UNITED STATES DEPARTMENT OF COMMERCE
Office of the Under Secretary for
Oceans and Atmosphere
Washington, D.C. 20230

JAN 19 1999

To all Interested Government Agencies and Public Groups:

Under the National Environmental Policy Act, an environmental review has been performed on the following action.

TITLE:	Environmental Assessment for an Emergency Rule to Implement Reasonable and Prudent Steller Sea Lion Protection Measures in the Pollock Fisheries of the Bering Sea and Aleutian Island Area and the Groundfish Fishery of the Gulf of Alaska
LOCATION:	Federal Waters of the Bering Sea and Aleutian Islands and Gulf of Alaska
SUMMARY:	This emergency rule would implement three types of management measures for the pollock fisheries of the BSAI and GOA: (1) Measures to temporally disperse fishing effort, (2) measures to spatially disperse fishing effort, and (3) pollock trawl exclusion zones around important Steller sea lion rookeries and haulouts.
RESPONSIBLE OFFICIAL:	Steven Pennoyer Regional Administrator Alaska Region National Marine Fisheries Service P.O. Box 21668 Juneau, AK 99802 Phone: 907-586-7221

The environmental review process led us to conclude that this action will not have a significant impact on the environment. Therefore, an environmental impact statement was not prepared. A copy of the finding of no significant impact, including the environmental assessment, is enclosed for your information. Also, please send one copy of your comment to me in Room 5805, PSP, U.S. Department of Commerce, Washington, D.C. 20230.

Sincerely,

Susan Fruchter

Director of the Office of Policy
and Strategic Planning

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, Maryland 20910

JAN 14 1999

MEMORANDUM FOR: Susan B. Fruchter
Director of the Office of Policy
and Strategic Planning

FROM: Rolland A. Schmitten

SUBJECT: Transmittal of the Environmental Assessment for an Emergency Rule to Implement Reasonable and Prudent Steller Sea Lion Protection Measures in the Pollock Fisheries of the Bering Sea and Aleutian Islands Area and the Gulf of Alaska Implemented Under the Authority of Section 305(c) of the Magnuson-Stevens Fishery Conservation and Management Act -- DECISION MEMORANDUM

Based on the subject environmental assessment, I have determined that no significant environmental impacts will result from the proposed action. I request your concurrence in this determination by signing below. Please return this memorandum for our files.

1. I concur. Susan Fruchter 1/19/99.
Date

2. I do not concur. ______.
Date

Attachment

ENVIRONMENTAL ASSESSMENT/REGULATORY IMPACT REVIEW FOR AN EMERGENCY RULE TO IMPLEMENT REASONABLE AND PRUDENT STELLER SEA LION PROTECTION MEASURES IN THE POLLOCK FISHERIES OF THE BERING SEA AND ALEUTIAN ISLANDS AREA AND THE GULF OF ALASKA

Prepared by

National Marine Fisheries Service
Alaska Regional Office and
Alaska Fisheries Science Center

January 1999

TABLE OF CONTENTS

Executive Summary

The purpose of this emergency rule is to implement reasonable and prudent alternatives to avoid the likelihood of the pollock fisheries off Alaska jeopardizing the continued existence of the western population of Steller sea lions, or adversely modifying its critical habitat. In 1990, the Steller sea lion (*Eumetopias jubatus*) was designated as a threatened species under the Endangered Species Act of 1973 (ESA). The designation followed severe declines throughout much of the Gulf of Alaska and Aleutian Islands region. In 1993, critical habitat for the species was defined to include (among other areas), the marine areas within 20 nm of major rookeries and haulouts of the species west of 144°W longitude. In 1997, two separate populations were recognized, and the western population (west of 144°W longitude) was reclassified as endangered. Counts of adults and juveniles in the western population of Steller sea lions declined by 72% between the late 1970s and 1990. The decline has continued in the 1990s, with counts dropping 27% between 1990-1996 and an additional 9% from 1996 to 1998. While the absolute magnitude of the decline has been smaller in recent years because the population has been severely reduced the rate of decline, however, remains a serious problem.

Multiple factors have contributed to the decline, but considerable evidence indicates that lack of available prey is a major problem. Foraging studies confirm that Steller sea lions depend on pollock as major prey, and sea lions may be particularly sensitive to the availability of prey during the winter. The significance of pollock to sea lions may have increased since the 1970s due to shifts in community composition related to oceanographic changes. Pollock are also the target of extensive fisheries that have become concentrated in time and space. This concentration occurs in Steller sea lion critical habitat, and may reduce prey availability at critical times in the life history of sea lions. Pollock trawl fisheries, then, may compete with sea lions, and either contribute to their decline or impede their recovery.

On December 3, 1998 NMFS issued a Biological Opinion on the pollock fisheries of the Bering Sea and Aleutian Islands Management Area (BSAI) and Gulf of Alaska (GOA), and the Atka mackerel fishery of the Aleutian Islands Subarea. The Biological Opinion concluded that the BSAI and GOA pollock trawl fisheries, as proposed, are likely to (1) jeopardize the continued existence of the western population of Steller sea lions, and (2) adversely modify its critical habitat. The clause "jeopardize the continued existence of" means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). The clause "adversely modify its critical habitat" means "a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical" (50 CFR 402.02).

The Biological Opinion concluded that to avoid the likelihood of jeopardizing the continued existence of the western population of Steller sea lions, or adversely modifying its critical habitat, reasonable and prudent alternatives to the proposed pollock trawl fisheries in the Bering Sea, Aleutian Islands, and Gulf of Alaska must accomplish temporal and spatial dispersion of the BSAI and GOA pollock fisheries and contain pollock trawl exclusion zones around major rookeries and haulouts.

At its December 1998 meeting, the North Pacific Fishery Management Council (Council) adopted an emergency rule to implement the reasonable and prudent alternatives prior to the start of the pollock fisheries on January 20, 1999. The emergency rule recommended by the Council would implement three types of management measures for the BSAI and GOA pollock fisheries: (1) pollock trawl exclusion zones, (2) temporal dispersion of the pollock fishery, and (3) spatial dispersion of the pollock fishery. This analysis concludes that the emergency rule is not likely to significantly affect the quality of the human environment. Therefore an environmental impact statement was not prepared.

1.0 INTRODUCTION

The groundfish fisheries in the Exclusive Economic Zone (EEZ; 3 to 200 miles offshore) off Alaska are managed under the Fishery Management Plan for the Groundfish Fisheries of the Gulf of Alaska and the Fishery Management Plan for the Groundfish Fisheries of the Bering Sea and Aleutian Islands Area. Both fishery management plans (FMPs) were developed by the North Pacific Fishery Management Council (Council) under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). The Gulf of Alaska (GOA) FMP was approved by the Secretary of Commerce and became effective in 1978 and the Bering Sea and Aleutian Islands Area (BSAI) FMP became effective in 1982.

Actions taken to amend FMPs or implement other regulations governing the groundfish fisheries must meet the requirements of Federal laws and regulations. In addition to the Magnuson-Stevens Act, the most important of these are the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), Executive Order (E.O.) 12866, and the Regulatory Flexibility Act (RFA). NEPA and E.O. 12866 requires a description of the purpose and need for the proposed action as well as a description of alternative actions that may address the problem. This information is included in section 1 of this document. Section 2 contains goals, objectives, and analyses of the alternatives, and section 3 includes information on the biological and environmental impacts of the alternatives as required by NEPA. Impacts on endangered species and marine mammals are also addressed in this section. Section 4 contains a Regulatory Impact Review (RIR) which addresses the requirements of both E.O. 12866 and the RFA that economic impacts of the alternatives be considered.

This Environmental Assessment/Regulatory Impact Review (EA/RIR) addresses an emergency rule to implement reasonable and prudent alternatives to avoid the likelihood of the pollock fisheries off Alaska jeopardizing the continued existence of the western population of Steller sea lions, or adversely modifying its critical habitat.

1.1 Purpose of and Need for the Action

The purpose of this emergency rule is to implement reasonable and prudent alternatives to avoid the likelihood of the pollock fisheries off Alaska jeopardizing the continued existence of the western population of Steller sea lions, or adversely modifying its critical habitat. In 1990, the Steller sea lion (*Eumetopias jubatus*) was designated as a threatened species under the Endangered Species Act of 1973 (ESA). The designation followed severe declines throughout much of the Gulf of Alaska and Aleutian Islands region. In 1993, critical habitat for the species was defined to include (among other areas), the marine areas within 20 nm of major rookeries and haulouts of the species west of 144°W longitude. In 1997, two separate populations were recognized, and the western population (west of 144°W longitude) was reclassified as endangered. Counts of adults and juveniles in the western population of Steller sea lions declined by 72% between the late 1970s and 1990. The decline has continued with the population counts dropping 27% between 1990 and 1996. From 1996 to 1998, the count dropped by 9%. Similarly, between 1994 and 1998, counts of pups dropped by 19%. The absolute magnitude of the decline has been smaller in recent years because the population has been severely reduced. The rate of decline, however, remains a serious problem.

Multiple factors have contributed to the decline, but considerable evidence indicates that lack of available prey is a major problem. Foraging studies confirm that Steller sea lions depend on pollock as major prey, and sea lions may be particularly sensitive to the availability of prey during the winter. The significance of pollock to sea lions may have increased since the 1970s due to shifts in community composition related to oceanographic changes. Pollock are also the target of extensive fisheries that have become concentrated in time and space. This concentration occurs in Steller sea lion critical habitat, and may reduce prey availability at critical times in the life history of sea lions. Pollock trawl fisheries, then, may compete with sea lions, and either contribute to their decline or impede their recovery.

On December 3, 1998 NMFS issued a Biological Opinion on the pollock fisheries of the Bering Sea and Aleutian Islands Management Area (BSAI) and Gulf of Alaska (GOA), and the Atka mackerel fishery of the Aleutian Islands Subarea. The Biological Opinion concluded that the BSAI and GOA pollock trawl fisheries, as proposed, are likely to (1) jeopardize the continued existence of the western population of Steller sea lions, and (2) adversely modify its critical habitat. The clause "jeopardize the continued existence of" means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). The clause "adversely modify its critical habitat" means "a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical" (50 CFR 402.02).

The Biological Opinion concluded that to avoid the likelihood of jeopardizing the continued existence of the western population of Steller sea lions, or adversely modifying its critical habitat, reasonable and prudent alternatives to the proposed pollock trawl fisheries in the Bering Sea, Aleutian Islands, and Gulf of Alaska must accomplish temporal and spatial dispersion of pollock fishing effort and create pollock trawl exclusion zones around Steller sea lion haulouts and rookeries.

1.1.1 Temporal dispersion

The first objective of temporal dispersion is to avoid removal of prey during the winter period when Steller sea lions, and particularly adult females and juveniles, may be especially vulnerable to competition or lack of available prey. The current fishing schedule prohibits fishing from 1 November through 19 January in the pollock trawl fisheries in the Bering Sea subarea. The reasonable and prudent alternatives should continue this prohibition and expand it into the Gulf of Alaska.

A second objective of temporal dispersion is to more evenly distribute the pollock trawl fisheries catch throughout the remainder of the year and thereby eliminate the probability of localized depletions associated with removing large amounts of catch in short periods of time (e.g., "derby" fishing). In the BSAI, the pollock fishery has become temporally concentrated from about 10 months in 1990 to less than 3 months in 1998 (split into two seasons). This kind of pulse fishery represents one extreme of temporal dispersion. At the other extreme, the catch would be evenly distributed from 20 January to December 31. An even distribution of the catch throughout the year would reduce the likelihood for adverse ecosystem effects by minimizing the potential for temporary localized depletion. On the other hand, a significant effort by fishing vessels on a nearly year-round basis may increase the potential for interactive competition (i.e., disturbance of foraging sea lions by fishing activities). The division of the 20 January to December 31 period into four seasons represents an intermediate approach that reduces the potential for temporary depletion in either existing season by about one-half, and more evenly disperses the fishery through the period from 20 January to 31 October. The four-season approach has already been used in the GOA pollock fishery.

In the BSAI, about 45% of the entire TAC is currently taken in a six- to eight-week period during the winter A (roe) season, beginning 20 January, and then no pollock are removed until the fall season (1 September to 31 October; 55% of TAC). Because sea lions must depend on spawning aggregations of pollock during winter season, a third objective of temporal dispersion must be the dispersal of the roe-fishery. Possible protective measures could include reduction of the pollock TAC in the winter season, or splitting of the winter season into two seasons (winter and spring; e.g., January 20 and February 20), or both. Splitting of the winter TAC into two seasons reduces the potential for localized depletions, while still allowing for two seasons in which roe-bearing pollock can be fished. This approach satisfies the need to increase protection for sea lions without unnecessarily constraining the pollock trawl fisheries. Splitting the existing winter season into two seasons represents a reasonable stepping up of protection for sea lions. The possibility of localized depletion at any one time will be reduced by about half simply by splitting the current 45% A season apportionment into a winter and spring season.

To ensure that seasonal TACs are reasonably balanced and accomplish the desired temporal dispersal of catch, the portion of the total TAC removed in any particular season must be constrained. An even distribution of the TAC would result in a 25% split to each of four seasons. Due to various seasonal considerations (which may be important to sea lions, the fisheries, or both) some flexibility in the single season cap is desirable. An increase from 25% in a season to 30% (which amounts to a 20% increase from an even distribution) would still maintain a four-season approach. An increase from 25% to 35% would not maintain a four-season approach as 100% of the annual TAC could be taken in three seasons. Therefore, a 30% cap is essential to maintain the integrity of the four-season approach.

To maintain the integrity of the four-season approach and ensure temporal dispersion, seasonal TACs should not be open to in-season adjustment as a simple function of fishing practices. That is, by adjusting their fishing practices, the pollock trawl fisheries should not be able to move large parts of the TAC among seasons. Some small rollover from one season to the next is reasonable if undertaken to compensate for TAC not taken due to imprecision of management monitoring and premature closure of a given season.

On the basis of these concerns, catch must be dispersed temporally in accordance with the following principles:

a. Continue existing BSAI prohibition on pollock trawling from November 1 through January 19 and extend this prohibition to the Gulf of Alaska.

b. Distribute the pollock fishery into at least four seasons (two in the period from January through May and two in the period from June through October).

c. Limit combined TAC in the winter and spring periods to a maximum of 45% of the annual TAC (the current limit on the existing winter season).

d. Allocate single-season TACs to be no more than 30% of the annual TAC.

e. Prevent concentration of pollock catch at the end of one season and the beginning of the next season which, in effect, could result in a single pulse of fishing. Mechanisms for limiting such concentration might include inter-seasonal no-fishing periods, or limits on the proportion of a seasonal TAC that can be taken in the latter part of a season. Other measures to spread or reduce effort may be necessary.

f. Limit rollover of portions of seasonal TACs so that the overall TAC taken in any one season does not exceed 30% of the annual TAC.

1.1.2 Spatial dispersion

The first objective of spatial dispersion of pollock trawl fisheries is to ensure that the distribution of catch mirrors the distribution of exploitable pollock biomass for each seasonal TAC. This would include TAC allocation to areas both within critical habitat and outside of critical habitat.

In some areas, further reduction of catch may be necessary to provide sufficient protection for sea lions. That is, pollock harvest rates that are assumed to be safe for the pollock stocks may still constitute serious and detrimental competition between fisheries and the endangered and declining western population of sea lions. Thus, in some cases, the first principle of distributing catch according to the distribution of the pollock stock may not provide sufficient protection by itself.

As a management principle, the use of the pollock stock distribution to spatially allocate catch is problematic in both the BSAI and GOA. Stock assessment surveys are currently designed to determine pollock biomass, not distribution with respect to Steller sea lion critical habitat. In addition, the surveys are not conducted year-round, and are therefore sufficient to determine distribution during selected seasons only.

As fish stock distribution is generally not known in, for example, the winter season of the BSAI, then a precautionary approach must be followed to ensure that removals are not excessive in Steller sea lion critical habitat. Prior to 1987, less than 30% of the annual catch was taken from Steller sea lion critical habitat in all years except 1971 (when about 31% was taken). After 1987, the annual percentage of the TAC removed from critical habitat increased to between 36% and 69%, with the 1987-1997 mean at about 52%. In the winter or A season (1995 to 1997), the mean percentage of catch has been about 75%. These values provide reference points or benchmarks for reductions in catch from Steller sea lion critical habitat. With rounding, those benchmarks are:

a. 75% — mean percentage of catch during the A season from 1992 to 1997,
b. 50% — mean percentage of catch annually from 1987 to 1997, largely in summer, and
c. 30% — maximum percentage of catch annually prior to 1987, again largely in summer.

Of these benchmarks, setting the maximum percentage to be taken from critical habitat at 75% would not result in a reduction of take and therefore would not avoid jeopardy or adverse modification. Setting the maximum percentage at 50% is consistent with past fishery practices and still provides a considerable reduction from the current mean percentage. Setting the summer maximum at 30% would be consistent with the history of the fishery for a period of about two decades prior to 1987. This level would provide considerably more protection for Steller sea lion critical habitat, but also increases the risk of unnecessary restriction of the pollock trawl fisheries.

In the GOA, the percentage of the annual pollock TAC taken from critical habitat was on the order of a few percent until 1979, when the level rose to about 35%. From 1982 to 1997, the level has been consistently above 50%, ranging to as high as 93% in 1988. Here, a cap of 50% from critical habitat is consistent with the lower limit of catches since 1982, but also represents a meaningful reduction from the mean annual percentage over this period.

Using these benchmarks, then, a cap of 50% would be required to achieve a meaningful reduction in the percentage of TAC taken from critical habitat. A 50% cap would also minimize the immediate consequences to the fisheries compared to the consequences of adopting a more severe cap.

Finally, the allocation of catch according to the geographic distribution of stock biomass implies some subdivision of the entire area of the stock into meaningful geographic units. For the pollock stocks in the BSAI region, some specific geographic areas have already been identified (e.g., Aleutian Islands area, Bogoslof area, eastern Bering Sea). The investigation of area-specific harvest rates in the BSAI that indicated excessive harvesting in the Catcher Vessel Operational Area (CVOA) during the fall (B) season was based on the CVOA, the area outside of the CVOA but east of 170°W long., and the area outside of the CVOA but west of 170°W long. In the GOA, geographic management areas 610, 620, and 630 have already been established, and the Shelikof Strait area (combined 621 and 631) has been identified as an area of particular concern (and a site for annual hydroacoustic trawl surveys). With respect to the Steller sea lion, the areas of particular concern are identified as critical habitat. Management areas for the spatial allocation of pollock trawl fishing should be based on these and/or other meaningful geographic delineations.

On the basis of these concerns, catch must be dispersed spatially in accordance with the following principles:

a. Allocate percentages of TAC to areas defined by critical habitat and broad management districts (see item c) based on the pollock biomass distribution.

b. Absent good scientific estimates of pollock biomass distribution, place a maximum limit on the percentage of TAC allocations from critical habitat areas for each season. A cap of 50%, for example, is consistent with past fishing practices, but still leads to meaningful reduction in the percentage of TAC from critical habitat.

c. Allow for the possibility of further reduction of the percentage of TAC in specific critical habitat areas.

d. Prevent redistribution of TAC from areas outside of critical habitat to areas inside of critical habitat.

e. Base spatial distribution of the TAC on existing study or management areas. In addition, in the southeastern Bering Sea, the CVOA and southeastern Bering Sea foraging area should be combined to form one CH/CVOA complex. Additional or alternative areas may be suggested but should not lead to further spatial concentration of catch. Alternative areas must distribute TAC in a manner that is equivalent to or better (for sea lions) than would be accomplished by the following set of management areas.

Eastern Bering Sea:
Winter - CH/CVOA, and outside CH/CVOA
Summer - CH/CVOA, outside of CH/CVOA east of 170°W, and west of 170°W

Gulf of Alaska:
Winter - Shelikof Strait (621 and 631 combined), 610, 620, 630
Summer - 610, 620, and 630

Aleutian Islands:
All districts - 541, 542, and 543

1.1.3 Pollock trawl exclusion zones

Trawl exclusion zones are an example of spatial dispersion wherein pollock catch is clearly not proportionate to pollock stock distribution. Complete exclusion of pollock trawl fishing is based on the available evidence that the regions around major rookeries and haulouts are so essential to the recovery and conservation of the western population that risk of competition from pollock trawl fisheries must be excluded completely. Such exclusions are particularly important to protection of prey resources for reproductive females and for pups and juveniles learning to forage.

Exclusion of potential competition from other fisheries may follow from consultation or review of those fisheries. Reasonable and prudent alternatives here are limited to measures directed at the pollock trawl fisheries.

Based on the need to eliminate the possibility of competition in foraging areas immediately adjacent to rookeries and haulouts, exclusion zones must be established to accomplish the following:

a. Spatial separation of pollock trawl fishing and Steller sea lion foraging areas adjacent to terrestrial haulouts and rookeries;

b. Protection of all rookeries and haulouts used by significant numbers of animals since the beginning of the decline in the 1970s; and

c. Protection zones in the eastern Bering Sea must have a minimum radius of 20 nm, and 10 nm in the GOA and Aleutian Islands.

1.2 Alternatives considered

The following alternatives are considered for analysis

1.2.1 Alternative 1: No action

Under this alternative, the BSAI and GOA pollock trawl fisheries would be determined under the ESA to be likely to (1) jeopardize the continued existence of the western population of Steller sea lions, and (2) adversely modify its critical habitat. As a consequence of these findings under the ESA, the pollock fisheries could not legally continue. For this reason, this alternative is not considered farther.

1.2.2 Alternative 2: Emergency rule to implement RPAs (Preferred)

At its December 1998 meeting, the North Pacific Fishery Management Council (Council) adopted an emergency rule to implement the reasonable and prudent alternatives prior to the start of the pollock fisheries on January 20, 1999. The emergency rule recommended by the Council and modified by NMFS would implement the following management measures:

1.2.2.1 Aleutian Islands

The Aleutian Islands Subarea would be closed to directed fishing for pollock.

1.2.2.2 Bering Sea

Closed areas. 20 nm closures to directed pollock fishing would be established around all major Steller sea lion rookeries and haulouts with the exception of the Cape Sarichef haulout which would be closed to 10 nm during 1999 and to 20 nm for 2000 and beyond. These pollock fishing closures supplement and do not replace existing trawl closures and no-entry zones. Steller sea lion protection areas in the Bering Sea Subarea are identified in Table 1.

Table 1. Steller sea lion protection areas[1] in the Bering Sea Subarea[2] are identified in the following table. Where two sets of coordinates are given, the baseline extends in a clock-wise direction from the first set of geographic coordinates along the shoreline at mean lower-low water to the second set of coordinates. Where only one set of coordinates is listed, that location is the base point.

Management Area/Island/Site	Boundaries to				(Effective through July 19, 1999) Directed fishing for pollock prohibited within. . .(nm)		Trawling prohibited within. . .(nm)	
	Latitude	Longitude	Latitude	Longitude	Nov. 1 through April 31	May 1 through Oct. 31	Jan. 1 through April 15	Year-round
Bering Sea								
Walrus	57 11.00N	169 56.00W			20	20		10
Uliaga	53 04.00N	169 47.00W	53 05.00N	169 46.00W		20		
Chuginadak	52 46.50N	169 42.00W	52 46.50N	169 44.50W		20		
Kagamil	53 02.50N	169 41.00W				20		
Samalga	52 46.00N	169 15.00W				20		
Adugak	52 55.00N	169 10.50W			20	20		10
Umnak/Cape Aslik	53 25.00N	168 24.50W			20	20		
Ogchul	53 00.00N	168 24.00W			20	20		10
Bogoslof/Fire Island	53 56.00N	168 02.00W			20	20		10
Emerald	53 17.50N	167 51.50W				20		
Unalaska/Cape Izigan	53 13.50N	167 39.00W			20	20		
Unalaska/Bishop Pt	53 58.50N	166 57.00W			20	20		
Akutan/Reef-lava	54 07.50N	166 06.50W	54 10.50N	166 04.50W	20	20		
Old Man Rocks	53 52.00N	166 05.00W			20	20		
Akutan/Cape Morgan	54 03.50N	166 00.00W	54 05.50N	166 05.00W	20	20	20	10
Rootok	54 02.50N	165 34.50W				20		
Akun/Billings Head	54 18.00N	165 32.50W	54 18.00N	165 31.50W	20	20	20	10
Tanginak	54 12.00N	165 20.00W			20			
Tigalda/Rocks NE	54 09.00N	164 57.00W	54 10.00N	164.59.00W	20	20		
Unimak/Cape Sarichef	54 34.50N	164 56.50W			10	10		
Aiktak	54 11.00N	164 51.00W			20			
Ugamak	54 14.00N	164 48.00W	54 13.00N	164 48.00W	20	20	20	10
Round	54 12.00N	164 46.50W				20		
Sea Lion Rock (Amak)	55 28.00N	163 12.00W			20	20	20	10
Amak+rocks	55 24.00N	163 07.00W	55 26.00N	163 10.00W	20	20		

---

[1] Three nm NO TRANSIT ZONES are described at 50 CFR 227.12(a)(2).

[2] Closure zones around many of these sites also extend into statistical area 610 of the Gulf of Alaska Management Area

Fishing seasons. New fishing seasons would be established for the four sectors of the pollock industry (inshore, catcher processor, mothership, and CDQ) as defined in the American Fisheries Act (AFA). These new seasons are summarized in Table 2.

Table 2. BSAI pollock fishing seasons by sector

Fishing Season[1]	Industry Sector			
	Inshore	**Catcher/ processor**	**Mothership**	**CDQ**
A1 Season	Jan. 20 - Feb. 15		Feb. 1 - April 15	Jan. 20 - April 15
A2 Season	Feb. 20 - April 15			
B Season	Aug. 1 - Sept. 15		Aug. 1 - Sept. 15	April 15 - Dec. 31
C Season	Sept. 15 - Nov. 1		Sept. 15 - Nov. 1	

[1] The time of all openings and closures of fishing seasons, other than the beginning and end of the calendar fishing year, is 1200 hours, Alaska local time (A.l.t.)

Seasonal apportionment of TAC. The pollock TAC allocated to each industry sector would be apportioned to the fishing seasons identified above according to Table 3. Overages and underages may be rolled over to subsequent fishing seasons during the same year except that no seasonal apportionment may exceed 30% of the annual TAC.

Table 3. Seasonal apportionment of pollock TAC in the BSAI.

Fishing Season	Industry Sector			
	Inshore	**Catcher/ processor**	**Mothership**	**CDQ**
A1 Season	27.5%		40%	45%
A2 Season	12.5%			
B Season	30%		30%	55%
C Season	30%		30%	

Critical Habitat/Catcher Vessel Operational Area (CH/CVOA). A combined CH/CVOA area would be established. This area includes the Bogoslof foraging area and that portion of the CVOA that extends eastward from the Bogoslof foraging area as identified below:

Bogoslof foraging area. The Bogoslof foraging area consists of the area between 170°00'W and 164°00'W, south of straight lines connecting 55°00'N/170°00'W and 55°00'N/ 168°00'W; 55°30'N/168°00'W and 55°30'N/ 166°00'W; 56°00'N/166°00'W and 56°00'N/ 164°00'W and north of the Aleutian Islands and straight lines between the islands connecting the following coordinates in the order listed:

52°49.2'N/169°40.4'W
52°49.8'N/169°06.3'W
53°23.8'N/167°50.1'W
53°18.7'N/167°51.4'W
53°59.0'N/166°17.2'W
54°02.9'N/166°03.0'W
54°07.7'N/165°40.6'W
54°08.9'N/165°38.8'W
54°11.9'N/165°23.3'W
54°23.9'N/164°44.0'W

Catcher Vessel Operational Area (CVOA). The CH/CVOA complex contains that portion of the CVOA between 164°00'W and 163°00'W, and south of a straight line connecting 56°00'N/164°00'W and 56°00'N/ 163°00'W.

Catch limitations within the CH/CVOA Complex. Pollock harvests within the CH/CVOA complex during the A1 and A2 seasons would be restricted to a percentage of each sector's seasonal TAC apportionment according to Table 4.

Table 4. TAC limit within the CH/CVOA complex.

Fishing Season	Industry Sector			
	Inshore	Catcher/ processor	Mothership	CDQ
A1 Season	70%	40%	50%	100%
A2 Season	70%	40%		
B Season	The Council will be asked to submit measures to spatially disperse fishing effort during the B and C seasons. In the absence of alternative Council recommendations, TAC will be allocated among the following three areas based on distribution of exploitable biomass as determined by summer surveys: (1) CH/CVOA complex, (2) East of 170°W and North of CH/CVOA complex, (3) West of 170°W, north of 56°N.			
C Season				

NMFS will monitor catch by each industry sector and close the CH/CVOA complex to directed fishing for pollock by a given sector when NMFS determines that its specified CH/CVOA limit has been reached. Catcher vessels less than 99 ft length overall (LOA) would be exempt from CH/CVOA closures from September 1 through March 31 unless the 70% cap for the inshore sector has been reached. NMFS will prohibit catcher/vessels over 99 ft LOA from directed fishing for pollock inside CH/CVOA before the 70% limit is reached to allow sufficient catch within CH/CVOA to support fishing by vessels less than 99 ft LOA.

1.2.2.3 Gulf of Alaska

Closed areas. 10 nm closures to directed pollock fishing would be established around all major Steller sea lion rookeries and haulouts with the exception of eight haulout locations for which 10 mile pollock trawl closures will be phased in for 2000 and beyond. These pollock fishing closures supplement and do not replace existing trawl closures and no-entry zones. Steller sea lion protection areas in the Gulf of Alaska are identified in Table 5.

Table 5. Steller sea lion protection areas[1] in the Gulf of Alaska[2]. Where two sets of coordinates are given, the baseline extends in a clock-wise direction from the first set of geographic coordinates along the shoreline at mean lower-low water to the second set of coordinates. Where only one set of coordinates is listed, that location is the base point.

Management Area/Island/Site	Boundaries to				(Effective through July 19, 1999) Directed fishing for pollock prohibited within. . .(nm)		Trawling prohibited within. . .(nm)	
	Latitude	Longitude	Latitude	Longitude	Nov. 1 through April 31	May 1 through Oct. 31	Jan. 1 through April 15	Year-round
Gulf of Alaska								
Bird	54 40.50N	163 18.00W			10	10		
South Rocks	54 18.00N	162 41.50W			10	10		
Clubbing Rocks	54 42.00N	162 26.50W	54 43.00N	162 26.50W	10	10		10
Pinnacle Rock	54 46.00N	161 46.00W			10	10		10
Sushilnoi Rocks	54 50.00N	161 44.50W				10		
Olga Rocks	55 00.50N	161 29.50W	54 59.00N	161 31.00W	10	10		
Jude	55 16.00N	161 06.00W			10	10		
The Whaleback	55 16.50N	160 06.00W			10	10		
Chernabura	54 47.50N	159 31.00W	54 45.50N	159 33.50W	10	10		10
Castle Rock	55 17.00N	159 30.00W				10		
Atkins	55 03.50N	159 19.00W			10	10		10
Spitz	55 47.00N	158 54.00W				10		
Kak	56 17.00N	157 51.00W				10		
Lighthouse Rocks	55 47.50N	157 24.00W			10	10		
Sutwik	56 31.00N	157 20.00W	56 32.00N	157 21.00W		10		
Chowiet	56 00.50N	156 41.50W	56 00.50N	156 42.00W	10	10		10
Nagai Rocks	55 50.00N	155 46.00W			10	10		
Chirikof	55 46.50N	155 39.50W	55 46.50N	155 43.00W	10	10		10
Puale Bay	57 41.00N	155 23.00W			10	10		
Takli	58 03.00N	154 27.50W	58 02.00N	154 31.00W		10		
Cape Gull	58 13.50N	154 09.50W	58 12.50N	154 10.50W		10		

[1] Three nm NO TRANSIT ZONES are described at 50 CFR 227.12(a)(2).

[2] Additional closures along the Aleutian Island chain that extend into statistical area 610 of the Gulf of Alaska are displayed in Table 4 of this part.

Table 5. (cont.)

