bottom (see diagram [to be added]). In addition, the bottom webbing is protected by the outer frame of the pot, and does not directly contact the bottom. The difference between golden king crab pots and traditional red king crab pots is that the industry is voluntarily moving toward use of larger webbing on the ends of the pot and the tunnel sides. The newer webbing is between 8¼" and 9" stretch mesh to reduce bycatch of undersized crab. Pots are set in strings of 20 to 80 pots, each pot connected to the other by 80 to 100 fathoms of floating polypropylene line. Therefore, a single string may be 2 to 5 miles long. The ends of each string are marked with buoys. A single buoy on each line is marked with the appropriate Fish and Game requirements.

Description of fishery operations: Pots are baited in a manner similar to that described for Bristol Bay, though nearly twice as much bait is used because of the longer soak times that are practiced in the longline fishery. Three to 7 day soak times are typical, though they may reach up to 3 weeks.

Limitations to the strength of the materials used in the longline make it imperative that the vessel be directly above the gear as it is hauled up. To accomplish this, the vessel must always haul the string from the end that lies up current, thus moving the vessel with the current. Three to four pots may hang in the catenary as the gear is hauled up, with the vessel positioned directly above the pot that is next to leave the bottom. Gear is usually visible on the vessel's depth sounding equipment as it is hauled.

Habitat type where fishery occurs: Golden king crabs are taken in areas consisting of rough, uneven bottom at depths of 100-400 fathoms (600 to 2,400 ft.). Fishery effort is concentrated at the entrances to passes between the islands.

Existing regulatory measures to mitigate effects of this fishery:
Gear. Pots are the only legal gear type. Pots require biodegradable panels to minimize "ghost fishing" by lost or derelict gear. Pots require escape rings and/or large mesh panels designed to permit the escape of non-target crabs. This fishery is managed exclusively as a longline fishery to reduce gear loss and "ghost fishing."

Fishing Seasons. The season length is usually determined by quota because fisheries are closed when the quota is reached. Recently, this has occurred after fewer than 6 weeks in the eastern Aleutians, and approximately 9 months in the western Aleutians.

Limited Access. Beginning in 2000, the license limitation program has provided for limits on the maximum number of vessels allowed in the fishery. An analysis is currently being undertaken, aimed at further rationalization of the fisheries.

Size and Sex Restrictions. A prohibition on the retention of female crabs is designed to maximize overall reproductive potential. Male size limits are set to ensure that males have at least one mating season before becoming vulnerable to the fishery. The legal size for mature males is 6".

Aleutian Islands Tanner Crab Fishery

Description of gear used: The gear used in this Tanner crab (C. bairdi) fishery is identical to that described for the Bering Sea Tanner crab fishery. In 1994, the last year the eastern district Tanner crab fishery was open, 8 vessels made a total of 6,323 pot lifts. The western district was last open in 1991, when 8 vessels made 986 pot lifts.

Description of fishery operations: Fishery operations are identical to those described for the Bristol Bay red king crab fishery.

Habitat type where fishery occurs: Tanner crabs are taken in areas of soft sediment types (silt, mud) at depths of 30-110 fathoms (180-660 ft.).

Existing regulatory measures to mitigate effects of this fishery: Existing mitigation measures are the same as those described for the Bering Sea Tanner crab fishery.

Bering Sea Tanner Crab Fishery

Description of gear used: The Bering Sea Tanner crab (C. bairdi) fishery is very similar to the Bristol Bay red king crab fishery, except that the tunnel height cannot be greater than 5", and escape rings of 5"-diameter are required. In 1996, the last year of a commercial Bering Sea Tanner crab fishery, a total of 196 vessels made 149,289 pot lifts during the 16-day fishery.

Description of fishery operations: Fishery operations are identical to that described for the Bristol Bay red king crab fishery.

Habitat type where fishery occurs: Tanner crabs are taken in areas of soft sediment types (silt, mud) at depths of 30 to 110 fathoms (180-660 ft.). Tanner crabs tend to inhabit the warmer waters of the Bering Sea where summer bottom temperatures exceed 4 degrees C. These occur in western Bristol Bay, the Pribilof Islands, and along the shelf edge.

Existing regulatory measures to mitigate adverse effects of this fishery: In addition to the measures described for the Bristol Bay fishery, the following apply: 1) The waters east of 163 W longitude are closed during the directed Tanner crab fishery to protect small male and female red king crab; 2) The fishery closes March 31 to protect molting king crab in the western portion of the eastern subdistrict; 3) At reduced abundance levels, this fishery is managed as a bycatch fishery during the Bristol Bay red king crab fishery for that area; 4) Legal size is 5½" carapace width for male Tanner crab; 5) Pot limits.

Bering Sea Snow Crab Fishery

Description of gear used: The Bering Sea snow crab (C. opilio) fishery is very similar to the Bristol Bay red king crab fishery, except that the tunnel height cannot be greater than 4", and escape rings of 4"-diameter are required. In 2000, a total of 229 vessels made 170,064 pot lifts during the 7-day opilio fishery.

Description of fishery operations: Fishery operations are identical to that described for Bristol Bay red king crab.

Habitat type where fishery occurs: Snow crabs are taken in areas of soft sediment types (silt, mud) at depths of 40 to 110 fathoms (240-660 ft.). They are generally found in colder areas of the Bering Sea where summer bottom temperatures are less than 4 degrees C. These areas occur in the mid-shelf region of the central portion of the eastern Bering Sea shelf. In areas of overlap with Tanner crab stocks, hybridization occurs.

Existing regulatory measures to mitigate adverse effects of this fishery: In addition to the measures described for Bristol Bay, the following apply: 1) The waters are closed to the retention of snow crab when soft shell conditions occur; 2) Legal size is 3.1" carapace width for male snow crab, although the industry standard is 4"; 3) Pot limits.

Alaska Salmon Drift Gillnet Fishery

Description of gear used: Gillnets function by catching the fish by the gill cover and preventing escape. Ggillnets are hung with corks on the top side and a leadline along the bottom. Maximum drift gillnet length and depth are limited by state regulations, which vary by region. Most gillnets are 200 fathoms long and 2-7 fathoms deep. Each end of the gillnet is marked with a buoy, but is not anchored to the bottom. Webbing for gillnets varies by region, however monofilament nets are not allowed. Mesh size varies with targeted species.

Description of fishery operations: Gill nets are set where there are signs of a salmon, such as 'jumpers' Most gillnet fisheries occur in marine waters. To set the net, one end of the net and buoy is put into the water and the remaining net is pulled off the vessel as it moves away. Sets are commonly made in a straight line, perpendicular to the shoreline. The net is pulled back onboard with the aid of a hydraulic reel mounted either on the stern or bow of the vessel. Salmon that try to swim through the net are caught by their gills. In most areas, drift gillnets do not contact the bottom. Drift gillnets -are used in most areas of the State.

Habitat type where fishery occurs: Drift gillnets are set over any bottom type, wherever salmon are migrating in the ocean, inlet, and bays. For the most part, gillnets are set in nearshore areas and are fished in the upper water column. Drift gill nets are not generally designed for bottom interactions, but occasionally contact occurs.

Existing regulatory measures to mitigate adverse effects of this fishery:
In some nearshore areas such as river mouths, fishing is closed to ensure escapement goals. One of the results of these closures is that accidental bottom contact may be avoided. Areas near stream mouths, identified by markers, are closed to fishing inshore from the markers. These areas would not have fishing effects from gill nets on salmon habitat.

Alaska Salmon Set Gill Net Fishery

Description of gear used: This fishery is prosecuted with anchored gill-nets. The gillnets are hung from the set line with corks on the top and a leadline on the bottom. Maximum gillnet size is limited by state regulations, which vary by region. Gillnets for the set gillnet fishery must be made of multifilament line. A mesh lead may be used in the intertidal area to guide salmon during the high tide periods.

Description of fishery operations: Most set gillnets are anchored on the beach and the offshore end secured to anchors and buoys. Some nets have what is called a lead, which is usually very large mesh seine webbing at the ends of the set gillnet to channel the fish toward the net. Some nets are not anchored to the shoreline, but held stationary with anchors on each end of the net. Set gillnets can be simply set in a straight line, or set to have a v-shaped hook at the end. Salmon are caught in the nets by their gills. Fishermen may use small skiffs to tend the nets and pick the salmon, or the nets can be accessed by motor vehicles and picked at low tide in some areas (e.g., Bristol Bay). In some areas, the entire net contacts the substrate at low tide. In other locations, only the leader and the shallower portion of the gillnet would contact the bottom. Set gillnets are used in most areas of the State.

Habitat type where fishery occurs: Most set net sites are attached to the shore in generally shallow areas with variable currents and varible bottom substrate.

Existing regulatory measures to mitigate adverse effects of this fishery: Set gillnet regulations vary according to area and district of the state. Spacing of nets with respect to each other and other natural features (e.g. stream mouths) may reduce potential interactions with salmon habitat.

Alaska Salmon Seine Fishery

Description of gear used: This fishery is primarily prosecuted with purse seines. The length and depth of seines can vary region of the state. Purse seines are nets with corks on the top and a leadline along the bottom; and can be closed at the bottom by means of a free running line through rings attached to the lead line or to a ribline, which runs parallel to the leadline, but is located in the body of the net above the leadline. Maximum seine size is limited by state regulations, which vary by region. The largest of these nets is 250 fathoms in length, and the smallest is 100 fathoms. Depth also varies regionally, with most salmon seines being about 10 fathoms in depth. Mesh size may vary throughout the net, with 3.5 and 4" mesh being most common. Twine size is generally #21, but may be as large as #42 in the meshes nearer the lead line.

A beach seine is a net that is set from and returned to the beach. This seine does not have a purse string, but is dragged along the bottom to pull the fish in.

Description of fishery operations: Sets are generally made where there are signs of a salmon such as 'jumpers'. At other times, sets may be made based on prior experience of the captain or crew. When setting a purse seine, one end of the net is held by the seine skiff, and the seiner moves in the opposite direction, launching the net. The skiff continues to pull until all of the net is off the deck. With the net hanging in the water like a curtain, the seine skiff and seine vessel meet and join both ends of the net to the seiner. Hauling in the bottom line or 'purse line' closes off the bottom of the net, entrapping the fish. Sets may be circular, or adjusted around depth contours, to avoid location of 'hang ups', or to prevent being pushed by current and waves, or other reasons. Following pursing up the net, the seine corks, webbing, and leadline are pulled back onto the deck through a power block that is suspended from a boom off the boat's mast. Once most of the net has been retrieved, the fish are lifted in the purse, which remains in the water. The fish are spilled onto the deck, and sorted into compartments below decks.

The beach seine must be set from, and hauled to, the beach, or to a vessel anchored to a beach. One end of the beach seine must remain on the beach above the water at all times during the set. There is no purse in a beach seine. The fish are contained by the walls of the net and the substratum.

In shallow water seine fisheries, there is likely to be interaction between seines and bottom habitat. The nets are set as close to shore as possible and configured in a "J" out from the shore. The level of interaction varies by operation and bottom type.

Habitat type where fishery occurs: Sets can occur over any bottom type and almost any depths. Most commonly, salmon seiners work in coastal waters. In most situations, the netting does not contact bottom, with the exception of beach seine contact points with the beach.

Existing regulatory measures to mitigate adverse effects of this fishery:
Areas near stream mouths, identified by markers, are closed to fishing inshore from the markers. These areas would not have fishing effects from gill nets on salmon habitat.

Alaska Salmon Troll Fishery

Description of gear used: This fishery is prosecuted with a series of hooks that are trolled behind a moving vessel. Two forms of trolling are legal, power troll and hand troll. Gear is restricted in Southeast Alaska as follows: power troll can have no more than four lines, except west of Cape Spencer and outside three miles, where six lines are permitted; hand troll can have four hand poles or two hand troll gurdies. A typical power troll vessel is 40' long and fishes with two to four poles. Attached to each pole are 2 tag lines, constructed of 300-400 pound test line. Main lines (wire) are 400-600 pound test stainless steel wire that passes through the tag lines. Each wire is weighted down by a 20-65 pound lead cannonball sinker, Cannonballs are attached to the wire with a 200-300 pound breaking strap. Cannonballs may have up to 10 or more spreads (leaders with hooks) attached. Spreads are placed every 2 fathoms up from the sinker. Baited hooks may be used on occasion, but more commonly lures, spoons, and hoochies fished behind a flasher are used.

Description of fishery operations: Salmon trolling is only done in Southeast Alaska - Yakutat area. Troll fisheries can occur in nearshore and offshore waters. Upon reaching the grounds, the poles are lowered and, one at a time, the wires are attached to tag lines. The cannonball is dropped overboard and the monofilament spreads are attached to the wire. The lines are set out and retrieved by either a hand crank (hand troller) or hydraulic power (power troller). Vessels troll at speeds of 1 to 3 knots. When a fish is hooked, the fishermen haul back on the wire. Fish are either gaffed and brought aboard if they are of legal size, or shaken off.

Habitat type where fishery occurs: Trolling can occur over any bottom type and at almost any depths. Trollers work in shallower coastal waters; but may also fish off the coast, such as on the Fairweather Grounds. In most situations, the gear rarely contacts the ocean bottom.

Existing regulatory measures to mitigate adverse effects of this fishery:
Troll gear fishing has minimal contact with the bottom habitat. Accidental contact occurs ocaisionally, however, potential loss of expensive fishing gear encourages fishing practices that minimize bottom contact. Troll gear is never intentionally in contact with the bottom.

Alaska Salmon Rod and Reel Fishery

Description of gear used: The rod and reel fishery uses including spinning, casting, trolling, and flyfishing gear.Hook sizes can vary depending upon target species, gear type, fishing method (bait, fly, or other artificial). In river fishing for salmon, salmon roe may be used as bait if regulations permit. Lead sinkers (or downriggers when in the ocean) may be attached to get the hooks to the depths where the salmon occur. Snagging is allowed in some tidewater areas. Snagging gear is generally a weighted treble hook. This practice can have potential effects on the bottom habitat (leaving lead on the bottom, moving wood on the bottom).

Description of fishery operations: River fishing is done by standing on banks, wading from shore, and from boats. Ocean fishing is done from shore and from boats. In most river fishing, the line is cast slightly upstream and allowed to sink and drift through areas holding salmon. These casts are repeated until a fish takes the hook or the angler changes location. In ocean fishing, baited hooks are trolled at slow speeds behind the recreational boats in areas where salmon may be feeding or migrating. When a fish is hooked, the angler 'plays' the fish, reeling in the line when possible. Landed fish are either released or retained.

Sports recreational, sports commercial, and subsistence fishing all employ rod and reel. Locations of operations vary.

Habitat type where fishery occurs: Rod and reel fishing occurs in a variety of habitat types including nearshore and offshore marine areas, rivers, and lakes. Mouths of rivers, as well as upstream on rivers and lakes receive the most fishing pressure. In river fishing, salmon are generally caught in areas with moderate flow near river banks. The bottom type is generally cobble and rocky due to the current. In ocean fishing, salmon are caught over a wide variety of bottom types and depths, and fishing can occur in offshore areas.

Existing regulatory measures to mitigate adverse effects of this fishery:
In some heavily utilized rivers, such as the Kenai River, State laws limiting bank disturbance, redd disturbance, boat speed and motor size, and number of people per vessel, are designed to limit impacts on salmon habitat based. Area specific restrictions also prevent fishing upstream from bridges at certain times of year. On the Kenai River, the most heavily fished river in Alaska, there is a long-term habitat mitigation program that involves habitat protection and restoration.

Alaska Salmon Fish Wheel Fishery (Commercial and Subsistence)

Description of gear used: This fishery is prosecuted in the Yukon , Copper, and Kuskakwim Rivers with stationary fish wheels. The Yukon has commercial fish wheels. Subsistence fishwheels occur on the Yukon River, the Kuskokwin, and on the Copper River. A fish wheel is constructed of two lift nets made of 2" galvanized screening attached to a circular frame operated by the river current. Paddle boards catch the current and create the movement of the fish wheel nets. These boards are adjusted to the speed of the river current so that maximum catching efficiency is achieved. The wheel is mounted on a floating raft. The raft is anchored to a tree or rock upriver and pushed out into the current.

Description of fishery operations: As a fish swims near the wheel, it is scooped up in the net, slides toward the axle as the wheel turns, and is deposited in a holding box. Fishermen generally unload the boxes several times per day.

Habitat type where fishery occurs: Fish wheels are located in areas of the river, close to the bank, where the salmon are migrating. In all situations, no part of the fish wheel contacts the river bottom.

Existing regulatory measures to mitigate adverse effects of this fishery:
Regulations on the rivers where fish wheels are used. Protective measures against icthyophonis? disease spreading among juvenile salmon.

Alaska Salmon Subsistence/Personal Use Fishery

Description of Gear Used: Drift Gillnets, Set Gillnets, Dip Nets, Beach Seines, Rod and Reel, Fish Wheels and Trolling are all used in the prosecution of subsistence fisheries for salmon in Alaska. Gear size limitations may pertain in these subsistence fisheries.

Description of Fishery Operations: The relative effect of subsistence fishing on fish populations varies by region within the state.

Habitat type where fishery occur: Nearshore, shoreside, river and.lakes may be involved in subsistence salmon fishing.

Existing regulatory measures to mitigate adverse effects of this fishery:

Bering Sea Pollock Trawl Fishery

Description of gear used: This fishery is prosecuted with pelagic otter trawls rigged to fish for schooled and scattered pollock. Vessels participating in this fishery include about 112 catcher vessels and 16 catcher/processor vessels. Typical vessel length for catcher vessels is about 120 feet (range is 70-190') LOA, and about 220-350 feet LOA for catcher/processors. The gear used has meshes in the front end as large as 32 to 64 meters (105-210 ft), and typically has a headrope to foot rope vertical distance "rise" of 10-30 fathoms (60-180 ft). To achieve these large openings with a minimum of drag, the mesh sizes are very large and twine size relatively small. Net mesh gets smaller towards the intermediate and codend, with the codend typically having 4" to 4.5" stretched mesh. Otter board or "doors" are used to spread the net and keep it open during towing. Doors are made of steel and range in size from 5-14 square meters. In the pelagic fishery the doors do not come in contact with the ocean floor. Door spread in most fishing depths ranges from 100 to 180 meters (328-590 ft), and trawl warp/scope to depth ratio is typically 3 to 1. Contact with the seafloor, when it occurs, is from weight clumps and footrope. Long wire rope bridles attach the net to the doors (the doors are not on the bottom). Unlike other groundfish trawl fisheries, there are no discs attached to the footropes on these trawls. Footropes typically extend 180 to 450 meters (590-1475 ft).

Trawl codends are usually made with polyethylene netting attached to four longitudinal riblines. The riblines are typically chain, wire or synthetic rope. Floats are attached along the length of the codend to counteract the weight of the steel components. "Container lines" around the circumference are attached along the length of the codend to restrict the expansion of the netting, preventing damage and allowing the codend to be hauled up a stern ramp. Sacrificial "chafing gear", typically polyethylene fiber, is attached to the codend to protect it from abrasion on the stern ramp. Everything from the footrope aft, including the codend, is neutrally boyant.

Description of fishery operations: Sets are made on schooled or scattered pollock as indicated by electronics. When set, the codend, net, and sweeps are unwound from a net reel, then the doors are attached. Wire cable, attached to each door, is let out to a distance of approximately 3 times the depth. Modern trawl winches are designed to automatically adjust tension and release when necessary. Tow duration in this fishery ranges from 20 minutes to 10 hours (depending upon catch rates), at a speed of 3.5 to 4.5 knots. Tows may be in a straight line or adjusted to curve around depth contours, or avoid location of 'hangs' and fixed gear, or pushed by current, or other reasons. Quite often, vessels will turn around (180°) while towing, making several passes over the same general area. At haulback, the setting procedure is reversed, and the codend is dumped into the fish hold below decks.

