

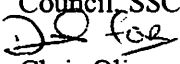
Public Testimony Sign-Up Sheet

Agenda Item C-6 BS+AI cod split

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NOTE to persons providing oral or written testimony to the Council: Section 307(1)(I) of the Magnuson-Stevens Fishery Conservation and Management Act prohibits any person "to knowingly and willfully submit to a Council, the Secretary, or the Governor of a State false information (including, but not limited to, false information regarding the capacity and extent to which a United State fish processor, on an annual basis, will process a portion of the optimum yield of a fishery that will be harvested by fishing vessels of the United States) regarding any matter that the Council, Secretary, or Governor is considering in the course of carrying out this Act.

MEMORANDUM

TO: Council, SSC and AP Members
FROM: 
Chris Oliver
Executive Director
DATE: January 30, 2007
SUBJECT: BS and AI Pacific Cod Allocation Split

ESTIMATED TIME 2 HOURS

ACTION REQUIRED

- (a) Review BS and AI split for Pacific cod discussion paper
- (b) Report on Pacific cod genetics study (SSC only)

BACKGROUND

BS and AI Cod Split

In October 2006, the Council requested staff continue to refine the discussion paper regarding apportionment of BSAI Pacific cod sector allocations between the BS and AI subareas, should the TAC be split in the future. The updated discussion paper is attached as **Item C-6(a)**. Included in the updated discussion paper is 2004 and 2005 retained catch data and Pacific cod destined for fishmeal production. In addition, the paper includes a discussion of an option added in October that changes separate Bering Sea and Aleutian Islands LLP area endorsements into an area-wide endorsement for the Pacific cod fishery.

Pacific Cod Genetics

Approximately 4,200 samples from Pacific cod were obtained from eight geographic locations in waters of Washington, Alaska, and Japan. Greater stock discretion in Pacific cod has been shown than previously recognized. Strong genetic divergence between Asian and North American samples and the isolation-by-distance pattern exhibited by the latter group suggest restricted spatial dispersal. Once more extensive geographic screening is complete, a more specific recommendation regarding harvesting or targeted research will be possible. A no-cost extension of this Sea Grant project has been granted until May 2007, which will enable processing at least two samples of potential relevance for evaluating stock structure within the BSAI: one taken from the western Aleutian Islands in 2005 and another from the Pribilof Islands that is planned for this spawning season. A proposed continuation of this project as a component of the Bering Sea Integrated Ecosystem Research Program, under development for submission to the North Pacific Research Board, would allow for more extensive, directed sampling within and between management regions. Supplemental samples from Pacific cod fisheries conducted in the Aleutian Islands and in Russian waters are also being sought. The full report is under **Item C-6(b)**.

**Discussion Paper on Apportionment of BSAI Pacific Cod Sector
Allocations to BS and AI Subareas
January 30, 2007**

In October 2006, the Council requested staff continue refining the discussion paper on apportionment of the BSAI Pacific cod sector allocations for February 2007 by incorporating (1) updated information for 2004-2005 under Alternative 4, (2) add a new option to each of the alternatives that would change separate Bering Sea and Aleutian Island LLP area endorsements into a single BSAI area-wide endorsement for the Pacific cod fishery, only if there is a Bering Sea and Aleutian Island ABC/TAC split, and (3) include fishmeal production data in the discussion paper. The following discussion paper provides updated information, the historical background on the issue, and a summary of the impacts of each of the alternatives.

I. Problem Statement and Existing Alternatives

Problem Statement: Apportionment of BSAI Pacific cod Sector Allocations between BS and AI

In the event that the BSAI Pacific cod ABC/TAC is apportioned between the BS and the AI management areas, a protocol needs to be established that would continue to maintain the benefits of sector allocations and minimize competition among gear groups; recognize differences in dependence among gear groups and sectors that fish for Pacific cod in the BS and AI; and ensure that the distribution of harvest remains consistent with biomass distribution and associated harvest strategy.

The following are the existing alternatives that were included in BSAI Amendment 85 prior to Council removal:

ALTERNATIVE 1: No action. A methodology to apportion the BSAI Pacific cod allocations to the jig, trawl, and fixed gear sectors between the BS and AI subareas would not be selected.

ALTERNATIVE 2: Sector allocations remain as BSAI (with BS and AI TACs)

No allocation to a sector of a specific percentage of a sub-area. Sectors would have a BSAI allocation to fish in either sub-area (BS and AI) if the sub-area is open for directed fishing and TAC is available.

Option 2.1 Upon splitting the BSAI Pacific cod ABC/TAC between the Bering Sea and Aleutian Islands, separate BS and AI LLP area endorsements would be converted to BSAI area-wide endorsement for the Pacific cod fishery.

ALTERNATIVE 3: BS and AI sector allocations based on equal percentage from BSAI sector allocations

This alternative provides an allocation to a sector of equal percentage in both sub-areas. The percentage of BSAI TAC a sector receives would result in that same percentage being applied to both the BS and AI sub-areas so that a sector would have the same percentage in both sub-areas.