Management Area/Island/Site	Boundaries to				(Effective through July 19, 1999) Directed fishing for pollock prohibited within. . .(nm)		Trawling prohibited within. . .(nm)	
	Latitude	Longitude	Latitude	Longitude	Nov. 1 through April 31	May 1 through Oct. 31	Jan. 1 through April 15	Year-round
Sitkinak/Cape Sitkinak	56 34.50N	153 51.50W			10	10		
Kodiak/Cape Ugat	57 52.00N	153 51.00W			10	10		
Shakun Rock	58 33.00N	153 41.50W			10	10		
Twoheaded Island	56 54.50N	153 33.00W	56 53.50N	153 35.50W	10	10		
Cape Douglas	58 51.50N	153 14.00W				10		
Latax Rocks	58 42.00N	152 28.50W	58 40.50N	152 30.00W	10	10		
Ushagat/SW	58 55.00N	152 22.00W				10		
Ugak	57 23.00N	152 15.50W	57 22.00N	152 19.00W		10		
Sea Otter Island	58 31.50N	152 13.00W			10	10		
Long	57 47.00N	152 13.00W			10			
Kodiak/Cape Chiniak	57 37.50N	152 09.00W			10	10		
Sugarloaf	58 53.00N	152 02.00W			10	10		10
Sea Lion Rocks (Marmot)	58 21.00N	151 48.50W			10	10		
Marmot	58 14.00N	151 47.50W	58 10.00N	151 51.00W	10	10		10
Perl	59 06.00N	151 39.50W			10	10		
Outer (Pye) Island	59 20.50N	150 23.00W	59 21.00N	150 24.50W	10	10		10
Steep Point.	59 29.00N	150 15.00W				10		
Chiswell Islands	59 36.00N	149 34.00W			10	10		
Wooded Island (Fish)	59 53.00N	147 20.50W			10	10		
Glacier Island	60 51.00N	147 09.00W			10	10		
Seal Rocks	60 10.00N	146 50.00W			10	10		
Cape Hinchinbrook	60 14.00N	146 38.50W				10		
Hook Point	60 20.00N	146 15.50W				10		
Cape St. Elias	59 48.00N	144 36.00W			10	10		

[1] Three nm NO TRANSIT ZONES are described at 50 CFR 227.12(a)(2).

Fishing seasons and TAC apportionments. New fishing seasons and TAC apportionments would be established for the GOA pollock fishery in the Western and Central (W/C) Regulatory Areas of the GOA as displayed in Table 6. The TAC for pollock in the combined W/C Regulatory Areas is apportioned among Statistical Areas 610, 620, and 630 in proportion to the distribution of the pollock biomass as determined by the most recent NMFS surveys. The pollock fishing season in the Eastern Regulatory Area would be unchanged.

Table 6. Pollock fishing seasons and TAC apportionments for the Western/Central Regulatory Areas of the Gulf of Alaska.

Fishing season	TAC apportionment	Dates[1]	
		From	To
A Season	30%	January 20	April 1
B Season	20%	June 1	July 1
C Season	25%	September 1	The date of closure of a statistical area (610, 620, 630) to directed fishing, or October 1, whichever comes first.
D Season	25%	Five days after the date of closure of statistical area to directed fishing	November 30.

[1]The time of all openings and closures of fishing seasons, other than the beginning and end of the calendar fishing year, is 1200 hours, A.l.t.

Catch limits within the Shelikof Strait foraging area. During the A season for Areas 620 and 630, NMFS will establish a cap within each area that may be taken from within Shelikof Strait. This cap will be based on the proportion of each area's TAC that is derived from survey biomass estimates inside Shelikof Strait. When the Shelikof Strait cap within each area is reached, NMFS will close the Shelikof strait portion of the area to directed fishing for pollock.

1.2.3 Alternative 3: Emergency Rule to implement AFSC example

During early development of the Biological Opinion on the pollock and Atka mackerel fisheries off Alaska, the Alaska Fisheries Science Center (AFSC) developed an example RPA implementation strategy in the event that the Biological Opinion concluded jeopardy with respect to the pollock fisheries off Alaska. This example implementation strategy was presented to the public in a series of workshops and is set out here as an alternative approach to the Council's emergency rule recommendations.

1.2.3.1 Bering Sea management actions

RPA Principle	*Short-term*	*Long-term*
Temporal TAC Distribution	Trimester: A (Jan 20): 35% B (Jul 1): 15% C (Sep 1): 50%	Same
Spatial TAC Distribution	*A-Season:* Maximum of 50% of TAC removed from critical habitat[1] *B&C Seasons:* Most recent survey biomass distributions as basis for TAC allocation inside and outside of critical habitat[1]	A, B, and C season TACs distributed on the basis of survey biomass distributions inside and outside of critical habitat[1]
Trawl Exclusion Zones	20 nm around sites on critical habitat[1] list	20 nm around sites on critical habitat[1] list

[1] Critical habitat list of rookeries and haulouts as amended to include those sites with >200 animals not included in exisiting no-trawl zones.

[2] 33% cap on seasonal removals from critical habitat realizes a 50% reduction from previous critical habitat removals without simply displacing the catch from 0-10 nm to the rest of critical habitat.

1.2.3.2 Aleutian Islands management actions

RPA Principle	*Short-term*	*Long-term*
Temporal TAC Distribution	No New Seasonal Allocation	No New Seasonal Allocation
Spatial TAC Distribution	No New Spatial Allocations	A, B, and C season TACs distributed on the basis of survey biomass distributions inside and outside of critical habitat[1]
Trawl Exclusion Zones	10 nm around sites on critical habitat[1] list	10 nm around sites on critical habitat[1] list

[1] Critical habitat list of rookeries and haulouts as amended to include those sites with >200 animals not included in trawl exclusion zones.

[2] 33% cap on seasonal removals from critical habitat realizes a 50% reduction from previous critical habitat removals without simply displacing the catch from 0-10 nm to the rest of critical habitat.

1.2.3.3 Gulf of Alaska management actions

RPA Principle	*Short-term*	*Long-term*
Temporal TAC Distribution	Trimester: A (Jan 20): 35% B (Jul 1): 15% C (Sep 1): 50%	Same
Spatial TAC Distribution	*A-Season:* Maximum of 50% of TAC removed from critical habitat[1] *B&C Seasons:* No more than 33%[2] of the aggregate B&C season TAC removed from critical habitat[1]	A, B, and C season TACs distributed on the basis of survey biomass distributions inside and outside of critical habitat[1]
Trawl Exclusion Zones	10 nm around sites on critical habitat[1] list from 144°-164°W, and 20 nm around sites on critical habitat[1] list from 164°-170°W	10 nm around sites on critical habitat[1] list from 144°-164°W, and 20 nm around sites on critical habitat[1] list from 164°-170°W

[1] Critical habitat list of rookeries and haulouts as amended to include those sites with >200 animals not included in existing no-trawl zones.

[2] 33% cap on seasonal removals from critical habitat realizes a 50% reduction from previous critical habitat removals without simply displacing the catch from 0-10 nm to the rest of critical habitat.

1.3 Pollock Fishery in the BSAI and GOA

1.3.1 Stock Description and Life History

Walleye pollock (*Theragra chalcogramma*, hereafter referred to as pollock) is the most abundant species within the eastern Bering Sea and the second most abundant groundfish stock in the Gulf of Alaska. It is widely distributed throughout the North Pacific in temperate and subarctic waters (Wolotira, Sample et al. 1993). Pollock is a semidemersal schooling fish, which becomes increasingly demersal with age. Approximately 50% of female pollock reach maturity at age four at a length of approximately 40 cm. Pollock spawning is pelagic and takes place in the early spring on the outer continental shelf. In the Eastern Bering Sea the largest concentrations occur in the southeastern portion of the Eastern Bering Sea (north of Unimak Pass). In the GOA, the largest spawning concentrations in Shelikof Strait and the Shumagin Islands (Kendall, Schumacher et al. 1996). Juvenile pollock are pelagic and feed primarily on copepods and euphausiids. As they age, pollock become increasingly piscivorous and can be highly cannibalistic, with smaller pollock being a major food item (Livingston 1991). Pollock are comparatively short lived, with a fairly high natural mortality rate estimated at 0.3 (Wespestad and Terry 1984; Hollowed, Brown et al. 1997) and a maximum recorded age of around 22 years.

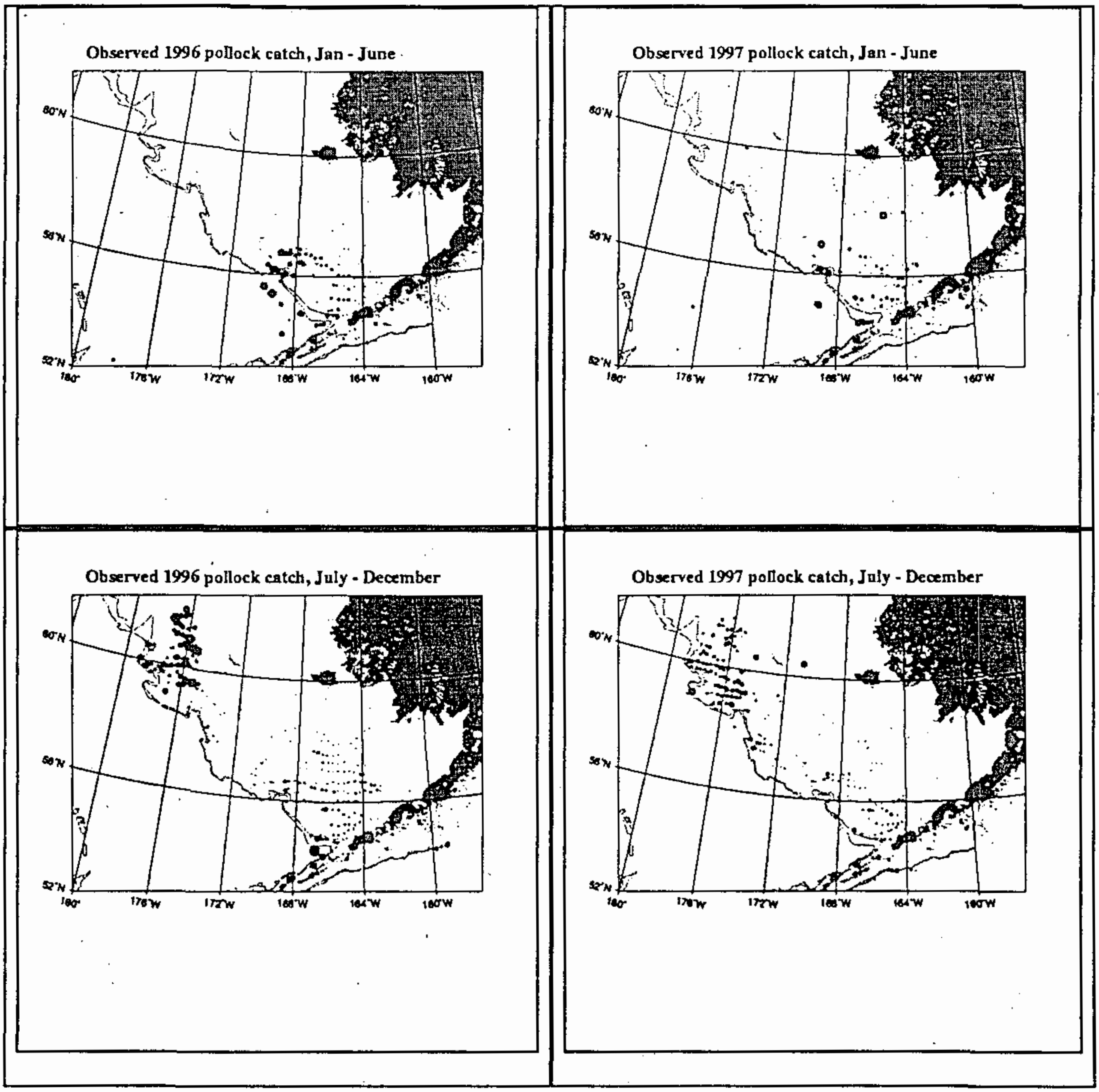
Although stock structure of Bering Sea pollock is not well defined (Wespestad 1993), three stocks of pollock are recognized in the BSAI for management purposes; eastern Bering Sea, Aleutian Islands and Aleutian Basin. Pollock in the GOA are thought to be a single stock (Alton and Megrey 1986) originating from springtime spawning in Shelikof Strait (Brodeur and Wilson 1996).

1.3.2 Overview of the pollock fisheries

Pollock supports the largest fishery in Alaskan waters. In the BSAI, pollock comprise 75-80% of the catch. In the Gulf, pollock constitute 25-50% of the catch. Most pollock (91%) is taken with pelagic trawl gear, the remainder with bottom trawl gear.

The directed fishery for BSAI pollock is prosecuted by catcher/processor and catcher vessels using pelagic and bottom trawl gear. The season is broken into two parts, a roe season during early winter, and a surimi/filet season during the second half of the year. The TAC is usually divided 45:55 between these two seasons. Observed pollock fishery trawl locations in 1996 by season are shown in Figure 1. BSAI pollock are caught as bycatch in other directed fisheries, but because they occur primarily in well defined aggregations, the impact of this bycatch is typically minimal. Most discard of pollock occurs in the non-directed pollock trawl fisheries (72% of all discards in 1996). Recent discard rates (discards/retained catch) of pollock in the directed fishery have been about 7% (Wespestad, Ianelli et al. 1997). Pollock are caught as bycatch in the trawl fisheries for Pacific cod, rock sole, and yellowfin sole. In 1996, 21,000 mt of pollock were discarded in the directed fishery compared to 55,200 mt discarded in all other fisheries (Wespestad, Ianelli et al. 1997). Starting in 1998, discarding of pollock is prohibited except when pollock is closed to directed fishing.

From the mid-1970s to 1990, the pollock fishery, along with all other groundfish fisheries in Alaska, was transformed by the passage of the Magnuson Fishery Conservation and Management Act (Magnuson Act). One of the principal objectives of the Magnuson Act was to promote full domestic use of the offshore fisheries of the United States. Prior to passage of the Magnuson Act, most pollock harvested off Alaska were caught and processed solely by distant-water fleets of foreign nations, including Japan, the former U.S.S.R., Republic of Korea,and Poland. Most of the fishery effort for pollock was located in the Eastern Bering Sea and Aleutian Islands region (i.e., the BSAI).


Observed 1996 pollock catch, Jan - June

Observed 1997 pollock catch, Jan - June

Observed 1996 pollock catch, July - December

Observed 1997 pollock catch, July - December

Figure 1 Distribution of fishery operations during 1996-1997. Circle size represents the average magnitude of the catch per haul.

Catches of BSAI pollock increased quickly from about 100,000 mt in 1964 to over 1.8 mmt in 1972. Beginning in 1973, declines in BSAI pollock abundance led to reductions in catch quotas to about 1.0 mmt in 1977. Little fishing effort was devoted to pollock in the GOA until the mid-1970s, when about 100,000 mt was caught per year.

After passage of the Magnuson Act in 1976, increasing amounts of pollock TAC were allocated to joint-venture operations between domestic catcher vessels and foreign processing ships to encourage development of the domestic fishing industry. Joint-ventures for pollock first became important in the GOA after discovery of the pollock spawning assemblage in Shelikof Strait in 1980. This discovery led to a tripling of GOA pollock landings between 1980 and 1985 to about 300,000 mt. The Shelikof Strait pollock fishery targeted on roe-bearing females during the winter and early spring. Due to declines in the size of the spawning population in Shelikof Strait, NMFS reduced the GOA pollock TAC in 1986 to about 80,000 mt. Seeking other sources of roe, the joint-venture fishery moved to another large spawning assemblage of pollock near Bogoslof Island in the eastern Aleutian Basin of the BSAI region. In the GOA, both catching and processing components of the pollock fishery were entirely domestic by 1988, while in the BSAI region a small amount of pollock was allocated to joint ventures as late as 1990. Beginning in 1992, pollock catch quotas have been allocated separately to the onshore (i.e., shoreside or inshore) and offshore (i.e., catcher processors or factory trawlers) as a result of the passage of the Inshore/Offshore amendments to the BSAI and GOA FMPs (numbers 18 and 23, respectively). These amendments mandated that 100% of the pollock catch from the GOA be processed at shoreside plants; in the BSAI, the onshore/offshore split of the pollock TAC was 35%:65% from 1992-98.

Megrey (1989) documented the historical expansion of the pollock fishery in the Gulf of Alaska. He identified four phases of expansion, beginning with a developmental phase between 1964 and 1971 when the fishery was dominated by foreign trawlers that captured pollock incidentally in mixed species catches. The second phase occurred between 1972 and 1980, when directed pollock harvests were initiated by foreign and joint venture fisheries. Floating freezer-surimi trawlers were active in the Gulf of Alaska during the second phase of fishery development. The third phase of development occurred between 1980 and 1985. This phase was characterized by joint venture operations which emphasized surimi production and roe harvest. During this period the Shelikof Strait spawning concentrations were discovered. In more recent years, foreign vessels have been eliminated from the pollock fishery. This final phase was marked by the passage of Amendments 18/23 (inshore/offshore) which allocated 100% of the TAC to vessels catching pollock for delivery to the inshore sector. During this period the fishing community moved from a bottom trawl fishery to a mid-water fishery due to management measures established to control bycatch of prohibited species. The temporal and spatial distribution of the pollock catch changed as fishery participation changed. Between 1963 and 1997 in both the BSAI region and GOA, the pollock fishery worked increasingly in fall and winter and fished more in areas which were designated as critical habitat for Steller sea lions 1993.

1.3.3 Temporal distribution of effort

In the BSAI region prior to 1987 (when the spawning assemblage near Bogoslof Island was first exploited), the pollock fishery was conducted primarily in spring and summer (April-September) when about 70-80% of the landings were taken. Since 1987, however, the proportion caught during fall and winter (September-March) increased to between 35 and 65% as the fishery targeted the higher-priced roe-bearing fish available in winter. Beginning in 1990, the BSAI annual pollock TAC was divided into an "A," or roe, season from January to mid-April which initially received 40% of the TAC, and a "B" season beginning in June and lasting until the TAC was reached (BSAI FMP Amendment 14). This measure ensured sufficient pollock TAC for the B season, but also increased the first quarter's proportion of the annual pollock catch. In 1993, the A season allocation was increased to 45%, and has remained at that level since. The starting date for the B season was also moved to August 15 in 1993 and then to September 1 beginning in 1996.

The temporal distribution of pollock catches in the GOA has been different than in the BSAI region. From 1964 to 1997, a greater percentage of pollock was harvested in the fall and winter in the GOA than in the BSAI, but total removals were less. However, when landings from the GOA exceeded 150,000 mt from 1981-85 during the Shelikof roe fishery, the proportion caught in fall and winter exceeded 50%, and ranged as high as 90%. Even after catches declined in 1986-89 in response to declining pollock biomass, the

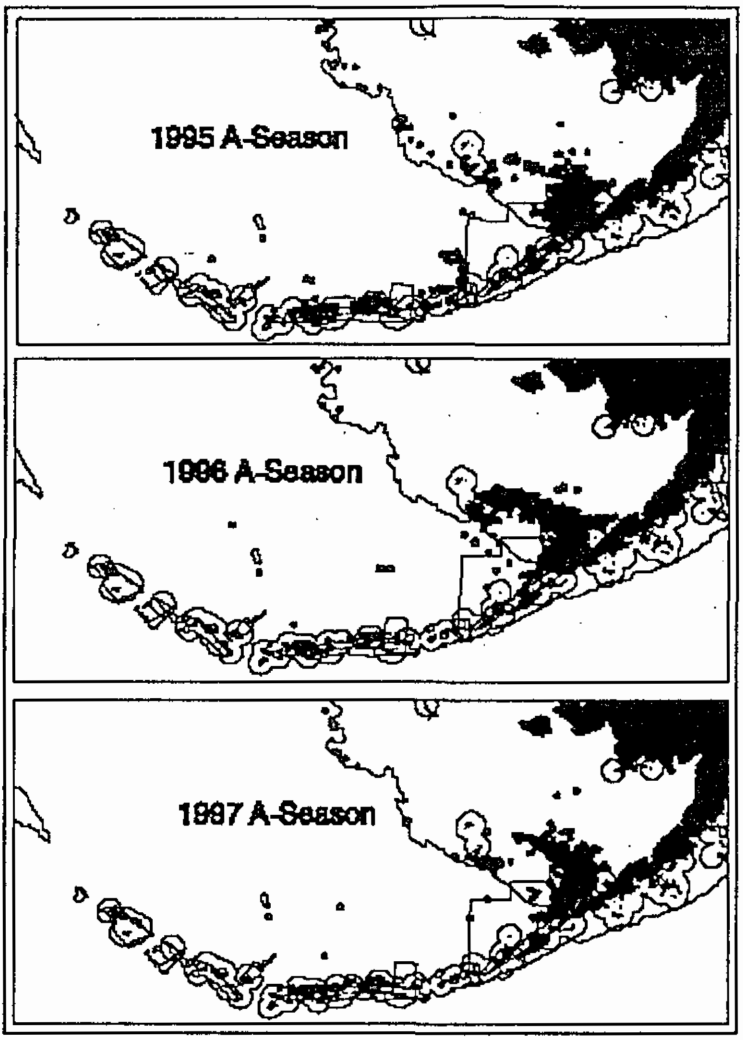


Figure 2 BSAI pollock trawl locations during the A season, 1995-1997.

proportion caught in fall and winter remained above 70%. In 1990, the GOA pollock TAC was allocated quarterly (GOA FMP Amendment 19) to help prevent its early preemption by large catcher/processors. These vessels, which usually worked in the BSAI region where the pollock TAC is larger, caught a large percentage of the available pollock TAC in the GOA in a short amount of time, and precluded pollock fishing opportunities for vessels based in the GOA. As pollock biomass and TACs declined in the mid 1990s, the number of seasonal releases was reduced to three (January, June, and September), with 25% of the annual TAC assigned to each of the first two seasons and 50% to the last. For the 1998 GOA pollock fishery, the seasonal allocations to the 2nd and 3rd seasons were changed to 35% and 40%, respectively, to reduce the pollock catches during the fall in response to an increase in TAC.

1.3.4 Spatial Distribution

Increases in the proportions of the annual regional pollock TAC caught in Steller sea lion critical habitat in the BSAI and GOA occurred simultaneously with the exploitation of spawning concentrations of pollock near Bogoslof Island in 1987 and in Shelikof Strait in 1982. In the BSAI, the percentage caught within critical habitat increased from between 5-20% in the late 1960s to 15-30% from 1971 to 1986. Actual removals mirrored the total catch during this period (1964-1986) and peaked at over 500,000 mt in 1971 and 1972, before decreasing to between 200,000 and 300,000 mt from 1977-86. From 1987-95, however, both the catch tonnage and percentage of annual removals of pollock from critical habitat increased more than threefold to over 800,000 mt and 60%, respectively. This shift resulted from increasing pollock fishery effort in fall and winter, when pollock are more concentrated within critical habitat) and an evolution in fleet composition from a mobile processing fleet (e.g., foreign factory trawlers) to one increasingly dominated by shore-based processors and their catcher vessels which fish in coastal fishing areas often located within critical habitat. Furthermore, the Bogoslof area (Area 518) was closed in 1992 to protect the Aleutian Basin pollock stock. As a result, effort in the eastern Bering Sea's A season became concentrated on the spawning aggregation on the shelf north of Unimak Island.

The recent increase in BSAI critical habitat catches has occurred principally during the A season (January-March), as evidenced by high amounts (between 250,000 mt and 550,000 mt) and percentages (between 50-90%) removed from critical habitat between 1992 to 1997. Recent effort in the B season has shown some movement out of critical habitat during the summer. Since 1992, catches of pollock from critical habitat

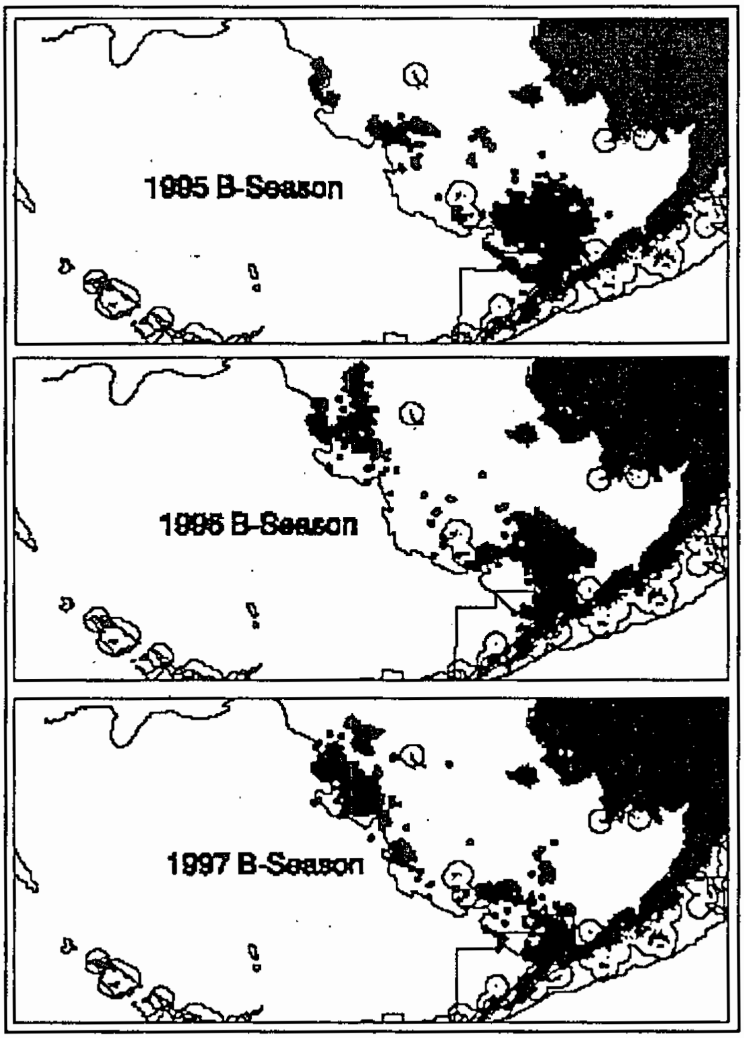


Figure 3 BSAI pollock trawl locations during the B season, 1995-1997.

during the B season have declined from about 350,000-400,000 mt to 250,000 mt, while the percentages have declined from about 50% to 40% of total B-season removals. Recent 3-year averages by season are:

A season	73%
B season	44%

Observed trawl locations in the BSAI pollock fishery for 1995-1997 are shown by season in Figures 2 and 3.

In the GOA, pollock catches from critical habitat increased (as the TAC increased) from trace amounts prior to 1979 to over 200,000 mt in 1985, primarily from Shelikof Strait. Pollock landings from GOA critical habitat dropped (as the annual TAC declined) to about 50,000 mt in 1986, and have ranged between 35,000 and 90,000 mt through 1997. However, the percentage of total annual GOA pollock catches taken from critical habitat did not decline after 1985, but has remained between 50% and 90%. Recent (1995-1997) percentages of pollock catch taken from critical habitat are shown by season in Figure 4. As in the BSAI, percentage removals from critical habitat during the roe-harvesting season (January) have generally been the highest.

Recent 3-year averages by season are:

○	January	90%
○	June/July	73%
○	September/October	58%

Recent pollock fishery distribution patterns suggest that competition with sea lions in critical habitat is ongoing despite the partitioning that was achieved in the vicinity of rookeries with the establishment of trawl exclusion zones. In the BSAI, where the pollock quota is allocated to broad Eastern Bering Sea and Aleutian Islands management areas, the creation of 10- and 20-nautical mile trawl exclusion zones did not constrain landings from sea lion critical habitat. Pollock removals from critical habitat began increasing prior to 1991-

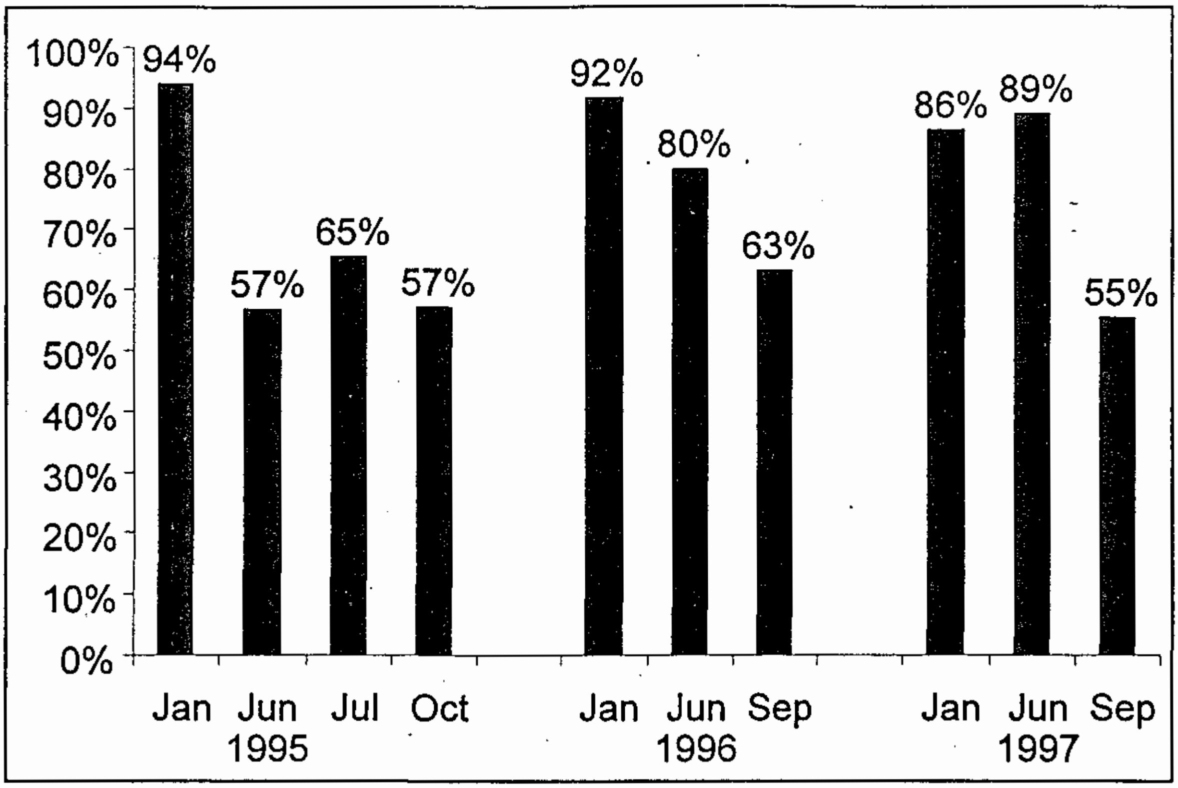


Figure 4. Percentage of observed pollock catch caught within Steller sea lion critical habitat in the GOA pollock fisheries in 1995 to 1997, by season.

1993, and may might increased further if protective measures had not been enacted. It must be noted, however, that the areas within the existing trawl exclusion zones were not heavily utilized by either the BSAI or GOA pollock fisheries prior to their creation; from 1984-1991, the annual percentage of pollock caught within these areas ranged only 1-7% in the BSAI and 0-3% in the GOA. In the GOA, the combination of spatial pollock allocations and trawl exclusion zones may have stabilized pollock removals and effort at 1986-1991 levels, but did not reduce them.

1.3.5 Pollock catch history

The current age and size distributions of the eastern Bering Sea and Aleutian Island pollock stocks are discussed in Wespestad et al. (1997). As noted above, pollock biomass increased to almost 8 mmt in 1971, as catches increased from negligible amounts to over 1.8 mmt. As biomass declined through 1978, catches also declined to about 1.0 mmt. As biomass increased after 1978 and then fluctuated into the 1990s, catches fluctuated between 1.0 mmt and 1.5 mmt. Calculated harvest rates (catch/biomass) fluctuated widely in the beginning of the fishery, from about 10-15% in the mid-1960s to between 20-35% in the mid-1970s. Since 1979, estimated area-wide harvest rates of eastern Bering Sea pollock have fluctuated between 7% and 15%.