Habitat type where fishery occurs: Pollock tend to aggregate mid-water column over areas with sand, sandy silt, and muddy bottom at depths of 35 to 250 fathoms (210-1500 ft).

Existing regulatory measures to mitigate effects of this fishery: The BSAI pollock fishery is restricted to using only pelagic trawls, as defined in regulations. Pelagic trawl gear has evolved and developed over time as a result of technological changes, regulatory amendment requirements, changes resulting from implementation of Co-ops, and electronical advancements (net electronics, onboard electronics, VMS). The Pribilof Islands Habitat Conservation Area had some effort for pollock prior to being closed to all trawling. Area 516 in the Bering Sea is closed to trawling from March 15 through June 15. The Bristol Bay near shore area is closed to all trawl fisheries. Prior to being closed, Pollock fishing had also occurred in area 518 (Bogoslof Area) and sea lion rookeries and haulouts on Amak, Akutan, Akun, and Unimak Islands. Chum salmon savings area is closed to pollock trawling August 15th to September 15th and can trigger for longer. Chinook salmon and herring savings areas are also closed once predetermined trigger levels are reached.

Aleutian Islands and Bogoslof Pollock Trawl Fishery

Although the Bogoslof area is closed, it would have fleet characteristics of the Bering Sea but habitat and fishery descriptions of the Aleutian Islands.

Description of gear used: This fishery is prosecuted with otter trawls rigged to fish for schooled and scattered pollock. Vessels that have participated in this fishery included about 30 catcher vessels and about 10 catcher/processor vessels. Typical vessel length for catcher vessels is about 140 feet LOA, and about 220-350 feet LOA for catcher/processors. The gear used is very large mesh midwater trawls, typically having a headrope to foot rope vertical distance "rise" of 10-30 fathoms. To achieve these large openings with a minimum of drag, the mesh sizes are very large and twine size relatively small. Front meshes of a large midwater net may be as large as 32-64 meters (105-210 ft). Net mesh gets smaller towards the intermediate and codend, with the codend typically having 4" to 4.5" stretched mesh. Otter board or "doors" are used to spread the net and keep it open during towing. Doors are made of steel and range in size from 7-14 square meters. Door spread in most fishing depths ranges from 100 to 180 meters (328-590 ft), and a trawl warp/scope ratio of 3 to 1. In the Aleutian Islands pollock fishery. There is no intentional seafloor contant because of the rough bottom conditions, which would result in torn or lost midwater trawls. Long wire rope bridles attach the net to the doors. Unlike other groundfish trawl fisheries, there are no discs attached to the footropes on these trawls. Footropes typically extend 180-450 meters (590-1475 ft).

Trawl codends are usually made with polyethylene netting attached to four longitudinal riblines. The riblines are typically chain, wire or synthetic rope. Floats are attached along the length of the codend to counteract the weight of the steel components. "Container lines" around the circumference are attached along the length of the codend to restrict the expansion of the netting, preventing damage and allowing the codend to be hauled up a stern ramp. Sacrificial "chafing gear", typically polyethylene fiber, is attached to the codend to protect it from abrasion on the stern ramp. Everything from the footrope aft, including the codend, is neutrally boyant.

Seasons are short, low quota, low effort compared to Bering Sea. Quota taken in A season, January to the end of March.

Description of fishery operations: Sets are made on schooled or scattered pollock as indicated by electronics. When set, the codend, net, and sweeps are unwound from a net reel, then the doors are attached. Wire cable, attached to each door, is let out to a distance of approximately 3 times the depth. Modern trawl winches are designed to automatically adjust tension and release when necessary. Tow duration in this fishery is about 3 hours (depending upon catch rates), at a speed of 3.5 to 4.5 knots. Tows may be in a straight line or adjusted to curve around depth contours, or avoid location of 'hangs' and fixed gear, or pushed by current, or other reasons. Quite often, vessels will turn around (180°) while towing, making several passes over the same general area. At haulback, the setting procedure is reversed, and the codend is dumped into the fish hold below decks.

Habitat type where fishery occurs: Pollock tend to aggregate in areas with bottom sediments ranging from volcanic sand to hard bottom. Pollock schools may be located close to the bottom in depths of 200-1500 ft, or adjacent to steep edges at this same depth range. Pollock are also fished at depths of 600 to 1500 feet over much deeper bottom depths (>3000 ft). Pollock aggregate in subterranean canyons on the upflow side.

Existing regulatory measures to mitigate effects of this fishery: The BSAI pollock fishery is restricted to using only pelagic trawls, as defined in regulations. The AI pollock fishery has been closed in recent years as a precautionary measure to reduce potential competition with Steller seal lions.

Bering Sea Pacific Cod Trawl Fishery

Description of gear used: This fishery is prosecuted with bottom trawls. Vessels participating in this fishery include approximately 84 catcher vessels and 27 catcher/processor vessels. Typical vessel length for catcher vessels is a range of 60 to 180 feet LOA, and about 107 to 295 feet LOA for catcher/processors. The gear used includes many different types of bottom trawls, most typically having a headrope to foot rope vertical distance "rise" of 1 to 5 fathoms (6-30 ft). Net mesh gets smaller towards the intermediate and codend, with the codend typically having 5½ to 8" stretched diamond mesh. Otter board or "doors" are used to spread the net and keep it open during towing. Doors are made of steel and range in size from 4-10 square meters. Door spread in most fishing depths is typically 100 meters (328 ft), and the trawl warp/scope to depth ratio is typically 4 to 1. The mouth of the net is a horizontal opening of about 15 meters (49 ft). Contact with the seafloor is from doors, sweeps, and bobbins. The vertical opening is achieved by floats attached to the headrope. Floats may be spaced intermittently along the riblines to achieve neutral buoyancy. Modern doors (starting in the mid-1980's) are designed to spread with minimal bottom contact. Vented, cambered, foam-filled, etc doors are examples are more modern doors.

Trawl codends are usually made with polyethylene netting attached to four longitudinal riblines. The riblines are typically chain, wire or synthetic rope. Floats are attached along the length of the codend to counteract the weight of the steel components. "Container lines" around the circumference are attached along the length of the codend to restrict the expansion of the netting, preventing damage and allowing the codend to be hauled up a stern ramp. Sacrificial "chafing gear", typically polyethylene fiber, is attached to the codend to protect it from abrasion on the stern ramp.

Sweeps are made of wire and covered with rubber disks ranging from 4-8 inches in diameter. Footropes, constructed of chain or steel cable, typically extend 100 to 200 feet, and are covered with rubber discs and bobbins designed to roll, which are 8 to 18 inches in diameter. The larger diameter bobbins are spaced at intervals of 12 to 48 inches.

Description of fishery operations: When set, the codend, net, and sweeps are unwound from a net reel, and the doors are attached. Wire cable, attached to each door, is let out to a distance of approximately 4 times depth. Modern trawl winches are designed to automatically adjust tension and release when necessary. Tow duration in this fishery is 2-4 hours (depending upon catch rates), at a speed of 3-4 knots. Tows may be in a straight line or adjusted to curve around depth contours, or avoid location of 'hangs' and fixed gear, or pushed by current, or other reasons. Quite often, vessels will turn around (180°) while towing, making several passes over the same general area. At haulback, the setting procedure is reversed.

Habitat type where fishery occurs: Pacific cod tend to aggregate in areas with sand, sandy mud, and gravel, at depths of 20 to 90 fathoms (120-540 ft).

Existing regulatory measures to mitigate effects of this fishery: The Pribilof Islands Habitat Conservation Area, the Nearshore Bristol Bay Area, and the Red King Crab Savings Area had some effort for Pacific cod prior to being closed to bottom trawling. Cod trawling also took place in the sea lion rookeries, haulouts, and foraging areas of the Bering Sea and Aleutian Islands prior to those areas closing.

Bering Sea Rock Sole Trawl Fishery

<u>Description of gear used</u>: This is a bottom trawl fishery using an otter trawl rigged to fish effectively for flatfish which generally live on or very near the substrate. All vessels currently involved with this fishery in the Bering Sea are trawl CPs. Typical vessel length (LOA) for boats targeting rocksole are from 107 to 295 feet LOA for catcher/processors. Approximately 20 vessels participate in the rock sole directed fishery.

Rock sole is fished with a two- or four-seam trawl with a relatively low vertical opening (typically 1 to 3 fathoms). Nets are made of polyethylene netting., with codends and intermediates using 5.5 to 8 inch mesh in square or diamond configuration. Trawl codends are usually made with polyethylene netting attached to four longitudinal riblines. The riblines are typically chain, wire or synthetic rope. Floats are attached along the length of the codend to counteract the weight of the steel components. "Container lines" around the circumference are attached along the length of the codend to restrict the expansion of the netting, preventing damage and allowing the codend to be hauled up a stern ramp. Sacrificial "chafing gear", typically polyethylene fiber, is attached to the codend to protect it from abrasion on the stern ramp.

Steel trawl doors ranging in size from 5 to 11 square meters spread the nets horizontally. Door spread varies with fishing depth and rigging style, but generally ranges from 100 to 200 meters (328- 656 ft). The rigging between the net and the doors includes bridles and sweeps ('mudgear'), ranging in length from 30 to 200 meters (98-656 ft), which herd fish into the path of the trawl. Sweeps are made of steel cable covered by rubber disks ranging from 4-8 inches in diameter. Footropes keep the front of the net off the bottom to protect it from damage. They are made of rubber disks and bobbins 12 to 18 inches in diameter strung on chain or wire at 18- to 48-inch intervals. Bobbins are mostly rubber but sometimes are hollow steel balls designed to roll along the seabed.

Contact with the seafloor is predominantly from doors, sweeps, and bobbins. A design objective for modern flatfish nets is to fish the net with minimum bottom contact, to reduce gear damage and drag and to maintain the quality of the catch. Ideally, only the doors, sweeps and footrope bobbins will touch the bottom, and these will only touch enough to ensure fish are herded into the trawl. Any increase in bottom contact increases the drag of the system, causing a reduction in towing speed and/or an increase in fuel consumption along with an increased risk of damage to the gear. Additionally, more bottom contact can cause sand to mix with the catch, which increases processing cost and decreases the value of the product.

<u>Description of fishery operations</u>: When set, the net is unwound from a net reel, the sweeps attached, then the doors attached. Wire cable, attached to each door, is let out to a distance of approximately 3 times the depth. Modern trawl winches are designed to automatically adjust tension and release when necessary. The tow duration in this fishery is about 1 to 4 hours, at a speed of 3 to 4 knots. Tows may be in a straight line or adjusted to curve around depth contours, or avoid location of 'hangs' and fixed gear, or pushed by current, or other reasons. At haulback, the setting procedure is reversed, and the codend is dumped into the fish hold below decks.

<u>Habitat type where fishery occurs</u>: In the spring, the fish tend to aggregate in areas with sand, sandy silt, and muddy bottom at depths of 120-300 ft. They are often taken in a mixed Pacific cod fishery. There is no target rocksole fishery outside of spring season (January 20 to the beginning of March). The general fishing grounds are from 162° W to 165° W longitude and 56° 10 minutes N to 55° N latitude.

Existing regulatory measures to mitigate effects of this fishery: The bottom trawl closure areas (Pribilof Islands Habitat Conservation Area, Bristol Bay Nearshore Closure, and Red King Crab Savings Area) included some historically important fishing grounds for rock sole.

Bering Sea Yellowfin Sole Trawl Fishery

Description of gear used: This fishery is prosecuted with otter trawls rigged to fish effectively for flatfish, which live on or very near the substrate. Nearly 20 to 30 vessels are currently involved with this fishery in the Bering Sea are trawl CPs. Typical vessel length (LOA) for boats targeting yellowfin are from 107 to 341 feet. Yellowfin is fished with a two- or four-seam trawl with a relatively low vertical opening (typically 1 to 3 fathoms). Nets are made of polyethylene netting., with codends and intermediates using 5.5 to 8 inch mesh in square or diamond configuration. Trawl codends are usually made with polyethylene netting attached to four longitudinal riblines. The riblines are typically chain, wire or synthetic rope. Floats are attached along the length of the codend to counteract the weight of the steel components. "Container lines" around the circumference are attached along the length of the codend to restrict the expansion of the netting, preventing damage and allowing the codend to be hauled up a stern ramp. Sacrificial "chafing gear", typically polyethylene fiber, is attached to the codend to protect it from abrasion on the stern ramp.

Otter board or "doors" are used to spread the net and keep it open during towing. Steel trawl doors ranging in size from 5 to 11 square meters spread the nets horizontally. Door spread varies with fishing depth and rigging style, but generally ranges from 100 to 200 meters (328-656 ft). The rigging between the net and the doors includes bridles and sweeps ('mudgear'), ranging in length from 30 to 200 meters (98-656 ft), which herd fish into the path of the trawl. Sweeps are made of steel cable covered by rubber disks ranging from 4-8 inches in diameter. Footropes keep the front of the net off the bottom to protect it from damage. They are made of rubber disks and bobbins 12 to 18 inches in diameter strung on chain or wire at 18- to 48-inch intervals. Bobbins are mostly rubber but sometimes are hollow steel balls designed to roll along the seabed.

Contact with the seafloor is predominantly from doors, sweeps, footropes, and to a lesser extent from the codend. Although codends are usually rigged with some poly twine chafing gear, a design objective for modern flatfish nets is to employ sufficient poly floats to buoy the net body and codend to keep it mostly off the bottom or at least reduce the drag on the bottom to the greatest extent possible. This reduces the problem of sand and mud in the catch (which lowers product value and complicates processing). Sweeps are made of steel cable covered by rubber bobbins and disks ranging from 4-8 inches in diameter. Sweep sections (both sides) range in length from 250-800 feet and occasionally longer for nets with smaller footrope extensions and larger sweeps extensions. Foot ropes are designed to keep the net off the bottom by utilizing rubber disks and bobbins that range in size from 8-16 inches in diameter. Steel cable and chain used for the footrope runs through rubber disks spaced intervals of 18 to 48 inches. Floatation on the net head rope provides lift to the footrope to reduce unnecessary drag and increase towing efficiency and performance. Some headrope/footrope combinations are designed to be as much as 70% buoyant at depth. Footropes typically extend 100 to 200 feet.

Description of fishery operations: When set, the net is unwound from a net reel, the sweeps attached, then the doors attached. Wire cable, attached to each door, is let out to a distance of approximately 3 times the depth. Modern trawl winches are designed to automatically adjust tension and release when necessary. The tow duration in this fishery is about 1 to 4 hours, at a speed of 3 to 4 knots. Tows may be in a straight line or adjusted to curve around depth contours, or avoid location of 'hangs' and fixed gear, or pushed by current, or other reasons. At haulback, the setting procedure is reversed, and the codend is dumped into the fish hold below decks.

Habitat type where fishery occurs: In the late spring, the fish tend to aggregate in shallow (<150 feet) sandy areas to spawn. At other times of the year, they are occur over sand, sandy silt, and muddy bottom at depths of 100-300 ft.

Existing regulatory measures to mitigate effects of this fishery: The bottom trawl closure areas (Pribilof Islands Habitat Conservation Area, Bristol Bay Nearshore Closure, and Red King Crab Savings Area) included some historically important fishing grounds. A portion of Bristol Bay, south and west of Nushagak Peninsula, was designated as open to trawling from April 1 to June 15 to allow the fishery to target aggregated yellowfin sole when they are aggregated over sandy bottoms and the fishery can be conducted with minimal bycatch.

Bering Sea Flathead Sole/Other Flatfish Trawl Fishery

Description of gear used: This is a bottom trawl fishery using an otter trawl rigged to fish effectively for flatfish which generally live on or very near the substrate. All vessels currently involved with this fishery in the Bering Sea are trawl CPs. Typical vessel length (LOA) for boats targeting rocksole are from 107 to 295 feet LOA for catcher/processors. Approximately 20 to 30 vessels participate in the flathead sole directed fishery, as well as other flatfish fisheries.

Flathead sole is fished with a two- or four-seam trawl with a relatively low vertical opening (typically 1 to 3 fathoms). Nets are made of polyethylene netting., with codends and intermediates using 5.5 to 8 inch mesh in square or diamond configuration. Trawl codends are usually made with polyethylene netting attached to four longitudinal riblines. The riblines are typically chain, wire or synthetic rope. Floats are attached along the length of the codend to counteract the weight of the steel components. "Container lines" around the circumference are attached along the length of the codend to restrict the expansion of the netting, preventing damage and allowing the codend to be hauled up a stern ramp. Sacrificial "chafing gear", typically polyethylene fiber, is attached to the codend to protect it from abrasion on the stern ramp.

Steel trawl doors ranging in size from 5 to 11 square meters spread the nets horizontally. Door spread varies with fishing depth and rigging style, but generally ranges from 100 to 200 meters (328-656 ft). The rigging between the net and the doors includes bridles and sweeps ('mudgear'), ranging in length from 30 to 200 meters (98-656 ft), which herd fish into the path of the trawl. Sweeps are made of steel cable covered by rubber disks ranging from 4-8 inches in diameter. Footropes keep the front of the net off the bottom to protect it from damage. They are made of rubber disks and bobbins 12 to 18 inches in diameter strung on chain or wire at 18- to 48-inch intervals. Bobbins are mostly rubber but sometimes are hollow steel balls designed to roll along the seabed.

Contact with the seafloor is predominantly from doors, sweeps, and bobbins. A design objective for modern flatfish nets is to fish the net with minimum bottom contact, to reduce gear damage and drag and to maintain the quality of the catch. Ideally, only the doors, sweeps and footrope bobbins will touch the bottom, and these will only touch enough to ensure fish are herded into the trawl. Any increase in bottom contact increases the drag of the system, causing a reduction in towing speed and/or an increase in fuel consumption along with an increased risk of damage to the gear. Additionally, more bottom contact can cause sand to mix with the catch, which increases processing cost and decreases the value of the product.

Description of fishery operations: When set, the net is unwound from a net reel, the sweeps attached, then the doors attached. Wire cable, attached to each door, is let out to a distance of approximately 3 times the depth. Modern trawl winches are designed to automatically adjust tension and release when necessary. The tow duration in this fishery is about 1 to 4 hours, at a speed of 3 to 4 knots. Tows may be in a straight line or adjusted to curve around depth contours, or avoid location of 'hangs' and fixed gear, or pushed by current, or other reasons. At haulback, the setting procedure is reversed, and the codend is dumped into the fish hold below decks.

Habitat type where fishery occurs: Flatfish tend to aggregate in areas with sand, sandy silt, and muddy bottom at depths of 100-1200 ft depending upon species and season. For example, Alaska plaice are caught in shallow waters (<300 feet), but flathead sole and other species are caught down to much greater depths.

Existing regulatory measures to mitigate effects of this fishery: The bottom trawl closure areas (Pribilof Islands Habitat Conservation Area, Bristol Bay Nearshore Closure, and Red King Crab Savings Area) included only minor fishing grounds for flathead sole, Alaska plaice and other flatfish.