The current age and size distributions of GOA pollock are discussed in Hollowed et al. (1997). As pollock biomass increased to almost 3 mmt in 1981, catches increased from negligible amounts to about 140,000 mt. From 1981-85, biomass declined but catches increased to over 300,000 mt, resulting in the only period since 1969 when harvest rates exceeded 10%. From the peak in 1981, population biomass declined to less than 1 mmt in 1995 and 1996, while catches since 1986 have generally been less than 100,000 mt each year. In the last 12 years, (1986 to 1997), estimated harvest rates of GOA pollock have ranged between 4 and 10%.

1.3.6 Inshore/Offshore allocations and the American Fisheries Act

In the BSAI region, the allocation of pollock between the inshore and offshore sectors of the fishing industry is a complex issue involving considerations of optimal utilization versus waste, economics and issues related to domestic versus foreign ownership, social considerations such as the stability and economic well-being of local fishing communities, and ecosystem considerations such as the distribution of fishing effort in time and space and the effects of the fishery on protected species such as the Steller sea lion. These same considerations apply in the GOA, but allocation in the GOA has been primarily to prevent larger catcher/processors from displacing smaller catcher vessels, such as occurred in 1989. Strictly speaking, the question of who removes pollock from the ecosystem should not have a direct effect on Steller sea lions or other protected species. However, protected species are affected because the various sectors of the fishing industry behave or operate differently.

The industry includes three main sectors: catcher/processors, motherships, and inshore processors. Catcher-processors have the ability to catch and process pollock, motherships are essentially floating processors that take catch from catcher vessels, and inshore processors are shore plants and anchored floating processors that take delivery from catcher vessels. The distinction between motherships and catcher/processors is somewhat artifical. Many catcher/processors receive codends from catcher vessels to supplement their own catch when fishing is slow. In addition, several of the dedicated motherships could in fact operate as catcher/pocessors except for the fact that they were constructed in foreign shipyards and are therefore ineligible to catch fish in US waters and are limited to processing only. Processing at sea (the offshore sector) allows greater flexibility in terms of areas fished, whereas processing of small vessel catch at shoreside processors (the inshore sector) provides greater economic benefits for local communities with catcher vessels and/or processing facilities. Again, these general distinctions become blurred as these fishing sectors modify their behavior (e.g., catcher vessels delivering to motherships or catcher/processors).

Inshore/offshore allocations of pollock were first established in 1992 under FMP Amendments 18 (BSAI) and 23 (GOA). In the BSAI region, 35% of the pollock TAC (after subtraction of reserves) was allocated to the inshore sector and 65% to the offshore sector. A catcher vessel operation area (CVOA) was established with the same boundaries as currently in place except that the western boundary was 0°30' west of its current location. The CVOA was in effect from September 1 to the end of the year, and motherships (and catcher/processors acting as motherships) were allowed to receive catches inside the CVOA only if they did not participate in directed fishing for pollock. In 1995, the allocation (35%:65%) was unchanged, the CVOA was reduced to its current configuration, and catcher/processors were allowed to fish for pollock in the CVOA if the pollock allocation for the inshore sector had been taken prior to the end of the fishing season. BSAI Amendment 51 would establish the following for 1999 to 2001: a) after subtraction of reserves, 39% of the BSAI pollock TAC would be allocated to the inshore sector and 61% to the offshore sector; b) a portion of the inshore allocation equal to 2.5% of the BSAI pollock TAC, after subtraction of reserves, would be set aside for catcher vessels under 125 ft length overall and would become available on or about August 25 of each year; and c) all vessels harvesting pollock for processing by the offshore component would be prohibited from fishing inside the CVOA after September 1 of each year, unless the inshore component of the pollock fishery is closed to directed fishing (i.e., the inshore portion of the TAC has been taken).

In the GOA, Amendment 23 (1992) allocated 100% of the pollock TAC to the inshore sector and 90% of the Pacific cod TAC to the inshore sector; 10% of the cod TAC was left for the offshore sector. Amendment 40 (1995) maintained this allocation scheme, and Amendment 51 would do the same.

On October 21, 1998, the President signed into law the American Fisheries Act (AFA), which changed the allocation scheme for pollock in the BSAI beginning in 1999. Under the AFA, 10% of the pollock TAC is allocated to the CDQ program and the remaining 90% of the TAC, after subtraction of an allowance for incidental catch in other fisheries, is allocated 50% to vessels delivering to the inshore sector, 40% to catcher processors and catcher vessels delivering to catcher processors, and 10% to catcher vessels delivering to motherships. These new allocation percentages mandated by the AFA represent a shift of 15% of the TAC from the offshore to the inshore sectors.

The AFA also contains a number of additional measures that affect the BSAI pollock and Atka mackerel fisheries:

- The AFA increases the US ownership requirement to 75% for vessels with US fisheries endorsements and prohibits new fisheries endorsements for vessels greater than 165 ft, LOA, greater than 750 gross registered tons, or with engines capable of producing greater than 3,000 shaft horsepower.
- Under the provisions of a $90 million buyout, nine factory trawlers will be lose their US fisheries endorsements on January 1, 1999 and eight of these vessels will be scrapped.
- Vessels and processors eligible to participate in the offshore, mothership, and inshore sectors are identified in the AFA, creating a closed class of vessels eligible to participate in the BSAI pollock fishery.
- Vessels catching pollock for the offshore, mothership and inshore sectors are authorized to form harvesters cooperatives under which the participants may agree to divide up the TAC among themselves.
- The AFA establishes various limits on the ability of BSAI pollock vessels and processors to participate in other fisheries. These limits are designed to prevent pollock vessels and processors from using the flexibility of a cooperative to increase their level of participation in other fisheries.

1:4 Status of the Steller Sea Lion

1.4.1 Species description

The Steller sea lion (*Eumetopias jubatus*) is the only extant species of the genus *Eumetopias*, and is a member of the subfamily Otariinae, family Otariidae, superfamily Otarioidea, order Pinnipedia. The closest extant relatives of the Steller sea lion appear to be the other sea lion genera, including *Zalophus*, *Otaria*, *Neophoca*, and *Phocartos*, and the fur seals of the genera *Callorhinus* and *Arctocephalus*. Loughlin et al. (1987) provide a brief but informative summary of the fossil record for *Eumetopias*. Repenning (1976) suggests that a femur dated 3 to 4 million years old may have been from an ancient member of the *Eumetopias* genus, thereby indicating that the genus is at least that old. Presumably, *Eumetopias jubatus* evolved entirely in the North Pacific (Repenning 1976).

1.4.2 Distribution

The Steller sea lion is distributed around the North Pacific rim from the Channel Islands off Southern California to northern Hokkaido, Japan. In the Bering Sea, the northernmost major rookery is on Walrus Island in the Pribilof Islands and their northernmost major haulout is on Hall Island off the northwestern tip of St. Matthew Island. Their distribution also extends northward from the western end of the Aleutian chain to sites along the eastern shore of the Kamchatka Peninsula. The center of distribution has been considered to be in the GOA and the Aleutian Islands (NMFS 1992). Land sites used by Steller sea lions are referred to as rookeries and haulout sites. Rookeries are used by adult males and females for pupping, nursing, and mating during the reproductive season (late May to early July). Haulouts are used by all size and sex classes but are generally not sites of reproductive activity. The continued use of particular sites may be due to site fidelity, or the tendency of sea lions to return repeatedly to the same place, often the site of their birth. Presumably, these sites were chosen and continue to be used because they provide protection from predators, some measure of protection from severe climate or sea surface conditions, and, perhaps most importantly, are in close proximity to prey resources.

The movement patterns of Steller sea lions are not yet well understood. Their movement patterns from a land base (rookery or haulout) might be categorized into at least three types. First, sea lions move on- and offshore for feeding excursions. Limited data are available to describe these movements (e.g., Gentry 1970, Sandgren 1970, Merrick and Loughlin 1997), but such descriptions are essential for understanding foraging patterns, nursing strategies, and energetics. Second, at the end of the reproductive season, some females may move with their pups to other haulout sites and males may "migrate" to distant foraging locations (Spaulding 1964, Mate 1973, Porter 1997)). Limited data are available indicating that animals do shift from rookeries to haulouts, but the timing and nature of these movements need further description (e.g., distances involved, are movements relatively predictable for individuals, do movements vary with foraging conditions?). Description of these types of movements are essential for understanding seasonal distribution changes, foraging ecology, and apparent trends as a function of season. Third, sea lions may make semi-permanent or permanent one-way movements from one site to another (Chumbley et al. 1997; Burkanov et al. unpubl. report (cited in Loughlin 1997)). Calkins and Pitcher (1982) reported movements in Alaska of up to 1500 km. They also describe wide dispersion of young animals after weaning, with the majority of those animals returning to the site of birth as they reach reproductive age. The distribution of Steller sea lions at sea is also not well understood, but is, however, a critical element to any understanding of potential effects of fisheries on Steller sea lions, and will be considered in greater detail below in the section on foraging patterns.

1.4.3 Reproduction

Steller sea lions have a polygynous reproductive system where a single male may mate with multiple females. As mating occurs on land (or in the surf or intertidal zones), males are able to defend territories and thereby exert at least partial control over access to adult females and mating privileges. The pupping and mating season is relatively short and synchronous, probably due to the strong seasonality of the sea lions' environment and the need to balance aggregation for reproductive purposes with dispersion to take advantage of distant food resources (Bartholomew 1970). In May, adult males compete for rookery territories. In late May and early July, adult females arrive at the rookeries, where pregnant females give birth to a single pup. The sex ratio of pups at birth is assumed to be approximately 1:1 (e.g., York 1994) or biased toward slightly greater production of males (e.g., Pike and Maxwell 1958, Lowry et al. 1982, NMFS 1992).

Mating occurs about one to two weeks later (Gentry 1970). The gestation period is probably about 50 to 51 weeks, but implantation of the blastocyst is delayed until late September or early October (Pitcher and Calkins 1981). Due to delayed implantation, the metabolic demands of a developing fetus are not imposed until well after fertilization.

For females with a pup, the nursing period continues for months to several years. Thorsteinson and Lensink (1962) suggested that nursing of yearlings was common at Marmot Island in 1959. Pitcher and Calkins (1981) suggested that it is more common for pups to be weaned before the end of their first year, but they also observed nursing juveniles (aged 1 to 3). Porter (1997) distinguished metabolic weaning (i.e., the end of nutritional dependence of the pup or juvenile on the mother) from behavioral weaning (i.e., the point at which the pup or juvenile no longer maintains a behavioral attachment to the mother). He also suggested that metabolic weaning is more likely a gradual process occurring over time and more likely to occur in March-April, preceding the next reproductive season. The transition to nutritional independence may, therefore, occur over a period of months as the pup begins to develop essential foraging skills, and depends less and less on the adult female. The length of the nursing period may also vary as a function of the condition of the adult female. The nature and timing of weaning is important because it determines the resources available to the pup during the more demanding winter season and, conversely, the demands placed on the mother during the same period. The maintenance of the mother-offspring bond may also limit their distribution or the area used for foraging.

Relatively little is known about the life history of sea lions during the juvenile years between weaning and maturity. Pitcher and Calkins (1981) reported that females sampled in the late 1970s reached reproductive maturity between ages 2 and 8, and the average age of first pregnancy was 4.9 ±1.2 years. These results suggest a mean age of first birth of about 6 years. The available literature indicates an overall reproductive (birth) rate on the order of 55% to 70% or greater (Pike and Maxwell 1958, Gentry 1970). Those rates illustrate a number of important points and assumptions. First, the probability of pupping is rare (about 10%) for animals 4 years of age or younger. Second, maturation of 100% of a cohort of females occurs over a prolonged period which may be as long as 4 years. Third, the reported constancy of fecundity extending from age 6 to 30 indicates that either senescence has no effect on fecundity, or our information on fecundity rates is not sufficiently detailed to allow confident estimation of age-specific rates for animals older than age 6. Given the small size of the sample taken, the latter is a more likely explanation for such constancy.

Merrick et al. (1995) compared pup sizes at different sites where Steller sea lion populations were either decreasing or increasing, to determine if pup size or growth may be compromised in decreasing populations. Their results were not consistent with that hypothesis; rather, they found that pups about two to four weeks of age were larger at sites in the Aleutian Islands and GOA than they were in southeast Alaska or Oregon. These observed differences indicate that at least this phase of reproduction may not be affected; that is, if females are able to complete their pregnancy and give birth, then the size of those pups does not appear to be compromised. Possible alternative explanations for the observed size differences are that pups were measured at different ages (i.e., pups in the GOA and Aleutian Islands may have been born earlier and therefore were older when weighed), or that over time, harsher environmental conditions have selected for larger size in pups born in the Aleutian Islands or the GOA.

The reproductive success of an adult female is determined by a number of factors. The reproductive cycle includes mating, gestation, parturition, and nursing or post-natal care. The adult female's ability to complete this cycle successfully is largely dependent on the resources available to her. While much of the effort to explain the Steller sea lion decline has focused on juvenile survival rates, considerable evidence suggests that the decline may also be due, in part, to decreased reproductive success.

- Younger females collected in the 1970s were larger than females of the same age collected in the 1980s (Calkins et al. 1998). As maturity is likely related to size, females in the 1980s would also be more likely to mature and begin to contribute to population productivity at a later age.

- Pitcher et al. (in review) provide data from the 1970s and 1980s that suggests a much higher pregnancy rate after the mating season (97%; both periods), which declined to 67% for females collected in the 1970s and 55% for females collected in the 1980s. These changes in pregnancy rate suggest a large fetal mortality rate that could be a common feature of the Steller sea lion reproductive strategy (i.e., may occur even when conditions are favorable and population growth is occurring), but is more likely an indication of stress (possibly nutritional) experienced by individual females.

- The observed late pregnancy rates (67% in the 1970s and 55% in the 1980s) were not significantly different statistically. However, the direction of the difference is consistent with the hypothesis that reproductive effort in the 1980s was compromised.

- Pitcher et al. (in review) did observe a statistical difference in the late season pregnancy rates of lactating females in the 1970s (63%) versus lactating females in the 1980s (30%). This difference indicates that in contrast to lactating females in the 1970s, lactating females in the 1980s were less able to support a fetus and complete a consecutive pregnancy.

Males appear to reach sexual maturity at about the same time as females (i.e., 3 and 7 years of age; Perlov 1971 reported in Loughlin et al. 1987), but generally do not reach physical maturity and participate in breeding until about 8 to 10 years of age (Pitcher and Calkins 1981). A sample of 185 harem bulls from the Marmot, Atkins, Ugamak, Jude, and Chowiet Islands in 1959 included animals 6 to 17 years of age, with 90% from 9 to 13 years old (Thorsteinson and Lensink 1962).

1.4.4 Survival

Much of the recent effort to understand the decline of Steller sea lions has been focused on juvenile survival, or has assumed that the most likely proximate explanation is a decrease in juvenile survival rates. This contention is supported by direct observations and a modeling study, and is consistent with the notion that juvenile animals are less adept at avoiding predators and obtaining sufficient resources (prey) for growth and survival.

The direct observations consist of extremely low resighting rates at Marmot Island of 800 pups tagged and branded at that site in 1987 and 1988 (Chumbley et al. 1997) and observations of relatively few juveniles at Ugamak (Merrick et al. 1988). The low resighting rates do not themselves confirm that the problem was a corresponding drop in juvenile survival, but only that many of the marked animals were lost to the Marmot Island population. Migration to other sites where they were not observed is a possibility, but unlikely. If the "loss" of these animals is viewed in the context of the overall sea lion decline in the central GOA (from 1976 to 1994 the number of non-pups counted at Marmot Island declined by 88.9% and by 76.9% at the 14 other trend sites in the Gulf; Chumbley et al. 1997), then a significant increase in juvenile mortality is a much more plausible conclusion.

Modeling by York (1994) provides evidence that the observed decline in sea lion abundance in the GOA may have been due to an increase in juvenile mortality. York used the estimated rate of decline between the 1970s and the 1980s, and the observed shift in the mean age of adult females (≥3 years of age) to explore the effects of changes in adult reproduction, adult survival, and juvenile survival. While she pointed out that the observed decline did not rule out all other possible explanations, she concluded that the observed decline is most consistent with a decrease in juvenile survival on the order of 10 to 20% annually.

However, juvenile survival may not be the only factor influencing the decline of the western population of Steller sea lions. Evidence indicating a decline in reproductive success was presented above. Changes in adult survival may also have contributed to the decline. At present, survival rates for adult animals can not be determined with sufficient resolution to determine if those rates have changed over time or are somehow compromised to the extent that population growth and recovery are compromised.

1.4.5 Age distribution

Two life tables have been published with age-specific rates. The first was from Calkins and Pitcher (1982) and was based on sea lions killed in the late 1970s. York (1994) created a second life table using a Weibull model and the data from Calkins and Pitcher (1982) and Calkins and Goodwin (1988). York's analysis of these two data sets suggests a shift from the 1970s to the 1980s in the mean age of females older than 3 years of age. The shift was about 1.55 years, and provided the basis for her determination that increased juvenile mortality may have been an important proximate factor in the decline of Steller sea lions, since a shift in mean age would occur as the adult population aged without expected replacement by recruiting young females.

The most apparent limitations of these data and the resulting life tables are: (1) The collected sea lions were not from the same locations and the relations between populations at different sites have not been described (e.g., were they experiencing similar trends and were their age structures comparable), (2) the data and estimated vital rates are also time-specific, and do not necessarily apply to the current population, (3) the assumption of a stable age distribution may be faulty even if trends at these different sites were consistent, and (4) the data set is relatively small and does not provide a basis for estimating age-specific survival rates for very young ages (0-2 years of age) or for possibly senescent older animals (say greater than 12 years of age). Until senescence is assessed, longevity for Steller sea lions will be difficult to describe. The data reported in Pitcher and Calkins (1981) indicate that female sea lions may live to 30 years of age. A Weibull function fit to these data (York 1994) indicates, however, that fewer than 5% of females live to age 20.

The present age distribution may or may not be consistent with these life tables. Nevertheless, these tables provide the best available information on vital parameters, and the present age structure of sea lions may be similar if the immediate causes of the decline (e.g., low juvenile survival or low reproductive rates) have remained relatively constant.

1.4.6 Foraging patterns

The foraging patterns of the Steller sea lion are clearly central to any discussion of the potential for interaction between this species and groundfish or other fisheries in the BSAI or GOA. The 1998 Biological Opinion on the pollock and Atka mackerel fisheries contains a list of studies on the foraging patterns of

Steller sea lions, together with notes on the sample sizes, locations, years, and primary findings of those studies.

1.4.6.1 Foraging distributions

At present, our understanding of Steller sea lion foraging distribution is based on observations of foraging behavior (or presumed foraging behavior) in areas such as the southeastern Bering Sea (Fiscus and Baines 1966, Kajimura and Loughlin 1988), records of incidental take in fisheries (Perez and Loughlin 1991), and satellite telemetry studies (e.g. Merrick et al. 1994, Merrick and Loughlin 1997). Observations and incidental take of sea lions (Loughlin and Nelson 1986, Perez and Loughlin 1991) in the vicinity of Seguam Pass, the southeastern Bering Sea, and Shelikof Strait provided a basis for establishment of those areas as critical habitat (58 FR 45269).

The results of telemetry studies suggest that foraging distributions vary by individual, size or age, season, site, and reproductive status (i.e., is the female still supporting a pup; Merrick and Loughlin 1997). The foraging patterns of adult females differed during summer months when females were with pups versus winter periods when considerable individual variation was observed, but this may be attributable to the lactation condition of the females. Trip duration for females ($n = 14$) in summer was approximately 18 to 25 hours. For five of those females that could be tracked, trip length averaged 17 km and they dove approximately 4.7 hours per day. For five females tracked in winter months, mean trip duration was 204 hours, mean trip length was 133 km, and they dove 5.3 hours per day. The patterns exhibited by females in winter varied considerably, from which the investigators inferred that two of them may still have been supporting pups. Those two females continued to make relatively shorter trips (mean of 53 km over 18 hours) and dove 8.1 hours per day, whereas the other three ranged further, dove 3.5 hours per day, and spent up to 24 days at sea. Five winter young-of-the-year exhibited foraging patterns intermediate between summer and winter females in trip distance (mean of 30 km), but shorter in duration (mean of 15 hours), and with less effort devoted to diving (mean of 1.9 hours per day). Estimated home ranges (mean ± 1 SE) were 319 ± 61.9 km^2 for adult females in summer, 47,579 ± 26,704 km^2 for adult females in winter, and 9,196 ± 6799 km^2 for winter young-of-the-year.

The sea lions used in Merrick and Loughlin's (1997) study were from the GOA (Sugarloaf Island, Latax Rocks, Marmot Island, Long Island, Chirikof Island, Atkins Island, and Pinnacle Rock), and the BSAI region (Ugamak Island and Akun Island). This information is, therefore, directly pertinent to the action areas for both the GOA and BSAI fisheries, although it is perhaps most relevant to the GOA action area.

1.4.6.2 Foraging depths

The sea lions in the Merrick and Loughlin (1997) study tended to make relatively shallow dives, with few dives recorded at greater than 250 m. Maximum depth recorded for the five summer adult females were in the range from 100 to 250 m, and maximum depth for the five winter adult females was greater than 250 m. The maximum depth measured for winter young-of-the-year was 72 m. These results suggest that sea lions are generally shallow divers, but are capable of deeper dives (i.e., greater than 250 m).

The instruments used to record diving depths do not determine the purpose of a dive, and many of the recorded dives may not be indicative of foraging effort. Dives between 4 and 10 m depth may be for foraging, or they may simply be grooming, porpoising, or transiting between locations. For example, animals transiting to and from foraging locations during rough sea surface conditions may transit in a series of long, shallow dives to avoid such conditions. The relatively large number of dives recorded between 4 and 10 m may therefore bias the assessment of "foraging" depths for these sea lions.

The results from this study also may not be indicative of diving depths and patterns for other sea lions at other times of year or in other locations. The winter young-of-the-year had instruments attached during the period from November to March, when they were probably about five to nine months old and may have still been nursing. At this age, they are just beginning to develop foraging skills, which may take years to learn. The diving depths and patterns exhibited by these young-of-the-year are likely poor indicators of the foraging patterns of older juveniles (one- to three-year-olds). For example, Swain and Calkins (1997) report dives of a 2-year-old male sea lion to 252 m, and regular dives of this animal and a yearling female to 150 m to 250 m. Clearly, if young-of-the-year are limited to relatively shallow depths, and older animals are capable of diving to much greater depths, then those younger animals are just beginning to develop the diving and foraging skills necessary to survive. The rate at which they develop those skills and, for example, begin to dive to greater depths or take prey at greater depths, is unknown, but probably occurs rapidly after weaning to take advantage of otherwise unavailable prey resources.

1.4.6.3 Prey, energetics and nutrition, and diversity

At the least, an understanding of Steller sea lion foraging requires a listing of their prey species, a qualitative or (preferably) quantitative measure of the relative importance of different prey types, descriptions of prey characteristics and predator-prey dynamics, and an assessment of diet diversity. A (partial) listing of Steller sea lion prey species or prey types would include (not in order of priority): Atka mackerel, capelin, crabs, dogfish sharks, eulachon, flatfish, greenling, hake, halibut, herring, lamprey, lingcod, molluscs, octopus, Pacific cod, pollock, ratfish, rockfishes, salmon, sand lance, sculpins, shrimps, smelt, squid, and yellowfin sole.

Qualitative or quantitative indices of prey importance might be developed on the basis of prey "selection" or "preference." However, we rarely have information on the distribution or availability of different prey types, and therefore don't have a basis for inferring "selection" or "preference" (Lowry et al. 1982, Frost and Lowry 1986). In most studies of Steller sea lion prey, rank frequency of occurrence is used as a qualitative (or semi-quantitative) index of relative importance. For example, the data from Merrick et al. (1997) and NMFS (1995) indicate that throughout the range of the western population of Steller sea lions, either pollock or Atka mackerel are the dominant prey on the basis of frequency of occurrence. Therefore, pollock and Atka mackerel can reasonably be assumed to be essential prey of Steller sea lions. Quantitative estimation of the importance of different prey types is considerably more difficult. The value of a prey type should be quantified on the basis of the observed net gain in calories and nutrients resulting from predation on that prey type versus other prey types. Such a determination would require information on biomass consumed, caloric and nutrient content of that biomass, energy and nutrients gained, and energy and nutrients expended (i.e., the costs of predation). Caloric and nutrient content of different prey types are relatively easy to determine using proximate analysis, although Stansby (1976) cautioned that individuals of the same prey type may vary considerably as a function of season, site, reproductive condition, and other factors. Assimilation efficiency has also been studied (Fadely et al. 1994, Rosen and Trites *in prep*) and appears to be relatively straightforward. Biomass consumed and costs of predation are more difficult to quantify, particularly with respect to any particular prey type. Many of the studies on Steller sea lion foraging patterns provide information on frequency of occurrence, but such information cannot be readily converted into biomass consumed unless additional data are provided. Biomass estimates are more readily determined from volumetric measurements of stomach contents, but can also be estimated from length-weight relationships combined with measured lengths of prey or estimated length at age (with age based on otoliths; e.g., Frost and Lowry 1986). Costs of predation may also vary considerably by prey type, depending on the distribution, life history characteristics, and behavior of the prey.

Important prey characteristics include their tissue or body composition, individual size (mass), availability, depth in the water column, their degree of association with the bottom, their reproductive behaviors, their degree of aggregation (e.g., solitary versus schooling), and their temporal and spatial distribution patterns. To date, the limited information available indicates that sea lions generally forage at depths less than 250 m. Many of their prey are, at one life stage or another, associated with the bottom. Predation on prey associated with the bottom is a common pinniped strategy, perhaps because the bottom limits the spatial dimensionality of the predator-prey arena and thereby limits the prey's alternatives for escape. Male Atka mackerel may be susceptible to predation because they fertilize and then guard eggs laid by the female on the bottom. Schooling behavior of pollock and Atka mackerel probably enhances their value as prey, as such schooling may increase sea lion consumption relative to costs associated with searching and capture.

The spatial and temporal distributions of prey types is a critical determinant of their availability to sea lions. The consistent pattern of the Atka mackerel fishery over time indicates that aggregations of Atka mackerel are distributed in patches that are relatively predictable. Aggregations of pollock are less predictable in time and space than aggregations of Atka mackerel, but also demonstrate considerable predictability, particularly for winter and spring spawning aggregations. To varying degrees, then, both of these prey species appear to be distributed in more (Atka mackerel) or less (pollock) predictable prey patches, and the availability and characteristics of those patches may be essential to the foraging success of sea lions. Important patch characteristics may include their size, location, persistence, and density (number of patches per area).

The quality of the sea lion diet appears to be determined not only by the individual components (species) of the diet, but also by the mix or diversity of prey in the diet. Merrick et al. (1997) found a correlation between a measure of diet diversity in different geographic regions of the western population and population trends in those regions. Their conclusions were that reliance on a single prey type may not be conducive to population growth; a diversity of prey may be necessary for recovery of the western population. Unfortunately, diet diversity is a function not only of prey selection, but of the diversity of prey available. To the extent that pollock or Atka mackerel currently dominate the prey field, sea lions survive on those prey.

1.4.6.4 Foraging - integration and synthesis

While much remains to be learned about Steller sea lions, the available information is sufficient to begin a description of their foraging patterns. The emerging picture appears to be that:

- Steller sea lions are land-based predators, but their attachment to land and foraging patterns/distribution may vary seasonally and as a function of age, sex, and reproductive status;

- Steller sea lions tend to be relatively shallow divers, but also exploit deeper waters;

- Steller sea lions consume a variety of demersal, semi-demersal, and pelagic prey;

- a diet of a diversity of prey appears to be advantageous to Steller sea lions;

- at present, pollock and Atka mackerel appear to be their most common or dominant prey;

- the life history and spatial/temporal distribution of pollock and Atka mackerel are therefore likely important determinants of sea lion foraging success;

- foraging patterns and prey requirements probably vary by season, due to changes in reproductive status, prey availability, and environmental conditions;

- foraging sites relatively close to rookeries may be particularly important during the reproductive season, when lactating females are limited by the nutritional requirements of their pups; and

- the transition by young animals from dependence on their mothers to independent feeding may occur over a period of months or even years.

The question of whether competition exists between the Steller sea lion and pollock or Atka mackerel fisheries is a question of sea lion foraging success. For a foraging sea lion, the net gain in energy and nutrients is determined, in part, by the availability of prey or prey patches it encounters within its foraging distribution. Competition occurs if the fisheries reduce the availability of prey to the extent that sea lion condition, growth, reproduction, or survival are diminished, and population recovery is impeded. The question of whether competition occurs will be addressed in the "environmental baseline" and "effects of the action" sections below.

1.4.7 Natural predators

The Recovery Plan for the Steller Sea Lion (NMFS 1992) states: "Steller sea lions are probably eaten by killer whales and sharks, but the possible impact of these predators is unknown. The occurrence of shark predation on other North Pacific pinnipeds has been documented, but not well quantified (Ainley et al., 1981)." The likelihood of shark attack is probably greater for Steller sea lions off the Washington, Oregon, and California coasts than in waters further north. A killer whale attack has been documented off the Oregon coast (Mate 1973), but killer whales are probably much more frequent predators in the waters of British Columbia and Alaska (Barrett-Lennard et al., unpubl. rep.). Barrett-Lennard et al. surveyed 126 respondents to estimate the rate of observation of sea lion/killer whale interactions. Of 492 interactions witnessed, 32 (6.5%) reportedly involved sea lion mortality. The lethal interaction rate appeared to be greatest in the Aleutian Islands region, but those results were based on the "vague recollection" of one observer of three kills over a 24-year period. Perhaps the most noteworthy anecdotal observation of apparent killer whale predation on sea lions occurred in 1992, when flipper tags from 14 sea lions that were both tagged and branded were found in the stomach of a killer whale dead on the beach in Prince William Sound (NMFS 1995). Barrett-Lennard et al. (unpubl. rep.) model sea lion mortality due to killer whales, and suggest that while such predation may account for a significant portion of natural mortality at the current low size of the sea lion population, it was not likely to have been the cause of the decline. The most recent status report on Steller sea lions (NMFS 1995) concurs and points out that relative abundance of killer whales is likely greater off southeast Alaska, where sea lion populations have been slowly increasing.

1.4.8 Natural competitors

Competition may take several forms. For exploitative competition to occur, the potential competitors must utilize the same resource, the availability of that resource must be limited relative to the needs of the potential competitors, and use of the available resource by one of the potential competitors must impede use by the other (Krebs 1985). Interference competition can occur even when resources are not limited if the use of the resource by one potential competitor harms another. With respect to other (nonhuman) species, Steller sea lions are most likely to compete with for food, although they may also compete for habitat (e.g., potential competition with northern fur seals for rookery or haulout space).

Steller sea lions forage on a variety of marine prey that are also consumed by other marine mammals such as northern fur seals, harbor seals, humpback whales, marine birds, and marine fishes (e.g., pollock, arrowtooth flounder). To some extent, these potential competitors may partition the prey resource so that little direct competition occurs. For example, harbor seals and northern fur seals may consume smaller pollock than Steller sea lions (Fritz et al. 1995). Competition may still occur if the consumption of smaller pollock limits the eventual biomass of larger pollock for sea lions, but the connection would be difficult to demonstrate. Such competition may occur only seasonally if, for example, fur seals migrate out of the area of competition in the winter and spring months. Similarly, competition may occur only locally if prey availability or prey selection varies geographically for either potential competitor. Finally, competition between sea lions and other predators may be restricted to certain age classes, as diet may change with age or size.

1.4.9 Disease

Hoover (1988) lists evidence of exposure of sea lions to leptospirosis (Fay et al. 1978), chlamydiosis (Goodwin and Calkins 1985), and San Miguel sea lion virus (Goodwin and Calkins 1985, Barlough et al. 1987). Barlough et al. (1987) also present evidence of eight types of calicivirus (including seven types of San Miguel sea lion virus and Tillamook [bovine] virus). And recent tests, indicate exposure to brucellosis.