Aleutian Islands POP and Northern Rockfish Trawl Fishery

Description of gear used: This fishery is prosecuted with otter trawls rigged to fish over generally rougher substrates. Target species in the BSAI fishery include Pacific ocean perch, shortraker rockfish, and rougheye rockfish. All vessels currently involved with this fishery are trawl CPs. Typical vessel length (LOA) for boats targeting rockfish are from 107 to 295 feet. The gear used is a four seam otter trawl and a headrope to foot rope vertical distance "rise" of about 4 to 6 fathoms. Nets are made of polyethylene. Net mesh is 8 inch diamond in the wings and forward belly and 5.5 inch diamond in the intermediate and codend. Double meshes may be used in the codend, and the codend is equipped with chafing gear. Otter board or "doors" are used to spread the net and keep it open during towing. Doors are made of steel and range in size from 6.5-12 square meters. Door spread in most fishing depths and trawl warp/scope combinations is typically 45 to 50 meters (148-164 ft). Contact with the seafloor is predominantly from doors, bridles, and bobbins. Rockfish nets are designed to stay off the bottom as much as possible by employing numerous floats to buoy the net body and codend. Bridles are made of steel cable, and are generally 90 feet long on each side. Foot ropes are designed to keep the net off the bottom and may utilize tire gear, large disk tires (24 inch diameter airplane tires), 21 inch discs or bobbins, or a combination of these. Footropes typically extend 100 to 200 feet, plus an additional 40 foot extension from net wing ends on both sides. Steel cable and chain used for the footrope runs through bobbins or discs spaced at intervals of 24 inches or tires grouped together at the bosum, which is the center 30 to 80 feet. Floatation on the net head rope and riblines provides lift to reduce unnecessary drag and increase towing efficiency and performance.

Description of fishery operations: When set, the net is unwound from a net reel, the sweeps attached, then the doors attached. Wire cable, attached to each door, is let out to a minimum distance necessary to achieve the fishing depth. Modern trawl winches are designed to automatically adjust tension and release when necessary. The tow duration in this fishery is about 1 to 4 hours, at a speed of 3 to 4 knots. Tows are adjusted to curve around depth contours, or avoid location of 'hangs' and fixed gear. At haulback, the setting procedure is reversed, and the codend is dumped into the fish hold below decks. The tows in the rockfish fishery have more intermittent bottom contact compared to the other bottom trawl fisheries due to the nature of substrate and fish behaviors.

Because rockfish is fished over rough bottom adjacent to areas with large potential for hangs in some areas, the net is usually fished with very short scope (the ratio of warp to towing depth) to minimize actual contact with the substrate and allow the net to be quickly lifted if a hangup is sighted. The combination of short trawl warp and the large amount of floatation applied to the headropes and rib lines increases the likelihood that the net will bounce off a rock or hang that may be encountered. This avoids damage to the net. Flotation on the net body reduces potential for ripping or abrading the net on volcanic sand or rock surfaces.

Habitat type where fishery occurs: Rockfish are caught all along the narrow slope area. Bottom types include areas with rocks and living substrates at depths of 175-500 m (574-1640 ft) and deeper.

Existing regulatory measures to mitigate effects of this fishery: The allocation of POP TAC by the Aleutian Islands management areas (541, 542, and 543) based on the distribution of biomass as determined by resource assessment surveys, serves to spread the fishery out and reduce the impacts of spatially concentrated harvests. Furthermore, the spatial and temporal Steller sea lion closures and critical habitat catch limits restrict fishing effort and effort distribution in this fishery. Short Raker/Rougheye TAC allocated among gear types, resulting in less trawling for rockfish. In recent years there has been no directed rockfish trawl fishing in the Bering Sea.

Aleutian Islands Atka Mackerel Trawl Fishery

Description of gear used: This fishery is prosecuted with otter trawls rigged to fish over generally rougher substrates. All vessels currently involved with this fishery are trawl CPs (approximately 8 to 12 vessels). Typical vessel length (LOA) for boats targeting Atka Mackerel are from 107 to 295 feet. The gear used is a four seam otter trawl and a headrope to foot rope vertical distance "rise" of about 1 to 4 fathoms. Nets are made of polyethylene. Net mesh is 8 inch diamond in the wings and forward belly and 5.5 inch diamond in the intermediate and codend. Double meshes may be used in the codend, and the codend is equipped with chafing gear. Otter board or "doors" are used to spread the net and keep it open during towing. Doors are made of steel and range in size from 6.5-12 square meters. Door spread in most fishing depths and trawl warp/scope combinations is typically 45 to 50 meters (148-164 ft). Contact with the seafloor is predominantly from doors, bridles, and bobbins. Atka Mackerel nets are designed to stay off the bottom as much as possible by employing numerous floats to buoy the net body and codend. Bridles are made of steel cable, and are generally 90 feet long on each side. Foot ropes are designed to keep the net off the bottom and may utilize tire gear, large disk tires (24 inch diameter airplane tires), 21 inch discs or bobbins, or a combination of these. Footropes typically extend 100 to 200 feet, plus an additional 40 foot extension from net wing ends on both sides. Steel cable and chain used for the footrope runs through bobbins or discs spaced at intervals of 24 inches or tires grouped together at the bosum, which is the center 30 to 80 feet. Floatation on the net head rope and riblines provides lift to reduce unnecessary drag and increase towing efficiency and performance.

Description of fishery operations: When set, the net is unwound from a net reel, the sweeps attached, then the doors attached. Wire cable, attached to each door, is let out to a minimum distance necessary to achieve the fishing depth. Modern trawl winches are designed to automatically adjust tension and release when necessary. The tow duration in this fishery is about 1 to 4 hours, at a speed of 3 to 4 knots. Tows are adjusted to curve around depth contours, or avoid location of 'hangs' and fixed gear. At haulback, the setting procedure is reversed, and the codend is dumped into the fish hold below decks. The tows in the rockfish fishery have more intermittent bottom contact compared to the other bottom trawl fisheries due to the nature of substrate and fish behaviors.

Because mackeral is fished over rough bottom adjacent to areas with large potential for hangs in some areas, the net is usually fished with very short scope (the ratio of warp to towing depth) to minimize actual contact with the substrate and allow the net to be quickly lifted if a hangup is sighted. The combination of short trawl warp and the large amount of floatation applied to the headropes and rib lines increases the likelihood that the net will bounce off a rock or hang that may be encountered. This avoids damage to the net. Flotation on the net body reduces potential for ripping or abrading the net on volcanic sand or rock surfaces.

Habitat type where fishery occurs: Mackerel are caught in areas with volcanic sand, rocks, and living substrates at depths of 125-200 m (410-656 ft). The fishery occurs in very discrete locations, and tows are generally made in the same locations each year. Mackerel live in a lot of areas where the fishery cannot target them.

Existing regulatory measures to mitigate effects of this fishery: The allocation of Atka mackerel TAC by the Aleutian Islands management areas (541, 542, and 543) based on the distribution of biomass as determined by resource assessment surveys, serves to spread the fishery out and reduce the impacts of spatially concentrated harvests. Furthermore, the spatial and temporal Steller sea lion closures and critical habitat catch limits restrict fishing effort and effort distribution in this fishery. A recently implemented platoon system further limits the amount of effort spatially and temporally.

BSAI Pacific Cod Longline Fishery

Description of gear used: This fishery is prosecuted with stationary lines, onto which baited hooks are attached. Vessels participating in this fishery include small to medium (<75') catcher vessels and catcher-processors (aka freezer-lingliners) that range from 90 to 200 feet in length. About 5-10 catcher vessels and 35 catcher-processors participate in the directed cod fishery. Gear components that contact the bottom include the anchors, groundline, gangions, and hooks.

For catcher vessels, anchors are two prong standard anchors weighing 50 lb, groundlines are generally constructed of 3/8 sinking line, 16" long gangions of #72 twine, and 14/0 circle hooks. Many of the catcher vessels use snap on gear with gangions spaced at 12 foot intervals. On catcher vessels, an average set consists of 12 'skates' of groundline, with each skate 300 fathoms long, for a total length of 3.5 n mi. Squid is the preferred bait. The ends of each set are anchored and marked with buoys. The lower shot (s) (33 fathoms each) of the anchor line is made of 3/4" floating poly, and the upper shot of line is made of 5/8" sinking line. Attached to the line are plastic buoys.

Catcher processors use slightly different gear: 9 mm groundline is employed with 10 to 14" gangions spaced 3 ½ feet apart, No. 6 to 14 modified "J" or full circle hooks. Most vessels use swivel gear.

Description of fishery operations: For catcher vessels, the first anchor is set and the boat steams ahead with the groundline and baited hooks being set off the stern of the boat. The set is not made in a straight line; instead the boat will steer to ensure the groundline is set in the preferred areas based on depth contour and bottom structure. The second anchor is deployed and the line is left to fish for 2-24 hours depending upon the catch rates. Upon haulback, the groundline is fed through a hauler, and the fish are stripped off the hooks.

Freezer longliner gear is normally set through autobaiting equipment, which adds tension to the groundline and this minimizes the movement of the groundline on the seafloor. Normally a GPS plotter is used to determine the exact trackline of the set, enabling the vessel to retrieve the gear without dragging it across the bottom. It is in the best interest of the fishing operation to do this in order to avoid gear damage. Generally the gear is set in a straight line, the average set being 8 miles long. Such a set would deploy 12,320 hooks at a depth of about 30 - 80 fathoms, with an occasional set as deep as 120 fathoms. Often two sets are made, parallel to one another and 1/2 - 3/4 mile apart. The total time the gear is in the water ranges from 4 to 20 hours. Vessels do not usually set back in the same place, but leapfrog. About 4 sets are made in a day. Gear is set with an anchor at each end, sometimes with an anchor in the middle of the set. Some vessels use intermediate weights of about 3 to 10 pounds, and most use swivel gear which adds weight to the line.

Habitat type where fishery occurs: The catcher vessel longling fishery occurs over gravel, cobble, and rocky bottom. In the summer, the fish are found in shallow (150-250 ft) waters, but are deeper (300-800 ft) in the winter. Catcher-processors fish over sandy/silt bottom in the Bering Sea, but over more rocky bottoms in the Aleutian Islands.

Existing regulatory measures to mitigate effects of this fishery: The sea lion closures prohibit this fishery from some nearshore areas.

BSAI Sablefish/Tubot Longline Fishery

Description of gear used: This fishery is prosecuted with stationary lines, onto which baited hooks are attached. Vessels participating in this fishery include a few small to medium (<75') catcher vessels and 35 catcher-processors (aka freezer-lingliners) ranging from 90 to 200 feet in length. Gear components that contact the bottom include the anchors, groundline, gangions, and hooks.

For catcher vessels, anchors are two prong standard anchors weighing 50 lb, groundlines are generally constructed of 3/8 sinking line, 12" long gangions of #72-#86 twine, and 13/0-14/0 circle hooks. Many of the catcher vessels use snap on gear with gangions spaced at 3-4 foot intervals. On catcher vessels, an average set consists of 20 'skates' of groundline, with each skate 100-150 fathoms long. Squid is the preferred bait. The ends of each set are anchored and marked with buoys. The lower shot (s) (33 fathoms each) of the anchor line is made of 3/4" floating poly, and the upper shot of line is made of 5/8" sinking line. Attached to the line are plastic buoys.

For freezer longliners, this fishery uses 9 mm groundline is employed with 10 to 14" gangions spaced 3 ½ feet apart, No. 6 to 14 modified "J" or full circle hooks. Most vessels use swivel gear and autobaiting equipment.

Description of fishery operations: For catcher vessels, the first anchor is set and the boat steams ahead with the groundline and baited hooks being set off the stern of the boat. The set is not made in a straight line; instead the boat will steer to ensure the groundline is set in the preferred areas based on depth contour and bottom structure. The second anchor is deployed and the line is left to fish for 2-24 hours depending upon the catch rates. Upon haulback, the groundline is fed through a hauler, and the fish are stripped off the hooks.

For freezer longliners in the turbot fishery, the gear is set in 250 – 500 fathoms of water, with most of the fishery taking place in 350 – 400 fathoms. The sets are 4 – 5 miles in length. Normally two sets are made, with subsequent sets leapfrogging. Soak time is highly variable, minimum 5 hours.

In the sablefish fishery, the freezer longliners set their gear in 150 – 600 fathoms (900-3,600 ft), with average depth of 300 – 400 fathoms (1,800-2,400 ft). The sets are 3 – 4 miles in length, leapfrogging at roughly the same depth. The freezer-longliner quota is a small part of the overall IFQ quota. The fishery is conducted in the GOA and in the BSAI. Freezer longliner halibut IFQ quota is taken as bycatch by small number of freezer longliners engaged in this fishery

Habitat type where fishery occurs: The sablefish/Greenland turbot fishery occurs over silt, muc, gravel, cobble, and rocky bottom at depths of 150 to 600 fm.

Existing regulatory measures to mitigate effects of this fishery: Sablefish is an IFQ fishery.

Bering Sea Pacific Cod Jig Fishery

Description of gear used: This fishery is prosecuted with actively fished vertical lines, onto which baited hooks are attached. Vessels participating in this fishery include small (<60') catcher vessels. Gear components include a 8 pound jig weight, a 400 lb test monofiliment mainline, and long shank 10/0 J-hooks that are looped directly onto the mainline. Vessels employ 2-4 jig machines per vessel. Hooks are dressed with colorful segments of rubber surgical tubing, and are generally baited with strips of Atka mackerel.

Description of fishery operations: The vessels look for concentrations of Pacific cod, and position their vessel to drift over the fish. The machines drop the jig weight to the bottom, and may move the jigs up and down slightly to instigate the fish into biting. Each jig machine is adjusted to haulback when there is the right amount of tension on the line (amount of fish). Machines haul up the fish, which are then removed one by one. The vessels move often to keep over fish concentrations. There is no intentional contact with the bottom although such contact may occur.

Habitat type where fishery occurs: The fishery occurs over gravel, cobble, and rocky bottom. In the summer, the fish are found around rockpiles in shallow (150-250 ft) waters, but are deeper (300-800 ft) in the winter. Jig vessels fish the area of Shulin Bank between Bishop Point and Akutan, all within 10 nm of Unalaska.

Existing regulatory measures to mitigate effects of this fishery: None.

BSAI Pacific Cod Pot Fishery

Description of gear used: The pot cod fishery is prosecuted with square pots set on single lines. In 1999, a total of 45 catcher vessels (mostly 60-125' LOA) and 5 catcher-processors (>125' LOA) participated in the fishery. The fishery begins at the end of the opilio fishery (March in recent years) and stops in April; A second season occurs during September and October (until the Bristol Bay red king crab fishery starts). Pots used in a directed cod fishery modified crab pots, which are constructed with a steel bar frame (1.25" diameter) and covered with tarred nylon mesh netting (3.5" stretched mesh). Pot sizes range from 6' to 8' square, with the average vessel using 7'x7' pots. Each pot has two tunnel openings on opposite sides, with plastic "finger" funnels to retain the fish. The pot is attached with a 6' to 8' bridle, generally constructed of 1" diameter poly line. A 30' to 60' surge, constructed of heavy duty line, is attached to the bridle. The lower shots (33 fathoms each) of line are made of 3/4" floating poly, and the upper shot of line is made of 5/8" sinking line. Attached to the line is a plastic buoy ("bag"), with an auxiliary buoy attached on a tether line.

Description of fishery operations: The average number of pots per vessel is 120. An estimated total of 6,000 pots in the fishery. The average number of days of fishing per year is 40 to 50 days. Pots are set and retrieved once every 24 hours. Pots are baited with chopped herring placed in hanging bait buckets in the center of the pot. On most vessels, the pot is set tipped into the sea with a pot launcher. The shots of line are thrown overboard, followed by the buoys, and the pot sinks to the bottom. The pot rests directly on the bottom. The pot remains stationary on the bottom until it is retrieved, generally about 24 hours later. Pots are retrieved as follows: the crewman throws a hook between the buoys to get the line. The line is fed into the hauler and the pot is brought aboard by a crane and placed on the pot hauler. Pacific cod are dumped into totes. The fish are put on ice below decks. The pots are rebaited and reset, or stored if they are being moved or it is the end of the season. There is a very small footprint in this fishery (an estimated 0.17 square mile footprint combined). The average size of a fish is 8 to 9 pounds.

Habitat type where fishery occurs: The Pacific cod pot fishery occurs primarily around the west side of Unimak Island and around Unalaska Island, on areas of mud, sand, cobble and low relief hard bottom at a depth range of 50-300 m (165-985 ft).

Existing regulatory measures to mitigate effects of this fishery: Pots require biodegradable panels, constructed of #30 cotton twine. Halibut excluder devices (rigid tunnel eye openings are no more than 9 inches wide and 9 inches high) are required. The sea lion closures prohibit this fishery from some nearshore areas.

GOA Pollock Trawl Fishery

Description of gear used: This fishery is prosecuted with primarily pelagic otter trawls rigged to fish for schooling pollock. Vessels participating in this fishery are shore-based catcher vessels between 58 and up to 125 feet and ranging in horsepower from 350 hp to 1,600. The gear includes primarily large mesh midwater trawls and to a limited extent, bottom trawls.

Mid water pelagic trawls typically have a headrope to foot rope vertical distance "rise" of 7 to 30 fathoms and a horizontal opening of 12 to 60 fathoms (wing-end spread of 18 to 80 fathoms). Typical sizes are 20 fathoms vertical and 40 fathoms horizontal and 60 fathoms wing-end spread for vessels with an average horsepower of 1,000. Wing-end spread is typically 15 percent greater than horizontal opening size. To achieve these large openings with a minimum of drag, the mesh sizes are very large and twine size relatively small. Front meshes of a large midwater net may be as large as 120 feet. Net mesh gets smaller towards the intermediate and codend, with the codend typically having 5" stretched mesh. Otter board or "doors" are used to spread the net and keep it open during towing. Doors are made of steel and range in size from 3 up to 7 square meters. Door spread in most fishing depths and trawl warp/scope combinations is typically 100 to 180 meters. Contact with the seafloor, when it occurs, is from the weight chains attached to the wing ends and/or the center section of the footrope. Long wire rope bridles attach the net to the doors. Unlike other groundfish trawl fisheries, there are no discs attached to the footropes on these trawls.

Different types of bottom trawls are used, most typically having a headrope to foot rope vertical distance "rise" of 2 to 5 fathoms. Typical foot rope length is from 90 to 120 feet. Wing-end spread is typically 12 fathoms with a 120-foot footrope. Net mesh gets smaller towards the intermediate and codend, with the codend typically having 5.5 inch stretched mesh, hung either square or diamond. Otter board or "doors" are used to spread the net and keep it open during towing. Low aspect doors are made of steel and range in size from 2.5 to 6 square meters with typical horizontal length of 6 to 9 feet and typical angle of attack is 30 to 36 degrees. High aspect doors have a typical horizontal length of 2 to 4 feet and angle of attack of 30 to 36 degrees. Bottom contact usually is about one half or less of the horizontal length of the door. Sweeps are typically 45 fathoms at 11 to 15 degrees. Contact with the seafloor is from doors, sweeps, and footropes. Sweeps are made of wire and covered with rubber bobbins and disks ranging from 2.5 to 4 inches in diameter. Footropes are covered with rubber discs and bobbins, which are 8 to 24 inches in diameter. The larger diameter bobbins are spaced at intervals of 12 to 48 inches.

A bottom trawl with headline length of 90 feet and footrope length of 120 feet weighs approximately 1,800 pounds. Footrope for same net 14 inch rockhopper disc weighs 2,100 pounds, steel components 750 pounds, rubber components 2,100 pounds, flotation 700 to 800 pounds headrope floats. Hydro dynamic affects contributes to reduced downward force.

Description of fishery operations: Sets are made on pollock schools as indicated by electronics. When set, the net is unwound from a net reel, the sweeps attached, then the doors attached. Wire cable, attached to each door, is let out, and the winches are tightened. Tow duration in this fishery is typically 3 hours, ranging from 2 to 12 hours depending upon catch rates, at a speed of 2.5 to 4 knots. Typically, this is done 2 to 3 times a day with the number of tows depending on catch rates. Tows may be in a straight line or adjusted to curve around depth contours, or avoid location of 'hangs' and fixed gear, or pushed by current, or for other reasons. Quite often, vessels will turn around 180 degrees while towing, making several passes in the same general area. The rough substrate in the Gulf of Alaska would damage mid-water nets, creating an incentive to avoid touching the bottom. In addition, the characteristic of the narrow shelf create conditions where the pollock are often found up in the water column. At haulback, the setting procedure is reversed, and the codend is dumped into the fish hold below decks.