Hoover (1988) also lists parasites known to infect sea lions, including cestodes of the genera *Diplogonoporus*, *Diphyllobothrium*, *Anophryocephalus*, *Adenocephalus*, and *Pyramicocephalus*; trematodes of the genera *Pricetrema*, *Zalophotrema*, and *Phocitrema*; acanthocephalans of the genera *Bulbosoma* and *Corynosoma*; and nematodes of the genera *Anisakis*, *Contracaecum*, *Parafilaroides*, *Uncinaria*, and *Phocanema* (Hill 1968, Dailey and Brownell 1972, Daily 1975, Fay et al. 1978, Geraci 1979, Dieterich 1981). In addition, Thorsteinson and Lensink (1962) reported two types of parasites: Body louse (*Antarctophthirus michrochir*) severely infesting pups and nose mites *(Orthohalarachne diminuta*) invariably found on adults. And Scheffer (1946) reported ascarid worms (*Porocaecum decipiens*) nearly always found in adult stomachs.

While a range of different diseases or maladies have been documented for Steller sea lions, the available evidence is not sufficient to demonstrate that disease has played or is playing any significant part in the decline of the western population. Disease may have contributed to the *in utero* mortality rate observed in animals collected in 1975-1978 and 1985-1986 (Pitcher et al. in review) but, again, that hypothesis is not substantiated by any data. The long-term continuous nature of the decline, and the lack of morbid or moribund specimens argue that disease has not been a primary factor.

1.4.10 Population dynamics

The breeding range of the Steller sea lion covers virtually all of the North Pacific Rim from about 34° N to 60°N lat. Within this range, sea lions are found in hundreds of rookeries and haulouts. These rookery and haulout sites are frequently grouped into rookery/haulout clusters on the basis of politics, geography, demographic patterns, genetics, foraging patterns, or other reasons related to scientific study or management. Political divisions are drawn to separate animals that are found off Japan or the Republic of Korea, in Russian territories, in Alaska, British Columbia, or along the western coast of Washington, Oregon, and California. These divisions are largely drawn for the purpose of management or jurisdiction, but may affect sea lion population dynamics because of differing management strategies or objectives.

Geographic distinctions are frequently made on the basis of variable habitat or ecosystem characteristics in differing parts of the range. For example, rookeries and haulouts in the Aleutian Islands are often separated from those in the GOA, and these two areas are again separated from southeastern Alaska and British Columbia. These distinctions may have demographic significance because of the important variability in ecosystem features such as prey resources. Sea lion rookeries and haulouts are also grouped on the basis of observed demographic trends (York et al. 1996).

Many descriptions of the decline of Steller sea lions begin with the statement that the decline was first witnessed in the eastern Aleutian Islands in the mid 1970s and then spread westward to the central Aleutian Island and eastward to the western GOA in the late 1970s and early 1980s. Similarly, counts are frequently presented for the area from Kenai to Kiska Island, which is considered to enclose the center of abundance for the species. Genetic studies (Bickham et al. 1996, Loughlin 1997) provided the basis for distinguishing western and eastern management stocks of the sea lion, and additional work may allow further differentiation of stocks. The relation between diet diversity and population trend was studied using rookery groups identified by geographic location and rates of change. The rookery groups were those identified by York et al. (1996). These examples indicate that, depending on the purpose at hand, the total sea lion population may be split meaningfully into subpopulations in any number of ways.

However, if the purpose is to study or understand the natural (i.e., without human influence) population structure of the Steller sea lion, then the biogeography of the species must be defined more narrowly. Genetic studies may provide the best description of the result of biogeographic patterns, as they are likely the least influenced by human interaction. Demographic trends and foraging patterns may be influenced by human activities and, clearly, the artificial boundaries determined for political purposes should not have an influence on the natural biogeography of sea lions.

Those natural factors that determine their biogeography include climate and oceanography, avoidance of predators, distribution of prey, the reproductive strategy of the species, and movement patterns between sites. The marine habitat of the Steller sea lion tends to reduce variation in important environmental or climatic features, allowing the sea lion to disperse widely around the rim of the North Pacific Ocean. The decline of Steller sea lions off California may indicate a contraction in their range, depending on the explanation for that decline. Avoidance of terrestrial predators must clearly be an important factor, as rookeries and haulouts are virtually all located at sites inaccessible to such predators. Distribution of prey is likely a critical determinant of sea lion biogeography, and probably determines the extent of their dispersion during the non-reproductive season. The reproductive strategy of the species, on the other hand, requires aggregation at rookery sites, and therefore likely places important limits on the species' movement patterns and dispersion. Finally, movement patterns between sites determine, in part, the extent to which groups of sea lions at different rookeries and haulout sites are demographically independent. Steller sea lions are generally not described as migrators. Adult males, for example, are described as dispersing widely during the non-reproductive seasons, and juveniles are described as dispersing widely after weaning and not returning to the reproductive site until they are approaching reproductive age (Calkins and Pitcher 1982).

An understanding of the natural biogeography of the Steller sea lion is essential to describe their population dynamics and identify the effects of potential human-related influences on their dynamics. Without a better understanding of movement patterns of sea lions, the geographic extent of potential fisheries effects can not be estimated with confidence. For example, we cannot, at this time, describe the geographic extent of fishing for Atka mackerel at Seguam Pass because we can not confidently determine whether the sea lions foraging at that site are from just Seguam and Agligadak Island rookeries, or perhaps also from Yunaska and Kasatochi Island rookeries or sites more distant. Similarly, the pollock fisheries in Shelikof Strait may have influenced the dynamics of sea lion populations at Chirikof and Chowiet Islands, or may have even farther reaching effects if, for example, sea lions from the Shumagin Islands forage in Shelikof Strait. In addition, descriptions of population size, variability, and stability may vary depending on the definition of population units.

1.4.11 Population status and trends

Assessment of the status and trends of Steller sea lion populations are based largely on (1) counts of nonpups (juveniles and adults) on rookeries and haulouts, and (2) counts of pups on rookeries in late June and early July. Both kinds of counts are indices of abundance, as they do not necessarily include every site where animals haul out, and they do not include animals that are in the water at the time of the counts. Population size can be estimated by standardizing the indices (e.g., with respect to date, sites counted, and counting

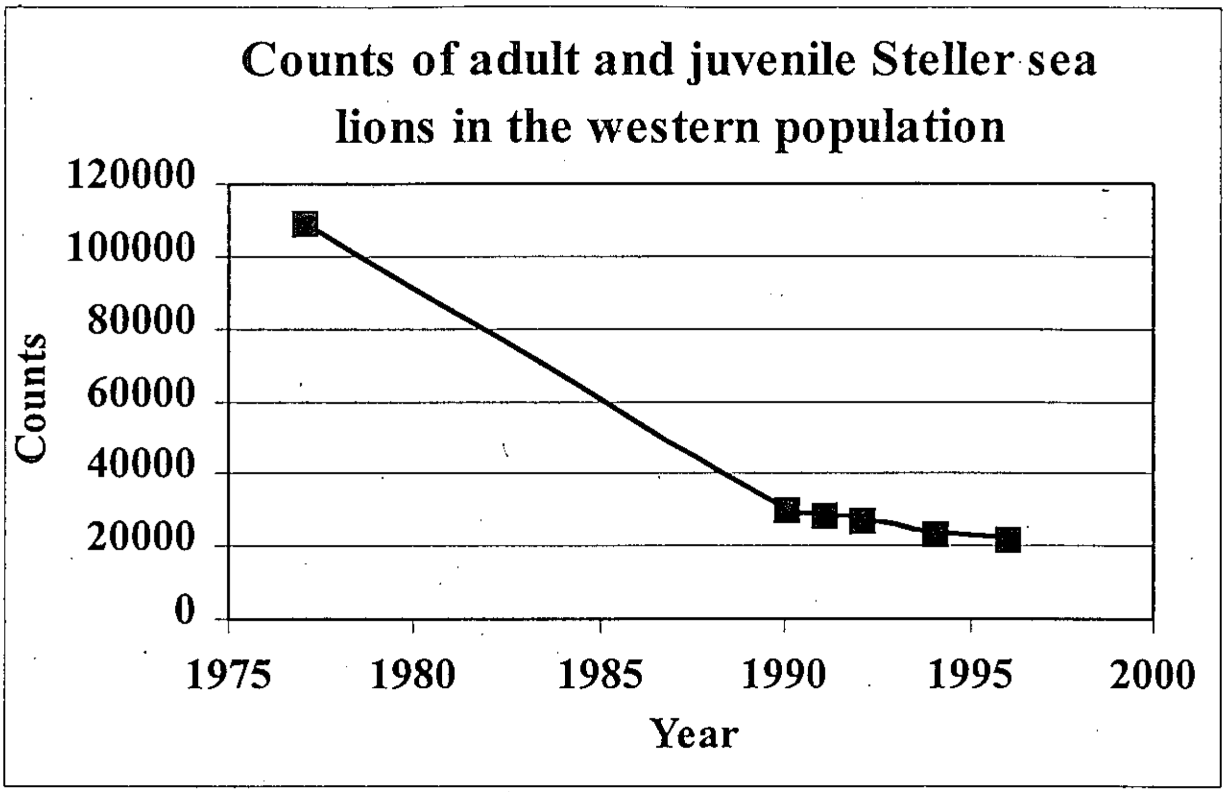


Figure 5. Counts of adult and juvenile Steller sea lions in the western population.

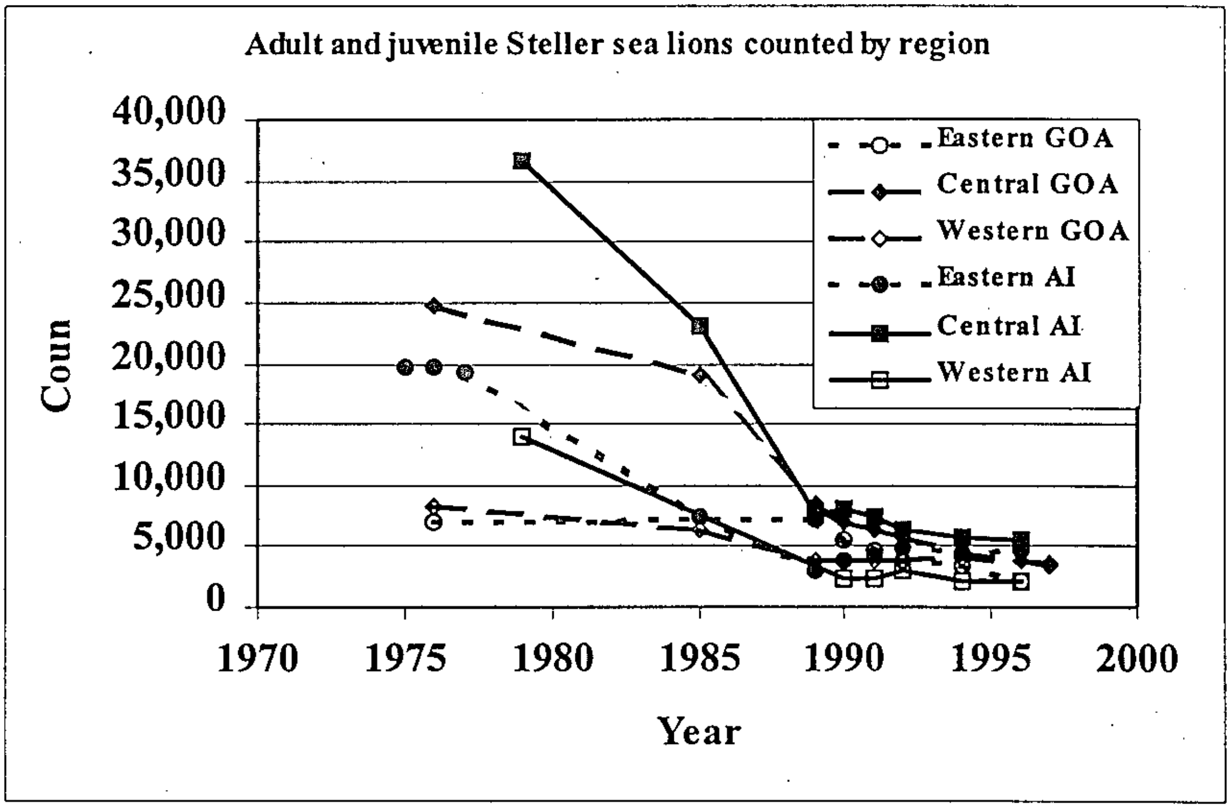


Figure 6. Counts by region of adult and juvenile Steller sea lions in the western population.

method), by making certain assumptions regarding the ratio of animals present versus absent from a given site at the time of the count, and by correcting for the portion of sites counted. Population estimates from the 1950s and 1960s (e.g., Kenyon and Rice 1961; see also Trites and Larkin 1992, 1996) are used with caution because counting methods and dates were not standardized, and the results contain inconsistencies that indicate the possibility of measurement error at some sites in some years. Efforts to standardize methods began in the 1970s (Braham et al. 1980); as a result, counts conducted since the late 1970s are the most reliable estimates of the total population or subpopulations.

For the western U.S. population (i.e., west of 144°W long.), counts of adults and juveniles have fallen from 109,880 animals in the late 1970s to 22,167 animals in 1996, a decline of 80% (Figure 5). Although the number of animals lost appears to have been far greater from the late 1970s to the early 1990s, the rate of decline has remained high. The 1996 count was 27% lower than the count in 1990. Final results from counts conducted in 1998 are not yet available, but preliminary results for trend sites between the Kenai Peninsula to Kiska Island indicate a decline of about 9% in nonpups since 1996, and 19% in pups since 1994. From the late 1970s to 1996, abundance estimates for the GOA dropped from 65,296 to 9,782 (85%) and for the BSAI region dropped from 44,584 to 12,385 (72%). Counts in Russian territories (to the west of the action area for the BSAI pollock and Atka mackerel fisheries) have also declined and are currently estimated to be about one-third of historic levels (NMFS 1992). Counts in southeast Alaska (to the east of the action area for the GOA pollock fishery) are increasing slowly.

Some demographic patterns are lost when estimates are pooled for large areas. The index counts are often described by geographic region (Figure 6). Counts at all trend sites by region indicate a slow decline in the central and western GOA between 1976 and 1985, followed by a severe drop in both regions from 1985 to 1989, and continued decline in the central Gulf continuing to at least 1997. Counts in the eastern, central, and western Aleutians all declined sharply from the late 1970s to the early 1990s, and since have been variable but declining in the western region, declined moderately in the central region, and relatively stable in the eastern region, at least through 1996. The decline of sea lions in the GOA and BSAI regions has effectively shifted the center of abundance for the species to the east. In the 1970s, for example, Ugamak Island in the eastern Aleutian Islands was the largest rookery in the world. As abundance declined at Ugamak Island, rookeries at Marmot and Sugarloaf Islands in the Central GOA became numerically dominant. But as abundance at these sites declined, the rookery at Forrester Island (southeast Alaska) became dominant.

Although the decline of Steller sea lions has occurred over extensive areas, site-by-site evaluation of the counts may be essential to understand the decline, and to anticipate the nature of threats to the species as local populations dwindle to extremely low numbers. However, changes observed at specific sites must be interpreted with caution because animals are known to move between sites on temporary, seasonal, and permanent bases. Therefore, the extent to which the collection of animals at a given site represent an independent or meaningful population unit is not yet clear.

1.4.12 Population variability and stability

Populations change as a function of births, deaths, immigration, and emigration. During the nonreproductive season, some sea lions may move between the western and eastern populations (Calkins and Pitcher 1981), but net migration out of the western population is not considered a factor in the decline. The amount of growth observed in the eastern population is equivalent to only a small fraction of the losses in the western population. Thus, the decline must be due primarily to changes in birth and death rates. As mentioned above, computer modeling (York 1994) and mark-recapture experiments (Chumbley et al. 1997) indicate that the most likely problem leading to the decline is decreased juvenile survival, but lower reproductive success is almost certainly a contributing factor. Finally, adult survival has not been characterized and even small changes in the survival rate of adult females may be contributing significantly to past or current population trends.

These changes in vital rates would likely lead to changes in the age structure which, in turn, may tend to destabilize populations. With declining reproductive effort or juvenile survival, populations tend to become top-heavy with more mature animals, followed by a drop in population production as mature animals die without replacement through recruitment of young females. The extent to which the age structure is destabilized and the effect on population growth rate depends, in part, on the length of time that reproduction and/or juvenile survival remain suppressed. Increased mortality of young adult females may have the strongest effect on population growth and potential for recovery, as these females have survived to reproductive age but still have their productive years ahead of them (i.e., they are at the age of greatest reproductive potential).

Vital rates and age structures may change as a function of factors either extrinsic or intrinsic to the population. Steller sea lions fit the description of a "K-selected" species of large-bodied long-lived individuals with delayed reproduction, low fecundity, and considerable postnatal maternal investment in the offspring. These characteristics should make sea lion populations relatively tolerant of large changes in their environment. Thus, the observed decline of the western population over the past two to three decades is not consistent with the description of the species as K-selected, and suggests that the combined effect of those factors causing the decline has been severe. The ability of the population to recover (i.e., its resilience) and the rate at which it recovers will be determined by the same K-selected characteristics (longevity, delayed reproduction, and low fecundity), as well as its metapopulation structure. Its maximum recovery rate will likely be limited to 8% to 10% annually (based on its life history characteristics and observed growth rates of other Otariids), which means that recovery could require 20 to 30 years. The metapopulation structure of the western population may enhance or deter recovery. Dispersal of populations provides some measure of protection for the entire species against relatively localized threats of decline or extinction. And rookeries that area abandoned may be more likely recolonized by seals migrating between sites. On the other hand, the division of the whole population into smaller demographic units may exacerbate factors that accelerate small populations toward extinction (e.g., unbalanced sex ratios, allee effects, inbreeding depression). Such acceleration has been referred to as an "extinction vortex" (Gilpin and Soulé 1986).

Finally, any description of population stability for the Steller sea lion should be written with caution. Over the past three decades (or perhaps longer), we have witnessed a severe decline of the species throughout most of its range. Our inability to anticipate those declines before they occurred, and our limited ability to explain them now, and our limited ability to predict the future suggests that we are not yet capable of describing the stability of Steller sea lion populations.

1.4.12 Population projections

Population viability analyses have been conducted by Merrick and York (1994) and York et al. (1996). While such analyses require some assumptions, they provide a context for management and an indication of the severity and urgency of the sea lion dilemma, given the set of assumptions made in the analyses.

The results of these analyses indicate that the next 20 years may be crucial for the Steller sea lion, if the rates of decline observed in 1985 to 1989 or 1994 continue. Within this time frame, it is possible that the number of adult females in the Kenai-to-Kiska region could drop to less than 5000. Extinction rates for rookeries or clusters of rookeries could increase sharply in 40 to 50 years, and extinction for the entire Kenai-to-Kiska region could occur in the next 100-120 years.

1.4.13 Listing Status

On 26 November 1990, the Steller sea lion was listed as threatened under the Endangered Species Act of 1972 (55 FR 49204). The listing followed a decline in the U.S. population of about 64% over the three decades prior to the listing. In 1997, the species was split into two separate stocks on the basis of demographic and genetic dissimilarities (Bickham et al. 1996, Loughlin 1997), the status of the western stock was changed to endangered, and the status of the eastern stock was left unchanged (62 FR 30772).

1.4.14 Critical habitat description

The term "critical habitat" is defined in the Endangered Species Act (16 U.S.C. 153) to mean: (i) the specific areas within the geographic area occupied by the species, at the time it is listed in accordance with the provisions of section 4 of this Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management consideration or protection; and (ii) the specific areas outside of the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of this Act, upon a determination by the Secretary that such areas are essential to the conservation of the species.

The definition continues: "except in those circumstances determined by the Secretary, critical habitat shall not include the entire geographical area which can be occupied by the threatened or endangered species."

By this definition, critical habitat includes those areas that are essential to the "conservation" of a threatened or endangered species. The ESA defines the term "conservation" as: ". . . to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary." That is, the status of the species would be such that it would be considered "recovered." Therefore, the area designated as critical habitat should contain the physical and biological resources necessary to support and sustain a population of a threatened or endangered species that is sufficiently large and persistent to be considered recovered.

1.4.14.1 Establishment of Critical Habitat

The areas designated as critical habitat for the Steller sea lion were determined on the basis of the available information on life history patterns of the species, with particular attention paid to land sites where animals haul out to rest, pup, nurse their pups, mate, and molt, and to marine sites considered to be essential foraging areas. The foraging areas were determined on the basis of sightings of sea lions at sea, incidental catch data (Loughlin and Nelson 1986, Perez and Loughlin 1991), and foraging studies using satellite-linked tracking systems. Critical habitat areas were determined with input from NMFS scientists and managers, the Steller Sea Lion Recovery Team, independent marine mammal scientists invited to participate in the discussion, and the public. The proposed rule for establishment of critical habitat for the Steller sea lion was published on 1 April 1993 (58 FR 17181), and the final rule was published on 27 August 1993 (58 FR 45269). The following areas have been designated as critical habitat in the action area of one or more of the proposed fisheries.

> *Alaska rookeries, haulouts, and associated areas. In Alaska, all major Steller sea lion rookeries identified in Table 1 [their Table 1] and major haulouts identified in Table 2 [their Table 2] and associated terrestrial, air, and aquatic zones. Critical habitat includes a terrestrial zone that extends 3,000 feet (0.9 km) landward from the baseline or base point of each major rookery and major haulout in Alaska. Critical habitat includes an air zone that extends 3000 feet (0.9 km) above the terrestrial zone of each major rookery and major haulout in Alaska, measured vertically from sea level. Critical habitat includes an aquatic zone that extends 3,000 feet (0.9 km) seaward in State*

and Federally managed waters from the baseline or basepoint of each major haulout in Alaska that is east of 144° W long. Critical habitat includes an aquatic zone that extends 20 nm (37 km) seaward in State and Federally managed waters from the baseline or basepoint of each major rookery and major haulout in Alaska that is west of 144° W long.

Three special aquatic foraging areas are in Alaska, including the Shelikof Strait area, the Bogoslof area, and the Seguam Pass area.

(1) *Critical habitat includes the Shelikof Strait area in the Gulf of Alaska which . . . consists of the area between the Alaska Peninsula and Tugidak, Sitkinak, Aiaktilik, Kodiak, Raspberry, Afognak and Shuyak Islands (connected by the shortest lines): bounded on the west by a line connecting Cape Kumlik (56°38 "/157°26'W) and the southwestern tip of Tugidak Island (56°24'/154°41'W) and bounded in the east by a line connecting Cape Douglas (58°51'N/153°15'W)and the northernmost tip of Shuyak Island (58°37'N/152°22'W).*

(2) *Critical habitat includes the Bogoslof area in the Bering Sea shelf which . . . consists of the area between 170°00'W and 164°00'W, south of straight lines connecting 55°00'N/170 00'W and 55°00'N/168°00'W; 55°30'N/168°00'W and 55°30'N/166°00'W; 56°00'N/166°00'W and 56°00'N/164°00'W and north of the Aleutian Islands and straight lines between the islands connecting the following coordinates in the order listed:*

52°49.2'N/169°40.4'W;
52°49.8'N/169°06.3'W;
53°23.8'N/167°50.1'W;
53°18.7'N/167°51.4'W;
53°59.0'N/166°17.2'W;
54°02.9'N/163°03.0'W;
54°07.7'N/165°40.6'W;
54°08.9'N/165°38.8'W;
54°11.9'N/165°23.3'W;
54°23.9'N/164°44.0'W

(3) *Critical habitat includes the Seguam Pass area which . . . consists of the area between 52°00'N and 53°00'N and between 173°30'W and 172°30'W.*

1.4.14.2 Physical and biological features of Steller sea lion critical habitat

For the Steller sea lion, the physical and biological features of its habitat that are essential to the species' conservation are those that support reproduction, foraging, rest, and refuge. Land or terrestrial habitat is relatively easy to identify on the basis of use patterns and because land use patterns are more easily observed. The areas used are likely chosen because they offer refuge from terrestrial predators (e.g., are inaccessible to bears), include suitable substrate for reproductive activities (pupping, nursing, mating), provide some measure of protection from the elements (e.g., wind and waves), and are in close proximity to prey resources.

Prey resources are the most important feature of marine critical habitat. Marine areas may be used for a variety of other reasons (e.g., social interaction, rafting or resting), but foraging is the most important sea lion activity that occurs when the animals are at sea. Two kinds of marine habitat were designated as critical. First, areas around rookeries and haulouts were chosen based on evidence that many foraging trips by lactating adult females in summer may be relatively short (20 km or less; Merrick and Loughlin 1997). Also, mean distances for young-of-the-year in winter may be relatively short (about 30 km; Merrick and Loughlin 1997). These young animals are just learning to feed on their own, and the availability of prey in the vicinity of rookeries and haulouts must be crucial to their transition to independent feeding after weaning. Similarly, areas around rookeries are likely to be important for juveniles. While the foraging patterns of juveniles have not been studied in the BSAI region, it is possible that they depend considerably on resources close to haulouts. Evidence indicates that decreased juvenile survival may be an important proximate-cause of the sea lion decline (York 1994, Chumbley et al. 1997), and that the growth rate of individual young seals was depressed in the 1980s. These findings are consistent with the hypothesis that young animals are nutritionally stressed. Furthermore, young animals are almost certainly less efficient foragers and probably have relatively greater food requirements which, again, suggests that they may be more easily limited or affected by reduced prey resources or greater energetic requirements associated with foraging at distant locations. Therefore, the areas around rookeries and haulouts must contain essential prey resources for at least lactating adult females, young-of-the-year, and juveniles, and those areas were deemed essential to protect.

Second, three areas were chosen based on (1) at-sea observations indicating that sea lions commonly used these areas for foraging, (2) records of animals killed incidentally in fisheries in the 1980s, (3) knowledge of sea lion prey and their life histories and distributions, and (4) foraging studies. In 1980, Shelikof Strait was identified as a site of extensive spawning aggregations of pollock in winter months. Records of incidental take of sea lions in the pollock fishery in this region provide evidence that Shelikof Strait is an important foraging site (Loughlin and Nelson 1986, Perez and Loughlin 1991). The southeastern Bering Sea north of the Aleutian Islands from Unimak Island past Bogoslof Island to the Islands of Four Mountains is also considered a site that has historically supported a large aggregation of spawning pollock, and is also an area where sighting information and incidental take records support the notion that this is an important foraging area for sea lions (Fiscus and Baines 1966, Kajimura and Loughlin 1988). Finally, large aggregations of Atka mackerel are found in the area around Seguam Pass. These aggregations have supported a fishery since the 1970s, and are in close proximity to a major sea lion rookery on Seguam Island and a smaller rookery on Agligadak Island. Atka mackerel are an important prey of sea lions in the central and western Aleutian Islands. Records of incidental take in fisheries also indicate that the Seguam area is an important for sea lion foraging (Perez and Loughlin 1991).

While many of the important physical and biological elements of Steller sea lion critical habitat can be identified, most of those features (particularly biological features) cannot be described in a complete and quantitative manner. For example, prey species within critical habitat can not be described in detail or with a demonstrated measure of confidence, and the lack of such information is an important impediment to the analysis of fishery effects. Walleye pollock, Atka mackerel, Pacific cod, rockfish, herring, capelin, sand lance, other forage fish, squid, and octopus are important prey items found in Steller sea lion critical habitat but for most (if not all) of these species, we are not able to reliably describe their abundance, biomass, age structure, or temporal and geographic distribution within critical habitat with sufficient clarity and certainty to understand how they interact with Steller sea lions or other consumers, including fisheries. Atka mackerel may be one of the more easily characterized sea lion prey items, but we can not describe their onshore and offshore movements, their distribution inside and outside of critical habitat or in the vicinity of rookeries and haulouts, the relation between eastern and western stocks (or whether separate stocks exist), the causes for their (apparent) two- to three-fold changes in abundance over the last two decades, and so on. Pollock appear to be considerably more dynamic in their spatial and temporal patterns, and their presence within Steller sea lion critical habitat is even more difficult to describe in a detailed or quantitative fashion.

1.4.14.3 Critical habitat and environmental carrying capacity

Prey resources are not only the primary feature of Steller sea lion critical habitat, but they also appear to determine the carrying capacity of the environment for Steller sea lions. Therefore, the concepts of critical habitat and environmental carrying capacity are closely linked: critical habitat reflects the geographical extent of the environment needed to recover and conserve the species. The term "environmental carrying capacity" is generally defined as the number of individuals that can be supported by the resources available. The term has two main uses: first as a descriptive measure of the environment under any given set of circumstances, and the second as a reference point for the environment under "natural" conditions (i.e., unaltered by human activities). Thus, the definition can have markedly different implications depending on whether it is used as a reference point for the natural carrying capacity of the environment, or the carrying capacity of the environment as it may have been altered by human-related activities.

The changes observed in the 1970s and 1980s in Steller sea lion growth, reproduction, and survival are all consistent with limited availability of prey. At this time, the best scientific and commercial data available are not sufficient to distinguish the relative influences of natural (i.e., oceanographic) factors and human-related activities (i.e., fisheries) on the availability of prey for sea lions. The notion that the observed changes in sea lion vital parameters are consistent with a change in "carrying capacity" does not necessarily mean that the changes are entirely natural. If carrying capacity is defined as a measure of the environment under any set of conditions, then that capacity could also have been reduced by fisheries. That is, natural and human-related changes to the carrying capacity are not mutually exclusive; both types of factors may have been operating at the same time. Natural and human-related factors that may have affected Steller sea lions or their environment in the past are described in the next section.

2.0 ENVIRONMENTAL EFFECTS OF THE ALTERNATIVES

An environmental assessment (EA) is required by the National Environmental Policy Act of 1969 (NEPA) to determine whether the action considered will result in significant impact on the human environment. If the action is determined not to be significant based on an analysis of relevant considerations, the EA and resulting finding of no significant impact (FONSI) would be the final environmental documents required by NEPA. An environmental impact statement (EIS) must be prepared for major Federal actions significantly affecting the human environment. This section contains the discussion of the environmental impacts of the alternatives including impacts on threatened and endangered species and marine mammals.

The environmental impacts generally associated with fishery management actions are effects resulting from (1) harvest of fish stocks which may result in changes in food availability to predators and scavengers, changes in the population structure of target fish stocks, and changes in the marine ecosystem community structure; (2) changes in the physical and biological structure of the marine environment as a result of fishing practices, e.g., effects of gear use and fish processing discards; and (3) entanglement/entrapment of non-target organisms in active or inactive fishing gear.

A summary of the effects of the annual groundfish TAC amounts on the biological environment and associated impacts on marine mammals, seabirds, and other threatened or endangered species are discussed in the Final Supplemental Environmental Impact Statement on the Groundfish Total Allowable Catch Specifications and Prohibited Species Catch Limits (NMFS 1998)

The potential environmental impacts of the alternatives fall into two categories: those that would result from temporal redistribution of the fishery and those that would result from geographic redistribution.

2.1 Trophic interactions

The diet of pollock in the eastern Bering Sea has been studied extensively (Dwyer 1984; Livingston 1991b; Livingston, Ward et al. 1993; Lang and Livingston 1996; Livingston and DeReynier 1996). These studies have shown that juvenile pollock is the dominant fish prey in the eastern Bering Sea; other fish are also consumed by pollock including juvenile Pacific herring, Pacific cod, arrowtooth flounder, flathead sole, rock sole, yellowfin sole, Greenland turbot, Pacific halibut and Alaska plaice. On the shelf area of the eastern Bering Sea, the contribution of these other fish prey to the diet of pollock tends to be very low (i.e., usually less than 2% by weight of the diet; (Livingston 1991b; Livingston, Ward et al. 1993; Livingston and DeReynier 1996). However, in the deeper slope waters, deep-sea fish (myctophids and bathylagids) are a relatively important diet component (12% by weight), along with euphausiids, pollock, pandalid shrimp and squid (Lang and Livingston 1996).

The cannibalistic nature of pollock, particularly adults feeding on juveniles, is well documented by field studies in the eastern Bering Sea (Dwyer, Bailey et al. 1987; Bailey 1989a; Livingston 1989; Livingston 1991; Livingston, Ward et al. 1993; Livingston and DeReynier 1996; Livingston and Lang 1997). As mentioned previously, cannibalism by pollock in the Aleutian Islands region has not yet been documented (Yang 1996).

Cannibalism rates in the eastern Bering Sea vary depending on year, season, area, and predator size (Dwyer, Bailey et al. 1987; Livingston 1989b; Livingston and Lang 1997). Cannibalism rates are highest in autumn, next highest in summer, and lowest in spring. Cannibalism rates by pollock larger than 40cm are higher than those by pollock less than 40cm. Most pollock cannibalized are age-0 and age-1 fish, with most age-1 pollock being consumed northwest of the Pribilof Islands where most age-1 pollock are found. Pollock larger than 50 cm tend to consume most of the age-1 fish. Smaller pollock consume mostly age-0 fish. Although age-2 and age-3 pollock are sometimes cannibalized, the frequency of occurrence of these age groups in the stomach contents is quite low. Laboratory studies have shown the possibility of cannibalism among age-0 pollock (Sogard and Olla 1993). Field samples have confirmed this interaction, but so far this interaction appears not to be very important. Field and laboratory studies on juvenile pollock have examined behavioral and physical factors that may influence vulnerability of juveniles to cannibalism (Bailey 1989; Sogard and Olla 1993; Olla, Davis et al. 1995; Sogard and Olla 1996). Although it had previously been hypothesized that cannibalism occurred only in areas with no thermal stratification, these recent studies show that age-0 pollock do move below the thermocline into waters inhabited by adults. Larger age-0 fish tend to move below the thermocline during the day, and all age-0 fish tend to inhabit surface waters at night for feeding. Most cannibalism may occur during the day. If food availability is high, all sizes tend to stay above the thermocline, but when food resources are low then even small age-0 fish do move towards the colder waters as an energy-conserving mechanism. Thus, prediction of cannibalism rates may require knowledge of the thermal gradient and food availability to juveniles in an area.

Various studies have modeled pollock cannibalism (Knechtel and Bledsoe 1981; Laevastu and Larkins 1981; Knechtel and Bledsoe 1983; Dwyer 1984; Honkalehto 1989; Livingston 1991a; Livingston, Ward et al. 1993; Livingston 1994). The Knechtel and Bledsoe (Knechtel and Bledsoe 1983) size-structured simulations produced several conclusions regarding cannibalism. Under conditions simulating the current fishing mortality rate ($F=0.3yr^{-1}$) the population tended toward equilibrium. They also found that cannibalism is a stabilizing influence, with the population showing less variation than in simulations which did not include cannibalism. Zooplankton populations were also simulated in the model, and Knechtel and Bledsoe concluded that food was limiting, particularly for adult pollock.

The trend in more recent modeling efforts (Honkalehto 1989; Livingston 1993; Livingston 1994) has been to examine cannibalism using more standard stock assessment procedures such as virtual population analysis or integrated catch-age models such as Methot's (1990) synthesis model. The purpose is to obtain better estimates of juvenile pollock abundance and mortality rates, which can improve our knowledge of factors affecting recruitment of pollock into the commercial fishery at age 3. Results from Livingston (Livingston 1993; Livingston 1994) highlight several points with regard to cannibalism. In the current state of the eastern Bering Sea, cannibalism appears to be the most important source of predation mortality for age-0 and age-1 pollock. Predation mortality rates for juvenile pollock are not constant, as assumed in most population assessment models, but vary across time mainly due to changes in predator abundance but perhaps also due to predators feeding more heavily on more abundant year classes. The decline in pollock recruitment observed at high pollock spawning biomasses appears to be due to cannibalism. There also appears to be an environmental component to juvenile pollock survival (Wespestad, Fritz et al. 1997), wherein surface currents during the first three months of life may transport larvae to areas more favorable to survival (e.g., away from adult predators or in areas more favorable for feeding). Estimates of total amount of pollock consumed by important groundfish predators confirm that cannibalism is the largest source of removal of juvenile pollock by groundfish predation (Livingston 1991a; Livingston, Ward et al. 1993; Livingston and DeReynier 1996).

Other groundfish predators of pollock include Greenland turbot, arrowtooth flounder, Pacific cod, Pacific halibut, and flathead sole (Livingston, Dwyer et al. 1986; Livingston 1991; Livingston, Ward et al. 1993; Livingston and DeReynier 1996). These species are some of the more abundant groundfish in the eastern Bering Sea, and pollock constitutes a large proportion of the diet for many of them. Other less abundant species that consume pollock include Alaska skate, sablefish, Pacific sandfish, and various sculpins (Livingston 1989a; Livingston and DeReynier 1996). Small amounts of juvenile pollock are even eaten by small-mouthed flounders such as yellowfin sole and rock sole (Livingston 1991; Livingston, Ward et al. 1993; Livingston and DeReynier 1996). Age-0 and age-1 pollock are the targets of most of these groundfish predators, with the exception of Pacific cod, Pacific halibut, and Alaska skate, which may consume pollock ranging in age from age 0 to greater than age 6 depending on predator size.

Pollock is a significant prey item of marine mammals and birds in the eastern Bering Sea. Studies suggest that pollock is a primary prey item of northern fur seals when feeding on the shelf during summer (Sinclair, Loughlin et al. 1994; Sinclair, Antonelis et al. 1997), although squid and other small pelagic fish are also eaten in slope areas or in other seasons. The main sizes of pollock consumed by fur seals range from 3-20 cm or age-0 and age-1 fish. Older age classes of pollock may appear in the diet, during years of lower abundances of young pollock (Sinclair, Antonelis et al. 1997). Pollock has been noted as a prey item for other marine mammals including harbor seals, fin whales, minke whales, and humpback whales but stomach samples from these species in the eastern Bering Sea have been too limited to substantiate the importance of pollock in the diets (Kajimura and Fowler 1984). Pollock are one of the most common prey in the diet of spotted seals and ribbon seals, which feed on pollock in the winter and spring in the areas of drifting ice (Lowry, Burkanov et al. 1997).

Essentially five species of piscivorus birds are dominant in the avifauna of the eastern Bering Sea: northern fulmar, red-legged kittiwake, black-legged kittiwake, common murre, and thick-billed murre (Kajimura and Fowler 1984; Schneider and Shuntov 1993). Pollock is sometimes the dominant component in the diets of northern fulmar, black-legged kittiwake, common murre and thick-billed murre while red-legged kittiwakes tend to rely more heavily on myctophids (Hunt, Burgeson et al. 1981; Kajimura and Fowler 1984; Springer, Roseneau et al. 1986). Age-0 and age-1 pollock are consumed by these bird species, and the dominance of a particular pollock age-class in the diet varies by year and season. Fluctuations in chick production by kittiwakes have been linked to the availability of fatty fishes such as myctophids, capelin and sandlance (Hunt, Decker et al. 1995). Changes in the availability of prey, including pollock, to surface-feeding seabirds may be due to changes in sea surface temperatures and the locations of oceanographic features such as fronts which could influence the horizontal or vertical distribution of prey (Springer 1992; Decker, Hunt et al. 1995).

The diet of pollock, particularly adults, in the GOA has not been studied as thoroughly as in the eastern Bering Sea. Larvae, 5-20 mm in length, consume larval and juvenile copepods and copepod eggs (Kendall, Clarke et al. 1987; Canino 1994). Early juvenile pollock (25-100 mm) in the GOA primarily eat juvenile and adult copepods, larvaceans, and euphausiids while late juvenile pollock (100-150 mm) eat mostly euphausiids, chaetognaths, amphipods, and mysids (Walline 1983; Krieger 1985; Livingston 1985; Grover 1990a; Brodeur and Wilson 1996; Merati and Brodeur 1997). Juvenile and adult pollock in southeast Alaska rely heavily on euphausiids, mysids, shrimp and fish as prey (Clausen 1983). Euphausiids and mysids are important to smaller pollock and shrimp and fish are more important to larger pollock in that area. Copepods are not a dominant prey item of pollock in the embayments of southeast Alaska but appear mostly in the summer diet. Similarly, the summer diet of pollock in the central and western GOA does not contain much copepods (Yang 1993). Euphausiids are the dominant prey, and make up a relatively constant proportion of the diet by weight across pollock sizes groups. Shrimp and fish are the next two important prey items.

Fish prey become an increasing fraction of the pollock diet with increasing size in the GOA. Over 20 different species of fish have been identified in the stomach contents of pollock from this area but the dominant fish consumed is capelin (Yang 1993). A high diversity of prey fish were also found in pollock stomachs. Commercially important fish prey included: Pacific cod (*Gadus macrocephalus*), pollock, arrowtooth flounder (*Atheresthes stomias*), flathead sole (*Hippoglossoides elassodon*), Dover sole (*Microstomus pacificus*), and Greenland halibut (*Reinhardtius hippoglossoides*). Forage fish such as capelin (*Mallotus villosus*), eulachon (*Thaleichthys pacificus*) and Pacific sand lance (*Ammodytes hexapterus*), were also found in pollock stomach contents.

Dominant populations of groundfish in the GOA that prey on pollock include arrowtooth flounder, sablefish, Pacific cod, and Pacific halibut (Jewett 1978; Albers and Anderson 1985; Best and St-Pierre 1986; Yang 1993). Pollock is one of the top five prey items (by weight) for Pacific cod, arrowtooth flounder, and Pacific halibut. Other prey fish of these species include Pacific herring and capelin (an osmerid fish). Other predators of pollock include great sculpins (Carlson 1995) and shortspined thornyheads (Yang 1993). As found in the eastern Bering Sea, Pacific halibut and Pacific cod tend to consume larger pollock, and arrowtooth flounder consumes pollock that are mostly less than age three. Unlike the eastern Bering Sea, however, the main source of predation mortality on pollock at present appears to be the arrowtooth flounder (Livingston 1994).

Research on the diets of marine mammals and birds in the GOA was less intensive than for the Bering Sea, but recently has been greatly accelerated (Pitcher 1980a; Pitcher 1980b; Pitcher 1981; DeGange and Sanger 1986; Calkins 1987; Lowry, Frost et al. 1989; Hatch and Sanger 1992; Brodeur and Wilson 1996; Merrick and Calkins 1996) (also see Section 3.5). Brodeur and Wilson's (Brodeur and Wilson 1996) review summarized both bird and mammal predation on juvenile pollock. The main piscivorus birds that consume pollock in the Gulf of Alaska are black-legged kittiwakes, common murre, thick-billed murre, tufted puffin, horned puffin, and probably marbled murrelet. The diets of murres have been shown to contain around 5% to 15% age-0 pollock by weight depending on season. The tufted puffin diet is more diverse and tends to contain more pollock than that of the horned puffin (Hatch and Sanger 1992). Both horned puffins and tufted puffins consume age-0 pollock. The amount of pollock in the diet of tufted puffin varied by region in the years studied, with very low amounts in the north-central Gulf and Kodiak areas, intermediate (5-20%) amounts in the Semidi and Shumagin Islands, and large amounts (25-75%) in the Sandman Reefs and eastern Aleutians. The proportion of juvenile pollock in the diet of tufted puffin at the Semidi Islands varied by year and was related to pollock yearclass abundance.

Walleye pollock is a major prey of Steller sea lions and harbor seals in the Gulf of Alaska (Pitcher 1980a; Pitcher 1980b; Pitcher 1981; Merrick and Calkins 1996). Harbor seals tend to have a more diverse diet, and the occurrence of pollock in the diet is lower than in sea lions. Pollock is a major prey of both juvenile and adult Steller sea lions in the Gulf of Alaska. It appears that the proportion of animals consuming pollock increased from the 1970s to the 1980s, and this increase was most pronounced for juvenile Steller sea lions. Sizes of pollock consumed by Steller sea lions range from 5-56cm and the size composition of pollock consumed appears to be related to the size composition of the pollock population. However, juvenile sea lions consume smaller pollock on average than adults. Age-1 pollock was dominant in the diet of juvenile Steller sea lions in 1985, possibly a reflection of the abundant 1984 year class of pollock available to sea lions in that year.

At present, there is no basis for suggesting that any of the alternatives (especially those that reduce the chance for localized depletions of pollock) would have significant negative impacts on these species.

2.2 Groundfish bycatch in the pollock fisheries

In the BSAI, most discard of pollock occurs in the trawl fisheries targeting species other than pollock (72% of all discards in 1996). Pollock are caught as bycatch in the trawl Pacific cod, rock sole, and yellowfin sole fisheries. Recent discard rates (discards/total catch) of pollock in the pollock fishery have been about 7% (Wespestad et al. 1997). In 1996, 21,300 mt of pollock were discarded in the directed fishery compared to 55,200 mt discarded in all other fisheries (Wespestad et al. 1997). Starting in 1998, discarding of pollock is prohibited except in the fisheries when pollock is closed to directed fishing.

Bycatch species of the BSAI pollock fishery include juvenile pollock, other groundfish, and other species, most of which are caught at rates well below 1%. In the GOA, most discard of pollock occurs in the trawl fisheries targeting species other than pollock (69% of all discards in 1996). Discard rates of pollock in the pollock fishery were 3.4% in 1996. Pollock are also caught as bycatch in the trawl fisheries for various flatfish and Pacific cod, and to a lesser extent, rockfish. In 1996, 1,600 mt of pollock were discarded in the directed fishery compared to 3,600 mt discarded in all other fisheries. Starting in 1998, discarding of pollock is prohibited except in the fisheries where pollock are in bycatch only status.

Bycatch species of the GOA pollock fishery include juvenile pollock, other groundfish, and other species. Bycatch of groundfish other than pollock has generally been less than 5% (mt bycatch species/mt pollock), while bycatch rates of other species has been well below 1%.

2.3 Prohibited species bycatch in the pollock fisheries

Salmon is currently the prohibited species of greatest concern in the pollock fisheries. Bycatch of other prohibited species by pollock vessels has already been dealt with by a series of measures that will be unaffected by this action. Beginning in 1999, bottom trawling for pollock will be prohibited in the BSAI because the Council has recommended that no percentage of the BSAI pollock TAC be apportioned to the bottom trawl pollock target. In addition, the Council has forwarded to NMFS an FMP amendment that would prohibit the use of non-pelagic trawl gear in the directed pollock fisheries and that would establish a performance standard restricting the number of crab that pollock boats can have on board at any one time. These measures are expected to reduce crab and halibut bycatch in the pollock fishery of the BSAI regardless of the temporal and spatial dispersion of the pollock fishery under this emergency rule.

2.3.1 Seasonality of Chinook salmon bycatch

ADF&G (1995) examined Chinook salmon bycatch in the domestic fisheries of the BSAI as part of the analysis for Amendment 21B and concluded that Chinook salmon bycatch occurs primarily in the first and last four months of the year, although groundfish catch is fairly constant throughout the year, if not higher during the summer months. The high bycatch during the months of January through April is apparent. Bycatch of chinook salmon declined significantly during the summer months, although groundfish catch remained high through the summer months.

This pattern also was apparent in the foreign and joint-venture fisheries. Salmon bycatch is high from September or October through, and declines in the summer. In the foreign fisheries, ADF&G concluded that approximately 50% of the total groundfish catch was taken during the bycatch season in any given year or fishery. However, nearly all of the chinook salmon taken in the foreign fisheries were captured during the bycatch season. The joint venture fisheries showed a gradual shift in groundfish catch from a high proportion of summer groundfish catch in earlier years to a high proportion of groundfish catch taken during the bycatch season in later years. A high proportion of chinook salmon were taken during the bycatch season in the joint venture fisheries during any given year.

2.3.2 Areal patterns in salmon bycatch

As indicated in the series of annual observer summaries prepared by the NMFS Alaska Fisheries Science Center (e.g. Guttormsen et al. 1990), chinook salmon bycatch is largely associated with groundfish catches in the "Horseshoe," which is in the area north of Unimak Island, and along the 200 m contour that demarcates the shelf break and forms a horseshoe shape on nautical charts. This area falls largely within the CH/CVOA complex and the extent to which pollock fishing is pushed further north and west of the "Horseshoe," Chinook salmon bycatch may decrease under the emergency rule. It is notable that chinook salmon bycatch does not extend, for the most part, far from the contour, from the "horseshoe", or from the north of Unimak Island. This is especially true for chinook salmon encounters during the months of January-April and

September-December, and there is little apparent bycatch during the summer season. Although very apparent across years, the spatial bycatch pattern within a given year appears to be more patchy within these defined areas (ADF&G 1995).

Patterns of chinook salmon bycatch during the first four months of the year in the domestic fishery have been concentrated within the 15 mile buffer sketched on either side of the 200 m contour (30 miles across buffer). Much of this bycatch is found within the "horseshoe" and especially at the eastern most corner of the "horseshoe." During the summer months, little chinook salmon bycatch is apparent. During the latter four months of the year, hauls with the greatest number of chinook salmon and highest bycatch rates are again for the most part within the buffer surrounding the contour at the "horseshoe" (ADF&G 1995).

The pattern of chinook salmon bycatch in the foreign fishery was very similar to that seen in the domestic fishery during the first third of the year with the exception that the area near the "horseshoe" was not as extensively fished by the foreign fleet. Chinook salmon (e.g. hauls with greater than 5 chinook per haul or bycatch rates greater than .5) were caught all along the 200 m contour, but were, for the most part, not intercepted outside of the 15 mi buffer strip. During the summer months, very few chinook salmon were intercepted. Bycatch during the final third of the year is very apparent again along the 200 m contour and in the "horseshoe."

The joint venture fisheries concentrated fishing effort in the area near the "horseshoe" and above Unimak Island, and also fished along the shelf. In the analysis for Amendments 21B (ADF&G 1995) the hauls with larger numbers of chinook salmon (or greater than 5 fish) also extended north from this area onto the shelf, however, the hauls with the highest bycatch rates were located in the vicinity of the "horseshoe." During the summer, the joint venture fisheries encountered more chinook salmon, on a haul by haul basis, than did the foreign or domestic fisheries, but the bycatch rates during the summer months for the joint venture fisheries remained low. As was the case with the domestic and foreign fisheries, chinook salmon bycatch increased in the final four months of the year, and was located in the area of the "horseshoe" and along the 200 m contour.

2.4 Impacts on endangered, threatened or candidate species

Endangered and threatened species under the ESA that may be present in the GOA and BSAI include:

Endangered

Western population Steller sea lion	*Eumetopias jubatus*
Northern right whale	*Balaena glacialis*
Sei whale	*Balaenoptera borealis*
Blue whale	*Balaenoptera musculus*
Fin whale	*Balaenoptera physalus*
Humpback whale	*Megaptera novaeangliae*
Sperm whale	*Physeter macrocephalus*
Snake River sockeye salmon	*Oncorhynchus nerka*
Short-tailed albatross	*Diomedea albatrus*

Threatened

Eastern population Steller sea lion	*Eumetopias jubatus*
Snake R. spring and summer chinook salmon	*Oncorhynchus tshawytscha*
Snake R. fall chinook salmon	*Oncorhynchus tshawytscha*

Spectacled eider	*Somateria fischeri*
Steller's eider	*Polysticta stelleri*

Section 7 consultations have been done for all the above listed species, some individually and some as groups. Below are summaries of consultations recently completed or currently underway. See the FSEIS, section 3.8, for summaries of all previous section 7 consultations and Biological Opinions (NMFS 1998). None of the alternatives considered in this amendment is expected to have a significant impact on endangered, threatened, or candidate species other than the Steller sea lion. The purpose of this emergency rule is to implement reasonable and prudent alternatives to avoid the likelihood of the pollock fisheries off Alaska jeopardizing the continued existence of the western population of Steller sea lions, or adversely modifying its critical habitat. To the extent to which this purpose is achieved, this action will benefit rather than harm Steller sea lions.

2.4.1 NMFS 1998 Biological Opinion, Authorization of the Pollock and Atka Mackerel Fisheries for 1999-2002

On December 3, 1998, NMFS issued its Biological Opinion on the 1999-2002 authorization of the BSAI Atka mackerel fishery, the BSAI pollock fishery, and the GOA pollock fishery under their respective groundfish fishery management plans (NMFS, 1998b). The opinion analyzes the effects of these actions on the endangered western population of Steller sea lions and its critical habitat. After reviewing (1) the 1998 status of ESA listed species, (2) the environmental baseline for the action area, (3) the effects of the proposed 1999-2002 fisheries, and (4) the recommendations of the NPFMC, NMFS' Biological Opinion concludes that the Atka mackerel fisheries will not jeopardize the continued existence of current ESA listed species or adversely modify their critical habitat if current proposed mitigation measures are effective in 1999 (see below). However, for the proposed 1999-2002 BSAI and GOA pollock fisheries, NMFS' Biological Opinion concluded that the action, as proposed, are likely to jeopardize the continued existence of the western population of Steller sea lions and adversely modify its critical habitat.

For the pollock fisheries, NMFS established RPAs to avoid jeopardizing Steller sea lions and presented those RPAs to the Council during its December meeting. Mitigation measures for the pollock fisheries were proposed by the Council and then modified by NMFS. These modified RPAs were issued by NMFS in a memorandum dated December 16, 1998 from Gary Matlock, Director, Office of Sustainable Fisheries. NMFS has determined that these mitigation measures would, if implemented, allow the proposed fishery to occur without jeopardizing the continued existence of Steller sea lions and avoid adverse modification of its critical habitat. NMFS is preparing an emergency rule (Alternative 2, the preferred alternative) that will implement the RPA actions as proposed by the Council and modified by NMFS. This emergency rule will be effective prior to the start of the 1999 pollock trawl fisheries, scheduled to start on January 20, 1999. However, if the emergency rule is not effective prior to the scheduled regulatory opening of the pollock trawl fisheries, NMFS will close trawl fishing for pollock by emergency rule.

2.4.2 NMFS 1998 Biological Opinion, Authorization of the BSAI and GOA Groundfish Fisheries for 1999

Pursuant to the ESA, NMFS has prepared a section 7 consultation Biological Opinion on the 1999 BSAI and GOA groundfish fisheries. The Biological Opinion examined the 1999 proposed TAC specifications for the BSAI and GOA and the effect of this action on ESA listed species. The Biological Opinion concluded that mitigation measures recommended by the Council and modified by NMFS, for the BSAI and GOA pollock fisheries and the BSAI Atka mackerel fisheries, are sufficient to avoid jeopardizing the continued existence of the western population of Steller sea lions and avoid adverse modification to its critical habitat. This conclusion requires that NMFS, implement the recommended revised reasonable and prudent alternatives before the scheduled regulatory start of the 1999 BSAI and GOA trawl fisheries. NMFS Biological Opinion concluded that implementation of the BSAI and GOA groundfish fisheries, as outlined under the FMPs and amended by the Steller sea lion mitigation measures for pollock and Atka mackerel, would not jeopardize the continued existence of Steller sea lions or other ESA listed marine mammals. If the recommended mitigation measures are not effective prior to January 20, 1999, NMFS, by emergency rule under authority of the Magnuson-Stevens Act, will close directed fishing with trawl gear in the BSAI and GOA until such time that the mitigation measures can be implemented.

2.4.3 Biological Opinion on Potential Impacts of BSAI and GOA Groundfish Fisheries on ESA Listed Salmon

In a letter dated December 1, 1998, Mr. William W. Stelle (NMFS, 1998b) concluded under an informal section 7 consultation that the continued implementation of the BSAI and GOA groundfish FMPs were unlikely to significantly impact endangered salmon species. Additional chinook and chum salmon have been proposed for listings, however, an assessment of impacts to these salmon will be better made once the listing decisions are known. NMFS must reinitiate this ESA consultation if new information becomes available or circumstances occur that may affect listed species or their critical habitat in a manner or to an extent not previously considered, or a new species is listed or critical habitat is designated that may be affected by the action.

2.4.4 USFWS Biological Opinion on the BSAI Trawl and Hook-and-Line Fisheries

In a letter dated December 2, 1998 (USFWS, 1998), the Fish and Wildlife Service extended the 1997-1998 Biological Opinion on the BSAI hook-and-line groundfish fishery and the BSAI trawl groundfish fishery for the ESA listed short-tailed albatross, until it is superseded by a subsequent amendment to that opinion. Based on current information available to the USFWS, they do not anticipate that their final Biological Opinion will determine that the 1999 BSAI groundfish fishery places the short-tailed albatross in jeopardy of extinction. The statutory receipt of a final BO and incidental take statement for the BSAI hook and line groundfish fishery is Friday, March 19, 1999.

2.5 Impacts on marine mammals

Interactions, either direct or indirect, between commercial fisheries and the 26 species of marine mammals inhabiting federal waters off Alaska vary widely, given those mammals diverse life histories and spatial distribution patterns. In general, the impacts resulting from the fisheries are likely to be constrained to those marine mammal species with the greatest potential dependence on prey species that are harvested commercially. Likewise, those marine mammals which feed more extensively in the commercial fishing grounds may be proportionally more affected. Of the 26 marine mammal species described in section 3.4 of the FSEIS (NMFS 1998), only a subset have been shown to consume groundfish species as a large part of their diet, and to potentially do so in areas coincident with groundfish harvest operations. Thus, the greatest emphasis is placed on those species: Steller sea lion, northern fur seal and harbor seal. Among the cetacean species, a few include groundfish in their diets, but most exploit a larger prey base, with extensive consumption of invertebrates and small schooling fishes. The impacts of the pollock fisheries off Alaska on marine mammals were analyzed in the FEIS (NMFS 1998). None of the alternatives under consideration is expected to impact marine mammals in a manner not considered in the SEIS.

Pollock is a significant prey item of marine mammals in the eastern Bering Sea. Studies suggest that pollock is a primary prey item of northern fur seals when feeding on the shelf during summer (Sinclair, Loughlin et al. 1994; Sinclair, Antonelis et al. 1997), although squid and other small pelagic fish are also eaten in slope areas or in other seasons. The main sizes of pollock consumed by fur seals range from 3-20 cm or age-0 and age-1 fish. Older age classes of pollock may appear in the diet, during years of lower abundances of young pollock (Sinclair, Antonelis et al. 1997). Pollock has been noted as a prey item for other marine mammals including harbor seals, fin whales, minke whales, and humpback whales but stomach samples from these species in the eastern Bering Sea have been too limited to substantiate the importance of pollock in the diets (Kajimura and Fowler 1984). Pollock are one of the most common prey in the diet of spotted seals and ribbon seals, which feed on pollock in the winter and spring in the areas of drifting ice (Lowry, Burkanov et al. 1997). Because the emergency rule would disperse the fishery temporally and spatially, the potential for localized depletions of pollock stock will be reduced. To this extent, this action may provide benefits to marine mammals other than Steller sea lions that also depend on pollock as a prey source. For this reason, none of the alternatives is expected to have a significant impact on these marine mammals.

2.6 Coastal Zone Management Act

Implementation of the emergency rule would be conducted in a manner consistent, to the maximum extent practicable, with the Alaska Coastal Management Program within the meaning of section 30(c)(1) of the Coastal Zone Management Act of 1972 and its implementing regulations.

2.7 Conclusions or Finding of no Significant Impact

NMFS acknowledges that certain mitigation measures must be in place before the start of the 1999 BSAI and GOA pollock fisheries so that a finding of no significant impact can be reached. The emergency interim rule set out as the preferred alternative in this analysis would implement the revised reasonable and prudent alternatives for the BSAI and GOA pollock fisheries as outlined by NMFS in the 1998 Biological Opinion (NMFS, 1998b), and as updated in a memorandum on December 16, 1998 (NMFS, 1998e). If the recommended mitigation measures are not effective prior to scheduled regulatory opening of the trawl fisheries on January 20, 1999, NMFS, by emergency rule under authority of the Magnuson-Stevens Act, will close directed fishing for pollock in the BSAI and GOA until such time that these mitigation measures can be implemented.

For the reasons discussed above, implementation of the preferred Alternative would not significantly affect the quality of the human environment. Therefore, the preparation of an environmental impact statement is not required by section 102(2)(C) of NEPA or its implementing regulations.

for

Assistant Administrator for Fisheries, NOAA

JAN 14 1999

Date

3.0 ECONOMIC AND SOCIOECONOMIC IMPACTS OF THE ALTERNATIVES

Implicit in the ESA is the assumption that society enjoys a net benefit from any action which protects threatened or endangered species, and/or facilitates the recovery of populations of such species. It is not necessary, therefore, to undertake an effort to estimate the size of this benefit. However, because the alternative actions which might be taken under the proposed Reasonable and Prudent Actions (RPAs) do carry with them economic and social costs, it is appropriate to evaluate, to the extent practicable, the trade-off society is making in order to obtain these ESA net benefits.

While society collectively benefits from the proposed actions, the potential attributable costs of the application of the RPA principles accrue most obviously to those who directly exploit and depend upon the environmental resource base in the affected areas. In the present context, this is the fishing industry operating in the BSAI and GOA which target pollock; and, by extension, the communities which support and depend upon those fisheries. The following discussion summarizes the economic and social impacts that might be expected to accompany adoption of an Emergency Rule to implement one or more of the alternative RPA management actions, in preparation for the 1999 Eastern Bering Sea, Aleutian Islands and Western/Central Gulf of Alaska pollock fisheries.[1]

The *"principles for reasonable and prudent alternatives,"* proposed by NMFS and set forth above, identify three fundamental elements in connection with management of the commercial pollock fisheries. These include: (1) temporal dispersion, (2) spatial dispersion, and (3) trawl exclusion zones. The economic implications of each of these RPA elements for the primary subsectors of the eastern Bering Sea, GOA, and Aleutian Islands pollock fisheries are treated in subsequent sections of this assessment. The management environment into which the RPAs must be integrated is described in the following section.

3.1 Historical management of the pollock fisheries

Since adoption and implementation of Amendments 18/23 to the FMPs for the groundfish fisheries of the BSAI and GOA, respectively, the pollock trawl fisheries have been governed by an Inshore/Offshore (I/O) TAC allocation regime. While this regime has evolved over time, it does provide a consistent structural basis for evaluating the harvesting and processing elements of the domestic pollock fishing industry in the North Pacific and Bering Sea.

Under I/O, there are two primary operational subsectors defined for the pollock target fishery. These included: Catcher/processors and motherships (which together comprise the offshore sector), and inshore processors which include shore plants and anchored floating processors).[2] For purposes of assessing the impacts which may accrue from application of one or more of the RPA principles, these same sectoral definitions will prove useful.

Subsequent to the I/O amendments (adopted in 1992, reauthorized in 1996, and amended in 1998), the Congress passed, and the President signed into law, the American Fisheries Act (AFA), which superseded I/O and, among other things, further clarified the relationship of the three BSAI subsectors with one another. It did so by precisely defining which individual vessels could participate in the BSAI pollock fisheries as

---

[1] The pollock fisheries in the eastern GOA are not directly affected by the proposed RPAs and thus will not be explicitly treated in the following analysis.

[2] In the GOA, 100% of the pollock TAC has been apportioned to the inshore sector. In the BSAI, the TAC was allocated 65% to the offshore sector and 35% to the inshore sector, respectively.

catcher/processors, motherships, or catcher vessels delivering to either component of the offshore sector, and by reapportioning the pollock TAC among the three processing/operational modes.[3]

Specifically, the AFA effectively limits the number of motherships participating in these BSAI fisheries to three vessels and the fleet of supporting catcher vessels to 19. The Act effectively limits the number of catcher/processors to 21, with an associated seven catcher vessels authorized to deliver pollock to the catcher/processors. Under provisions of the AFA, the BSAI inshore sector is somewhat less precisely identified at present, although the best available information suggests that there are eight inshore processors, supported by deliveries of pollock from a fleet of 118 catcher boats which qualify to fish for pollock under AFA.

The three fleets of catcher vessels supporting the three processing subsectors are mutually exclusive. That is, AFA precludes catcher vessels from delivering pollock to more than one subsector, so the vessel counts cited here are of unique operations. This is significant because it permits a relatively clear enumeration of the "universe" of pollock fishing and processing operations in the BSAI which might be directly impacted by RPA actions targeting the pollock fishery in this area.

The AFA does not establish criteria, nor identify qualifying operations, in the GOA pollock fisheries. Therefore, the GOA pollock fleet is somewhat less well defined. Nonetheless, NMFS Blend and ADF&G fish ticket data for the GOA indicate that 124 vessels participated in the pollock target fishery in 1997, of which 118 were catcher vessels and six were catcher/processors. These numbers were 95 and three, respectively, in 1996. All were classified as inshore operations. Eleven onshore processors participated in the GOA pollock fishery in 1997, with nine in Kodiak and one each in Sand Point and King Cove.[4]

Provisions of the I/O management regime specified that the BSAI pollock TAC would be allocated 65% to the at-sea sector (catcher/processors and motherships combined) and 35% to the inshore sector (after taking a 7.5% share for the CDQ fishery "off-the-top"). The pollock TAC is further apportioned between an A and B season, with 45% of each sector's share released on January 20, and the remaining 55% released on September 1 of the fishing year. The pollock target fishery is closed from November 1 to January 20.