The fishery occurs in four quarterly seasons and further is broken out into five separate management areas. There are standdown periods of no fishing between the quarterly seasons. Catch rates are generally higher during the winter roe season due to spawning aggregations. There are currently significant numbers of closed areas due to steller sea lion protection measures, which have altered fishing. The fishery has also changed over time due to State water closures to nonpelagic nets, Inshore/offshore allocations, steller sea lions mitigation measures, the American Fisheries Act, and a gradual increases in fishing capability.

Habitat type where fishery occurs: Pollock are generally ubiquitous throughout their gulf range. Pollock tend to aggregate and fishery generally occurs in areas with sand, sandy silt, muddy bottom, and pelagically over hard rocky bottoms at depths of 60 to 500 meters. Water depth may be greater than the depth at which fishery occurs. Pollock may aggregate to spawn, to feed, and to breed, and in relation to water temperature.

Existing regulatory measures to mitigate effects of this fishery: Some areas are closed to bottom trawling and/or all trawling, and there are season closures as well. Vessel size in this fishery is limited to 125 feet, with three hundred thousand pounds trip limits and no tendering allowed.

GOA Pacific Cod Trawl Fishery

Description of gear used: The inshore fishery is prosecuted by nonpelagic bottom trawls. Vessels participating in this fishery are shore-based catcher vessels between 58 and up to 125 feet and ranging in horsepower from 350 hp to 1,600 hp. The gear used includes many different types of bottom trawls, most typically having a headrope to foot rope vertical distance "rise" of 2 to 5 fathoms. Typical foot rope length is from 90 to 120 feet. Wing-end spread is typically 12 fathoms with a 120-foot footrope. Net mesh gets smaller towards the intermediate and codend, with the codend typically having 5.5 to –8-inch stretched mesh, hung either square or diamond. Otter board or "doors" are used to spread the net and keep it open during towing. Low aspect doors are made of steel and range in size from 2.5 to 6 square meters with typical horizontal length of 6 to 9 feet and typical angle of attack is 30 to 36 degrees. High aspect doors have a typical horizontal length of 2 to 4 feet and angle of attack of 30 to 36 degrees. Bottom contact usually is about one half or less of the horizontal length of the door. Sweeps are typically 45 fathoms at 11 to 15 degrees. Contact with the seafloor is from doors, sweeps, and footropes. . Sweeps are made of wire and covered with rubber bobbins and disks ranging from 2.5 to 4 inches in diameter. Footropes are covered with rubber discs and bobbins, which are 8 to 24 inches in diameter. The larger diameter bobbins are spaced at intervals of 12 to 48 inches.

The offshore fishery is prosecuted by nonpelagic bottom trawls. Vessels participating in this fishery are catcher processors between 98 and 200 feet LOA, with a horsepower from 900 to 3,500 hp. The gear used includes many different types of bottom trawls, most typically having a headrope to foot rope vertical distance "rise" of 2 to 5 fathoms. Typical foot rope length is from 120 to 190 feet. Net mesh gets smaller towards the intermediate and codend, with the codend typically having 5.5 to 8-inch stretched mesh, hung either square or diamond. Otter board or "doors" are used to spread the net and keep it open during towing. Low aspect doors are made of steel and range in size from 5.5 to 9 square meters with typical horizontal length of 9 to 12 feet and typical angle of attack is 30 to 36 degrees. High aspect doors have a typical horizontal length of 4 to 8 feet and angle of attack of 30 to 36 degrees. Bottom contact usually is about one half or less of the horizontal length of the door. Door spread is typically 45 fathom sweeps at 11 to 15 degrees. Contact with the seafloor is from doors, sweeps, and footropes. Sweeps are made of wire and covered with rubber bobbins and disks ranging from 2.5 to 4 inches in diameter. Footropes are covered with rubber discs and bobbins, which are 8 to 24 inches in diameter. The larger diameter bobbins are spaced at intervals of 12 to 48 inches.

A bottom trawl with headline length of 90 feet and footrope length of 120 feet weighs approximately 1,800 pounds. Footrope for same net 14 inch rockhopper disc weighs 2,100 pounds, steel components 750 pounds, rubber components 2,100 pounds, flotation 700 to 800 pounds headrope floats. Hydro dynamic affects contributes to reduced downward force.

Description of fishery operations: Sets are made on cod schools as indicated by electronics. Fishing predominantly occurs during daylight hours. When set, the net is unwound from a net reel, the sweeps attached, then the doors attached. Wire cable, attached to each door, is let out, and the winches are tightened. Tow duration in this fishery is variable, ranging from 1 to 4 hours depending upon catch rates, at a speed of 2.5 to 4 knots. Typically, this is done 2 to 3 times a day with the number of tows depending on catch rates. Catcher processors may occasionally make more tows per day to keep onboard factories operating. Tows may be in a straight line or adjusted to curve around depth contours, or avoid location of 'hangs' and fixed gear, or pushed by current, or for other reasons. Quite often, vessels will turn around 180 degrees while towing, making several passes in the same general area. The rough substrate in the Gulf of Alaska damages nets, creating an incentive to avoid rough bottom. At haulback, the setting procedure is reversed, and the codend is dumped into the fish hold below decks.

The fishery occurs in two seasons and further is broken out into four separate management areas. There is no directed fishing for cod from November 1 to January 20 and between the two seasons there is no directed fishing. Catch rates are generally higher during the winter due to spawning aggregations. There are currently significant numbers of closed areas due to steller sea lion protection measures, which have altered fishing. The fishery has also changed over time due to State water closures to nonpelagic nets, management of a State water Pacific cod fishery, Inshore/offshore allocations, Steller sea lions mitigation measures, the American Fisheries Act, and a gradual increases in fishing capability.

Habitat type where fishery occurs: Pacific cod tend to aggregate in areas with sand, sandy mud, cobble, and gravel, at depths of 100 to 600 feet.

Existing regulatory measures to mitigate effects of this fishery: Some areas are closed to bottom trawling and/or all trawling, and there are season closures as well. Size of catcher vessels is limited to 125 feet.

GOA Deepwater Flatfish Trawl Fishery

Description of gear used: Target species for this fishery include rex sole, Dover sole, arrowtooth flounder and other deepwater flatfish. This fishery is prosecuted by nonpelagic bottom trawls. Vessels participating in this fishery are shore-based catcher vessels between 58 and up to 125 feet and ranging in horsepower from 350 hp to 1,600 hp. Typically less than 20 vessels participate in this fishery.

Catcher vessels use many different types of bottom trawls, most typically having a headrope to foot rope vertical distance "rise" of 2 to 5 fathoms. Typical foot rope length is from 90 to 120 feet. Wing-end spread is typically 12 fathoms with a 120-foot footrope. Net mesh gets smaller towards the intermediate and codend, with the codend typically having 4.5 to 5-inch stretched mesh, hung either square or diamond. Codends have sacrificial 'chafing gear' (usually polyethylene fiber) attached to the bottom and sides to protect them from damage on the stern ramp. Otter board or "doors" are used to spread the net and keep it open during towing.

Low aspect doors are made of steel and range in size from 2.5 to 6 square meters with typical horizontal length of 6 to 9 feet and typical angle of attack is 30 to 36 degrees. High aspect doors have a typical horizontal length of 2 to 4 feet and angle of attack of 30 to 36 degrees. Bottom contact usually is about one half or less of the horizontal length of the door. Door spread is typically 60 to 100 fathom sweeps at 11 to 13 degrees. Contact with the seafloor is from doors, sweeps, and footropes. Sweeps are made of wire and covered with rubber bobbins and disks ranging from 2.5 to 4 inches in diameter. Footropes are covered with rubber discs and bobbins, which are 8 to 24 inches in diameter. The larger diameter bobbins are spaced at intervals of 12 to 48 inches.

Catcher processors also participate in this fishery with nonpelagic bottom trawls. Vessels participating in this fishery are catcher processors between 98 and 200 feet LOA, with a horsepower from 900 to 3,500 hp. Typically six catcher processors are involved in this fishery. The gear used includes many different types of bottom trawls, most typically having a headrope to foot rope vertical distance "rise" of 2 to 5 fathoms. Typical foot rope length is from 120 to 190 feet. Net mesh gets smaller towards the intermediate and codend, with the codend typically having 4.5 to 5-inch stretched mesh, hung either square or diamond. Codends have sacrificial 'chafing gear' (usually polyethylene fiber) attached to the bottom and sides to protect them from damage on the stern ramp. Otter board or "doors" are used to spread the net and keep it open during towing. Low aspect doors are made of steel and range in size from 5.5 to 9 square meters with typical horizontal length of 9 to 12 feet and typical angle of attack is 30 to 36 degrees. High aspect doors have a typical horizontal length of 4 to 8 feet and angle of attack of 30 to 36 degrees. Bottom contact usually is about one half or less of the horizontal length of the door. Door spread is typically 60 to 100 fathom sweeps at 11 to 13 degrees. Contact with the seafloor is from doors, sweeps, and footropes. Sweeps are made of wire and covered with rubber bobbins and disks ranging from 2.5 to 4 inches in diameter. Footropes are covered with rubber discs and bobbins, which are 8 to 24 inches in diameter. The larger diameter bobbins are spaced at intervals of 12 to 48 inches.

A bottom trawl with headline length of 90 feet and footrope length of 120 feet weighs approximately 1,800 pounds. Footrope for same net 14 inch rockhopper disc weighs 2,100 pounds, steel components 750 pounds, rubber components 2,100 pounds, flotation 700 to 800 pounds headrope floats. Hydro dynamic affects contributes to reduced downward force.

Description of fishery operations: When set, the net is unwound from a net reel, the sweeps attached, then the doors attached. Wire cable, attached to each door, is let out to a distance of approximately 3 times the depth, and the winches are tightened. To duration in this fishery is about 3 hours, at a speed of 2.5 to 3.5 knots. Tows may be in a straight line or adjusted to curve around depth contours, or avoid location of 'hangs' and fixed gear, or pushed by current, or other reasons. At haulback, the setting procedure is reversed, and the codend is dumped into the fish hold below decks.

A design objective for modern flatfish nets is to fish the net with minimum bottom contact, to reduce gear damage and drag and to maintain the quality of the catch. Ideally, only the doors, sweeps and footrope bobbins will touch the bottom, and these will only touch enough to ensure fish are herded into the trawl. Any increase in bottom contact increases the drag of the system, causing a reduction in towing speed and/or an increase in fuel consumption along with an increased risk of damage to the gear. Additionally, more bottom contact can cause sand to mix with the catch, which increases processing cost and decreases the value of the product.

The fishing seasons are driven by the quarterly halibut PSC apportionments. Typically, the fishery primarily occurs in April and May because of higher catch rates and better prices. The deepwater flatfish fishery has also changed over time due to State water closures to nonpelagic nets, the American Fisheries Act, market conditions, and a gradual increases in fishing capability.

Habitat type where fishery occurs: In the spring, the fish tend to aggregate in areas with sand, sandy silt, cobble, gravel, and muddy bottom at depths of 70 to 300 fathoms.

Existing regulatory measures to mitigate effects of this fishery:

GOA Shallow Water Flatfish Trawl Fishery

The shallow water flatfish fishery targets rock sole and flathead sole using nonpelagic bottom trawls. Catcher vessels participating in this fishery are shore-based catcher vessels between 58 and up to 125 feet and ranging in horsepower from 350 hp to 1,600 hp. Typically less than 25 vessels participate in this fishery.

The gear used by catcher vessels includes many different types of bottom trawls, most typically having a headrope to foot rope vertical distance "rise" of 2 to 5 fathoms. Typical foot rope length is from 90 to 120 feet. Wing-end spread is typically 12 fathoms with a 120-foot footrope. Net mesh gets smaller towards the intermediate and codend, with the codend typically having 5 to 6-inch stretched mesh, hung either square or diamond. Codends have sacrificial 'chafing gear' (usually polyethylene fiber) attached to the bottom and sides to protect them from damage on the stern ramp. Otter board or "doors" are used to spread the net and keep it open during towing. Low aspect doors are made of steel and range in size from 2.5 to 6 square meters with typical horizontal length of 6 to 9 feet and typical angle of attack is 30 to 36 degrees. High aspect doors have a typical horizontal length of 2 to 4 feet and angle of attack of 30 to 36 degrees. Bottom contact usually is about one half or less of the horizontal length of the door. Sweep lengths are typically 60 to 100 fathom at 11 to 13 degrees. Contact with the seafloor is from doors, sweeps, and footropes. Sweeps are made of wire and covered with rubber bobbins and disks ranging from 2.5 to 4 inches in diameter. Footropes are covered with rubber discs and bobbins, which are 8 to 24 inches in diameter. The larger diameter bobbins are spaced at intervals of 12 to 48 inches.

Catcher processors also participate in the shallow water flatfish fishery. Vessels participating in this fishery are catcher processors between 98 and 185 feet LOA, with a horsepower from 900 to 3,200 hp. Typically five catcher processors are involved in this fishery. The gear used includes many different types of bottom trawls, most typically having a headrope to foot rope vertical distance "rise" of 2 to 5 fathoms. Typical foot rope length is from approximately 90 to 130 feet. Net mesh gets smaller towards the intermediate and codend, with the codend typically having 5.5 to 7-inch stretched mesh, hung either square or diamond. Codends have sacrificial 'chafing gear' (usually polyethylene fiber) attached to the bottom and sides to protect them from damage on the stern ramp. Otter board or "doors" are used to spread the net and keep it open during towing. Low aspect doors are made of steel and range in size from 4.5 to 6 square meters with typical horizontal length of 6 to 9 feet and typical angle of attack is 30 to 36 degrees. High aspect doors have a typical horizontal length of 3 to 5 feet and angle of attack of 30 to 36 degrees. Bottom contact usually is about one half or less of the horizontal length of the door. Sweep lengths are typically 60 to 100 fathom at 11 to 13 degrees. Contact with the seafloor is from doors, sweeps, and footropes. Sweeps are made of wire and covered with rubber bobbins and disks ranging from 2.5 to 4 inches in diameter. Footropes are covered with rubber discs and bobbins, which are 8 to 24 inches in diameter. The larger diameter bobbins are spaced at intervals of 12 to 48 inches

A bottom trawl with headline length of 90 feet and footrope length of 120 feet weighs approximately 1,800 pounds. Footrope for same net 14 inch rockhopper disc weighs 2,100 pounds, steel components 750 pounds, rubber components 2,100 pounds, flotation 700 to 800 pounds headrope floats. Hydro dynamic affects contributes to reduced downward force.

Description of fishery operations: When set, the net is unwound from a net reel, the sweeps attached, then the doors attached. Wire cable, attached to each door, is let out to a distance of approximately 3 times the depth, and the winches are tightened. Tow duration in this fishery is about 3 hours, at a speed of 2 to 3 knots. Tows may be in a straight line or adjusted to curve around depth contours, or avoid location of 'hangs' and fixed gear, or pushed by current, or other reasons. At haulback, the setting procedure is reversed, and the codend is dumped into the fish hold below decks. Catcher vessels sort catch on deck.

A design objective for modern flatfish nets is to fish the net with minimum bottom contact, to reduce gear damage and drag and to maintain the quality of the catch. Ideally, only the doors, sweeps and footrope bobbins will touch the bottom, and these will only touch enough to ensure fish are herded into the trawl. Any increase in bottom contact increases the drag of the system, causing a reduction in towing speed and/or an increase in fuel consumption along with an increased risk of damage to the gear. Additionally, more bottom contact can cause sand to mix with the catch, which increases processing cost and decreases the value of the product.

The fishing seasons are driven by the quarterly halibut PSC apportionments. There are approximately 7 months of fishing occurring between January and November. The shallow water flatfish fishery has also changed over time due to State water closures to nonpelagic nets, the American Fisheries Act, market conditions, and a gradual increases in fishing capability.

Habitat type where fishery occurs: The fish tend to aggregate in areas with sand, sandy silt, and gravel at depths of 15 to 40 fathoms.

Existing regulatory measures to mitigate effects of this fishery: There are numerous State water closures to nonpelagic gear. Kodiak red king crab trawl closure areas include shallow water flatfish habitat.

GOA Slope Rockfish Trawl Fishery

The slope rockfish fishery is prosecuted by both bottom and pelagic trawls, targeting Pacific ocean perch (POP), northern rockfish, and other pelagic rockfish. Vessels participating in this fishery are shore-based catcher vessels between 70 to 125 feet and ranging in horsepower from 600 hp to 1,600 hp. Typically less than 30 vessels participate in this fishery. The pelagic trawls used for rockfish are generally used to target POP. Mid water configuration is similar to pelagic pollock net, only smaller.

Bottom trawls used in this fishery are rigged to fish over generally rougher substrates. The gear used is a four seam otter trawl and a headrope to foot rope vertical distance "rise" of about 4 to 6 fathoms (24 to 36 feet). Nets are made of polyethylene. Net mesh is 8-inch diamond in the wings and forward belly and 5.5-inch diamond in the intermediate and codend. Double meshes may be used in the codend, and the codend is equipped with chafing gear. Otter board or "doors" are used to spread the net and keep it open during towing. Doors are made of steel and range in size from 3.5 to 6 square meters. Door spread is a function of sweep lengths and angle of attack. Contact with the seafloor is predominantly from doors, bridles, and bobbins. Rockfish nets are designed to stay off the bottom as much as possible by employing numerous floats to buoy the net body and codend. Bridles are made of steel cable, and are generally 90 feet long on each side. Footropes are designed to keep the net off the bottom and may utilize tire gear, large disk tires (24-inch diameter airplane tires), 14- to 18-inch discs or bobbins, or a combination of these. Footropes typically extend from 90 to 120 feet. Steel cable and chain used for the footrope runs through bobbins or discs spaced at intervals of 24 inches or tires grouped together at the bosum, which is the center 10 to 20 feet. Flotation on the net head rope and riblines provides lift to reduce unnecessary drag and increase towing efficiency and performance.

Catcher processors also participate in this fishery using both bottom and pelagic trawls. Vessels participating in this fishery are catcher processors between 125 and up to 295 feet and ranging in horsepower from 1,200 hp to 6,000 hp. Typically 10 vessels participate in this fishery. The gear used is a four seam otter trawl and a headrope to foot rope vertical distance "rise" of about 4 to 10 fathoms. Nets are made of poly or spectra. Net mesh is 8 inch diamond in the wings and forward belly and 5.5-inch diamond in the intermediate and codend. Double meshes may be used in the codend, and the codend is equipped with chafing gear. Otter board or "doors" are used to spread the net and keep it open during towing. Doors are made of steel and range in size from 6.5 to 12 square meters. Angle of attack ranges from 30 to 36 degrees. Doors typically employ 4-inch wide door shoes. Door spread in most fishing depths and trawl warp/scope combinations is typically 40 to 45 meters. Contact with the seafloor is predominantly from doors, bridles, footropes, and to a lesser extent from the codend. Rockfish nets are designed to stay off the bottom as much as possible by employing numeroust poly floats to buoy the net body and codend. Bridles are made of steel cable, and are generally 90 to 180 feet long on each side. Footropes are designed to keep the net off the bottom by utilizing tire gear, large disk tires (24-inch diameter airplane tires), or 21-inch discs. Footropes typically extend 100 to 200 feet. Steel cable and chain used for the footrope runs through 18 to 21-inch diameter bobbins and disks spaced intervals of 6 inches. Flotation on the net head rope provides lift to the footrope to reduce unnecessary drag and increase towing efficiency and performance.

A bottom trawl with headline length of 90 feet and footrope length of 120 feet weighs approximately 1,800 pounds. Footrope for same net 14 inch rockhopper disc weighs 2,100 pounds, steel components 750 pounds, rubber components 2,100 pounds, flotation 700 to 800 pounds headrope floats. Hydro dynamic affects contributes to reduced downward force.