Under AFA, which at the time of this analysis has not yet been implemented but which will be the governing allocation framework in this area beginning in 1999, the pollock TAC will be reapportioned in the following way. The pollock TAC will be initially reduced by a 10% set aside for CDQs, then further reduced to accommodate pollock bycatch in non-pollock fisheries by an amount expected to be approximately 5% of the TAC. The remaining 85% of the TAC is then to be divided, 50% to the inshore sector, 10% to the true mothership sector, and 40% to the catcher/processor sector.

In the GOA, as previously noted, 100% of the pollock TAC is apportioned to the inshore sector. The AFA does not alter this relationship.

In recent history, pollock target fisheries have taken place over shorter and shorter periods of time. In the 1990 BSAI fishing season, for example, the fishery took place over a 10-month period. By 1998, the season lasted less than three months, divided between the A and B seasons. In the GOA, season length has fluctuated widely, but an overall trend has been for shortened seasons, even as pollock TACs in the GOA have increased. In the western Gulf (Area 610), the directed season lasted approximately 90 days in 1991,

---

[3] AFA did not alter the GOA pollock apportionment.

[4] Some pollock harvested in the Bering Sea was delivered for processing to GOA facilities.

fell to 54 days in 1992, then averaged just 18 days from 1994 through 1997. In the central Gulf (Areas 620 and 630) pollock target fishing has exhibited the same pattern of contraction. In Area 620, fishing season decreased from 90 days in 1991 to as few as 16 days in 1995. The 1997 season lasted approximately 45 days. In Area 630, the season length decreased from 90 days in the early 1990s to slightly fewer than 10 days in 1996. The 1997 season was 34 days long. This degree of temporal compression of the fishing season has a number of undesirable results, not the least of which is the risk of adverse impacts to Steller sea lions.

This, then, is the effective management and operational context which will prevail when the proposed RPA Emergency Action is adopted and implemented. Against this background, it may be possible to predict, at least in general terms, how the industry is likely to respond to each of the RPA principles, and to characterize, in turn, the nature and size of the economic and social impacts that may accompany these adjustments.

3.2 RPA principle one: Temporal dispersion

For the Eastern Bering Sea management area, the *"principles for reasonable and prudent alternatives"* provide for significant temporal adjustments to the status quo pattern of utilization of this area's pollock resource. Under the RPA principle of temporal dispersion, a primary objective is *"... to more evenly distribute the pollock trawl fisheries catch..."* throughout the fishing year. Temporal dispersion serves to diminish the risk of adverse impacts to Steller sea lions caused by pulse fishing.

To this end, this first principle provides that the existing A and B seasons in the eastern Bering Sea be further subdivided into four seasonal apportionments. At its December 1998 meeting, the North Pacific Fishery Management Council (NPFMC) adopted a motion to establish the following release schedule: an A1 season beginning January 20; an A2 season beginning on February 20; a B season which would begin on August 1; and a C season that would begin on September 15. As is the case under the status quo, the pollock fishery would be closed from November 1 through January 19, under this RPA proposal.

The GOA pollock fisheries would also be managed on the basis of seasonal TAC releases. Until 1996, the GOA fishery had been prosecuted under a four quarter apportionment regime. In 1996, the fishery was changed to a trimester release schedule with approximately equal shares of the TAC split between January, June, and September.[5] The temporal dispersal scheme for the GOA pollock fisheries, contained in the NPFMC's motion, is similar to that contemplated for the eastern Bering Sea, inasmuch as the current A season would be divided in two, with the A release becoming available on January 20, and a B allocation being made on June 1. The proposed C season release would be made on September 1, and the fourth quarterly apportionment would occur no later than October 1 of each fishing year, but in no case sooner than five days after the close of the C season.

Based upon the NPFMC motion, there would be no pollock target fishery in the Aleutian Islands management area.

3.3 RPA principle two: Spatial dispersion

A primary objective of the "spatial dispersion principle" for pollock trawl fisheries is to have the distribution of catch mirror the distribution of exploitable pollock biomass for each seasonal TAC, including allocations made to areas within critical habitat and outside of critical habitat.

---

[5] In 1998, slightly more of the GOA TAC was shifted into the September release, i.e., 40%.

Prior to 1987, less than 30% of the BSAI annual pollock catch was taken from Steller sea lion critical habitat in all years except 1971 (when about 31% was taken). After 1987, the annual percentage increased to between 36% and 69% (with an 1987 through 1997 mean removal of approximately 52%). From 1992 to 1997 during the A season, the percentage of pollock catch taken in these areas ranged from 53% to 89%, with a mean of 69%. This is change was due in part to increased allocations to the inshore sector which is based in Dutch Harbor/Akutan, and the increased importance of roe as a product.

In the GOA management areas, the percentage of the annual pollock TAC taken from Steller sea lion critical habitat was on the order of a few percent until 1979, when the level rose abruptly to about 35%. From 1982 to 1997, the level of removals from critical habitat was consistently above 50%, ranging to as high as 93% in 1988.

The allocation of catch according to the geographic distribution of stock biomass, as suggested by RPA principle two, implies some subdivision of the entire area of the stock into meaningful geographic units. For the pollock stocks in the BSAI region, some specific geographic areas have already been identified (e.g., Aleutian Islands area, Bogoslof area, eastern Bering Sea).

In the GOA, geographic management areas 610, 620, and 630 have already been established, and the Shelikof Strait area has been identified as critical habitat for Steller sea lions (and a site for annual hydroacoustic trawl surveys).

Consistent with RPA principle two, management areas for the spatial dispersion of pollock trawl fishing effort in the eastern Bering Sea and GOA target fisheries should be based on these and/or other meaningful geographic delineations which are proportionate to pollock stock distribution.

3.4 RPA principle three: Pollock trawl exclusion zones

Notwithstanding the foregoing discussion, in some circumstances spatial dispersion, wherein pollock catch is proportionate to pollock stock distribution within a given area, is not sufficient to provide the level of protection deemed necessary. In such cases, trawl exclusion zones are an appropriate management option. RPA principle three provides for complete exclusion of pollock trawl fishing from specific habitat zones, based on the available evidence that the regions around major rookeries and haulouts are so essential to the recovery and conservation of the western population of Steller sea lions that risk of competition from pollock trawl fisheries must be completely eliminated. Such exclusions are believed to be particularly important to protect prey resources for reproductive females and for pups and juveniles learning to forage.

Based on the need to eliminate the possibility of competition in foraging areas immediately adjacent to rookeries and haulouts, this principle proposes to establish exclusion zones which provide absolute spatial separation of pollock trawl fishing and Steller sea lion foraging areas adjacent to terrestrial haulouts and rookeries. These exclusion zones are specified so as to provide protection for all rookeries and haulouts used by significant numbers of animals since the beginning of the decline in the 1970s. In the eastern Bering Sea, pollock trawl protection zones are proposed to have a minimum radius of 20 nm with the exception of Cape Sarichef which would have a 10 nm exclusion zone in 1999 increasing to 20 nm for 2000 and beyond. In the GOA management area the zones extend to 10 nm except for eight sites which would have no exclusion zone for 1999 but would have 10 nm exclusion zones for 2000 and beyond.[6]

---

[6] The RPA specified a 10 nm zone in the Aleutian Islands management area, as well. However, the subsequent complete closure of this area to pollock target fisheries makes the size of the exclusion zones in this area irrelevant.

3.5 Economic implications of the RPA principles

While quantitative estimates of the probable economic or social impacts on the pollock fisheries of the eastern Bering Sea, GOA, and/or Aleutian Islands management areas attributable to any of the three proposed RPA dispersion principles are difficult to derive, there are several obvious (if largely qualitative) outcomes that can be predicted.

First, any regulatory action that requires an operator to involuntarily alter his or her fishing pattern (whether temporally or geographically) will impose costs. Furthermore, it is likely that some or all of these costs will be uncompensated under the newly mandated regulatory regime. Within the present RPA context, for example, it is unlikely that following time or area closures of fishing grounds that have historically been the preferred site of pollock harvesting activity for an operation, increases in catch in the areas which remain open (or during alternative time periods) will fully offset the costs imposed by the RPA action. If they did, then presumably, the profit maximizing operator would have adopted these fishing patterns and schedules voluntarily. So, temporal, spatial, and/or exclusion zone management actions, as defined under the RPA principles, will impose direct and unavoidable costs on the participants of the eastern Bering Sea, GOA, and Aleutian Islands pollock fisheries, if adopted.

The magnitude of such costs will likely vary by vessel depending on size, operating configuration, home port, principal product forms and markets. Empirical data on operating costs are not readily available for these fleets. However, the At-Sea Processors Association (APA) has voluntarily submitted estimates of economic impacts they suggest may be associated with RPA actions for operations they represent. While these data have not been independently verified, they may provide an indication of one sector's expectation about direct operating cost effects.

The APA asserts that, on average, the marginal operating cost per additional catcher/processor vessel day in the BSAI pollock fishery would be $20,000. There will be a total of 21 catcher/processors authorized to participate in the BSAI pollock fisheries under the AFA. On the basis of this information, if all authorized vessels took part in the fishery, the aggregate marginal operating cost per additional fishing day for this segment of the industry would be $400,000.

Because the RPAs are expected to shift the fisheries, both temporally and geographically, APA anticipates (perhaps reasonably) that CPUE will decline significantly. As a result, the number of fishing days required to take the TAC-share apportioned to each sector would have to increase. How many additional days may be required would vary by sector and cannot be anticipated at this time. To some extent, decreases in CPUE can be offset by increasing the number of hours fished per day and also by purchasing fish from catcher vessels.

Second, the distribution of these direct economic impacts among the participating fleets of vessels and processors will be uneven, with a disproportionate burden falling upon the less mobile, and/or less operationally diversified vessels and plants. Clearly, regulatory actions which move operations farther offshore, to more remote fishing areas (relative to their traditional delivery/operating ports), or reschedule openings during periods of more extreme weather and sea conditions, will impose a relatively greater burden on smaller operation than on their larger counterparts. In some circumstances, the physical safety of a vessel and crew may be threatened if openings occur at times, or in areas, which are at the operational limits of the capacity of the smaller elements of the fleet. In some cases, an operator may have to weigh the risk of testing the limits of a vessel's capability against the economic costs of dropping out of some or all of the fishery, as a result of RPA-induced dispersion of the pollock fishery. In the latter circumstance, this can be expected to result in some effective economic redistribution *within* any given sector or fleet.

There are, of course, several recent actions which could tend to ameliorate these disproportionate burdens, to some degree. For example, while smaller catcher vessels operating in the eastern Bering Sea pollock fishery and delivering inshore could be placed at a disadvantage relative to the catcher/processor or true mothership sectors by the proposed RPAs, due to their more limited operating range, the significant TAC reapportionment provided for under AFA, cited above, should offset some of this disadvantage by simply making a greater absolute quantity of pollock available to these inshore operations.

Likewise, provisions in AFA which, in the first year at least, [7] permit the BSAI pollock catcher/processor sector to enter into cooperative fishing arrangements, should mitigate some of the costs imposed by the suggested RPAs, in comparison to what the impacts would have been absent these AFA provisions.

To the extent that some individual ports such as Sand Point support resident fleets composed exclusively, or even primarily, of small vessels, there may be distributional effects across geographical regions, attributable to management actions deriving from the RPA principles. For example, if a time or area restriction in the pollock trawl fishery imposed operational limitations that made continued participation in the fishery effectively impossible for a significant number of vessels operating from a given port (e.g., running time and distances to open areas exceeded the operational capacity of the vessels in the resident fleet), the share of total pollock catch that would have accrued to those vessels, and through them to their home port community, could, in whole or in part, be taken by larger vessels from another port community, one with the physical capability to adapt to the mandated changes in fishing location and/or schedule. Even if not literally beyond the physical limitations of an individual vessel, the increased operating costs (e.g., additional fuel costs) relative to catch and holding capacity, and the logistical complexities (e.g., fuel carrying capacity) for many smaller operations could work to their economic disadvantage, should the pollock fishing environment change dramatically in response to RPAs. The emergency rule contains a trip limit of 136 mt which will limit the potential for displacement of small vessels by large vessels.

While the AFA largely precludes redistribution of TAC allocations *between* sectors, it does not foreclose intra-sectoral shifts (including, potentially, between GOA and BSAI inshore operators). Small communities with relatively greater dependence on the pollock fisheries, whether sites of inshore processing or simply fleet home ports, could be disproportionately impacted through this same economic mechanism. Specifically which fishing port (or ports) may be disadvantaged, and how and by how much they would be impacted, is an empirical question. Nonetheless, some regional distributional effect seems probable that could be attributed to RPAs.

The length of time between catching pollock and processing the catch is negatively correlated with product quality and value. For vessels which do not have the capability to process their own catch, given a fixed catch rate, holding capacity, and running speed, any action which increases the time between catch and delivery imposes costs. Beyond some point, which varies by vessel size, configuration, condition of the target fish, and weather/sea conditions, delivery of a usable catch is not feasible. That is, for any given operation, this combination of factors will define an operational limit beyond which the vessel cannot produce a marketable product for processing. This limit will be different for each area and vessel class, but could result in a disproportionate distribution of impacts among onshore processing facilities and ports.

---

[7] The mothership and inshore sectors are not permitted to enter into cooperatives in the first year of AFA. The Act does permit such cooperative arrangements in subsequent years, however, because the present analysis addresses the implementation of the RPA principles under an Emergency Rule, this provision of the AFA does not immediately bear on the discussion.

Similarly, some products such as roe are more sensitive to the period between catch and processing and output of these products could be disproportionally impacted. In the limit, some product forms, like pollock roe, could become effectively unavailable to some segments of the industry (e.g., some inshore operations) as a consequence of RPA-attributable changes in the timing of openings, distance between processing facility and open areas, etc.

A related consideration is how scheduling of the pollock fisheries may affect product quality. While some delay in (or reapportionment of TAC from) the January 20 opening date in the eastern Bering Sea fishery may actually enhance the value of the catch and improve the overall recovery rate of production, (by, for example, pushing the peak of the catch into the prime roe season), other scheduling changes may work in the opposite direction. For example, it has long been asserted by the industry that, at least in the BSAI,[8] post-spawn pollock are of poorer physical condition (e.g., soft flesh, high water content) and thus of significantly lower value than winter fish, or those taken later in the fall fishery. Furthermore, concentrations of pollock outside of the preferred fishing areas are reportedly, in general, composed of smaller fish. These attributes reduce the value of the pollock catch.

To the extent that the RPAs result in catches of pollock in the target fisheries with these attributes, economic losses may accrue. They may take the form of reduced revenues to fishermen; production constraints imposed on processors (lowering aggregate recovery rates and precluding or constraining production of some product forms); and supply shortages and product quality impacts on consumers.[9]

One of the fundamental tenants of the RPA proposal is the further subdivision of the pollock A and B seasons into four seasonal apportionments. Furthermore, it is asserted that, to be effective, these seasonal releases must be separated by meaningful closed periods. That is, without such closed intervals, it might be possible for the industry to strategically manage each release in such a way as to effectively combine two (or perhaps more) seasonal releases into a single fishing period. This outcome would be in direct conflict with the stated objectives of the temporal dispersion principle.

From the perspective of the fishing industry, idle periods between openings impose costs which are potentially substantial. These may be characterized as staging expenses. For example, transporting crews by air to and from remote Alaska locations four times in a fishing year (rather than twice, as is presently required) can represent a significant additional expense. APA reports that, on average, each catcher/processor carries a crew of between 100 and 125 crew members. The motherships, and many inshore plants, have at least as many transient employees. Under the specific season dates contained in the emergency rule with a 5-day closure between the A1 and A2 seasons and no required closure between the B and C seasons, these staging costs may be minimized.

Similarly, moving fishing supplies and support materials to and from the vessel's Alaska staging port two more times each season, as well as providing for secure stand-down status of the vessel and its equipment

---

[8] Informed sources suggest that in the GOA there is not the same concern about pollock taken in the post-spawn period (Per. comm. Chris Blackburn, 1998).

[9] Changes in the product mix or the amounts of individual products on the market resulting directly from the proposed RPA principles are difficult to anticipate or value. Further complicating the attempt to estimate impacts is the fact that a significant share of total pollock output from BSAI and GOA fisheries is exported, principally to Japan. Changes in consumer surplus (and, for that matter, producer surplus) attributable to a regulatory action, but which accrue to non-U.S. consumers (producers), are not to be included in impact estimates.

between openings, could impose considerably higher operating costs. Inshore plants could experience equivalent logistical costs, depending upon their relative level of operational diversification, geographic location, length of current operating season, etc.

It should be noted that the availability of pollock CDQ may enable operators with CDQ partners to bridge these mandatory closured periods and, thus, avoid some of these costs. This solution will not be available to all potentially affected operations, and actually works to subvert the fundamental objective of that aspect of the RPA which depends upon meaningful separation of seasonal releases.

Finally, if one assumes, for sake of argument, that none of the displaced pollock catch in the target fishery, attributable to trawling zone closures (or, in the case of the Aleutian Islands Subarea, complete closure of the target fishery), is made up in alternative areas (or during alternative time periods), an upper-bound estimate can be made of the gross exvessel and/or first wholesale value that would be foregone by pollock target operations, as a result of the RPA pollock trawl exclusion zone principle. In the case of the Aleutian Islands Subarea, there is a separate pollock TAC and this catch cannot be made up in alternative areas.

3.5.1 Worst-case foregone GOA catch

Beginning in the Gulf of Alaska, and using catch estimates derived for these target fisheries, it is projected that 31% of the total pollock catch came from areas which would be closed under the proposed RPA. In 1997, the total GOA target pollock trawl catch was 86,400 mt. This implies that approximately 26,784 tons of catch (i.e., 31% of 86,400 mt) could have been foregone, had the RPA-closures been in place and, as assumed, none of the projected catch loss was replaced from areas outside the RPA closure zones.

The 1997 SAFE document reports an estimated exvessel price per pound round weight for GOA pollock, in the target fishery, of $0.10. Using this and the estimated upper-bound foregone catch estimate, the projected economic impact attributable to the pollock trawl exclusion zone principle, on GOA pollock target operations, at exvessel, could reach $5.9 million annually.

At the first wholesale level, in the Gulf, total pollock output for 1997 was estimated to be 22,100 mt (all product forms combined), with a total product value of $47.5 million. Again, based upon the 1997 SAFE document, round weight to product weight for all product forms in GOA, was 0.2511 (i.e., 88,000 mt total pollock catch, all gear-types, yielding 22,100 mt of output, all product forms combined).

Applying this ratio to the potential foregone catch amount of 26,784 tons, and assuming a fixed product-mix, suggests that GOA pollock product output could be reduced by 6,726 mt. In 1997, the estimated product value per ton of pollock in the Gulf was approximately $2,149.00 ($539.70 per ton round weight equivalent value). Using this derived 1997 value estimate, and the worst-case foregone tonnage projection under the RPA exclusion zone principle, the product value at wholesale of this loss could exceed $14.5 million annually.

3.5.2 Worst-case Bering Sea foregone catch

The potential impacts on the eastern Bering Sea pollock target fisheries, attributable to the RPA principles, present a very different and much more complex picture. This is so for several reasons, including, among others, the fact that the size of the pollock target fishery in the eastern Bering Sea dwarfs those in either the GOA or the Aleutian Islands management areas, and thus amplifies the potential economic and social significance to the region and the Nation of specific RPA actions. Also, unlike the GOA where 100% of the pollock TAC is allocated to the inshore sector, in the eastern Bering Sea, apportionment of the pollock TAC has been the source of considerable contention among the three primary processor user groups, i.e., inshore processors, motherships, and catcher/processors. In this connection, under provisions of AFA, these TAC allocations and the operational environment within which they will be exploited in the future, are undergoing dramatic changes, independent of actions contemplated under the RPA principles. Clearly, the way in which the RPA principles are applied and administered in the eastern Bering Sea could have very significant, and largely unanticipated consequences for the AFA-governed pollock trawl fisheries. Precisely what those consequences are cannot be predicted at this time, but over the interval between adoption of this Emergency Rule and a final FMP amendment on RPAs, they will almost certainly emerge.

The eastern Bering Sea contains a large share of critical Steller sea lion habitat. The CVOA largely overlaps with critical habitat. In practice, much of the eastern Bering Sea pollock target catch comes from the CVOA and, therefore, the social and economic implication for the fishery (and the communities which support and depend upon it) of the RPA dispersion principles are potentially considerable. For example, employing several simplifying assumptions, the RPA-induced changes in pollock quotas for the CVOA alone could reduce the first wholesale value of the pollock harvested in the eastern Bering Sea by about $62 million to $85 million, annually, if none of the reduced catch in the CVOA is made up in other areas.

This is clearly an upper limit estimate and is based on the assumption that little of the catch foregone in the CVOA could be made up elsewhere. The estimates are based on the 1999 TAC of 992,000 mt and the sectoral apportionment established by the AFA.[10] The lower and upper ends of the estimated range are based on the 1997 and 1998 fisheries, respectively.

3.5.3 Worst-case Aleutian Islands foregone catch

The RPA program adopted by the Council calls for the closure of the Aleutian Islands management area pollock target fishery in connection with principle one. Although the total amount of catch and numbers of operators potentially impacted by this action are relatively small, the foregone catch cannot be made up in areas which remain open. Consequently, the economic and socioeconomic costs could be significant.

In 1996, for example, one mothership, twenty-three catcher/processors, and four inshore processors recorded pollock landings from the Aleutian Islands management area, according to NMFS Blend data files. The mothership was greater than 155 ft length overall (LOA), as were 22 of the 23 catcher/processors. One catcher/processor was reportedly less than 124 ft (LOA). ADF&G Fish Ticket data indicate that 22 catcher vessels delivered pollock to inshore processors from the Aleutian Islands area in that year. Of these, four were less than 124 ft (LOA), 13 were in the 124-155 ft LOA class, and five were greater than 155 ft in length.

The same data sources reveal that in 1997, there were no motherships participating in this fishery, there were 19 catcher/processors (all of which were greater than 155 ft LOA), and four inshore processors received pollock from the Aleutian Islands management area, and were supported by 19 catcher vessels (four under 124 ft LOA, 11 in the 124 - 155 ft length category, and four greater than 155 ft LOA).

Virtually all of these operations are participants in the much larger eastern Bering Sea pollock target fishery. Nonetheless, if none of the foregone catch associated with the Aleutian Islands pollock trawl closure were made up in other areas, or in other fisheries, there would be a substantial direct economic impact. In 1999, the pollock TAC for this area was scheduled to be just under 24,000 tons, round weight. If one assumes, as an upper-bound estimate, that, (1) this entire amount will be foregone, (2) the product mix will be held constant, and (3) the catch can be valued at the weighted average output price for all pollock production in

---

[10] The estimates do not include the impacts on the CDQ pollock fishery.

that year, then the attributable first wholesale loss from RPA closure of the Aleutian Islands target pollock fishery would reach just over $54.6 million.

This is clearly a crude estimate. The estimate reflects the gross wholesale value of the potentially foregone output and, thus, does not capture changes in operating and production costs that would accompany adjustments to the RPA closure. These changes would increase or decrease the estimated impact.

Finally, the closures may result in economic redistributions among operations in ways that have not been anticipated in the calculation. For example, smaller vessels may be relatively less capable of adjusting to the new management regime(s) than are their larger counterparts. How such intra-sectoral and geographic redistributions may effect individual sectors or communities cannot readily be assessed at this time and remain largely empirical questions. The Council did attempt to address some of these concerns by recommending an exemption to the CH/CVOA closure for vessels under 99 ft LOA and by establishing a 136 mt trip limit in the W/C GOA.

In any case, the exvessel and first wholesale impact estimates, presented above, represent a first approximation upper-bound limit on the potential reduction in gross revenue attributable to the proposed RPA action to geographically disperse the pollock target fisheries. As suggested, it is likely that some of the catch taken from areas which would be closed to trawling under a combination of the RPA principles could be made up outside the closed areas (or during alternative open fishing periods).[11] However, because of the resultant variability in product mix and yield, the possible intra-sectoral redistribution among elements of the industry, and the potential for geographic shifts in harvesting and processing of the TAC, it is not possible to quantify these outcomes with any greater precision.

3.5.4 Pollock dependent communities

The RPA principles may or may not result in substantial reductions in total pollock catch from a given management area, as a result of spatial, temporal, or exclusionary dispersion of the target fishery. However, some change in pollock target harvest quantities and patterns seems probable and, in the limit, could be very significant. For example, as an upper-bound limit on catch impacts, it has been assumed elsewhere in this assessment that none of the pollock catch which historically occurred in areas which will be closed under one or more of the RPA principles, will be made up outside the closed areas (or during alternative time periods). Interpretation of the following community impacts can be framed within the same context. That is, the size and scope of likely impacts on the principal pollock-dependent communities, adjacent to the eastern Bering Sea, Aleutian Islands, and GOA management areas, will vary directly with the magnitude of the foregone pollock catch, attributable to RPA regulatory changes.

When NMFS Blend data are employed to rank Alaska fishing ports, from highest to lowest, on the basis of their 1997 groundfish landings and value, the first five ports account for in excess of 95% of total Alaska groundfish landings, the vast majority of which is comprised of pollock. These communities are, in order:

---

[11] This would not be so in the case of the Aleutian Islands closure, since the entire TAC (minus some small quantity to accommodate bycatch needs in other fisheries) will be eliminated.

Port	*Metric tons** *(Groundfish)*	*Value*	*No. of Processors (Groundfish)*
1. Dutch Harbor/Unalaska	224,000	$59,774,500	6
2. Akutan	<120,000	NA	1
3. Kodiak	84,000	$33,488,800	9
4. Sand Point	<45,000	NA	1
5. King Cove	<25,000	NA	1

(* - estimated total groundfish landings ; NA - data cannot be reported due to confidentiality constraints)

The communities of Dutch Harbor/Unalaska and Akutan are located on the Bering Sea side of the Alaska Peninsula/Aleutian Island chain, while Sand Point and King Cove are on the Gulf of Alaska side. Kodiak Island, where the port and City of Kodiak are located, is in the Gulf of Alaska. Nonetheless, a substantial portion of the groundfish processed in Sand Point and King Cove is harvested in the Bering Sea, as is a somewhat lesser share of that landed in Kodiak. Historically, relatively small amounts of groundfish harvested in the GOA have been delivered for processing in Dutch Harbor/Unalaska and Akutan.

As suggested, pollock is the primary groundfish species landed and/or processed in these five ports, with Pacific cod making up almost all of the rest. In Dutch and Akutan, pollock represented 83% and 76%, respectively, of the 1997 total groundfish landings in these ports (Pacific cod accounting for virtually all of the balance).[12] In the case of Sand Point, pollock was 69% of groundfish landings, Pacific cod 29%, with fractional percentages of other groundfish species accounting for the rest. King Cove presented the single exception among these port communities, with pollock catch-share at 31% and Pacific cod at 69% of the groundfish total. Kodiak presented the most diversified species complex, with pollock representing 43%, Pacific cod 36%, assorted flatfishes at 14%, and a mix of other groundfish species making up the balance of the total. These data clearly demonstrate, however, the substantial dependence these five communities have on the pollock resource.

The majority of the output from the processing operations in these landings ports is exported, principally to Asian markets, although some enters the domestic market for secondary processing and/or sale.

While significant reductions in catch deliveries of any groundfish species, in the eastern Bering Sea, GOA, or Aleutian Islands management areas, could have indirect economic consequences for any or all of these port communities, the impacts would be most severe and direct if pollock catches were substantially reduced. Furthermore, these impacts would not be uniform in distribution across the five key groundfish landings port communities, owing to geographic location, physical proximity to fishing grounds, plant capacity and capability differences, availability and variety of support facilities offered, and intermediate and final markets served.

---

[12] Source: State of Alaska Fish tickets

In addition, the inshore processors in each of these port communities compete directly with the mothership and catcher/processor fleets, which participate in many of these same fisheries.[13] Each sector has different capabilities and limitations. And, while each supplies some amount of product into common markets, each also has developed the potential to focus a portion of its operation on specific markets. These attributes suggest variability in response to changing management environments, such as would be associated with application of the RPA principles.

Based upon the relatively limited data which are available on individual communities and processing facilities, the following characterizations of the principal pollock-dependent Alaska landings ports can be offered.

3.5.4.1 Dutch Harbor/Unalaska

Dutch Harbor/Unalaska is located approximately 800 miles southwest of Anchorage and 1,700 miles northwest of Seattle. Unalaska is the 11th largest city in Alaska, with a reported year-round population of just over 4,000. The name Dutch Harbor is often applied to the portion of the City located on Amaknak Island, which is connected to Unalaska Island by a bridge. Dutch Harbor is fully contained within the boundaries of the City of Unalaska, which encompasses 115.8 square miles of land and 98.6 square miles of water (Alaska Department of Community and Regional Affairs, 1998).

The population of Unalaska is primarily non-Native, although the community is culturally diverse. According to the 1990 U.S. Census, there were 682 total housing units, and 107 of these were vacant. More than 2,500 jobs were estimated to be in the community. The official unemployment rate at that time was 1.0%, with 7.8% of the adult population not in the work force. The median household income was reportedly $56,215, and 15.3% of residents were living below the poverty level.

Dutch Harbor/Unalaska has been called "the most prosperous stretch of coastline in Alaska." With 27 miles of ports and harbors and several hundred local businesses, most of them servicing, supporting, or relying on the seafood industry, this city is the heart of the Bering Sea fisheries.

Dutch Harbor is not only the top ranked fishing port in terms of the tonnage of fish landed in Alaska, but has held that distinction for the Nation, as a whole, each year since 1989, and ranked at or near the top in terms of value of fish landed over the same period.

Virtually the entire local economic base in Dutch/Unalaska is fishery-related, including fishing, processing, and fishery support functions such as fuel, equipment supply, repairs and maintenance, transshipment, and cold storage. Indeed, Dutch Harbor/Unalaska is unique among Alaska coastal communities in the degree to which it provides basic support services for a wide range of Bering Sea fisheries (Impact Assessment Incorporated, 1998). It has been reported that over 90% of the population of this community considers itself directly dependent upon the fishing industry, in one form or another (NPFMC 1994).

Historically, Dutch Harbor was principally dependent upon non-groundfish (primarily king and Tanner crab) landings and processing for the bulk of its economic activity. These non-groundfish species continue to be important components of a diverse processing complex in Dutch Harbor. In 1997, for example, nearly

---

[13] Some of these port communities earn considerable revenues from supporting and servicing the catcher/processor, catcher vessel, and mothership fleets. In these instances, a reduction in pollock catch in any of the three sectors could compound the economic dislocation for the local community.

2 million pounds of salmon, more than 1.7 million pounds of herring, and 34 million pounds of crabs were reportedly processed in this port.

Nonetheless, since the mid-1980s, groundfish and particularly pollock has accounted for the vast majority of landings in Dutch Harbor/Unalaska. Again, utilizing 1997 catch data, over 93.5% of total pounds landed and processed in this port were groundfish, 83% of which were pollock.

The facilities and related infrastructure in Dutch Harbor/Unalaska support fishing operations in the eastern Bering Sea, Aleutian Islands and GOA management areas. Processors in this port receive and process fish caught in all three areas, and the wider community is linked to, and substantially dependent upon, serving both the inshore and at-sea sectors of the fishing industry.

In a profile of regional fishing communities, published by the NPFMC in 1994, the local economy of Unalaska was characterized in the following way:

> *"If it weren't for the seafood industry, Unalaska would not be what it is today. . . In 1991, local processors handled 600 million lbs. of seafood onshore, and 3 billion lbs. of seafood were processed offshore aboard floating processors that use Dutch Harbor as a land base. Seven shore-based and many floating processors operate within municipal boundaries."* (NPFMC, 1994. p. 26).

While these figures presumably include both groundfish and non-groundfish species, and current sources identify at least eight shore-based processing facilities, they are indicative of the scope of this community's involvement in, and dependence upon, seafood harvesting and processing.