Description of fishery operations: When set, the net is unwound from a net reel, the sweeps attached, then the doors attached. Wire cable, attached to each door, is let out to a minimum distance necessary to achieve the fishing depth. The tow duration in this fishery is about 1 to 4 hours, at a speed of 3 to 4 knots. Tows are adjusted to curve around depth contours, or avoid location of 'hangs' and fixed gear. At haulback, the setting procedure is reversed, and the codend is dumped into the fish hold below decks. The tows in the rockfish fishery have more intermittent bottom contact compared to the other bottom trawl fisheries due to the nature of substrate and fish behaviors.

Because rockfish is fished over rough bottom adjacent to areas with large potential for hangs in some areas, the net is usually fished with very short scope (the ratio of warp to towing depth) to minimize actual contact with the substrate and allow the net to be quickly lifted if a hangup is sighted. The combination of short trawl warp and the large amount of floatation applied to the headropes and rib lines increases the likelihood that the net will bounce off a rock or hang that may be encountered. This avoids damage to the net. Flotation on the net body reduces potential for ripping or abrading the net on volcanic sand or rock surfaces.

The rockfish season opens in early July and ends by the first week of August. POP is usually a 2-week fishery and is followed by the Northern and pelagic shelf rockfish fisheries which ends by late July. The rockfish are caught along the narrow slope area of the shelf break. The rockfish fishery has also changed over time due to the trawl closure in Southeast Alaska, the American Fisheries Act, market conditions, gradual increases in fishing capability, and increased effort since 1996

Habitat type where fishery occurs: The POP fishery occurs over sand, gravel, and mud in 90 to 200 fathoms. The Northern and pelagic shelf rockfish fisheries occur over rock, gravel, and hard sand at depth of 40 to 80 fathoms.

Existing regulatory measures to mitigate effects of this fishery: The Southeast Alaska trawl closure contains vast amount of habitat for slope rockfish.

GOA Sablefish Longline Fishery

Description of gear used: This fishery is prosecuted with stationary lines, onto which baited hooks are attached. Vessels participating in this fishery include small (<60') and medium (60-90') catcher vessels and catcher-processors (aka freezer-lingliners) of small (<60'), medium (60-90') and a few large (>125') size vessels. Gear components that contact the bottom include the anchors, groundline, gangions, and hooks. For catcher vessels, anchors are two prong standard anchors weighing 50 lb, groundlines are generally constructed of 3/8 sinking line, 12" long gangions of #72-#86 twine, and 13/0-14/0 circle hooks. Catcher vessels generally use stuck gear (not snap on) with gangions spaced at 3-4 foot intervals. On catcher vessels, an average set consists of 15-30 'skates' of groundline, with each skate 100-150 fathoms long, for an average length of about 3 n mi. Squid is the preferred bait. The ends of each set are anchored and marked with buoys. Intermediate weights are used to minimize the movement of groundline across the bottom. The lower shot (s) (33 fathoms each) of the anchor line is made of 3/4" floating poly, and the upper shot of line is made of 5/8" sinking line. Attached to the line are plastic buoys and flag poles.

Description of fishery operations: The first anchor is set and the boat steams ahead with the groundline and baited hooks being set off the stern of the boat. The set are generally made in a straight line; with some deviation to ensure the groundline is set in the preferred areas based on depth contour and bottom structure. The second anchor is deployed and the line is left to fish for 6-24 hours depending upon the catch rates. Upon haulback, the groundline is fed through a hauler, and the fish are stripped off the hooks.

Since 1995 fishery occurs over an 8 month season opening March 15th and closing November 15th.

Habitat type where fishery occurs: The sablefish longline fishery occurs over gravel, cobble, and mud bottom at depths of 400 to >1000 m. This fishery is often a mixed halibut/sablefish fishery, with shortraker, rougheye, and thornyhead rockfish also taken.

Existing regulatory measures to mitigate effects of this fishery: Sablefish is an IFQ fishery which has reduced number of vessels, reduced crowding, gear conflicts and gear loss, and increased efficiency.

GOA Southeast Demersal Shelf Rockfish Longline Fishery

Description of gear used: Less than 20 vessels participate in this fishery. This fishery is prosecuted with stationary lines, onto which baited hooks are attached. The dominant species in this fishery is yelloweye rockfish (90%), with lesser catches quillback rockfish and several other rockfish species. Vessels participating in this fishery include few small to medium (<75') catcher vessels. Gear components that contact the bottom include the anchors, groundline, gangions, and hooks. For catcher vessels, anchors are two prong standard anchors weighing 30 to 50 lbs, groundlines are generally constructed of 3/8 sinking line, 12" long gangions of #72-, and 10/0-13/0 circle hooks. Many of the catcher vessels use snap on gear with gangions spaced at 3-4 foot intervals. On catcher vessels, an average set consists of 10 'skates' of groundline, with each skate 100-150 fathoms long, for a total length of one nautical mile. Both herring and squid are used for bait. The ends of each set are anchored and marked with buoys. The lower shot (s) (33 fathoms each) of the anchor line is made of 3/4" floating poly, and the upper shot of line is made of 5/8" sinking line. Attached to the line are plastic buoys (floats) to mark the gear.

Description of fishery operations: The first anchor is set and the boat steams ahead with the groundline and baited hooks being set off the stern of the boat. The set is generally made in a straight line; with some deviation to ensure the groundline is set in the preferred areas based on depth contour and bottom structure. Intermediate weights are used to minimize the movement of the groundline across the bottom. The second anchor is deployed and the line is left to fish for 2 to 12 hours depending upon the catch rates. Upon haulback, the groundline is fed through a hauler, and the fish are stripped off the hooks.

The fishery opens November 15th and generally lasts 1 to 2 weeks and reopens January 1st, again lasting 1 to 2 weeks.

Habitat type where fishery occurs: The demersal shelf rockfish directed longline fishery occurs in Southeast Alaska over bedrock and rocky bottoms at depths of 75 m to >200 m (246 to over 656 feet).

Existing regulatory measures to mitigate effects of this fishery: The fishery is managed by Alaska Department of Fish and Game (ADFG). There is no directed trawl fishing. The Sitka Pinnacles Marine Reserve includes areas important to demersal shelf rockfish, other rockfish species, and lingcod.

GOA Pacific Cod Longline Fishery

Description of Gear Used: This fishery is prosecuted by numerous catcher vessels (ranging from 30 to 60 feet in length) and less than 10 freezer longliners (catcher-processors) from 58 to 125 feet in length. Freezer longliners use 9 mm groundline employed with 10 to 14" gangions spaced 3 ½ feet apart, and No. 6 to 14 modified "J" or full circle hooks. Most vessels use swivel gear and set through autobaiting equipment. For catcher vessels, the gear is similar to as described above except generally hand-baited and sets are shorter in length (1 to 3 miles). Sets are weighted to minimize movement of the groundline on the sea floor. Sets are anchored at each end with an anchor weighing 30 to 60 pounds. Many of these vessels use snap-on gear with 5/16 groundline. Circle hooks are typically used and spaced 36 to 42 inches apart. Gear components that contact the bottom include the anchors, groundlines, intermediate weights, gangions, and hooks. Two to four sets are made each day.

Description of Fishery Operations: Freezer longliner gear is normally set through autobaiting equipment, which adds tension to the groundline and this minimizes the movement of the groundline on the seafloor. Normally a GPS plotter is used to determine the exact trackline of the set, enabling the vessel to retrieve the gear without dragging it across the bottom. It is in the best interest of the fishing operation to do this in order to avoid gear damage. Gear components that contact the bottom include the anchors, groundlines, intermediate weights, gangions, and hooks. Generally the gear is set in a straight line, the average set being 8 miles long. Sets are anchored at both ends with an anchor weighing 60 to 90 pounds. Such a set would deploy 12,320 hooks at a depth of about 30 to 80 fathoms, with an occasional set as deep as 120 fathoms.

Often two sets are made, parallel to one another and 1/2 to 3/4 mile apart. The total time the gear is in the water ranges from 4 to 20 hours. Vessels do not usually set back in the same place, but leapfrog. About 4 sets are made in a day. Gear is set with an anchor at each end, sometimes with an anchor in the middle of the set. Some vessels use intermediate weights of about 3 to 10 pounds, and most use swivel gear which adds weight to the line.

For catcher vessels, sets are marked at each end with flag pole and buoys, which are attached by bouy line to the first anchor. The first anchor is set and the boat steams ahead with the groundline and baited hooks being set off the stern of the boat. The set is generally made in a straight line; with some deviation to ensure the groundline is set in the preferred areas based on depth contour and bottom structure. The second anchor is deployed and the line is left to fish for 2 to 16 hours depending upon the catch rates. Upon haulback, the groundline is fed through a hauler, and the fish are stripped or taken off the hooks. The cod fishery may also take halibut as bycatch.

The cod longline fishery generally occurs in Western and Central Gulf of Alaska, opening on January 1st and lasting until early March. The fishery is sometimes curtailed by halibut PSC.

Habitat type where fishery occurs: The fishery occurs over gravel, cobble, mud, sand, and rocky bottom, in depths of 25 fathoms to 140 fathoms (150 to 840 feet).

Existing regulatory measures to mitigate effects of this fishery: Stellar sea lion closures have effected this fishery. The location of catcher vessel fishery changed from Cook Inlet to waters adjacent to Kodiak Island. In the past few years, there has been an increase in small "pocket" freezer longline effort in western gulf.

GOA Cod Jig Fishery

Description of gear used: This fishery is prosecuted with actively fished vertical lines, onto which baited hooks are attached. Vessels participating in this fishery include small (<60') catcher vessels. Gear components include a 8 pound jig weight, a 400 lb test monofiliment mainline, and long shank 10/0 J-hooks or 10/0 circle hooks that are looped directly onto the mainline. Vessels employ 2-4 jig machines per vessel. Hooks are dressed with colorful segments of rubber surgical tubing, hoochies, and may be baited with strips of herring or other fish.

Description of fishery operations: The vessels look for concentrations of Pacific cod, and position their vessel to drift over the fish, and may occasionally anchor. The machines drop the jig weight to the bottom, and may move the jigs up and down slightly to instigate the fish into biting. Each jig machine is adjusted to haulback when there is the right amount of tension on the line (amount of fish). Machines haul up the fish, which are then removed one by one. The vessels move often to keep over fish concentrations. The fishery opens January 1st and closes in early March due the quota being taken. A state managed fishery occurs in state waters.

Habitat type where fishery occurs: The fishery occurs over gravel, cobble, sand, mud, and rocky bottom. In the spring and summer, the fish are found nearshore in shallow (5 to 40 fathoms) waters, but are deeper (40-60 fathoms) in the winter. Jig vessels fish primarily from the ports of Homer and Kodiak. Black rockfish is a common "top-off" target species for this fishery.

Existing regulatory measures to mitigate effects of this fishery: None.

GOA Pacific Cod Pot Fishery

Description of gear used: The GOA pot cod fishery is prosecuted with square pots set on single lines. Vessels used in the inshore fishery are all catcher vessels of small (< 60' LOA) and medium size (60-125' LOA). The offshore fishery includes some catcher processors ranging from 90 to over 125 feet. The fishery begins on January 1st and concludes in early March. Pots used in a directed cod fishery modified crab pots, which are constructed with a steel bar frame (1.25" diameter) and covered with tarred nylon mesh netting (3.5" stretched mesh). Pot sizes range from 6' to 8' square, with the average vessel using 6'x6' pots. Each pot has two or three tunnel openings on opposite sides, with plastic "finger" funnels to retain the fish. The tunnel eye cannot be greater than 9 inches in any one dimension. The pot is attached with a 6' to 8' bridle, generally constructed of 1" diameter poly line. A 30' to 60' surge, constructed of heavy duty line, is attached to the bridle. The lower shots (33 fathoms each) of line are made of 3/4" floating poly, and the upper shot of line is made of 5/8" sinking line. Attached to the line is a plastic buoy ("bag"), with a an auxillary buoy attached on a tether line.

Description of fishery operations: Approximately 100 boats participate in this fishery. Pots are baited with chopped herring placed in hanging bait buckets or sacks in the center of the pot. On most vessels, the pot is set tipped into the sea with a pot launcher. The shots of line are thrown overboard, followed by the buoys, and the pot sinks to the bottom. The pot rests directly on the bottom. The pot remains stationary on the bottom (except during extreme weather) until it is retrieved, generally about 12 to 48 hours later. Pots are retrieved as follows: the crewman throws a hook between the buoys to get the line. The line is fed into the hauler and the pot is brought aboard by a crane or picking boom and placed on the pot launcher. Pacific cod are dumped into totes and bled. The fish are put on ice or into RSW tanks below decks. The pots are rebaited and reset, or stored if they are being moved or it is the end of the season. The fishery opens January 1st and is closed in early March due to quota being taken. There is a state managed fishery in state waters.

Habitat type where fishery occurs: The GOA Pacific cod pot fishery occurs primarily in the waters of Central and Western Gulf, including Cook Inlet and Prince William Sound on areas of sand, mud, rock, gravel, and cobble at depths of 25 to 140 fathoms (150 to 840 feet). Fish are usually found shallower in the summer and deeper in the winter.

Existing regulatory measures to mitigate effects of this fishery: Pots require biodegradable panels, constructed of #30 cotton twine. The sea lion closures prohibit this fishery from some nearshore areas.

Draft

Agenda C-8 Item (a)(1)
APRIL 2002

EFH SEIS
Discussion Paper
Criteria for Determining Minimal and Temporary Impacts
Alaska Fisheries Science Center

Background

From the final regulations on essential fish habitat (EFH): "Councils must act to prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable, if there is evidence that a fishing activity adversely affects EFH in a manner that is more than minimal and not temporary in nature based on" an evaluation of each fishery and/or "the cumulative impact analysis". In addition "it is not appropriate to require definitive proof of a link between fishing impacts to EFH and reduced stock productivity before Councils can take action". Cumulative impacts mean that Councils must act if present fishing activities "when added to other past, present, and reasonable foreseeable future actions" result in adverse effects.

The North Pacific Fishery Management Council's EFH Committee has asked scientists of the Alaska Fisheries Science Center to provide guidance on criteria for the terms minimal and temporary. To construe the appropriate use of these terms, we will review their context in the regulations and supporting documents, assess the types and level of knowledge available to make evaluations and generate likely examples to explore how the regulations and knowledge can be related.

To set the initial context, EFH is defined as those aquatic areas and their associated physical, chemical, and biological properties, as well as sediment, hard bottom, structures underlying the waters, and associated biological communities, required by a managed species over its full life cycle for spawning, breeding, feeding, or growth to maturity, to support a sustainable fishery and the species' contribution to a healthy ecosystem. The definition of adverse effects (those that require council action) is any impact that reduces the quality and/or quantity of EFH in a manner that is more than minimal and not temporary in nature. This clarifies that an effect must be **both** more than minimal and not temporary to require council action. To restate, effects which are either minimal or temporary do not require action. The final rule also specifically mentions that adverse effects may include loss of or injury to benthic organisms, prey species and their habitats, and modification of other ecosystem components.

The preamble to the final EFH rule provided some more specific guidance on the usage of minimal and temporary in response 14B: "Temporary impacts are those that are limited in duration and that allow the particular environment to recover without measurable impact. Minimal impacts are those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions." It is somewhat confusing that the writer of this comment used the word 'environment' instead of habitat or EFH in these descriptions. It is made clear in several other responses and in the regulations themselves that this law protects the habitats of managed species, not directly protecting the environment as a whole, though it will certainly benefit.

Defining temporary

"Temporary impacts are those that are limited in duration and that allow the particular environment to recover without measurable impact."

The use of words "limited duration and that allow....." implies that for an impact to be temporary the effect must be both of limited duration and allow the particular environment to recover. The words "limited duration" may need to be defined. Does an impact that lasts 50 days each year qualify as limited although on a cumulative basis it would be longer? Since cumulative impacts are to be considered, many fisheries impacts off Alaska would not be considered of limited duration. The assessment of fishing effects will change considerably if viewed over days, years, or decades. For practical use, a time scale needs to be selected that is not so short that natural recovery processes are not considered and not so long that persistent and cumulative effects are ignored.

Two possible views of "allow the particular environment to recover"

1) If the standard is recovery in the absence of fisheries, then the issue is whether there is damage to the potential for the environment to recover without measurable impact over a long period without fisheries. In this case, councils do not have to act to minimize effects unless changes are irreversible at some time scale. In the extreme for example, Council action would not be required even if fisheries radically altered the entire continental shelf, as long as sufficient seed populations of all species existed to eventually repopulate the region, given a long enough time without a fishery. The 'minimal' standard would only come into play if such a recovery could not be completely made and if the remaining effects were not small and were significant to ecological functions.

2) A sustained fishery can be considered a 'permanent' feature and hence present during any recovery period. The issue then becomes whether the effect of the fishery, allows the environment to recover without measurable impact. If an impact makes the quality or quantity of EFH measurably different between the start of one cycle (year) and the next, its effects are certainly not temporary. Even if the environment recovers between impact events there can be non-temporary impacts. That is, the life cycle of the fish population or habitat forming biota in relation to the time frame of recovery needs to be considered. For example, take a fishery that is conducted during a compressed time period and occurs every year at this same time. Even if recovery is complete, say at 100 days, there still can be non-temporary impacts because impacted habitat features may be seasonally essential to a species within the 100 day recovery period.

We believe that viewpoint 2) is the objective of the rule. If the rule had said, "temporary impacts are those that are limited in duration and maintain the potential of environment to recover without measurable impact." then viewpoint 1) would be appropriate.

Duration and measurability of impacts

In determining whether an effect is measurable, it should be necessary to distinguish it from natural year-to-year variability in EFH. Some guidance on the duration and measurability of impacts is provided in Collie et al. (2000). This study provided a quantitative meta-analysis of fishing impact studies based on 39 separate publications including a study in Alaska by Freese et al. (1999). Note that focus was on mobile fishing gear (beam trawling, otter trawling, and dredging) because studies on other gear types have generally not been conducted. A conclusion of this analysis was that recovery time was rarely less than 100 days regardless of classification (e.g., gear type, region, depth, habitat type), where recovery was defined as the time taken to reach control conditions after a disturbance event. Collie et al. also point out that when detailed taxonomic data were available recovery was closer to a minimum of 500 days and areas that are frequently fished are likely to be maintained in a permanently altered state. Such an occurrence is much more likely for areas containing structural biogenic habitats such as corals and sponges, where recovery times can exceed 15 years.

Recommended definition of temporary

We suggest that the following be used to define temporary. For a particular habitat type, an impact that makes the quality or quantity of EFH not measurably different between the start of one cycle of a fishery and the beginning of the next is temporary. However, if there are impacted habitat features that are essential to a species within the recovery period then such an impact is not temporary. In other words, a fishery impact is temporary if the habitat recovers by the time of the next fishery and if the habitat recovers by the time it is known to be needed by a species - life stage.

Defining Minimal

From the EFH final rule, "minimal impacts are those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions."

These criteria draw a distinction between the features of EFH, which may undergo small changes, and the ways in which they functionally support the managed species, for which changes must be insignificant. (Here is where we might apply any tests for 'significant' effects from the NEPA process). They also indicate that 'minimal' is not used in the dictionary sense of 'least possible', but rather means less than some low threshold level.

The assessment of whether impacts result in small changes is related to spatial extent of the fishery, fishing intensity, sensitivity or vulnerability of the habitat type, gear type, and the interaction of these factors. Thus establishing criteria for establishing whether impacts are minimal will require a multi-faceted approach.