Because of this high level of economic integration between Dutch Harbor/Unalaska and, in particular, the pollock fishing industry, any action which significantly reduced the total catch of pollock from the eastern Bering Sea or Aleutian Islands (and to a lesser extent the GOA) management areas would be expected to have a severely negative impact on the port and surrounding community.

While the port continues to be actively involved in support operations for crab, salmon, herring, and other groundfish fisheries, these resources do not hold the potential to offset economic impacts which would be associated with a significant reduction in pollock landings. Indeed, the newest and largest of the processing facilities in Dutch Harbor are dedicated to pollock surimi production, and could not readily shift production to an alternative species or product form, even if such an opportunity were to exist.

Detailed data on costs, net earnings, capital investment and debt service for the harvesting, processing, and fisheries support sectors in Dutch Harbor/Unalaska are not available. Therefore, it is not possible to quantify the probable net economic impacts on this community attributable to a significant reduction in pollock landings. It is apparent, however, that there are no alternative fisheries into which the port might diversify, in order to offset such a reduction in pollock target fishing activity. Neither are there prospects (at least in the foreseeable future) for non-fishery related economic activity in Dutch Harbor/Unalaska that could substantially mitigate impacts from a significant reduction in pollock fishing activity.

While Dutch Harbor has been characterized as one of the world's best natural harbors, it offers few alternative opportunities for economic activity beyond fisheries and fisheries support. Its remote location, limited and specialized infrastructure and transportation facilities, and high cost make attracting non-fishery related industrial and/or commercial investment doubtful, at least in the short-run.[14]

Without the present level of pollock fishing and processing activities, it is probable that many of the current private sector jobs in this community could be lost, or, at the very least, could revert to highly seasonal patterns, with the accompanying implications for community stability observed historically in this and other Alaska seafood processing locations dependent upon transient, seasonal work forces. It is likely, for example, that the number of permanent, year-round residents of Dutch Harbor/Unalaska would decline *significantly*. This, in turn, would alter the composition and character of the community and place new, and different, demands on local government.

The municipal government of the City of Unalaska is substantially dependent upon the tax revenues which are generated from pollock fishing, processing, and support activities. While a detailed treatment of municipal tax accounts is beyond the scope of this assessment, it is clear that, between the State of Alaska's Fisheries Business Tax and Fishery Resource Landings Tax revenues (both of which are shared on a 50/50 basis with the community of origin), local raw fish sales tax, real property tax (on fishery-related property), and permits and fees revenues associated with fishing enterprises, the City of Unalaska derives a substantial portion of its operating, maintenance, and capital improvement budget from fishing, and especially pollock fishing, related business activities. Should the pollock harvest in the eastern Bering Sea or Aleutian Islands management areas be substantially reduced, the municipality could experience a very significant reduction in its tax base and revenues. Potentially, the magnitude of these revenue reductions could be such that they could not be readily compensated for by the municipal government.

The local private business infrastructure which has developed to support the needs and demands of the fishery-based population of Dutch Harbor/Unalaska would very clearly suffer severe economic dislocation, should the number of employees in the local plants and fishing fleets decline in response to pollock catch reductions. While insufficient cost and investment data exist from which to estimate the magnitude of probable net losses to these private sector businesses, it seems certain that a substantial number would fail. With no apparent economic development alternative available to replace current levels of pollock harvesting and processing in Dutch Harbor/Unalaska (at least in the short run), there would be virtually no market value associated with these stranded capital assets.

3.5.4.2 Akutan

The community of Akutan is located on an island of the same name in the eastern Aleutians, one of the Krenitzin Islands of the Fox Island group. The community is approximately 35 miles east of Unalaska and 766 air miles southwest of Anchorage. Akutan is surrounded by steep, rugged mountains reaching over 2,000 feet in height. The village sits on a narrow bench of flat, treeless terrain. The small harbor is ice-free year round, but there are frequent storms in winter and fog in summer. The community is reported to have a population of 414 persons, although the population can swell to well over 1,000 during peak fish processing months.

During the 1990 U.S. Census, there were 34 total housing units, and three of these were vacant. There were 527 jobs estimated to be in the community. The official unemployment rate at that time was 0.4%, with 7.4%

---

[14] Sea floor minerals exploration, including oil drilling, in the region have been discussed. No such development seems likely in the short run, however. Unalaska, also, reportedly expected nearly 6,000 cruise ship visitors in 1996.

of all adults not in the work force. The median household income was $27,813, and 16.6% of the residents were living below the poverty level. There is one school in the community, serving 24 students.

Water is supplied from local streams, treated, and piped into homes. The seafood processing plant adjacent to the community operates its own water treatment facility.

Akutan ranks as the second most significant landings port for groundfish, most of which is pollock, on the basis of tons delivered and has been characterized as a *unique* community in terms of its relationship to the BSAI fisheries. According to a recent social impact assessment, prepared for the Council, while Akutan is the site of one of the largest of the inshore pollock processing plants in the region, the community is geographically and socially separate from the plant facility.

As a result, Akutan has a very different relationship to the region's pollock fisheries than does, for example, Dutch Harbor/Unalaska or Kodiak. While the community of Akutan derives economic benefits from its proximity to the large Trident Seafoods shore plant (and a smaller permanently moored processing vessel, operated by Deep Sea Fisheries, which handles only crab), the entities have not been integrated in the way other landings ports and communities on the list have. And, while the community derives some economic benefits, including a 1% raw fish tax from the nearby plant, unless a change in pollock landings were of sufficient magnitude to severely destabilize the region's pollock fisheries, which the Trident Seafood plant depends upon, there are not likely to be significant impacts on the village attributable to moderate changes in plant operating patterns.

Although this conclusion pertains to the community of Akutan, implications for the landings port of Akutan are quite different. Because the Trident plant is the principal facility [15] in the Akutan port, a substantial change in pollock landings in this region, in response to RPA induced management changes, could have profoundly negative implications. The port of Akutan does not have a boat harbor, nor is there an airport in the community. Beyond the limited services provided by the plant itself, there does not appear to be an opportunity in Akutan to provide a support base for other major commercial fisheries. Indeed, alternative economic opportunities of any kind are extremely limited.

There does not appear to be an obvious alternative fishery resources which could be developed to offset a significant reduction in pollock landings in Akutan. For example, fisheries for crabs, halibut, salmon, and herring, while important sources of income to the region, are fully developed. Therefore, should pollock landings to this port be significantly reduced in response to RPA temporal or geographic dispersion principles, most of the jobs held by employees of the plant would likely disappear, or at a minimum, become seasonal. Consequently, some people would likely leave the area.

No data on cost, net revenues, capital investment and debt structure are available with respect to Trident Seafood's Akutan plant complex. It is not possible, therefore, to quantify probable attributable net impacts to plant owners/operators of a potential reduction in pollock landings. While some adjustment to alternative groundfish species might be possible, in response to a sharp decline in pollock deliveries, insufficient data exist to support an analysis of this potential scenario. One may conclude, however, that this is an economically inferior solution for the plant, otherwise one would observe it engaged voluntarily in this behavior at present.

---

[15] Historically, a number of smaller, mobile processing vessels have operated out of the port of Akutan, seasonally.

While the distribution of impacts across ports would not be expected to be uniform, should pollock catches be reduced, it is likely that there could be substantial stranded capital costs and job losses in the port of Akutan. The size and rate of such losses is largely an empirical question.

3.5.4.3 Kodiak

The fishing port of Kodiak is located near the eastern tip of Kodiak Island, southeast of the Alaska Peninsula, in the Gulf of Alaska. The City of Kodiak is the sixth largest city in Alaska, with a population of 6,869 (Alaska Department of Community and Regional Affairs, 1998). The City of Kodiak is 252 air miles south of Anchorage. The port and community are highly integrated, both geographically and structurally. The port and community are the *de facto* center of fishing activity for the Gulf of Alaska.

Kodiak is primarily non-Native, and the majority of the Native population are Sugpiaq Eskimos and Aleuts. Filipinos are a large subculture in Kodiak due to their work in the canneries. During the 1990 U.S. Census, there were 2,177 total housing units, and 126 of these were vacant. An estimated 3,644 jobs were in the community. The official unemployment rate at that time was 4.4%, with 23% of the adult population not in the work force. The median household income was $46,050, and 6.2% of residents were living below the poverty level.

Kodiak supports at least nine processing operations which receive pollock harvested from the GOA and, to a lesser extent, the eastern Bering Sea and Aleutian Islands management areas, and four more which process exclusively non-groundfish species. The port also supports several hundred commercial fishing vessels, ranging in size from small skiffs to large catcher/processors and everything in between.

According to data supplied by the City, "The Port of Kodiak is 'home port' to 770 commercial fishing vessels. Not only is Kodiak the state's largest fishing port, it is also home to some of Alaska's largest trawl, longline, and crab vessels."

Unlike Akutan, or even Dutch Harbor/Unalaska, Kodiak has a more generally diversified seafood processing sector. The port historically was very active in the crab fisheries and, although these fisheries have declined from their peak in the late-1970s and early-1980s, Kodiak continues to support shellfish fisheries, as well as significant harvesting and processing operations for Pacific halibut, herring, sablefish, and the five Pacific salmon species.

Kodiak processors are highly dependent on pollock landings, with this species accounting for 43% of total groundfish deliveries, by weight, in 1997. Unlike the other primary landings ports discussed above, while pollock landings are an extremely valuable and important component of the suite of species processed, Kodiak tends to be much more of a multi-species fishing community. The port participates in a broader range of groundfish fisheries than any of the other ports in the state. Most of this activity centers on the numerous flatfish species which are present in the GOA, but also includes relatively significant rockfish and sablefish fisheries. In addition, salmon, halibut, crabs, and herring fisheries are very important to the local community. Many of these fisheries are highly seasonal, and Kodiak processors have come to rely upon pollock landings to bridge the inevitable operating gaps.[16] That is, Kodiak processors reportedly often depend on pollock deliveries as a means to maintain continuous operation of their plants and full employment of their processing crews.

---

[16] Per. Comm., Chris Blackburn, Kodiak, Alaska, December 1998.

Kodiak often ranks near the top of the list of U.S. fishing ports, on the basis of landed value, and is frequently regarded as being involved in a wider variety of fisheries than any other community on the North Pacific coast.

In 1997, for example, the port recorded salmon landings of just under 44 million pounds, with an estimated exvessel value of over $12 million. Approximately 4.3 million pounds of Pacific herring were landed in Kodiak with an exvessel value of more than $713,000. Crab landings exceeded 1.1 million pounds and were valued exvessel at more than $2.7 million.

In addition to seafood harvesting and processing, the Kodiak economy includes sectors such as transportation (being regarded as the transportation hub for southwest Alaska), federal/state/local government, tourism, and timber (the forest products industry, based upon Sitka spruce, is an important and growing segment of the Kodiak economy).

The community is, also, home to the largest Coast Guard base in the U.S., located a few miles outside of the city center proper, which contributes significantly to the local economic base. The University of Alaska, in conjunction with the National Marine Fisheries Service, operates a state-of-the-art fishery utilization laboratory and fishery industrial technology center in Kodiak, as well.

While Kodiak appears to have a much more mature and diversified economy than any other of the five primary groundfish landings ports in Alaska, it is likely that a substantial reduction in pollock landings in the GOA (and to a lesser degree, Aleutian Islands and/or eastern Bering Sea management areas) could impose significant adverse economic impacts on the community of Kodiak.

The absence of detailed cost, net revenue, capital investment and debt structure data for the Kodiak groundfish fishing and processing sectors precludes a quantitative analysis of the probable net economic impacts of such a change. Nonetheless, one may draw insights from history. In the early 1980s king crab landings declined precipitously and Kodiak suffered a severe community-wide economic decline. It was largely the development of the pollock and other groundfish fisheries which reinvigorated the local economy.

No alternative fishery resource appears available to Kodiak fishermen and processors that could ameliorate significant reductions in pollock landing that might be associated with the application of one or more of the RPA dispersion principles. Neither do there appear to be non-fishery based opportunities, at least in the short run, which could be developed to reduce the adverse economic impacts of such a change in pollock harvesting and processing.

3.5.3.4 Sand Point and King Cove

These are two independent and geographically separate landings ports (lying approximately 160 miles apart), but because each has only a single processor and each community is small and remote, they are described jointly in this section.

State of Alaska CIS data place Sand Point's 1998 population at 808, while King Cove's population is listed as 897. Sand Point is located on Humboldt Harbor, Popof Island, 570 air miles from Anchorage. Sand Point is described by the Alaska Department of Community and Regional Affairs as "a mixed Native and non-Native community" with a large transient population of fish processing workers. During the April 1990 U.S. Census, there were 272 total housing units, and 30 of these were vacant. A total of 438 jobs were estimated to be in the community. The official unemployment rate at that time was 2.9%, with 32.1% of all adults not in the work force. The median household income was $42,083, and 12.5% of the residents were living below the poverty level.

King Cove is located on the North Pacific side of the Alaska Peninsula, 625 miles southwest of Anchorage. The community is characterized as a mixed non-Native and Aleut village. In the 1990 U.S. Census, there were 195 total housing units, with 51 of these vacant. The community had an estimated 276 jobs, with an official unemployment rate of 1.8% and 24.0% of all adults not in the work force. The median household income was $53,631, and 10% of the residents were living below the poverty level.

Sand Point and King Cove, like Akutan, are part of the Aleutians East Borough. Both Sand Point and King Cove have had extensive historical linkages to commercial fishing and fish processing, and currently support resident commercial fleets delivering catch to local plants. These local catches are substantially supplemented by deliveries from large, highly mobile vessels, based outside of the two small Gulf of Alaska communities.

King Cove boasts a deep water harbor which provides moorage for approximately 90 vessels of various sizes, in an ice-free port. Sand Point, with a 25 acre/144 slip boat harbor and marine travel-lift, is home port to what some have called *"... the largest fishing fleet in the Aleutians"* (NPFMC, 1994).

For decades, each of these the two communities has concentrated principally on salmon fisheries. For example, in 1997, both Sand Point and King Cove recorded salmon landings of several million pounds.[17] In addition, King Cove had significant landings of Pacific herring and crabs. Recently, each community has actively sought to diversify its fishing and processing capabilities. Groundfish, especially pollock, is key to these diversification plans.

By any measure, these two communities are fundamentally dependent upon fishing and fish processing. In recent years, groundfish (primarily pollock and Pacific cod) have supplanted salmon, herring, and crabs as the primary target species, becoming the basis for both communities' economic activity and stability.

Few employment alternatives to commercial fishing and fish processing exist, within the cash-economy, in these communities. However, subsistence harvesting is an important source of food, as well as a social activity, for local residents in both Sand Point and King Cove.

Any action which significantly diminishes the harvest of GOA and BSAI pollock resources would be expected to adversely impact these two communities. King Cove is somewhat unique among the five key groundfish ports insofar as it is relatively more dependent upon Pacific cod than pollock, among the groundfish species landed (69% and 31%, respectively). Sand Point follows the more typical pattern with pollock and Pacific cod representing 69% and 29% of its groundfish landings, respectively, in 1997.

No data on cost, net revenues, capital investment and debt structure are available with respect to the Sand Point or King Cove plant complexes. It is not possible, therefore, to quantify probable attributable net impacts to plant owners/operators of the potential reductions in pollock catches and deliveries to these landings ports.

As suggested earlier, these are very small, isolated villages with exceedingly limited infrastructure. A significant reduction in pollock deliveries, especially those from eastern Bering Sea fisheries, would likely result in substantial stranded capital costs and job losses. Consequently, the economic stability of these small communities could be severely threatened. Furthermore, there does not appear to be any viable alternative

---

[17] State of Alaska data confidentiality requirements preclude reporting actual quantities and value when fewer than four independent operations are included in a category. Sand Point and King Cove each have one processor reporting catch and production data.

economic activity which could alleviate the probable adverse impacts on these small communities from a significant decline in their primary groundfish species deliveries.

3.5.5 Alaska's economic dependence upon seafood processing employment

While the foregoing discussion focused on the role of fishing and processing, particularly of pollock, by individual ports in Alaska, it is possible to see the contribution of this industry within a broader context. Drawing upon data and analysis developed by the State of Alaska Department of Labor, cited in a March 1996 volume of *Alaska Economic Trends*, the importance of the seafood processing to the Statewide economy becomes apparent. Excerpting from an article by Neal Fried, entitled *Alaska Seafood Processing - A Growing Job Source?*, the following insights are offered:

> *Seafood processing is the leading manufacturer in the state. In 1995, Alaska's 197 seafood processing plants accounted for about 64 percent of all manufacturing employment. No other state in the U.S. approaches this level of industrial concentration. Seafood processing provided an average of 11,000 jobs with a total payroll of more than $240 million. In July [*of that year*] the number of processing jobs climbed to 19,300. Over 25,000 people held fish processing jobs at some time during the year. These numbers exclude most of the factory trawler fleet and other off-shore processing vessels because much of their employment occurs outside the state's jurisdiction. Including factory trawlers, employment could add another 5,000 workers to the fish processing work force.*

The article continues:

> *After the collapse of the king crab fishery in the early 1980s, processing employment slid for three years and then changed little for the next five. But, in 1988, the Americanization of the groundfish resource along the state's coastal waters began to turbo-charge Alaska's fish processing industry. The next year, the volume of groundfish processed surpassed salmon production for the first time in history. During the past decade, employment in the processing industry grew much more rapidly than total wages and salary employment. From 1991 to 1995, processing employment, also boosted by strong salmon harvests, surpassed 10,000. Employment peaked in 1992 at 11,200.*
>
> *These figures tell only part of the story because the non-Alaskan factory trawler fleet harvests more than half of the groundfish. When this fleet's activity is included, the growth becomes even more impressive. In 1986, only 12 trawlers were fishing in Alaska's waters* [actually within the U.S. EEZ off Alaska]*, but by 1992 the trawler fleet had grown to 75. Including processing on the factory trawlers, Alaska's fish processing employment more than doubled in less than five years - a feat few other large industries have ever managed.*

The author presents region-specific processing employment numbers for 1995. These annual employment estimates pertaining to eastern Bering Sea, Aleutian Islands, and GOA pollock fisheries include: Aleutian East Borough - 2,175; Kodiak Island Borough - 2,034; and Aleutian West - 1,142.

Given the small local populations discussed in the port descriptions above, seafood processing employment clearly represents the foundation upon which these local economies are based. And, while these employment numbers include both groundfish and non-groundfish processing activity, for the principal processing ports, the vast majority of fish processed are pollock.

Any action which diminished the current level of fish processing activity, especially in the pollock-dominated regions of the State, could have significant, widespread, and sustained negative implications for the economic vitality and growth potential of the State of Alaska, as a whole. This is so because, as the Department of Labor analysis points out, the state is uniquely dependent upon fishing and fish processing. Furthermore, because pollock accounts for a substantial part of that industry's activity, significant reductions in pollock landings in the eastern Bering Sea, Aleutian Islands and/or GOA management areas could have negative implications reaching well beyond the ports and adjacent communities of Alaska's coastline. Impacts could extend, indirectly but quite literally, to every community and every citizen of the state, through reduced revenues supporting government programs and services including public education, community development, public health and safety, and transportation.

The extent and scope of any social and economic impacts deriving from application of one or more of the RPA principles is largely an empirical question. Nonetheless, society should be conscious of the trade-offs implicit in the ESA actions which are being contemplated under the RPA principles.

4.0 SUMMARY AND CONCLUSIONS

The purpose of this emergency rule is to implement reasonable and prudent alternatives to avoid the likelihood of the pollock fisheries off Alaska jeopardizing the continued existence of the western population of Steller sea lions, or adversely modifying their critical habitat. In 1990, the Steller sea lion (*Eumetopias jubatus*) was designated as a threatened species under the Endangered Species Act of 1973 (ESA). The designation followed severe declines throughout much of the Gulf of Alaska and Aleutian Islands region. In 1993, critical habitat for the species was defined to include (among other areas), the marine areas within 20 nm of major rookeries and haulouts of the species west of 144°W longitude. In 1997, two separate populations were recognized, and the western population (west of 144°W longitude) was reclassified as endangered. Counts of adults and juveniles in the western population of Steller sea lions declined by 72% between the late 1970s and 1990. The decline has continued in the 1990s, with counts dropping 27% from 1990 to 1996. The absolute magnitude of the decline has been smaller in recent years because the population has been severely reduced. The rate of decline, however, remains a serious problem.

Multiple factors have contributed to the decline, but considerable evidence indicates that lack of available prey is a major problem. Foraging studies confirm that Steller sea lions depend on pollock as major prey, and sea lions may be particularly sensitive to the availability of prey during the winter. The significance of pollock to sea lions may have increased since the 1970s due to shifts in community composition related to oceanographic changes. Pollock are also the target of extensive fisheries that have become concentrated in time and space. This concentration occurs in Steller sea lion critical habitat, and may reduce prey availability at critical times in the life history of sea lions. Pollock trawl fisheries, then, may compete with sea lions, and either contribute to their decline or impede their recovery.

On December 3, 1998 NMFS issued a Biological Opinion on the pollock fisheries of the BSAI and GOA and, and the Atka mackerel fishery of the Aleutian Islands Subarea. The Biological Opinion concluded that the BSAI and GOA pollock trawl fisheries, as proposed, are likely to (1) jeopardize the continued existence of the western population of Steller sea lions, and (2) adversely modify its critical habitat. The clause "jeopardize the continued existence of" means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (CFR §402.02). The clause "adversely modify its critical habitat" means "a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species. Such alterations include, but are not limited to, alterations adversely modifying any of those physical or biological features that were the basis for determining the habitat to be critical" (CFR §402.02).

The Biological Opinion concluded that to avoid the likelihood of jeopardizing the continued existence of the western population of Steller sea lions, or adversely modifying its critical habitat, reasonable and prudent alternatives to the proposed pollock trawl fisheries in the BSAI and GOA must accomplish temporal and spatial dispersion of the BSAI and GOA pollock fisheries and contain pollock trawl exclusion zones around major rookeries and haulouts.

At its December 1998 meeting, the Council adopted this emergency rule to implement the reasonable and prudent alternatives prior to the start of the pollock fisheries on January 20, 1999. The emergency rule recommended by the Council would implement three types of management measures for the BSAI and GOA pollock fisheries: (1) pollock trawl exclusion zones, (2) temporal dispersion of the pollock fishery, and (3) spatial dispersion of the pollock fishery. This analysis concludes that the emergency rule is not likely to significantly affect the quality of the human environment. Therefore an environmental impact statement was not prepared.

5.0 REFERENCES

Alaska Department of Fish and Game (ADF&G). 1995. EA/RIR/IRFA for Proposed Alternatives toLimit Chinook Salmon Bycatch in the Bering Sea Trawl Fisheries: Amendment 21b to the FMP for the Groundfish Fishery of the BSAI. ADF&G, Juneau, AK.

Albers, W. D. and P. J. Anderson. 1985. "Diet of Pacific cod, *Gadus macrocephalus*, and predation on the northern pink shrimp, *Pandalus borealis*, in Pavlov Bay, Alaska." *Fishery Bulletin* 83(4): 601-610.

Alton, M. S. and B. A. Megrey. 1986. Condition of the walleye pollock resource of the Gulf of Alaska as estimated in 1985. Condition of groundfish resources of the Gulf of Alaska region as assessed in 1985. R. L. Major, U.S. Department of Commerce, NOAA.

Bailey, K. 1989. "Interaction between the vertical distribution of juvenile walleye pollock *Theragra chalcogramma* in the eastern Bering Sea, and cannibalism." *Marine Ecol. Prog.* Ser. 53: 205-213.

Barrett-Lennard, L.G., K. Heise, E. Saulitis, G. Ellis and C. Matkin. *In prep.* The impact of killer whale predation on Steller sea lion populations in British Columbia and Alaska. Report for the North Pacific Universities Marine Mammal Research Consortium, Vancouver, B.C.

Best, E. A. and F. St-Pierre. 1986. Pacific halibut as predator and prey, International Pacific Halibut Commission, P.O. Box 95009, Seattle, WA 98145.

Bickham, J.W. et al. 1996. High variability for control-region sequences in a marine mammal: Implications for conservation and biogeography of Steller sea lions (*Eumetopias jubatus*). *J. Mammal.* 77(1):95-108.

Braham, H.W., et al. 1980. Northern sea lion decline in the eastern Aleutian Islands. *J. Wildl. Mgmt.* 44:25-33.

Brodeur, R. D. and M. T. Wilson. 1996. "A review of the distribution, ecology, and population dynamics of age-0 walleye pollock in the Gulf of Alaska." *Fisheries Oceanography* 5(Supplement 1): 148-166.

Calkins, D. G. 1987. Marine Mammals. in *The Gulf of Alaska: Physical Environment and Biological Resources*. D. W. Hood and S. T. Zimmerman. Washington, DC, Alaska Office, Ocean Assessments Division, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, and the Alaska OCS Region Office, Minerals Management Service, U.S. Department of the Interior: 527-560.

Calkins, D. G., and K.W. Pitcher. 1982. Population assessment, ecology and trophic relationships of Steller sea lions in the Gulf of Alaska. U.S. Dep. of Commer., NOAA. OCSEAP Final Report 19 (1983), pp. 445-546.
Bartholomew, G.A. 1970. A model for the evolution of pinniped polygyny. *Evolution* 24:546-559.

Calkins, D.C., E.F. Becker, and K.W. Pitcher. 1998. Reduced body size of female Steller sea lions from a declining population in the Gulf of Alaska. *Marine Mammal Science*, 14:232-244.

Canino, M. F. 1994. "Effects of temperature and food availability on growth and RNA/DNA ratios of walleye pollock, *Theragra chalcogramma* (Pallas), eggs and larvae." *J. Exp. Mar. Biol. Ecol.* 175: 1-16.

Carlson, H. R. 1995. "Consistent yearly appearance of age-0 walleye pollock, *Theragra chalcogramma*, at a coastal site in southeastern Alaska, 1973-1994." *Fishery Bulletin* 93: 386-390.

Chumbley, K. J. Sease, M. Strick, and R. Towell. 1997. Field studies of Steller sea lions (*Eumetopias jubatus*) at Marmot Island, Alaska 1979 through 1994. NOAA, National Marine Fisheries Service, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115-0070. NOAA Tech. Mem. NMFS-AFSC-77.

Clausen, D. M. 1983. "Food of walleye pollock, *Theragra chalcogramma*, in an embayment of southeastern Alaska." *Fishery Bulletin* 81(3): 637-642.

DeGange, A. R. and G. A. Sanger. 1986. Marine Birds. in *The Gulf of Alaska: Physical environment and biological resources*. D. W. Hood and S. T. Zimmerman, U.S. National Oceanic and Atmospheric Administration, Ocean Assessments Division, Anchorage, Alaska: 479-524.

Dwyer, D. A., K. M. Bailey, et al. 1987. "Feeding habits and daily ration of walleye pollock (*Theragra chalcogramma*) in the eastern Bering Sea, with special reference to cannibalism." *Canadian Journal of Fisheries Aquatic Science* 44: 1972-1984.

Dwyer, D. A. 1984. Feeding habits and daily ration of walleye pollock (*Theragra chalcogramma*) in the eastern Bering Sea. Seattle, WA, University of Washington: 102.

Fiscus, C.H., and G.A. Baines. 1966. Food and feeding behavior of Steller and California sea lions. *J. of Mammal.* 47:195-200.

Gentry, R.L. 1970. Social behavior of the Steller sea lion. Unpubl. Ph.D. thesis, Univ. California, Santa Cruz. 113 pp.

Gilpin, M.E., and M.E. Soulé. 1986. Minimum viable populations: processes of species extinction. Pp. 19-34 in *Conservation biology: the science of scarcity and diversity*, M.E. Soulé (ed.), Sinauer Associates, Inc., Sunderland, Massachusetts, 584 pp.

Goodwin E.A., and D.G. Calkins. 1985. Preliminary results of ongoing investigations of San Miguel Sea lion Virus, leptospirosis, and chlamydiosis in Alaska Steller sea lions and their relationship to declining pup counts. Sixth Biennial Conference on the biology of Marine Mammals, 22-26 November, Vancouver, B.C. (Abstract).

Grover, J. J. 1990a. "Feeding ecology of late-larval and early juvenile walleye pollock (*Theragra chalcogramma*) from the Gulf of Alaska in 1987." *Fishery Bulletin* 88(3): 463-470.

Guttormsen, M., R. Narita, and J. Berger. 1990. Summary of U.S. observer sampling of foreign and joint venture fisheries in the northeast Pacific Ocean and eastern Bering Sea, 1989. NOAA Tech. Mem. NMFS F/NWC-189.

Hatch, S. A. and G. A. Sanger. 1992. "Puffins as samplers of juvenile pollock and other forage fish in the Gulf of Alaska." *Marine Ecology Progress Series* 80: 1-14.

Hill, S., and D. DeMaster. 1998. Steller sea lion (*Eumetopias jubatus*): Western U.S. stock. In prep.

Hollowed, et al. 1997. Walleye pollock, North Pacific Fishery Management Council, 605 W. 4th Avenue, Suite 306, Anchorage, AK 99501: 362-396.

Honkalehto, T. 1989. A length-cohort analysis of walleye pollock based on empiracal estimation of cannibalism and predation by marine mammals. Proceedings Intl. Symp. Biol. Management Walleye Pollock, November 1988, University of Alaska, Fairbanks, AK 99775: 651-665.

Hoover, A.A. 1988. Steller Sea Lion. Pp. 159-193 in Selected Marine Mammals of Alaska: Species Accounts with Research and Management Recommendations, J.W. Lentfer (ed.). Marine Mammal Commission, Washington, D.C.

Hunt, et al. 1981. Feeding ecology of seabirds of the eastern Bering Sea. The Eastern Bering Sea Shelf: Oceanography and Resources. D. W. Hood and J. A. Calder. Seattle, WA, University of Washington Press. 2: 629-647.

Hunt, G. L., Jr., M. B. Decker, et al. 1995. Fluctuations in the Bering Sea ecosystem as reflected in the reproductive ecology and diets of kittiwakes on the Pribilof Islands, 1975 to 1990. *Aquatic Predators and their Prey*. S. P. R. Greenstreet and M. L. Tasker. Oxford, Blackwell Scientific Publications.

Jewett, S. C. 1978. "Summer food of the Pacific cod, *Gadus macrocephalus*, near Kodiak Island, Alaska." *Fishery Bulletin* 76(3): 700-706.

Kajimura, H., and T.R. Loughlin. 1988. Marine mammals in the oceanic food web of the eastern subarctic Pacific. *Bull. Ocean Res. Inst.* 26:187-223.

Kajimura, H. and C. W. Fowler. 1984. Apex predators in the walleye pollock ecosystem in the eastern Bering Sea and Aleutian Islands regions. Proceedings of the workshop on walleye pollock and its ecosystem in the eastern Berinf Sea. D. H. Ito, U.S. Department of Commerce, NOAA: 193-234.

Kendall, A. W., J. D. Schumacher, et al. 1996. "Walleye pollock recruitment in Shelikof Strait: Applied fisheries oceanography." *Fisheries Oceanography* 5(Supplement 1): 4-18.

Kendall, A. W., Jr., M. E. Clarke, et al. 1987. "Distribution, feeding and growth of larval walleye pollock, *Theragra chalcogramma*, from Shelikof Strait, Gulf of Alaska." *Fishery Bulletin* 85(3): 499-521.

Kenyon, K.W., and D.W. Rice. 1961. Abundance and distribution of the Steller sea lion. *J. Mammal.* 42:223-234.

Knechtel, C. D. and L. J. Bledsoe. 1983. A numerical simulation model of the population dynamics of walleye pollock, *Theragra chalcogramma* (Pallas 1811), in a simplified ecosystem: Part II, Model calibration, validation, and exercise, U.S. Department of Commerce, NOAA: 264.

Knechtel, C. D. and L. J. Bledsoe. 1981. A numerical simulation model of the population dynamics of walleye pollock, *Theragra chalcogramma* (Pallas 1811), in a simplified ecosystem. Part I, Model Description, U.S. Department of Commerce, NOAA: 212.

Krebs, C.J. 1985. *Ecology: The experimental analysis of distribution and abundance.* Harper & Row, Publishers, New York, 800 pp.