In Draft Programmatic SEIS some habitat indicators were used as criteria to assess the degree of impacts to habitat. These included the bycatch HAPC biota, the proportion area closed to trawling, and the spatial distribution of closed areas. While such criteria are somewhat quantifiable, there are some important caveats that are often over looked. For example, the bycatch of HAPC biota can at best be viewed only as a gear specific index of an impact.

Spatial scale and intensity

The requirements of EFH to be sufficient to support both a sustainable fishery and the species' role in a healthy ecosystem both imply considerations at the population level, as opposed to the local level. So long as there is sufficient total habitat to support those functions, local effects may occur. This is consistent with the above clarification of 'minimal'. A possible exception would occur if an ecological linkage of the species is dependant on its presence in a specific location and fishery effects on habitat sufficiently reduce its abundance at that location to alter the linkage. Example - A large bird rookery is near a spawning site of the fish species, and the fish are a significant prey item for the birds during nesting. If fishing effects make the site unusable for spawning and the fish go elsewhere, the role of that species in the ecosystem would be affected. This example echos the emphasis on ecological function of EFH as the critical aspect.

Spatial extent of a fishing impact could be defined as the proportion of EFH or habitat type that is impacted by a particular fishery. Intensity could be determined by the number of times an area is swept annually or cumulatively for trawling and the distance of ground gear (or # of hooks) per area for longline gear. Determining the response of the benthic community that considers both the spatial distribution and intensity (effort) of fishing may provide some guidance. Somerton (2002, in preparation) developed a "benthic overfishing model" that incorporated the spatial distribution of fishing, fishing effort, changes in body size of invertebrate biota, and multispecies considerations. This model recognized that habitat forming benthic species are in many cases non-motile, such that individuals removed or impacted by a trawl may not be rapidly replaced. Based on this model and conclusions of NRC (2002) a more aggregated fishery will inflict less impacts to habitat.

Recommended definition of minimal

A fishery impact is minimal if the intensity and spatial distribution is at such a level to allow x% of that type of habitat to remain (stabilize, equilibrate) at an unimpacted state (in the long term). The fishery impact is not minimal if less than x% of the habitat is in an unimpacted state due to cumulative impacts.

Establishing a scoring system for minimal and temporary

To guide an assessment of whether fishing effects meet the criteria for minimal and temporary (as well as any subsequent actions to minimize effects), the EFH final rule describes an evaluation of the potential adverse effects of each fishing activity on each type of habitat.

We suggest a scoring system be developed that will enable classification of each fishery. This scoring system is analogous to the "comparative risk assessment" approach described by NRC (2002) and should include scale of the impact, level of uncertainty, immediacy of the threat, irreversibility, and type of habitat impacted. Criteria for each risk can be classified as to whether they address the minimal or temporary issue. For each fishery, each risk is assigned a score from highest to lowest based on these criteria.

We recognize there is considerable uncertainty and controversy as to whether gear impacts result in significant changes in ecological function for certain habitat types. There should be agreement that removal of large-bodied long-lived species such as corals and sponges in stable environments results in non-temporary impacts to EFH. Also there should be agreement that fishing in mobile sandy habitats in very shallow (i.e, in the surf) wave-swept areas results in temporary and minimum impacts. In contrast, there will be less agreement in gravel, sandy, or mud habitats in moderate to deeper depths. For example until the study by McConnaughey et al. (2000), it was generally thought that sandy habitat characteristic of much of the Bering Sea was less susceptible to impacts because of extreme natural disturbances. In addition, agreement as to the relative impacts of different gear types (longlines vs trawls) is debatable. The bycatch of HAPC biota has been suggested as an indicator of relative damage to structural habitat features. However, as pointed out in the PSEIS at best the bycatch of living substrates should be viewed as a gear-specific index of impacts, because there is unobserved damage and mortality that undoubtedly differs by gear type. Professional judgement may be needed to assess the total impact on HAPC biota.

Based on the recommended temporary criteria scoring should be related to recovery time from the annual cycle of a fishery and seasonal life history requirements. For example using Collie et al. (2000) classification of habitat type relative to recovery time a scoring of temporary of 1 to 5 could be made: 1=sand (3 months); 2=muddy sand (15 months); 3=mud (?); 4=gravel (?), 5=biogenic (> 5 yrs). Perhaps finer scale habitat types should be used (i.e., NRC (2002); Figure 3.1). A factor for depth may need to be incorporated since depth is related to natural disturbance regime. It is not clear how to incorporate risks due seasonal life history requirements given the lack of information on this factor. Perhaps the level of uncertainty is the risk rating.

Minimal criteria should be based on the intensity and spatial extent of the impact. Risk due to intensity may need to consider HAPC and prey bycatch, unreported HAPC damage/mortality (professional judgement), and the cumulative effort per unit of habitat. It is unclear at this time how best to combine the criteria for intensity into a single quantity. For example, density of fishing effort may be the best proxy. Factors such as fisheries occurring over multiple habitat types may need to be considered. Spatial aggregation will need to consider the geographic distribution of fishing relative to habitat distribution. Amount of traditional fishing grounds now closed to the fishery would be a factor. Perhaps the modeling of mortality of HAPC biota in relation to fishing effort and spatial aggregation based on NRC (2002) or Somerton (2002) could be used to guide the risk assessment for the minimal criteria.

Following is an example of scoring table for temporary and minimal

Draft

Fishery	Temporary criteria		Minimal criteria	
	Habitat type (sediment type, depth)	Seasonal life history requirements	Intensity (effort) (area swept per area of habitat; miles of LL per area)	Spatial aggregation 1) % of fishing grounds closed to fishing 2) Is closure a cross section representative of fishing grounds? Depth coverage; distance from shore
A				
B				
C				
D				

Literature cited

DRAFT 3/19/02
Discussion Paper
Tools for minimizing or mitigating adverse impacts of fishing to fish habitat
Alaska Fisheries Science Center

Background

The Essential Fish Habitat Final Rule provides the following guidance:

> (iv) Options for managing adverse effects from fishing. Fishery management options may include, but are not limited to:
> (A) *Fishing equipment restrictions*. These options may include, but are not limited to: seasonal and areal restrictions on the use of specified equipment, equipment modifications to allow escapement of particular species or particular life stages (e.g., juveniles),prohibitions on the use of explosives and chemicals, prohibitions on anchoring or setting equipment in sensitive areas, and prohibitions on fishing activities that cause significant damage to EFH.
> (B) *Time/area closures*. These actions may include, but are not limited to: closing areas to all fishing or specific equipment types during spawning, migration, foraging, and nursery activities and designating zones for use as marine protected areas to limit adverse effects of fishing practices on certain vulnerable or rare areas/species/ life stages, such as those areas designated as habitat areas of particular concern.
> (C) *Harvest limits*. These actions may include, but are not limited to, limits on the take of species that provide structural habitat for other species assemblages or communities and limits on the take of prey species.

The categorization of tools recommended in the National Research Council report on Effects of Trawling and Dredging on Seafloor Habitat (in press) for managing the effects of trawling is almost identical for two of three categories:

"1) Fishing effort reductions. Effort reduction is the cornerstone of managing the ecological effects of fishing, including, but not limited to, effects on habitat. Other management tools (gear restrictions or modification and closed areas) may also require effort reduction to achieve maximum benefit. However, fishing effort reduction measures may not be sufficient to reduce effects in highly structured habitats with low recovery potentials.
2) Modification of gear design or restriction in gear type. Disturbance depends on the extent of contact of the gear with the seafloor, hence gear designs that minimize bottom contact can reduce habitat disturbance. In addition, shifts to a different gear type or operational mode may be considered, but the social, economic, and ecological consequences of gear reallocation should be recognized and addressed.
3) Establishment of areas closed to fishing. Closed areas have proved useful for protecting biogenic habitats (e.g., corals, bryozoans, hydroids, sponges, seagrass beds) that are disturbed by even low levels of fishing effort."

The closed area and gear modification categories seem to be similar in both of the documents, whereas the (C) Harvest limits category in the Final Rule refers to limiting the take of species that provide habitat features while the NRC report suggests 1) fishing effort reductions to indirectly decrease the impact on habitat in general.

Outline and Discussion of Tools

The above outlines and information from the Witherell Discussion Paper and a draft report from Korie Johnson (National Marine Fisheries Service, Office of Habitat Conservation) have been combined below for initial discussion of tools potentially relevant to the North Pacific groundfish fishery. An additional element, restoration and enhancement, has been included to cover a recommendation provided in the scoping process.

I. Fishing equipment restrictions and modifications.

A. Tools intended to reduce the rate of impact per unit of operation or effort.

1. modification of equipment to decrease or avoid habitat impact. Examples: discs or bobbins on sweeps or bridles of trawl gear; devices to keep the footrope a set distance off bottom, requirements for keeping doors off bottom, alternative compositions of sweeps to allow herding but minimize seafloor effects.
2. limits on gear size, weight, and strength to minimize crushing, uprooting, shearing. Example: maximum breaking strength or weaklinks on groundlines.
3. equipment modifications to allow escapement of prey.
4. disallowing use of specific gear types for specific target species. This approach was considered in alt. 5 of the Draft Programmatic SEIS. This allows TAC to be taken by another gear type, presumed to have less habitat impact per take of target species.

In many cases research would be necessary prior to determining gear specific effectiveness to justify implementation. One concern regarding gear tools (replacement or modification) would be if any new gear is less effective in capturing the target species, effort will likely be increased to take the available quota, so comparisons should be made on the amount of habitat damage per some measure of target catch: that is on the amount of habitat damage that would be caused in taking an equivalent amount of catch.

These tools are intended to reduce the rate of impact, but there will be no assurance (unless the rate is reduced to zero) that significant reduction in habitat quality won't still result or will not remain in an impacted state due to cumulative effects.

B. Other

1. prohibitions on the use of explosives and chemicals;
2. prohibitions on anchoring or setting equipment in sensitive areas;

II. Harvest limits. This includes directly limiting the take of habitat (biotic or otherwise) and limiting the take or impact on habitat by reducing the TAC and therefore the effort expended in taking target species.

A. limits on the take of species that provide structural habitat for other species assemblages or communities - Designate HAPC species as Prohibited Species. Such a designation in the NPFMC groundfish management plans would result in the following result.
B. limits on target species TAC which result in bycatch of species that provide habitat; This approach is used by the NPFMC to limit the take of Prohibited Species such as crab, halibut, and salmon. The fishery/gear specific rates that relate observed catch to mortality/impact has significant effect on the effectiveness and the assignment of responsibility to the different fishery/gear groups. While bycatch within gear groups may provide reasonable comparisons, there is little information on the relative habitat impact per observed catch between gear groups.
C. limits on the take of prey species. The EFH Final Rule says that loss of prey or prey habitat may be an adverse effect on EFH.

III. Time/area closures/openings. Time/area closures for minimizing fishing impacts on habitat have been grouped into three broad approaches:

A. Closures of specific gears to specified areas or habitat types. This approach would be used when the location of specific habitat types are known and their value is known or assumed to be high and the impact of specific fishing gear is known or assumed to be adverse.

   HAPC species site based protection is an example. We know the location of some HAPC species, we believe they provide benefit as part of the habitat, and we know some gear types remove these species during fishing operations. We don't know the overall impact of these removals at current levels, but a precautionary approach would be to assure that at least a certain amount of this habitat is protected.

   The HAPC approach tends to deals only with impacts to habitat that has conspicuous components or features such as coral, sponges, sea whips that are brought up on fishing gear. If there is a concern about impacts where there is no event readily observed, such as might happen on habitat with small benthic organisms, gouging, turnover of soft bottom habitat with little "catchable" features, the HAPC site based protection would not address such a concern.

   Alt 3 (Target Species Protection) of the Draft Programmatic SEIS included an option of ensuring that 20% of spawning habitat for target species currently fished during the spawning period is closed. The rationale was to protect target fish stocks against unforeseen consequences of harvesting on spawning concentrations and habitat of fish. The objective of protecting the habitat may be achieved if fishing only occurs during spawning periods, otherwise other fishing activity may impact the target specie's spawning habitat. A difficulty in applying this in the North Pacific is the lack of knowledge of the specific spawning habitat or location of many species.

   Sanctuaries, or marine protection areas (MPA's) are established for a variety of reasons:

protection from overfishing, protection of spawning biomass, protection of specific habitat, protection of specific ecosystem components, for e.g. The North Pacific groundfish fishery is considered to be well managed in terms of spawning biomass and risk of overfishing, however, some type of MPA could be tailored to address EFH concerns in the North Pacific.

B. Restricted open areas, where specific fishing is restricted to specified areas. The open areas may be historically fished areas or areas where habitat is thought not to be vulnerable. Alt. 5 (Habitat Protection) in the Draft Programmatic SEIS analyzed an example of restricting fishing to historically fished areas.

   This approach protects habitat outside the open area and accepts or assumes negligible, the risk of cumulative or further impacts in the open area. The apparent sustainability of North Pacific groundfish fisheries has suggested that this is not an unreasonable assumption, but one which requires careful consideration. Many studies report a shift from benthic communities dominated by species with relatively large adult body size towards dominance by high abundances of small-bodied organisms in areas where repeated trawling occurs (NRC report).

C. Closures of random or systematic areas to specific or all fishing. When little is known about location of specific habitat types, and especially when little is known about the effect of fishing on the various habitats, random or systematic closed areas would be applicable.

   Alternative 3 (Target Species Protection) of the DPSEIS incorporated a year-round closure of 20% of the EEZ to protect fish stocks against unforeseen consequences of fishing on fish habitat and the long-term sustainability of the fisheries. This tool was an all depth closure that would provide protection to all groundfish fisheries, regardless of the depth at which they reside. The areas were chosen in a systematic fashion that provided protection to a cross-section of habitat types.

   NPFMC groundfish are already managed reasonably well in terms of protecting from over-exploitation, so the most significant potential benefits of such closed areas would be the amount of habitat protection and most importantly their potential to provide contrasts in fishing impacts for scientific inference. This is most necessary where uncertainty and lack of information is as prevalent as there is in the study of fishing impacts.

D. Research closures/openings. The EFH Final Rule instructs that establishment of research closures be considered to evaluate the impacts of fishing activities. The DPSEIS Alternative 3 year-round closure would serve as a research closure as is, or could probably be refined to improve the scientific value. A design for research closures need only have units large enough to be enforceable and numerous enough to meet scientific needs for replication and representative coverage. Such closures may be a practicable type of mitigation tool in the North Pacific while serving the long-term purpose of validating whether restrictive measures in the future need be increased or relaxed.

Fishing in the North Pacific is already prohibited in large areas where establishment of research openings may be of scientific value in determining effects of fishing. Research openings would also have to meed the need for enforceability and replication.

IV. Restoration/enhancement. Common in mitigating impacts in terrestrial or estuarine habitats. Feasibility is unknown in marine situations due to logistics and general lack of understanding of impact effects and the biological requirements of marine fish.

A. Artificial habitat.

Artificial reefs were suggested in scoping sessions. Typically thought of as mitigation in the compensatory sense by enhancing fish production or opportunities, however, they could also directly minimize some forms of fishing impacts by obstructing and discouraging certain fishing operations. An artificial reef by definition would be in shallow waters, however, artificial structure could possibly be placed in deep waters where most federally managed fisheries occur. Determining the benefit of such measures and the determination of the types of artificial habitat that would enhance productivity in the most desirable form could be evaluated as part of scientific experimentation and monitoring.

Experiments with artificial habitat could possibly be used to determine the role that the physical structure of various habitat components play in the ecosystem. For e.g. compare the response of fish, prey, or other motile biota to artificial forms of sessile biota. If research determines that the physical structure is an important factor, perhaps the results can be used to forecast the future value of recovering closed areas. The future value of impacted areas may even be hastened by the placement of artificial forms of slow growing benthos.

DRAFT - Do Not Cite

Scientific studies relevant to the effects of Alaska groundfish fisheries on benthic habitats

The purpose of this white paper is to facilitate the assessment of effects of the fishing gears used in Alaska groundfish fisheries on essential fish habitat by providing information on relevant studies and relating them to the specific gear and habitats of the region. This draft will be reviewed during a March 2002 workshop at the Alaska Fisheries Science Center (AFSC). There have been many useful reviews of the general topic of the effects of fishing gears on benthic habitats and significant new reviews being produced in the near future, including a National Research Council review and an updated draft of a summary being prepared by Kori Johnson of the National Marine Fisheries Service (NMFS) national headquarters (an earlier draft of which was a source in building this document). It is not our intent to recover that well trod ground, but to help identify and focus on the portion of that research most relevant to Alaska groundfish fisheries.

While the workshop will include consideration of the gears used in crab, scallop and salmon fisheries, this draft does not yet include literature reviews for those gears. Crab fishery effects may be similar to groundfish pots, except where pots are interconnected in longlines (i.e. golden king crab fishery in Aleutians), where the effect of the connecting lines or cables is added and recovery dynamics may be changed. Direct review of crab, salmon and scallop gear will need to be added in later drafts.

The research summary will be preceded by general descriptions of fishing gear used in Alaska groundfish fisheries. These descriptions will be improved on a fishery by fishery basis during the workshop for which this paper is being prepared. That will be followed by development of a table of trawl research studies, including study, gear and habitat information which is used to generate subjective relevance classes. Brief reviews of the bottom trawl studies themselves will be followed by descriptions of the limited research on passive gears.

The current form of this document is a draft that is intended to be improved by comments from within and outside of the Alaska fisheries community before its application to assessments of effects on Alaska's essential fish habitats.

Fishing Gears used in Alaska Groundfish Fisheries

In considering the potential effects of fishing gear on benthic habitats of off of Alaska, it is useful to understand the characteristics of that gear. There are three main classes of fishing gear used in the groundfish fisheries affected by the proposed alternatives, otter trawls , longlines and pots. Each of these gear types are composed of several components whose characteristics will affect their actions on the benthic environment and hence their effects and the amount of habitat encountered. Effects will also be dependant on vulnerabilities of the subject substrate and organisms. The following will describe the characteristics of those gears as used in Alaska groundfish fisheries. Because there have been no comprehensive, systematic surveys of such gear, this information is based on the knowledge of NMFS gear researchers and related information available to them. Industry feedback at an upcoming workshop will help to clarify more of the detailed characteristics of gear used in specific fisheries.

Otter trawls

Otter trawls are conical nets that are pulled through the water, gathering fish that enter its open forward end and pass to a restricted bag (codend) at the back end. They have four main components that may contact the seabed: doors, sweeps, footrope and netting. Doors are flattened metal structures that ride vertically in the water and use the force of their motion through the water to spread the net horizontally. Some bottom trawl doors also use contact with the seafloor to augment this hydrodynamic spreading force. On pelagic trawls the doors are fished above the seafloor, without bottom contact. The weight of the doors (and some hydrodynamic forces) overcome the upward pull of the towing cables to force the net down into the water.

Sweeps (as the term is used here; nomenclature varies between regions and individuals) are steel cables which connect the doors to the trawl net. On bottom trawls these are commonly in contact with the seafloor and often have protective disks strung on them (> 7 cm diameter). Use of fiber and combination fiber/steel cables also occurs. The sweeps pass over the bottom at a narrow angle (i.e. 15 - 20 degree) from the direction of travel and herd near-bottom fish toward the trawl net.

The footrope of the trawl is a cable or chain connected along the bottom edge of the trawl net and is designed to contact the seafloor on bottom trawls. A 1996 survey of footrope types used off Alaska (168 observer delivered and returned forms from 95 vessels, unpublished data, Craig Rose) indicated that all vessels used large diameter (averaging (by fishery) 39 - 47 cm) cones, spheres or disks (we will use the generic term, bobbins), usually made of rubber, strung over the entire length of their footropes. Large-diameter supporting elements were separated by sections of small diameter disks, creating openings under the footrope, averaging 13 cm high and occupying an average of two-thirds of the footrope length. These serve to limit damage to the netting and reduce bycatch of crabs and other invertebrates by elevating much of the footrope above the seabed, increasing opportunities to pas beneath. Another quality of large diameter footropes is that they make it possible to fish in areas with hard and uneven substrates.