Krieger, K. J. 1985. Food habits and distribution of first-year walleye pollock, *Theragra chalcogramma* (Pallas), in Auke Bay, Southeastern Alaska, University of Alaska Southeast, 11120 Glacier Highway, Juneau, AK 99801: 57.

Laevastu, T. and H. A. Larkins. 1981. *Marine fisheries ecosystem, its quantitative evaluation and management*. Farnham, Surrey, England, Fishing News Books Ltd.

Lang, G. M. and P. A. Livingston. 1996. Food habits of key groundfish species in the eastern Bering Sea slope region, U.S. Department of Commerce, NOAA: 110.

Livingston, P. A. 1985. Summer food habits of young-of-the-year walleye pollock, *Theragra chalcogramma*, in the Kodiak area of the Gulf of Alaska during 1985, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115.

Livingston, P. A., et al. 1993. Groundfish food habits and predation on commercially important prey species in the eastern Bering Sea from 1987 to 1989, U.S. Department of Commerce, NOAA: 192.

Livingston, P. A. 1993. "Importance of predation by groundfish, marine mammals and birds on walleye pollock and Pacific herring in the eastern Bering Sea." *Marine Ecology Prog*. Ser. 102: 205-215.

Livingston, P. A. 1994. Overview of multispecies interactions involving walleye pollock in the eastern Bering Sea and Gulf of Alaska, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115.

Livingston, P. A. and Y. DeReynier. 1996. Groundfish food habits and predation on commercially important prey species in the eastern Bering Sea from 1990 to 1992, Alaska Fisheries Science Center, NMFS, NOAA, 7600 Sand Point Way NE, Seattle, WA 98115: 214.

Livingston, P. A. 1989. Interannual trends in walleye pollock, *Theragra chalcogramma*, cannibalism in the eastern Bering Sea. Proceedings of the International Symposium Biol. Management Walleye Pollock, November 1988.

Livingston, P. A. 1991. Total groundfish consumption of commercially important prey. Groundfish food habits and predation on commercially important prey species in the eastern Bering Sea from 1984 to 1986. P. A. Livingston, U.S. Department of Commerce, NOAA: 240.

Livingston, et al. 1986. Trophic interactions of key fish species in the eastern Bering Sea. Symposium on biological interactions in the North Pacific region and on factors affecting recruitment, distribution, and abundance of non-anadromous species, International North Pacific Fisheries Commission.

Livingston, P. A. and G. M. Lang. 1997. Interdecadal comparisons of walleye pollock cannibalism in the eastern Bering Sea. Ecology of Juvenile Walleye Pollock. R. D. Brodeur, P. A. Livingston, A. Hallowed and T. Loughlin, U.S. Department of Commerce, NOAA: 115-124.

Loughlin, T.R., M.A. Perez, R.L. Merrick. 1987. *Eumetopias jubatus*. *Mammalian Species* 283:1-7.

Loughlin, T. R. 1997. Using the phylogeographic method to identify Steller sea lion stocks. Pages 159-171, *in* A. Dizon, S. J. Chivers, and W. F. Perrin (eds.), Molecular genetics of marine mammals. Special Publication #3 of the Society for Marine Mammalogy.

Lowry, L.F., K.J. Frost, D.G. Calkins, G.L. Swartzman, and S. Hills. 1982. Feeding habits, food requirements, and status of Bering Sea marine mammals. Final report to the North Pacific Fishery Management Council, P.O. Box 3136 DT, Anchorage, Alaska 99510. Contract No. 81-4.

Lowry, L. F., V. N. Burkanov, et al. 1997. Importance of walleye pollock in the diet of phocid seals in the Bering Sea and northwestern Pacific Ocean, U.S. Department of Commerce, NOAA.

Mate, B.R. 1973. Population kinetics and related ecology of the northern sea lion, *Eumetopias jubatus*, and the California sea lion, *Zalophus californianus*, along the Oregon Coast. Ph.D. dissertation, University of Oregon, 94 pp.

Megrey, B. A. 1989. Exploitation of walleye pollock resources in the Gulf of Alaska, 1965-1988: Portrait of a fishery in transition. Proceedings of the International Symposium on the Biology and Management of walleye pollock, Anchorage, Alaska . Alaska Sea Grant Report 89-1, University of Alaska, Fairbanks, AK 99775.

Merati, N. and R. D. Brodeur. 1997. Feeding habits and daily ration of juvenile walleye pollock in the western Gulf of Alaska. Ecology of Juvenile Walleye Pollock *Theragra chalcogramma*. R. Brodeur, P. Livingston, T. Loughlin and A. Hollowed, U.S. Department of Commerce, NOAA: 65-80.

Merrick, R. L., and T. R. Loughlin. 1997. Foraging behavior of adult female and young-of-the-year Steller sea lions (*Eumetopias jubatus*) in Alaskan waters. *Canadian Journal of Zoology* 75 (5):776-786.

Merrick, R.L., M.K. Chumbley, and G.V. Byrd. 1997. Diet diversity of Steller sea lions (*Eumetopias jubatus*) and their population decline in Alaska: a potential relationship. *Can. J. Fish. Aquat. Sci.* 54:1342-1348

Merrick, R. L. and D. G. Calkins. 1996. Importance of juvenile walleye pollock, *Theragra chalcogramma*, in the diet of Gulf of Alaska Steller sea lions, *Eumetopia jubatus*. Ecology of Juvenile Walleye Pollock *Theragra chalcogramma*. R. Brodeur, P. Livingston, R. Loughlin and A. Hollowed, U.S. Department of Commerce, NOAA: 153-166.

Merrick, R.L., T.R. Loughlin, G.A. Antonelis, and R. Hill. 1994. Use of satellite-linked telemetry to study Steller sea lion and northern fur seal foraging. Polar Research 13:105-114.

Merrick, R., P. Gearin, S. Osmek, and D. Withrow. 1988. Field Studies of Northern sea lions at Ugamak Island, Alaska during the 1985 and 1986 breeding seasons. U.S. Dep. of Commer., NOAA Tech. Memo. NMFS F/NWC-143.

Merrick, R.L., R. Brown, D.G. Calkins, and T.R. Loughlin. 1995. A comparison of Steller sea lion, *Eumetopias jubatus*, pup masses between rookeries with increasing and decreasing populations. *Fish. Bull.* 93:753-758.

Methot, R. D. 1990. Synthesis model: An adaptable framework for analysis of diverse stock assessment data, International North Pacific Fisheries Commission: 259-277.

National Marine Fisheries Service (NMFS). 1998. Supplemental Environmental Impact Statement for Groundfish Total Allowable Catch Specifications and Prohibited Species Catch Limits Under the Authority of the Fishery Management Plans for the Groundfish Fishery of the Bering Sea and

Aleutian Islands Area and Groundfish of the Gulf of Alaska. NMFS-Alaska Region, PO Box 21668, Juneau, AK 99802.

NMFS. 1998b. Memorandum for the Record from William W. Stelle, Jr. November 1, 1998. NMFS Alaska Region, P.O. Box 21668, Juneau, Alaska 99802.

NMFS. 1995. Status review of the US Steller sea lion (*Eumetopias jubatus*) population. Available NMML, NMFS, NOAA, 7600 Sand Point Way NE, Seattle, WA 98115. 61 p.

NMFS. 1992. Recovery Plan for the Steller Sea Lion (*Eumetopias jubatus*. Prepared by the Steller Sea Lion Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. 92 pp.

Olla, B. L., M. W. Davis, et al. 1995. "Behavioural responses of larval and juvenile walleye pollock (*Theragra chalcogramma*): possible mechanisms controlling distribution and recruitment." International Council for the Exploration of the Sea Marine Science Symposium 201: 3-15.

Perez, M.A., and T.R. Loughlin. 1991. Incidental catch of marine mammals by foreign and joint venture trawl vessels in the U.S. EEZ of the North Pacific, 1973-88. NOAA Tech. Rep. NMFS 104, 57 pp.

Pike, G.C., and B.E. Maxwell. 1958. The abundance and distribution of the northern sea lion (*Eumetopias jubata*) on the coast of British Columbia. *J. Fish. Res. Bd. Canada* 15:5-17.

Pitcher, K.W., D.G. Calkins, and G.W. Pendleton. In review. Reproductive performances of female Steller sea lions from the Gulf of Alaska: Indications of nutritional stress? *Can. J. Zool.*

Pitcher, K. W. 1981. "Prey of the Steller sea lion, *Eumetopias jubatus*, in the Gulf of Alaska." *Fishery Bulletin* 79(3): 467-472.

Pitcher, K.W., D.G. Calkins, and G.W. Pendleton. *In review*. Reproductive performances of female Steller sea lions from the Gulf of Alaska: Indications of nutritional stress? *Can. J. Zool.*

Pitcher, K.W., and D.G. Calkins. 1981. Reproductive biology of Steller sea lions in the Gulf of Alaska. *J. Mammal.* 62:599-605.

Pitcher, K. W. 1980a. "Stomach contents and feces as indicators of harbor seal, *Phoca vitulina*, foods in the Gulf of Alaska." *Fishery Bulletin* 78(3): 797-798.

Pitcher, K. W. 1980b. "Food of the harbor seal, *Phoca vitulina richardsi*, in the Gulf of Alaska." *Fishery Bulletin* 78(2): 544-549.

Porter, B. 1997. Winter ecology of Steller sea lions (*Eumetopias jubatus*) in Alaska. M.S. dissertation, University of British Columbia, 84 pp.

Repenning, C.A. 1976. Adaptive evolution of sea lions and walruses. *Syst. Zool.* 25:375-390.

Rosen, D.A.S, and A.W. Trites. *In prep.* The metabolic effects of a low-energy prey on Steller sea lions, Eumetopias jubatus. Marine Mammal Research Unit, Fisheries Centre, University of British Columbia, Vancouver, B.C., 28 pp.

Schneider, D. C. and V. P. Shuntov. 1993. "The trophic organization of the marine bird community in the Bering Sea." *Reviews in Fisheries Science* 1: 311-335.

Sinclair, E. H., G. A. Antonelis, et al. 1997. Norther fur seal predation on juvenile walleye pollock, U.S. Department of Commerce, NOAA.

Sinclair, E. H., T. Loughlin, et al. 1994. "Prey selection by northern fur seals (*Callorhinus ursinus*) in the eastern Bering Sea." Fishery Bulletin 92(1): 144-156.

Sogard, S. M. and B. L. Olla. 1993. "Effects of light, thermoclines and predator presence on vertical distribution and behavioral interactions of juvenile walleye pollock, *Theragra chalcogramma* Pallas." *J. Exp. Mar. Biol. Ecol.* 167: 179-195.

Sogard, S. M. and B. L. Olla. 1996. "Food deprivation affects vertical distribution and activity of marine fish in a thermal gradient: potential energy-conserving mechanisms." *Mar. Ecol. Prog.* Ser. 133: 43-55.

Spaulding, G.C. 1964. Comparative feeding habits of the fur seal, sea lion, and harbour seal on the British Columbia coast. Fish. Res. Bd. Canada, Bull. No. 146.

Springer, A. M., D. G. Roseneau, et al. 1986. "Seabird responses to fluctuating prey availability in the eastern Bering Sea." *Marine Ecology Progress Series* 32: 1-12.

Strick, J.M., R.L. Merrick, D.C. McAllister, L.W. Fritz, and K.M. Wynne. *In press.* Aerial and ship-based surveys of Steller sea lions (Eumetopias jubatus) in sou southeast Alaska, the Gulf of Alaska, and Aleutian Islands during June and July 1996. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-00.

Thorsteinson, F.V., and C.J. Lensink. 1962. Biological observations of Steller sea lions taken during an experimental harvest. *J. Wildl. Management* 26:353-359.

Trites, A.W., and P.A. Larkin. 1992. The status of Steller sea lion populations and the development of fisheries in the Gulf of Alaska and Aleutian Islands. A report of the Pacific States Marine Fisheries Commission pursuant to National Oceanic and Atmospheric Administration Award No. NA17FD0177. Fisheries Centre, University of British Columbia, Vancouver, British Columbia, Canada V6T 1Z4.

Trites, A.W., and P.A. Larkin. 1996. Changes in the abundance of Steller sea lions (*Eumetopias jubatus*) in Alaska from 1956 to 1992: how many were there? *Aquat. Mamm.* 22:153-166.

USFWS. 1998. Memorandum for Steven Pennoyer, Administrator, Alaska Region, from the USFWS, Anchorage, Alaska, December 2, 1998. NMFS Alaska Region, P.O. Box 21668, Juneau, Alaska 99802.

Walline, P. D. 1983. Growth of larval and juvenile walleye pollock related to year-class strength. Seattle, WA, University of Washington: 144.

Wespestad, V. G., L. W. Fritz, et al. 1997. On Relationships between Cannibalism, climate variability, physical transport and recruitment success of Bering Sea Walleye Pollock, *Theragra chalcogramma.*

ICES International Symposium, Recruitment Dynamics of exploited marine populations: physical-biological interactions, Baltimore, MD.

Wespestad, V. G., J. N. Ianelli, et al. 1997. Bering Sea and Aleutian Islands walleye pollock assessment for 1998. Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea and Aleutian Islands Regions as Projected for 1998. Bering Sea and Aleutian Islands Plan Team, North Pacific Fishery Management Council, 605 W. 4th Avenue, Suite 306, Anchorage, AK 99501: 35-120.

Wolotira, R. J., Jr., T. M. Sample, et al. 1993. Geographic and bathymetric distributions for many commercially important fishes and shellfishes off the west coast of North America, based on research survey and commercial catch data, 1912-1984, U.S. Department of Commerce, NOAA: 184.

Yang, M. S. 1993. Food habits of the commercially important groundfishes in the Gulf of Alaska in 1990, U.S. Department of Commerce, NOAA: 150.

Yang, M. S. 1996. Diets of the important groundfishes in the Aleutian Islands in summer 1991, U.S. Department of Commerce, NOAA: 105.

York, A.E. 1994. The population dynamics of northern sea lions 1975-85. Marine Mammal Science 10:38-51.

6.0 AGENCIES AND INDIVIDUALS CONSULTED

Dave Ackley
Alaska Department of Fish and Game
Juneau, AK

7.0 LIST OF PREPARERS

Kent Lind, NMFS-Alaska Region
Tim Ragen, NMFS-Alaska Region
Lew Queirolo, NMFS-Alaska Region/Alaska Fisheries Science Center

Appendix 1. Catch and Product Value for the 1997 and 1998 EBS Pollock Fishery for Each of Four Cases

The RPAs will affect the temporal and spatial distribution of pollock catch in the eastern Bering Sea (EBS) pollock fishery. In addition, they may affect total catch in that fishery and the distribution of catch among the inshore, factory trawler, and mothership sectors of the pollock fishery. The American Fisheries Act (AFA) will also affect the distribution of catch among these three sectors.

Catch and production data for 1997 and 1998 and product price estimates for 1998 were used to estimate 1997 and 1998 catch and product value by sector for four cases. Observer data for the A and B seasons of 1997 and the A season of 1998 were used to identify catch in the CVOA/CH area defined by the RPAs. Observer data for the 1997 B season were used for the 1998 B season. Weekly catch and production data and seasonal product price data were used.

The four cases are as follows:

1. Actual 1997 and 1998 catch for the AFA processors;

2. 1997 and 1998 catch for the AFA processors constrained by the 1999 TAC and the AFA distribution of the TAC;

3. 1997 and 1998 catch for the AFA processors constrained by the 1999 TAC, the AFA distribution of the TAC, and the seasonal distributions of the TAC included in the RPAs; and

4. 1997 and 1998 catch for the AFA processors constrained by the 1999 TAC, the AFA distribution of the TAC, the seasonal distributions of the TAC included in the RPAs, and the RPA limits on catch in the CVOA/CH.

The AFA processors exclude the factory trawlers that are not expected to be eligible to participate in the pollock fishery.

Case 2 provides baseline estimates with the AFA and the 1999 TAC but without the RPAs. Case 3 provides lower bound estimates of the reductions in pollock catch and product value resulting from the seasonal distributions of the TAC included in the RPAs and the RPA limits on catch in the CVOA/CH. They are lower bound estimates because they are based on the assumption that the reduced catch in the CVOA/CH would be offset exactly by increased catch in other areas. Case 4 provides upper bound estimates of the reductions in pollock catch and product value resulting from those features of the RPAs because the estimates are based on the assumption that little of the reduced catch in the CVOA/CH would be offset by increased catch in other areas. The effects of the distribution of the EBS TAC between areas east and west of 170 degrees and the expanded pollock fishery trawl exclusion areas were not addressed in Cases 3 and 4. All three cases exclude the CDQ pollock fishery.

The AFA makes the following allocation of the EBS pollock TAC:

1. 10 percent to CDQs,;

2. an unspecified amount (assumed to be 5 percent) for incidental pollock catch in all non-pollock fisheries;

3. 50 percent of the remainder or 42.5 percent of the total TAC to the inshore sector;

4. 40 percent of the remainder or 34 percent of the total TAC to the factory trawler sector; and

5. 10 percent of the remainder or 8.5 percent of the total TAC to the mothership sector.

Prior to the AFA, the CDQs received 7.5 percent, there was no explicit allocation for incidental catch in all other fisheries, the inshore sector received 35 percent of the remainder or about 32.4 percent of the total, and the factory trawler and mothership sectors together received 65 percent of the remainder or 60.1 percent of the total.

The AFA and the 1999 TAC reduced the amount of pollock available to the factory trawler and mothership sectors but increased the amount available to the inshore sector. The Case 2 catch estimates were made for the factory trawler and mothership sectors by truncating the ends of the A and B seasons for these two sectors to prevent their AFA seasonal quotas from being exceeded. The Case 2 catch estimates were made for the inshore sector by extending the ends of the A and B seasons for this sector to ensure its AFA seasonal quotas were taken. The weekly catch rates for the extensions were based on actual catch rates for earlier weeks.

The differences between Cases 2 and 3 are the replacement of the A and B season TACs with TACs for four periods for the inshore and factory trawler sectors, a delayed start date for the mothership sector's A season, and a decrease in the percent of the TAC that could be taken in the roe season. Catch rates from earlier or later weeks were used to estimate weekly catch rates for weeks that had not been open in 1997 and 1998.

The difference between Cases 3 and 4 is the addition of the CVOA/CH area quotas for each sector. These quotas did not affect the factory trawler sector in the non-roe seasons because existing regulations allow it to operate in the CVOA only during the roe season. It is estimated that the CVOA/CH area quotas would have had substantially larger effects on the factory trawler and mothership sectors in 1998 than in 1997 due to the greater dependence on this area in 1998. Similarly, it is estimated that these quotas would have had substantially greater effects on the inshore sector than on the other sectors due to its very high dependence on catch from this area both years. The weekly catch estimates for each case and sector are in Table x-1 and the estimates of product value per metric ton of retained catch are in Table x-2.

The estimates of annual catch by sector and case are presented below in thousands of metric tons.

Inshore Sector

YR	Case 1	Case 2	Case 3	Case 4
97	339.23	421.58	421.60	323.96
98	348.93	421.60	421.62	326.50

Factory Trawler Sector

YR	Case 1	Case 2	Case 3	Case 4
97	410.48	337.29	337.27	335.58
98	408.87	337.28	337.37	299.60

Mothership sector

YR	Case 1	Case 2	Case 3	Case 4
97	108.88	84.32	84.33	82.82
98	116.82	84.32	84.32	67.44

All Sectors

YR	Case 1	Case 2	Case 3	Case 4
97	858.59	843.19	843.20	742.36
98	874.62	843.20	843.31	693.54

The resulting estimates of annual product value by sector and case are presented below in millions of dollars.

Inshore Sector

YR	Case 1	Case 2	Case 3	Case 4
97	217	267	260	199
98	203	241	238	189

Factory Trawler Sector

YR	Case 1	Case 2	Case 3	Case 4
97	234	186	183	183
98	201	161	157	132

Mothership Sector

YR	Case 1	Case 2	Case 3	Case 4
97	64	49	49	48
98	60	41	42	32

All Sectors

YR	Case 1	Case 2	Case 3	Case 4
97	516	502	492	430
98	464	443	438	353

These estimates suggest that the additional seasons and the decrease in the percent of the TAC that can be taken in the roe season (i.e., going from Case 2 to Case 3) would not affect total catch in any of the sectors but would result in relatively small decreases in total product value and in product value for the inshore and factory trawler sectors. For the three sectors combined, it is estimated that product value would have decreased by $10 million or about 2 percent and by $5 million or 1 percent in 1997 and 1998, respectively.

These estimates suggest that the addition of the CVOA/CH area quotas if most of the foregone catch in that area cannot be made up elsewhere (i.e., going from Case 3 to Case 4) would have been substantially greater. For the three sectors combined, the estimated total reductions in product value are $62 million or about 13 percent and $85 million or over 19 percent in 1997 and 1998, respectively.

Table A-1 Estimated catch by case and sector (1,000 metric tons).

Inshore Sector

Year	Season	Date	Case 1	Case 2	Case 3	Case 4
97	1	125	26.76	26.76	26.76	26.76
97	1	201	35.52	35.52	35.52	35.52
97	1	208	39.25	39.25	39.25	39.25
97	1	215	32.97	32.97	14.41	14.41
97	1	222	30.89	35.90	.00	.00
97	2	301	.00	19.30	30.89	4.20
97	2	308	.00	.00	21.81	.00
97	2	315	.00	.00	.00	.00
97	3	816	.00	.00	30.00	30.00
97	3	823	.00	.00	30.00	30.00
97	3	830	.00	.00	30.00	30.00
97	3	906	19.10	19.10	30.00	30.00
97	3	913	30.43	30.43	6.48	6.48
97	4	920	21.50	21.50	21.50	21.50
97	4	927	17.03	17.03	17.03	17.03
97	4	1004	26.57	26.57	26.57	26.57
97	4	1011	32.77	32.77	32.77	12.24
97	4	1018	26.44	26.44	28.61	.00
97	4	1025	.00	26.00	.00	.00
97	4	1101	.00	26.00	.00	.00
97	4	1108	.00	6.04	.00	.00
98	1	124	7.05	7.05	7.05	7.05
98	1	131	21.75	21.75	21.75	21.75
98	1	207	29.84	29.84	29.84	29.84
98	1	214	33.08	33.08	33.08	33.08
98	1	221	32.52	32.52	24.22	24.22
98	2	228	32.37	32.37	.00	.00
98	2	307	4.25	33.11	32.46	2.69
98	2	314	.28	.00	20.24	5.49
98	2	321	.00	.00	.00	.00
98	3	815	.00	.00	25.30	25.30
98	3	822	.03	.03	25.30	25.30
98	3	829	.11	.11	25.30	25.30
98	3	905	11.55	11.55	25.30	25.30
98	3	912	25.16	25.16	25.30	25.30
98	4	919	18.64	18.64	18.64	18.64
98	4	926	14.07	14.07	14.07	14.07
98	4	1003	26.99	26.99	26.99	26.99
98	4	1010	25.46	25.46	25.46	16.18
98	4	1017	28.68	28.68	28.68	.00
98	4	1024	23.07	23.07	12.65	.00
98	4	1031	13.51	25.51	.00	.00
98	4	1107	.52	25.00	.00	.00
98	4	1114	.00	7.62	.00	.00

Table A-1 Continued

Factory Trawler Sector

Year	Season	Date	Case 1	Case 2	Case 3	Case 4
97	1	125	2.87	2.87	2.87	2.87
97	1	201	52.54	52.54	52.54	43.54
97	1	208	52.33	52.33	37.34	15.10
97	1	215	54.18	44.04	.00	31.23
97	1	222	34.84	.00	.00	.00
97	2	301	.00	.00	42.16	40.47
97	2	308	.00	.00	.00	.00
97	2	315	.00	.00	.00	.00
97	3	816	.00	.00	.00	.00
97	3	823	.00	.00	.00	.00
97	3	830	.00	.00	.00	.00
97	3	906	30.87	30.87	42.13	42.13
97	3	913	59.05	59.05	59.05	59.05
97	4	920	31.06	31.06	31.06	31.06
97	4	927	51.90	51.90	51.90	51.90
97	4	1004	40.84	12.62	18.22	18.22
97	4	1011	.00	.00	.00	.00
97	4	1018	.00	.00	.00	.00
97	4	1025	.00	.00	.00	.00
97	4	1101	.00	.00	.00	.00
97	4	1108	.00	.00	.00	.00
98	1	124	.00	.00	.00	.00
98	1	131	47.16	47.16	47.16	44.50
98	1	207	49.79	49.79	45.70	11.05
98	1	214	47.55	47.55	.00	4.28
98	1	221	47.44	7.28	.00	2.75
98	2	228	.00	.00	42.16	25.74
98	2	307	2.70	.00	.00	8.93
98	2	314	.00	.00	.00	.00
98	2	321	.09	.00	.00	.00
98	3	808	.00	.00	.00	.00
98	3	815	.00	.00	.00	.00
98	3	822	.00	.00	.00	.00
98	3	829	.00	.00	32.04	32.04
98	3	905	26.29	26.29	32.04	32.04
98	3	912	37.09	37.09	37.09	37.09
98	4	919	27.03	27.03	27.03	27.03
98	4	926	22.82	22.82	22.82	22.82
98	4	1003	42.52	42.52	42.52	42.52
98	4	1010	24.81	24.81	8.80	8.80
98	4	1017	26.83	4.93	.00	.00
98	4	1024	5.74	.00	.00	.00
98	4	1031	.00	.00	.00	.00
98	4	1107	.00	.00	.00	.00
98	4	1114	1.01	.00	.00	.00

Table A-1 Continued

Mothership Sector

Year	Season	Date	Case 1	Case 2	Case 3	Case 4
97	1	125	.00	.00	.00	.00
97	1	201	13.74	13.74	.00	.00
97	1	208	13.99	13.99	13.99	13.99
97	1	215	16.40	10.21	16.40	6.74
97	1	222	11.07	.00	3.34	7.81
97	2	301	.21	.00	.00	3.68
97	2	308	.00	.00	.00	.00
97	2	315	.00	.00	.00	.00
97	2	322	.00	.00	.00	.00
97	3	816	.00	.00	.00	.00
97	3	823	.00	.00	.00	.00
97	3	830	.00	.00	.00	.00
97	3	906	8.40	8.40	8.40	8.40
97	3	913	10.58	10.58	10.58	10.58
97	4	920	10.60	10.60	10.60	10.60
97	4	927	11.23	11.23	11.23	11.23
97	4	1004	12.57	5.57	9.78	9.78
97	4	1011	.08	.00	.00	.00
97	4	1018	.00	.00	.00	.00
97	4	1025	.00	.00	.00	.00
97	4	1101	.00	.00	.00	.00
97	4	1108	.00	.00	.00	.00
98	1	124	.00	.00	.00	.00
98	1	131	11.53	11.53	.00	.00
98	1	207	13.98	13.98	13.98	13.98
98	1	214	14.01	12.43	14.01	2.87
98	1	221	14.12	.00	5.75	.00
98	2	228	.37	.00	.00	.00
98	2	307	.00	.00	.00	.00
98	2	314	.00	.00	.00	.00
98	2	321	.00	.00	.00	.00
98	3	808	.00	.00	.00	.00
98	3	815	.00	.00	.00	.00
98	3	822	.00	.00	.00	.00
98	3	829	.00	.00	.00	.00
98	3	905	8.82	8.82	8.82	8.82
98	3	912	11.68	11.68	11.68	11.68
98	4	919	8.36	8.36	8.36	8.36
98	4	926	4.58	4.58	4.58	4.58
98	4	1003	10.71	10.71	10.71	10.71
98	4	1010	8.63	2.23	6.44	6.44
98	4	1017	7.55	.00	.00	.00
98	4	1024	2.48	.00	.00	.00
98	4	1031	.00	.00	.00	.00
98	4	1107	.00	.00	.00	.00
98	4	1114	.00	.00	.00	.00

Table A-1 Continued

All Sectors

Year	Season	Date	Case 1	Case 2	Case 3	Case 4
97	1	125	29.63	29.63	29.63	29.63
97	1	201	101.80	101.80	88.06	79.06
97	1	208	105.57	105.57	90.58	68.34
97	1	215	103.56	87.22	30.81	52.38
97	1	222	76.80	35.90	3.34	7.81
97	2	301	.21	19.30	73.05	48.35
97	2	308	.00	.00	21.81	.00
97	2	315	.00	.00	.00	.00
97	3	816	.00	.00	30.00	30.00
97	3	823	.00	.00	30.00	30.00
97	3	830	.00	.00	30.00	30.00
97	3	906	58.37	58.37	80.53	80.53
97	3	913	100.07	100.07	76.12	76.12
97	4	920	63.17	63.17	63.17	63.17
97	4	927	80.16	80.16	80.16	80.16
97	4	1004	79.98	44.76	54.57	54.57
97	4	1011	32.85	32.77	32.77	12.24
97	4	1018	26.44	26.44	28.61	.00
97	4	1025	.00	26.00	.00	.00
97	4	1101	.00	26.00	.00	.00
97	4	1108	.00	6.04	.00	.00
98	1	124	7.05	7.05	7.05	7.05
98	1	131	80.44	80.44	68.91	66.26
98	1	207	93.61	93.61	89.52	54.87
98	1	214	94.64	93.06	47.09	40.23
98	1	221	94.09	39.80	29.97	26.97
98	2	228	32.74	32.37	42.16	25.74
98	2	307	6.95	33.11	32.46	11.62
98	2	314	.28	.00	20.24	5.49
98	2	321	.09	.00	.00	.00
98	2	328	.00	.00	.00	.00
98	3	815	.00	.00	25.30	25.30
98	3	822	.03	.03	25.30	25.30
98	3	829	.11	.11	57.34	57.34
98	3	905	46.65	46.65	66.16	66.16
98	3	912	73.93	73.93	74.07	74.07
98	4	919	54.03	54.03	54.03	54.03
98	4	926	41.48	41.48	41.48	41.48
98	4	1003	80.21	80.21	80.21	80.21
98	4	1010	58.90	52.50	40.70	31.42
98	4	1017	63.06	33.61	28.68	.00
98	4	1024	31.29	23.07	12.65	.00
98	4	1031	13.51	25.51	.00	.00
98	4	1107	.52	25.00	.00	.00
98	4	1114	1.01	7.62	.00	.00

Table A-2 Estimated product value per metric ton of retained catch by sector and date ($/mt).

Year	Season	Date	Inshore	Fac. Trawl	Mothership
97	1	125	657.07	622.56	-
97	1	201	692.25	664.66	650.80
97	1	208	692.42	749.71	723.02
97	1	215	867.32	785.05	716.24
97	1	222	716.85	863.22	690.16
97	2	301	700.29	849.56	832.22
97	2	308	658.40	136.97	-
97	2	329	522.22	-	-
97	3	816	572.52	437.18	501.93
97	3	823	572.52	437.18	501.93
97	3	830	572.52	437.18	501.93
97	3	906	572.52	437.18	501.93
97	3	913	572.52	437.18	501.93
97	4	920	572.52	437.18	501.93
97	4	927	572.52	437.18	501.93
97	4	1004	572.52	437.18	501.93
97	4	1011	572.52	437.18	501.93
97	4	1018	572.52	437.18	501.93
97	4	1025	572.52	437.18	501.93
98	1	124	542.75	-	-
98	1	131	726.83	595.45	539.52
98	1	207	728.32	676.61	548.43
98	1	214	700.83	658.63	548.43
98	1	221	654.88	703.10	743.46
98	2	228	552.16	703.10	722.91
98	2	307	510.43	680.42	-
98	2	314	510.43	125.40	-
98	2	321	318.08	212.53	-
98	3	815	518.12	344.99	443.15
98	3	822	518.12	344.99	443.15
98	3	829	518.12	344.99	443.15
98	3	905	518.12	344.99	443.15
98	3	912	518.12	344.99	443.15
98	4	919	518.12	344.99	443.15
98	4	926	518.12	344.99	443.15
98	4	1003	518.12	344.99	443.15
98	4	1010	518.12	344.99	443.15
98	4	1017	518.12	344.99	443.15
98	4	1024	518.12	344.99	443.15
98	4	1031	518.12	344.99	443.15

Note: A constant value is used for the non-roe seasons because the estimated value per metric ton of surimi was assumed to be constant and the product mix is relatively constant and because estimates were needed for weeks with no non-CDQ pollock fishery in 1997 and 1998.