During fishing, the footrope takes a shape like a horizontally spread 'U' with the opening forward. Bobbins were used nearly always on the sides of the U (wings). In the center section, an alternative called 'tire gear' was indicated by all six reports from the Atka mackerel fishery and about half of those from the Gulf of Alaska fisheries for cod, rockfish and Dover and rex soles. This gear consists of vehicle tires or sections of tires linked side-by-side to form a continuous cylinder (averaging 68 cm diameter). This gear is very effective at protecting the netting and allows fishing in areas of rougher substrates than would otherwise be possible.

The netting is the least likely component of bottom trawls used in Alaska to directly contact the seafloor. The bobbin or tire footropes raise the netting so that only particularly prominent seafloor features should touch the netting without entering the trawl. An exception to that is if the codend contains enough fish that are heavier than water (typically flatfish; pollock and cod have swim bladders to keep neutrally bouyant) or rocks to pull it down to the seafloor. Then the bottom of the codend would drag across the seafloor. Because of the need to pull codends up the vessel's stern ramp, codends are equipped with ropes that limit their diameter to less than 8 feet. This would also limit the amount of bottom affected by a dragging codend.

An important aspect of gear design, when considering bottom habitat effects is the proportion of the trawl contact footprint that is made by each of the components. Trawl doors used in Alaska are typically less than 3 m along the edge that contacts the seafloor and, because they are fished at an angle to their direction of movement, will affect a path narrower than that. Sweeps length will vary with target species, substrate and individual preference. A large vessel targeting flatfish on smooth bottom may use 350 m of sweeps, while a small rockfish trawler on rough bottom may only use 30 m. Adjusting for the angle of the sweeps, sweep path may vary from 100 m to 10 m on either side of the net. Thus, the area covered by the sweeps can be highly variable. The width of the trawl net itself will depend on how large a trawl the vessel can pull and whether a high opening or wide, low trawl is selected. An approximate range would be from 12 to 30 m across. Thus, most of the trawl's footprint will be affected by the sweeps, followed by the footrope, with a relatively small area contacted by the doors.

A special case of otter trawls that is very important in Alaska groundfish fisheries is the pelagic trawl, a class designed for harvesting fish that may inhabit the waters above the seabed. These trawl have very large mesh openings in their forward sections and the doors are fished above the bottom. More detailed descriptions will be included below in conjunction with the considerations of EFH effects.

Longlines

Demersal longlines consist of two buoy systems that are situated on each end of a mainline to which are attached leaders (gangions) and hooks. The mainline, usually made of sinking line (more dense than water), can be several miles in length and have several thousand baited hooks attached. Small weights may be attached to the mainline at intervals. Below each buoyed end is a weight or an anchor. A vessel may set a number of lines, depending on the area, fishery and site. The principal components of the longline that can contact the seabed are the anchors or weights, the hooks and the mainline (ICES 2000).

Longline gear in Alaska is fished on-bottom. In 1996, average set length was 9 km for the sablefish fishery, 16 km for Pacific cod and 7 km for Greenland halibut; average hook spacing was 1.2 m for the sablefish fishery, 1.4 m for Pacific cod and 1.3 m for Greenland halibut. The gear is baited by hand or by machine, with smaller boats generally baiting by hand and larger boats generally baiting by machine. Circle hooks usually are used, except for modified J-hooks on some boats with machine baiters. The gear usually is deployed from the vessel stern with the vessel traveling at 5-7 knots. Some vessels attach weights to the longline, especially on rough or steep bottom, so that the longline stays in place and lays on-bottom.

Pots

Pots are enclosures, usually with one-way entrances, that retain entering fish. Pots used in the Alaska cod fishery are generally modified from the designs developed for the crab fishery, with one way entrances modified to prevent fish escape. The most common design is a rectangular frame approximately 2 X 2 X 1 m made of welded steel rods with entrances on opposite walls. These weigh 5 - 700 pounds and, because of solid steel construction, that weight is not greatly reduced by immersion in water. Alaska groundfish regulations require that each pot have its own buoyed line, so there are no underwater lines connecting adjacent pots (longlining). Each pots is sufficiently heavy that no additional anchors are required.

Effects of fishing gear on benthic habitats - Research relevant to Alaska fisheries

Reviews of fishing gear effects on benthic habitats broadly recognize several factors that influence the occurrence and degree of any effects. Among these are: 1) the intensity of fishing, 2) the frequency of fishing 3) the class and specific characteristics of the fishing gear, 4) the vulnerability of habitat features and 5) the severity of effects relative to naturally occurring effects. The purpose of this paper is to review the literature from the perspective of assessing the effects of the groundfish fisheries of Alaska. In addition to presenting the results of experimental studies, we will compare their intensity and frequency of fishing, gear characteristics and affected environments to those of the Alaska groundfish fisheries. Studies based on gears not used in these fisheries will not be directly evaluated (i.e. beam trawls and dredges). Unfortunately, we are not able to be selective in which studies of passive gears to review, because there are so few.

Otter Trawls

Information was collected for a range of studies of the effects of otter trawl fishing on benthic habitats (Table 1). Indicators of gear (footrope diameter), fishing intensity, and habitat (substrates, depth, latitude, and region) were indicated where available, as well as whether recovery was observed. The following paragraphs indicate the conditions that pertain to Alaska fisheries, which were used to divide the studies into broad classes of relevance. Assignment to these relevance classes were not based on quantitative analysis and hence are subjective.

While Alaska waters include a full range of substrates, the dominant bottom trawl fisheries target species that are most abundant on substrates with mean particle sizes in the sand and gravel ranges, including yellowfin and rock soles (Smith and McConnaughey 1999, McConnaughey and Smith 2000) and cod. Studies on silt/clay environments will be more relevant to the smaller fisheries for flathead, Dover and rex soles and Alaska plaice. Studies of hard bottom, gravel and boulder habitats may apply more to rockfish and Atka mackerel fisheries.

As mentioned previously, Alaska trawl fisheries primarily use groundgear with large diameter (average 39-47 cm) elements separated by small diameter spacer sections, resulting in non - continuous contact across the footrope (Tire gear being an exception). Studies with radically smaller footropes may well affect the habitat differently (Moran & Stephenson 2000, VanDolah et al. 1987).

While fishing depths off of Alaska also range widely (10 - 1000 m), most of the effort is concentrated in the 25 - 100 m range. Average fishing depth is deeper in the Gulf of Alaska than the Bering Sea with more effort in the 100-200m range. Alaska fisheries are conducted between 51 and 61 degrees latitude. Biotic habitat responses affecting recovery may be different in warmer climes.

Relative to many of the areas where fishing effects research has been done, (i.e. NW Atlantic and North Sea), Alaska experiences lower overall fishing intensity. A comparative survey (NRC, in press) estimated that the percentage of small (5 x 5 km) areas with trawling intensities above 1 per year was < 2% for the Bering Sea, 3% for the Aleutians and 2% for the Gulf of Alaska, compared to 56% for the Northeast region. Thus, the question of whether annual intensities below 1.0 have lasting effects will be important for Alaska fisheries. A more detailed study of the distribution of effort intensities during recent years is being conducted at the AFSC. The fishing intensities, in number of trawl passes each location is estimated to experience, associated with each study are noted in Table 1.

Finally, some of the studies contained information on the rate of recovery from fishing effects. The length of the recovery period observed was also included in Table 1.

Six studies were selected as most relevant to Alaska groundfish fisheries, including two in Alaska (one with a following paper) and four from eastern Canada using similar scale gear in a comparable environment. The six studies with the next level of similarity had somewhat different gear or environments or, in the one Alaska study, looked at crab injury rates, which could be an indirect indicator of effects on benthic habitat. The third class included many studies with very small or unknown footropes (shrimp or *Nephrops* trawls), many in silt / clay or very deep environments and some in low latitude areas. Putting studies in this final class by no means indicates that they do not contain useful information, rather that results should be interpreted with the noted differences in mind and that they may apply only to a small portion of the Alaska trawl effort, if at all.

Finally, five studies from Alaska were identified that have yet to be published, but for which field work has been completed. These will all be of high relevance to this subject when their results become available.

General

Based on the information available to date, the predominant effects caused by bottom trawling include smoothing of sediments, moving and turning of rocks and boulders, resuspension and mixing of sediments, removal of seagrasses, damage to corals, and damage or removal of epibenthic organisms (Auster et al. 1996, Heiftez 1997, Hutchings 1990, ICES 1973, Lindeboom and de Groot 1998, McConnaughey et al. 2000). Otter trawls affect the seafloor through contact of the otter boards, footropes and footrope gear, and the net sweeping along the seafloor (Goudey and Loverich 1987). Otter trawl doors leave furrows in the sediments that vary in depth and width depending on the shoe size, door weight, and seabed composition. The footropes and net can disrupt benthic biota and dislodge stones sitting on or protruding above the surface. If the footrope is rigged with tickler chains the effects of the footrope are amplified. Alternatively, larger diameter, lighter footropes may reduce damage to epifauna (Moran and Stephenson 2000).

McConnaughey et al. (2000) sampled megafauna from unfished and heavily fished areas (between 44 - 52 m depth) in the eastern Bering Sea. A relatively short fishing history and extensive observer coverage provides a good certainty that the control site has never been fished. Significance of results were adjusted for multiple comparisons (Bonferoni corrections), limiting the likelihood of false positives to the stated 5% and the power of tests was reported to assess the liklihood of false positives. Principal conclusion include: (1) 15 of 18 sedentary megafauna (i.e., anemones, soft corals, sponges, whelk eggs, ascidians), neptunid whelks and empty shells were more abundant in unfished areas; of these disparities, significant differences were detected in Actinaria, *Neptunea*, gastropod eggs, gastropod shells and Porifera for one of the two participating vessels (2) motile groups (i.e., crabs, sea stars, buccinid whelks) and infaunal bivalves exhibited mixed responses, suggesting the importance of life history considerations, such as habitat requirements and feeding modes; (3) overall diversity of sedentary taxa was greater in unfished areas, primarily due to less dominance of the seastar *Asterias amurensis* (77% of average catch compared to 80% in trawled area. Pair by pair, diversity had a high negative correlation with A. amurensis abundance.); and (4) reductions in gastropod shells may explain lower abundance of gastropod eggs, which use them for attachment, and hermit crabs, which use them for shelter. Furthermore, long-lived, slow-growing taxa were significantly more patchy in highly fished areas, suggesting a slow impact recovery process.

A review of the fishing history of the trawled areas indicated that, with minimal effort intensity (< 0.1%, ratio of estimated trawling effort (in square area) to area of site) in intervening years, the areas were primarily fished 4, 5 and 8 years before sampling at intensities of approximately 4, 6 and 14 times per year, respectively (assuming no overlap of effort). Therefore, the detected differences persisted in spite of at least 4 years of recovery from high intensity fishing (1991, 92) and 8 years of recovery from very intensive fishing (1988 foreign vessels). This is especially of interest since the study detects durable, chronic effects in a relatively high energy habitat (strong tidal flow and within range of storm wave effects).

A study done in the GOA (Freese et al., 1999) included trawling at eight sites (206 - 274 m) in August 1996, using a chartered trawler with a Nor'eastern bottom trawl, modified with 60 cm tires in the center of the footrope and fitted with 45 cm rockhopper discs and steel bobbins along the wings. From a research submersible, the researchers videotaped each trawl path, along the 5 m section impacted by the tire gear, and a nearby reference transect. The tapes were analyzed to obtain quantitative data. The researchers found that a single trawl pass affected the dominant features on the seafloor, displacing a significant number of boulders, removing or damaging large epifaunal invertebrates. A significantly lower density of undamaged sponges and anthozoans was found in the trawled transects than the reference transects, and more of these organisms in the trawled transects were damaged. Approximately 70% of vase sponges, 55% of sea whips, over 20% of brittle stars, and 13% of finger sponges were damaged. The study did not detect any change in the density of most motile invertebrates, or damage to them.

A subsequent survey at these sites one year later found the site relatively unchanged (Freese, in press). Sponge density was still higher outside of the path of the tire gear than within it (3.5 /100m^2 vs. 2.76 in 1997 compared to 3.73 and 3.15 in 1996). The percent of vase sponges with damage had declined to 46.7%. These changes were reasonably interpreted to indicate that some of the damaged sponges had subsequently died. One of the vase sponge groups had 9.9% of damaged sponges showing some necrosis, while the other two had none. The damaged sponges showed no signs of repair or regrowth.

Epifaunal invertebrates add structural complexity to the seabed, which may provide important cover and prey for demersal fishes. When boulders are displaced, they can still provide cover and surface area for the attachment of structural biota, but separating piles of boulders may alter the number and complexity of crevices. The researchers observed that various taxa, primarily rockfish (*Sebastes* spp.), use cobble-boulder and epifaunal invertebrates for cover, but it was not clear which habitat elements are required.

Other studies have noted the preference of rockfish for different kinds of cover. Krieger (1993) noted that adult (longer than 25 cm) Pacific ocean perch in Alaska are associated with pebble substrate on flat or low-relief bottom; that juvenile Pacific ocean perch exhibit a preference for rugged areas containing cobble-boulder and epifaunal invertebrate cover; and that shortraker rockfish strongly prefer rugged, high-profile habitat interspersed with boulders. Carlson and Straty (1981), Straty (1987), and Pearcy et al. (1989) also noted that juvenile rockfish exhibit a preference for high-relief habitat.

Although reducing the number of sponges and associated invertebrate taxa reduces the shelter value of the invertebrate community, it is not known whether this change produces a measurable difference in recruitment for any taxon.

In a fine sediment area of the Grand Banks of Newfoundland at 120 - 150 m water depth, which had been closed to fishing for 10 years, physical effects of intensive, long term otter trawling (12 times a year for 3 years) over fine - medium grained sandy bottoms were examined. These features of the experimental trawl are consistent with trawl gears used in Alaska fisheries.

Publications from this study have included a general summary (Gordon et al. 1998), habitat structure effects (Schwinghamer et al. 1996, 1998), megaepibenthos effects (Prena et al. 1999)and macrobenthos (Kenchington et al. 2001). Untrawled areas were hummocky, mottled, and had more flocculated organic matter while trawled areas were smoother and cleaner. Complexity of the sediment structure down to a depth of 4.5 cm. was reduced. Otter door tracks were visible for at least 10 weeks and in some cases for up to a year (Schwinghamer et al. 1998). Prena et al. (1999) found that immediate results of trawling included: decreased biomass of sand dollars, brittle stars, soft corals, snow crabs and sea urchins, an influx of scavenging crabs and no effect on four species of molluscs. Epibenthic sampling did not allow recovery or long term effects to be separated from immediate effects, as trawled sites were always sampled after the experimental trawling for that year had been completed. Kenchington et al. (2001) found significant infauna community changes due to trawling in only one of the three years. That year, a number of polychaete species were reduced 39 - 61% after trawling. Proportions of damaged sand dollars and brittle stars did not change due to trawling. Tests for changes between years showed little indication of long-term effects and that when disturbance was evident, it mimicked natural disturbance.

Gilkinson et al. (1998) pulled a calibrated model of a trawl doors through a prepared test bed of sandy sediment, with clam implanted in it, to test the effect of trawl doors on substrate and infauna. They found that only 2 of 42 clams were significantly damaged by passage of a simulated trawl door, while most individuals were displaced along with the sediment out of the door's track. However, 64% of the displaced specimens were wholly or partially exposed afterward, leaving the clams more vulnerable to predation. The simulated door was similar in scale to some used in Alaska fisheries.

Brylinsky et al. (1994) examined physical and biological effects of experimental fishing using a flounder trawl with 28 cm rubber rollers and no tickler chains in an intertidal estuary in the Bay of Fundy, Nova Scotia. Trawl doors made furrows that were visible for 2-7 months and rollers compressed sediments. They sampled chlorophyll a (as an indicator of benthic diatoms) and abundance of nematodes within door furrows before and after trawling and found that both were reduced for approximately 1 month after trawling. Nematodes recovered fully after 4-6 weeks and cholorphyll a concentrations increased by fourfold after 80 days, thus, authors conclude that no enduring effects occurred to either benthic diatoms or macrobenthos. Authors state that the quick recovery was expected since sediments in the area are commonly exposed to natural stresses by storms and winter ice.

A single pass with a roller-rigged trawl in a hard bottom sponge and coral community at 20 m in South Carolina damaged finger sponge, vase sponge, barrel sponges, whip coral, fan coral, stick coral, and stony tree coral, and caused a decrease in density of barrel sponges (Van Dolah et al. 1987). Damage rates were 31.7% for sponges, 30.4 % of hard corals and 3.9% of octocorals. Impacts were not detectable when checked one year later. The contrast between these results and those of Freese (in press) is likely due to the warmer and shallower experimental site.

Bergman and Santbrink (2000) estimated mortalities of North Sea mega- and macro- fauna from single passes of an otter trawl with 20 cm rollers in a study that also tested three types of beam trawls. At silty sites, direct mortality from otter trawling was lower than that for beam trawling. Differences at a single sandy site were less consistent. Estimated immediate mortalities by otter trawl ranged from 0 - 52 %.

Sparks-McConkey and Watling (2001) tested for effects of trawling and recovery over a 16 month period on a silt/clay bottom in an enclosed bay with minimal scouring of bottom by tides or storm events. Immediate post-trawl differences were detected for surface measurements of several sediment parameters (none at 5-7 cm depth), abundances of nearly all organisms and four community indices. Nearly all of these differences had converged to non significant levels after 3 months. Differences remaining detectable after both 3 and 6 months included elevated abundances of a predatory nemertean and lower abundance of one polychaete.

A study was undertaken to estimate the rates of injuries to hard-shelled red king crab when they encounter trawls. An estimate was made of the rate of injuries sustained by red king crabs passing under the center sections of three types of bottom trawl footropes commonly used in the bottom trawl fisheries of the eastern Bering Sea (BS). Injury rates of 5%, 7%, and 10% were estimated for crabs passing under the three types of commercial footropes (Rose 1999).

In a study by Rumohr and Krost (1991), sedentary organisms living in the upper 5 cm of the seabed were found to be most vulnerable to damage from trawl doors. Thin-shelled, large bivalves and starfish had the highest proportion of injuries when collected by a dredge following a trawl door, while thick-shelled bivalves were less likely to be damaged.

Moran and Stephenson (2000) found that the light, medium-diameter (20 cm diameter disks separated by 30 - 60 cm sections of 9 cm disks) footropes currently in use in northwest Australia results in less mortality (15.5% vs 89% documented by Sainsbury et al. in 1997) than heavy, small gear used in the past (continuous 15 cm disks). These tests were conducted at depths of 50 - 55 m with abundant attached macrobenthos. Similar bobbin and disk footropes used in most Alaska trawl fisheries average 39 to 47 cm in diameter, even larger (more than 2 X) than the less disruptive of the two Australian footropes.

Engel and Kvitek (1998) sampled lightly and heavily fished areas off central California. Sediments were similar between sites and consisted of gravel, sand, and silt-clay. Results indicated that heavily fished sites have more trawl tracks, confirming their limited data on trawling distribution, more exposed sediment/shell fragments, fewer rocks and mounds, and less flocculent material.

Invertebrate epifauna were more abundant in lightly trawled areas and nematodes and polychaetes were more abundant in heavily trawled areas. Authors concluded that trawling reduces habitat complexity and biodiversity while increasing opportunistic infauna and prey important in the diet of some commercially important species.

From 1987 to 1993, modifications to fishing gear allowed fishermen to trawl rocky, boulder habitat. Observations in these rock and boulder fields on Jeffrey's Ledge in the Gulf of Maine documented that mobile fishing gear moved and rolled boulders and decreased the percent cover of sponges (Auster et al. 1996). Laboratory predation experiments (Lindholm et al. 1999) demonstrated that decreased habitat complexity lead to increased predator success, and therefore, decreased survival of 0-year cod. Thus reduction in benthic epifauna by mobile fishing could have a major effect on fish populations.

At a 200 m silty-clay environment in the eastern Mediterranean Sea, Smith et al. (2000) took video, sediment and macrofauna samples before, during and after an 8 month trawling season inside and outside of an established trawling lane. Otter trawl gear used by the commercial fishery was not specified. Video observations confirmed that trawl door disturbance was limited to the lane and persisted through the 4 month closed season. While organic carbon, chlorophyll and phaetopigment differed between sites in the track, they did not differ from adjacent sites outside of the track, except in one case. There was no indication of deep sediment mixing. Macrofaunal communities varied between trawled and control stations, with diversity, abundance and biomass higher in control stations and eveness lower. Echinoderms and sipunculids were most affected by trawling. Differences in megafauna were also apparent.

Sanchez et al. (2000) observed the immediate effects of 7 and 14 passes of otter trawls along adjacent tracks and compared them to nearby, untrawled areas. The site had muddy sediments, was 30 - 40 m deep and the ground contact components of the trawl were not specificed. Sidescan records clearly showed the tracks of the trawl doors on the seafloor. Infauunal diversity and richness indices were not significantly affected by trawling. Nine of 33 taxa had higher abundances in the 7 trawl area than in the untrawled section due to a decrease in the untrawled site. Eleven of the 33 were lower in the 14 trawl path than the reference area. Results suggested that sporadic trawling episodes in muddy habitats may cause relatively few changes in community composition.

Mayer et al. (1991) conducted experimental trawling in 20 m water depth over protected, fine grain, mud areas with a 60 foot (footrope length) otter trawl with chain groundgear. The 200 pound doors produced furrows several cm deep and the chain and net produced very thin and inconsistent planing of surficial features. Organic matter profiles were unaffected by trawling except for indications of export of a thin layer of surficial sediment. A similar experiment with a scallop drag produced much more significant effects.

Frid et al. (1999) developed a priori predictions concerning the effects of fishing effort on species abundances, and tested those predictions using time series data from sand habitats in 55 m of water and silt/clay habitats in 80 m of water off Northeast England. The *Nephrops* trawls used in this area have small diameter cable/chain footropes (Lindboom and deGroot 1998). Taxa predicted to increase with fishing effort included errant or mobile polychaetes and asteroid echinoiderms. Taxa predicted to decrease with fishing effort included sedentary or fragile taxa such as echinoid echinoderms, large bivalves, and sedentary polychaetes. Outside fishing grounds those species predicted to increase and/or decrease with fishing remained constant. Inside heavily fished areas those predicted to increase with fishing did, but those predicted to decline remained the same. Results suggest that species abundances in unfished areas are determined by natural changes in organic input, but that inside fished areas some species abundances were more dependent on fishing effort than on natural influences.

Ball et al. (2000) studied effects of trawling in 30-40 m water depth over mud areas of the Western Irish Sea which used shipwrecks as controls for experimental trawling with a *Nephros* trawl with a tickler chain. Differences were detected between wreck sites and those exposed to fishing, which had fewer large-bodied fragile organisms, fewer species, more opportunists, and more small polychaetes in an altered, but stable, community. Effects of wreck proximity may have been confounding with interpretations regarding gear effects.

Tuck et al. 1998 compared two sites before and after one was fished with a 'trawl' with no net and rockhopper (rubber disks rigged to not roll) groundgear on a silt/clay substrate in 35 - 40 fathoms of water site sheltered Scottish loch. Impact trawling lasted for 16 months (1 tow per month) and sampling, including 1 pretrawling survey, continued for 18 months after trawling ceased. Marks from the trawl doors noticeably changed the surface of a previously featureless bottom. Faint marks were still detectable 18 months after trawling. The trawled site had increased number of species and total individuals, with lower diversity and eveness indices. Some community differences persisted after 18 months.

Drabsh et al. (2001) compared infauna communities in trawled sites and lightly trawled sites (trawling had not been reported in the last fishing season and very light trawling had been reported for the last 10 years) on sand and silt substrates in a bay in southern Australia. Trawling was done with a triple prawn trawl. Non-overlapping, replicate cores were taken at the same small scale sites across time to avoid effects of spatial variability. Analysis of multidimensional scaling (MDS) and individual species patterns found no clear indications of short term trawling effects. Sampling did not include door tracks.

Lindegarth et al. (2000) examined changes in macrofauna at 3 control and 3 trawled sites in Swedish fjord before and during the last four months of a year of weekly trawling. Trawl gear was a shrimp trawl with a small (2 cm) footrpe. Large temporal changes occurred at both control and trawled sites, resulting in no significant indication of trawl effects, though the centroids of trawled sites moved more than untrawled and spatial and temporal variability was higher at trawled sites.

Thrush et al. (1998) tested hypotheses regarding trends for benthic fauna along a gradient of fishing effort by sampling 18 locations with similar habitats but varying fishing effort in the Hauraki Gulf, New Zealand. Typical doors used in that fishery weighed 480 kg and footrope gear is 14 - 15 cm rubber or steel bobbins. However, interpretation of results in terms of trawl effects is confounded by the use of bottom seines in the area at effort levels five times that of trawling and the use of scallop dredges at most of the high impact sites. Sediments were described as 1-48% mud and depths ranged from 17-35 m. After accounting for differences of location and sediment, 15-20% of the variability in macrofauna community composition was attributed to fishing. With less fishing effort, large epifauna, echinoderms, and the number of species and diversity of fauna were greater and the number of deposit feeders and small opportunists were less. These results indicate broad-scale changes in benthic communities directly related to fishing, and because they were taken over a large sampling area, suggest ramifications for the entire ecosystem.

Gibbs et al. (1980) sampled macrobenthos before and after trawling with a shrimp trawl at three trawled and one control sites in southeastern Australia and made underwater observations of trawl - seabed interaction. Classification analyses did not detect a trawling effect. Underwater observations indicated only light footrope contact.

Seamounts are also affected by trawl fishing. Corals from seamount slope areas comprised the largest bycatch in trawl tows (using otter trawls with large bobbins along the ground rope) taken in water depths of 662-1524 m in tropical New Zealand. These coral patches may require over 100 yrs to recover, and many may be crushed or overturned without coming to surface in a net (Probert et al. 1997). Koslow and Garrett-Holmes (1995) sampled benthic fauna over seamounts in Tasmania subject to varying levels of fishing effort. Substrates in heavily fished areas were predominantly bare rock or coral rubble and sand, colonial corals and associated fauna were lacking, and species abundance and richness were lower than in lightly fished areas. Authors attribute these differences to fishing effort and recommend permanent closed areas to protect the seamount ecosystem.

Destruction to coral-like bryozoan growths in the Tasman Bay, New Zealand during the 1970s and 1980s were attributed to chains, bobbins, sweep wires and otter boards of mobile fishing gear

(Bradstock and Gordon 1983). These were coincident with declines in juvenile trakihi and snapper abundance.

Upcoming and unpublished studies

Several relevant studies have recently been done in Alaska waters for which field work has been completed and analysis and reports are in process. These are expected to provide relevant and useful information on the effects of bottom trawling in this region. Comparative parameters of these studies are included in Table 1.

Infauna collections taken in 1997 from paired heavily fished and unfished sites in the Bering Sea (pairing similar to McConnaughey et al. 2000) have been processed and results are being analyzed. Lead Invesigator - Bob McConnaughhey, AFSC, Seattle.

A comparison of megafauna, biogenic structures and sediment characteristics within and outside of a zone closed to bottom trawling in the Gulf of Alaska. Lead Invesigator - Bob Stone, Auke Bay Lab

A comparison of megafauna and sediment characteristics inside of experimentally trawled sites with untrawled control sites in an area of sea whip habitat near Kodiak Island (area closed to fishing). Stomach contents of resident fish species before and after trawling were also collected. Lead Invesigator - Bob Stone, Auke Bay Lab

A comparison of infauna, epifauna and sediment characteristics within and outside of a zone closed to bottom trawling in inner Bristol Bay. Lead Invesigator - Eloise Brown, University of Alaska.

A comparison of infauna, epifauna and sediment characteristics inside of experimentally trawled sites with untrawled control sites in inner Bristol Bay (area closed to fishing). Lead Invesigator - Eloise Brown, University of Alaska.

A comparison of epifauna, infauna and geological characteristics (including bedforms, sediment composition and chemistry) inside of experimentally trawled sites with untrawled control sites in outer Bristol Bay (area closed to fishing). Lead Invesigator - Bob McConnaughhey, AFSC, Seattle.

Laboratory observations of habitat preference and its effects on predation, particularly regarding structural complexity, have been made for juvenile flatfish. These will be related to results of Alaska studies of fishing effects. Lead Investigator - Al Stoner, Alaska Fisheries Science Center.

The Aleutian Islands area has not been studied specifically to determine effects of trawling, but Harold Zenger at the Alaska Fisheries Science Center conducted a pilot study to examine the distribution and frequency of gorgonian and other corals in the Seguam Pass area of the Aleutian

Islands. Historically, these corals were a major bycatch component of the Atka mackerel fishery in this area. The study goal was to examine coral distribution and appearance of corals in heavily trawled areas of Seguam Pass, as compared to less-trawled areas. Underwater video provided images of a number of distinct habitat types and associated fishes, invertebrates, sponges and corals. Apparent trawl damage to hydrocorals was documented in an area known to be heavily fished in the past. Other areas showed no obvious signs of disturbance by fishing gear. The study documented interaction of rockfish and Atka mackerel with the habitat. The Seguam Pass area is composed of many habitat types ranging from large, barren sand dunes to dense sponge gardens associated with massive rock formations and gradations of and/rock and faunal densities in between.[1]

Summary

In relating otter trawl research to the fisheries of Alaska, some conclusions can be drawn:

1) Otter trawls commonly, but not always, cause detectable short term changes in infauna, epifauna, megafauna and substrate in different habitat types.
2) In comparable environments, studies using larger diameter footropes with non-continuous contact along their length , such as those used in Alaska, indicated less damage to upright, attached epifauna than those with smaller diameters and continuous contact (Moran and Stepheson 2000, VanDolah et al. 1987).
3) At higher trawling intensities, bottom trawling with large diameter footropes can produce persistent changes in megafauna communities (McConnaughey et al. 2000) on sandy substrates.
4) Even at relatively high intensities (12 tows per year), effects on infaunal communities may not persist (Kenchington et al. 2001).
5) Large bodied, attached and emergent epifauna are particularly vulnerable to trawl damage, even by a single pass at unimpacted sites (Collie et al. 2000, Van Dolah et al. 1987, Freese et al. 1998, Moran and Stepheson 2000) and effects can remain for at least a year in Alaska waters (Freese, in press). In Alaska these fauna are considered the living substrate categories of HAPC.
6) Specific effects on essential fish habitat will depend on the fine scale distribution and intensity of fishing effort relative to habitat distribution, levels of natural variability relative to fishing effects and the nature of habitat dependencies by managed (shell)fish stocks. These are poorly known for Alaska EFH. Given discrete but overlapping spatial distributions of species reflecting different habitat preferences/requirements (e.g., McConnaughey and Smith 1999), differential responses to fishing gear effects are likely.

Pelagic Trawl Gear

Walleye pollock is caught in the Bering Sea exclusively by pelagic trawls; nonpelagic trawling for pollock is prohibited. Pelagic trawls dominate the GOA pollock fishery and other fisheries also use pelagic gear. Because pelagic trawls have very large mesh openings in their forward sections,

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[1]Harold Zenger, "Personal communication," Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115, July 23, 2001.

greatly reducing hydrodynamic drag, vessels can fish pelagic trawls that are much taller and wider than bottom trawls which they may use. These large meshes also allow the escape of bycatch species that are not herded as easily as pollock, including halibut, sole and crabs. The legal definition regulating pelagic trawls focuses on requiring these large meshes. Seafloor contact is not prohibited, but discouraged by prohibiting devices which protect trawl footropes. The resulting danger of trawl damage is likely effective in preventing fishing with pelagic trawls in contact with the seafloor in areas of rough, hard or complex substrates, but not necessarily in areas where significant obstructions are unlikely. An indication of the distribution of such substrates is that NMFS surveys the entire eastern Bering Sea shelf with a trawl whose footrope is as vulnerable as those of pelagic trawls. However, they have been forced to use bobbin- protected footropes in the Gulf of Alaska and Aleutians because of the frequency of rough substrates.

Pelagic trawls have no known effect on habitat when fished within the water column, not in contact with the seafloor. However, anecdotal evidence has suggested that in some seasons and areas, pollock are distributed so close to the seabed that they could not be effectively caught without putting pelagic trawls in contact with the seafloor. Some confirmation that such near bottom distributions can be widespread include: 1. In 5 out of 9 years that both acoustic and bottom trawl surveys were conducted in the Bering Sea, the bottom trawl, which opens only 2 m high, detected more than 95% of the total biomass estimate for pollock more than 2 years old (2000 Bering Sea/AI SAFE) and 2. The average acoustic measurements of pollock density from those surveys were five times higher half a meter above the bottom than at 2 - 4 m (unpublished data, Neal Williamson, AFSC). In such conditions, it would be very advantageous to include those pollock very near the seafloor in the catch, giving a significant incentive for on-bottom fishing.

The effects from pelagic gear being fished on the bottom have not been specifically studied, and there are some important differences from bottom trawls that need to be considered in assessing likely habitat impacts. Pelagic trawls used off Alaska are generally designed to fish downward, with the entire net fishing deeper in the water column than the that they are towed behind. Pelagic doors are not designed to contact the seafloor. Thus, the source of the most intensive effects of bottom otter trawls is eliminated. Pelagic trawls are pulled downward by weights attached to the lower wing ends producing several hundred pounds of downward force. If the trawl is put in firm contact with the seafloor, most of this weight will be supported by the bottom, producing narrow scour tracks. Pelagic trawl footropes used in Alaska are most commonly made of steel chain, with some use of steel cable. Thus, their effects on habitat will have more similarity to tickler chains or small diameter trawl footropes than to the large diameter, bobbin-protected, footropes used in Alaska bottom trawls. Small footrope diameter will reduce the height that sediments are suspended into the water column, but make penetration of the sediment when bumps and ridges are encountered more likely. Animals anchored on or in the substrate would be vulnerable to damage or uprooting by this type of footrope. The very large mesh openings in the bottom panels of these trawls makes it very unlikely that animals not actively swimming upward in reaction to the net will be retained and hence removed from the seafloor, though they may be displaced a short distance.

In summary, pelagic trawls may be fished in contact with the seafloor and there are times and places where there may be strong incentives to do so, for example the Bering Sea shelf during the Summer. No data are available to directly estimate the frequency of this practice. Potential impacts would depend on the vulnerability of epibenthic animals in sand or mud substrates to contact with the small diameter footrpes. Prohibition of footrope protection makes the use, and hence impact, of such gear on hard or rugged substrates unlikely.

Longline Gear

Very little information exists regarding the effects of longlining on benthic habitat and published literature is essentially non-existant.

Observers on hook and line vessels have recorded bycatch of HAPC biota. Bycatches of benthic epifauna by Pacific cod fisheries using longline gear off Alaska were comparable to those using trawl gear (NMFS 2000). Bycatches of anemones and seawhips/pens were higher for longlines than trawls on both total weight and weight per cod catch bases, while trawl bycatches were higher for corals and sponges. On a regional scale, these removals do not represent a large portion of the population. For example, anemone abundance on the eastern Bering Sea shelf, likely underestimated due to the sampling trawl not catching 100% of anemones in the trawl path, was estimated at 26,570,000 kg (Bob McConnaughey, unpublished data) of which the three year (1997 - 1999) longline bycatch of 86,063 kg was at most 0.3%. A similar estimate for the Aleutians, where more of the hard substrates favored by anemones are available, could not be included because the trawl used for those surveys retains very few of the anemones in its path.

Observations of halibut gear made by NMFS scientists during submersible dives studying other aspects of longline gear off southeast Alaska provide some information on potential ways that longlines can affect bottom habitats (High 1998). The following is a summary of these observations:

> Setline gear often lies slack and meanders considerably along the bottom. During the retrieval process, the line sweeps the bottom for considerable distances before ascending. It snags on objects in its path, including rocks and corals. Smaller rocks are upended, hard corals are broken, and soft corals appear unaffected by the passing line. Invertebrates and other lightweight objects are dislodged and pass over or under the line. Fish, notably halibut, frequently moved the groundline numerous feet along the bottom and up into the water column during escape runs, disturbing objects in their path. This line motion was noted for distances of 50 feet or more on either side of the hooked fish.

In addition to the High (1998) observations, Sigler & Lunsford (2001) cite observations by K.J. Kreiger of small *Primnoa* colonies attached to < 0.4 m diameter boulders that had been tipped and dragged, which he attributed to longline gear.

These submersible observations only demonstrate the potential and some mechanisms for effects of longlines on benthic habitat, particularly structure-forming animals. Those observations are insufficient to assess whether habitats are significantly altered at either local or regional levels. Important missing information includes the area of seafloor affected by longlines, the proportion of animals in that area that are affected, the severity of effects, rates of recovery and the importance of affected structures in the function of essential fish habitat.

Pot Gear

Pots are considered to be less damaging than mobile gear, because they are stationary in nature, and thus, come into direct contact with a much smaller area of the seafloor. Pots affect habitat when they settle to the bottom and when they are hauled back to the surface. (Eno et al. 2001, Stewart 1999).

Physical damage from pots is highly dependent on habitat type. Sand and soft sediments are less likely to be affected, whereas reef-building corals, sponges, and gorgonians are more likely to be damaged because of their three-dimensional structure above the seafloor (Quandt 1999). Damage by pots also makes coral more susceptible to secondary infections. In south Florida, Sutherland et al. (1983) completed a submersible survey of derelict pots following the closure of the pot fishery in the state. Pots were set either singly or in lines, and most were set within 20-45 m of a coral reef and rock ledge. Of 23 derelict/ghost traps, 15 were on sand or algal flats, 4 were on high profile reef, and 4 were in livebottom area.

Eno et al. (2001) observed effects of pots set in water depths from approximately 14-23 m over a wide range of sediment types in Great Britain: mud communities with sea pens, limestone slabs covered by sediment, large boulders interspersed with coarse sediment, and rock. Observations demonstrated that sea pens were able to recover fully from pot impact (left in place for 24-48hrs) within 72-144 hours of the pots being removed. Pots remained static on the seafloor, except in cases where insufficient line and large swells caused pots to bounce off the bottom. When pots were hauled back along the bottom, a track was left in the sediments, but abundances of organisms within that track were not affected. Authors did record incidences of detachment of ascidians and sponges and damage to ross coral, but it was not clear if these resulted from this study or from previous damage. Authors conclude that no short-term effects result from the use of pots, even for sensitive species. The study did not examine chronic impacts.

Although pots might be considered less damaging to habitat than mobile gears, lost pots can have considerable effects on populations of fish and crustaceans. Bullimore et al. (2000) observed traps left out off the coast of Wales, UK to fish for 398 days and reported that lost pots continued to fish for as long as they were left out, even though the bait was gone after 13-27 days.

Pot Gear used off Alaska

The pots used off Alaska are much larger and heavier than those in any of the studies cited and interconnecting them with longlines is prohibited. Little research has been conducted to date on their habitat effects. The area swept by the pot during retrieval is unknown and expected to strongly depend on vessel operations, weather and current. Pacific cod pots take a very small amount of bycatch of HAPC species relative to other gears.

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