Option 3.1 Upon splitting the BSAI Pacific cod ABC/TAC between the Bering Sea and Aleutian Islands, separate BS and AI LLP area endorsements would be converted to BSAI area-wide endorsement for the Pacific cod fishery.

ALTERNATIVE 4: (Selected as preliminary preferred alternative in February 06). BS and AI sector allocations based on a sector's historic harvest in the AI with remainder of sector's

overall BSAI allocation to be caught in the BS. Sector's BSAI allocation is maintained and used in annual calculation.

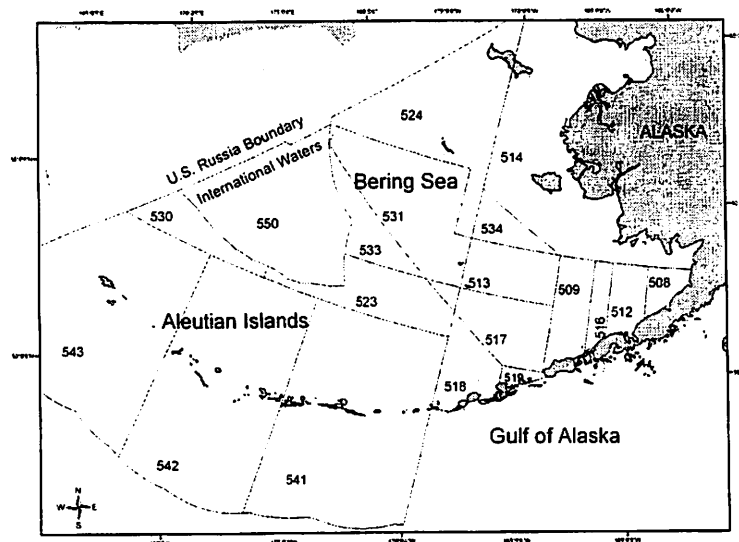
- Option 4.1 1995–2002
- Option 4.2 1997–2003
- Option 4.3 2000–2003
- Option 4.4 2002–2003

Option 4.5 Upon splitting the BSAI Pacific cod ABC/TAC between the Bering Sea and Aleutian Islands, separate BS and AI LLP area endorsements would be converted to BSAI area-wide endorsement for the Pacific cod fishery.

II. Background

The BS and AI management areas are comprised of the Federal management areas shown below in Figure 1. The AI is comprised of Areas 541, 542, and 543. The BSAI Pacific cod ABC is currently based on an Eastern Bering Sea assessment model and expanded by a multiplier into a BSAI-wide amount.

Figure 1 BSAI Federal management areas



The issue of whether to split the combined BSAI ABC (and TAC) by subarea has been raised at Plan Team, SSC, and Council meetings during the last several years. In December 2003, the SSC recommended that the ABC should be split between BS and AI subareas, but noted that management implications may preclude the Council from adopting separate subarea TACs in the specifications process. The SSC requested that the assessment authors evaluate potential methods for splitting the ABC and their potential management implications, so that specific recommendations could be made to the Council in the future. In the November 2005 BSAI Pacific cod SAFE report, the stock assessment authors noted the following:

At present, ABC of BSAI Pacific cod is not allocated by area. Pacific cod is something of an exception in this regard. Based on a Kalman filter analysis of the shelf bottom trawl survey time series in the EBS and AI, last year's assessment concluded that the best estimate of the BSAI Pacific cod biomass distribution was 85% EBS and 15% AI (Thompson and Dorn, 2004). The

analysis was not repeated for this year's assessment, because no AI survey was conducted this year...if there were no other management complications, setting a separate ABC for the AI would be expected to impose only a modest new constraint on the existing fishery while helping to control future expansion of the fishery in this area. However, at present, there are potentially significant management complications arising from certain allocation formulas (by gear type, CDQ, etc.) pertaining to Pacific cod in the Fishery Management Plan. Until such time as these complications can be resolved, specification of separate ABCs for the EBS and AI is not recommended. [excerpt from 2005 BSAI SAFE]

While the decision to split the BSAI cod TAC into BS and AI subarea TACs is not part of of this action, at the February 2006 Council meeting, the SSC requested that the Amendment 85 analysis include additional background information on the biological basis for managing cod as separate BS and AI stocks rather than as a single BSAI stock (SSC minutes, February 2006). The SSC specifically asked whether evidence suggests that the BS and AI stocks are separate and that cod form a single stock throughout the AI, or whether evidence suggests that cod form a suite of independent or partially independent stocks along the length of the AI. The following response from stock assessment scientists at the Alaska Fisheries Science Center indicates that there is not sufficient evidence at this time that Pacific cod stocks in the BS and AI are separate:

At present, there is insufficient evidence to confirm or refute the hypotheses that the BS and AI stocks are separate, that cod form a single stock throughout the AI, or that cod form a suite of independent or partially independent stocks along the length of the Aleutian Islands. The available data, or lack thereof, may be summarized as follows:

- 1) Size Composition. The size compositions of catches taken from the AI are typically more heavily weighted toward large fish than the size compositions of catches taken from the BS. However, this could be evidence of a difference in fishing mortality rates or gear selectivities between the two areas rather than evidence of biological structure.*
- 2) Length at Age. Although a good collection of age data are available for Pacific cod in the BS, very few (<100) age data are available for Pacific cod in the AI, making it difficult to draw firm conclusions about possible differences in length at age between the two areas. More age data from Pacific cod in the AI should be available within a few weeks.*
- 3) Tagging. In a study described by Shimada and Kimura (1994, Fishery Bulletin 92:800-816), substantial numbers of Pacific cod were tagged in both the AI and BS management areas. Over 300 fish tagged in the BS management area were recovered. The vast majority of these were recovered in the BS management area, although there were isolated cases of BS-tagged fish being recovered in the AI management area. Two fish tagged in the vicinity of Unimak Pass were recovered near Seguam Pass within 250 days. Very few recoveries were made of AI-tagged fish. However, two fish tagged in Tanaga Pass near Adak Island were captured on the outer northwest shelf in the BS management area (above 57°N) after 3 and 5 years at liberty. In a separate study, AFSC's Fisheries Interaction Team tagged large numbers of Pacific cod in the vicinity of Unimak Pass. Out of 2,609 tag returns, only 1 was recovered in the AI management area.*
- 4) Genetics. Grant et al. (1987, Can. J. Fish. Aquat. Sci. 44:490-498) showed clear differentiation between Pacific cod in the Asian and North American portions of the species' range, but little differentiation within the North American portion. A new study, using more powerful methodology, is currently underway at the AFSC. Although final results will not be available for a few months, preliminary results confirm Grant et al.'s finding of a distinct break between Asian and North American populations, and also indicate the potential for stock structure on scales finer than the species' North American range. Unfortunately, very few data from the Bering Sea were available for the new analysis. Once the present study is completed, the authors hope to*

conduct further studies (pending availability of funds), including expanded coverage of the Bering Sea portion of the species' range (Thompson, March 2, 2006).

As noted in the summary above, there are a few ongoing research studies of BSAI Pacific cod, but at the time of updating this discussion paper, no further information is available that would shed any new light on the biology of splitting BSAI Pacific cod TAC between BS and AI.

It is thus uncertain whether the Plan Team and/or SSC would recommend splitting the BSAI Pacific cod ABC/TAC into separate BS and AI subarea ABCs/TACs in the future. While Pacific cod is currently managed as a single unit in the BS and AI, historically, the great majority of the BSAI Pacific cod catch has come from the BS management subarea. The stock assessment model for Pacific cod is configured to represent the portion of the Pacific cod population inhabiting the BS survey area. The model projections are then adjusted to include biomass in the AI survey area. As stated above, the best estimate of long-term average biomass distribution is 85% in the BS and 15% in the AI (Thompson and Dorn). Consider the example that results if separate BS and AI TACs were set in 2007. Using the 2007 TAC of 170,720 mt and subtracting a 10.7% CDQ allocation, if the subarea split was implemented as described above, the BS and AI ITACs would be 129,585 mt and 22,868 mt, respectively.¹

Given the management implications related to the numerous sector allocations in the BSAI, the Pacific cod TAC has continued to be established for the entire BSAI management area. However, if the Council determines that it is likely that the TAC groupings will be modified in the foreseeable future, it would be beneficial to provide direction to NMFS regarding the formula for establishing new subarea allocations to each sector. This discussion paper provides three alternative approaches for this action in addition to a brief discussion on alternative approaches. The intent is to provide direction to NMFS regarding how to establish sector allocations in the BS and AI management areas prior to separate TACs being issued in the annual specifications process. Absent this direction, there is concern that the time necessary to undergo an analysis and notice and comment rulemaking after the TAC is divided would cause significant disruption of the cod fisheries. Absent any action on this issue, NMFS could likely only implement equal allocations in both areas (e.g., if a sector receives a 40% BSAI allocation, it would receive 40% of the BS TAC and 40% of the AI TAC upon a TAC split). While this is one of the methodologies evaluated (Alternative 3), the public and the Council raised concerns about this methodology being the only potential solution by default. The primary concern being that it does not reflect recent historical catch by sector in the Aleutian Islands subarea.

Note that methods to apportion the BSAI Pacific cod CDQ reserve between the BS and AI subareas are not included in this discussion paper. Alternatives 1–4 only apply to the non-CDQ fisheries. The regulations for the CDQ reserves are at 50 CFR 679.20(b)(1)(iii). Paragraph (C)(1) addresses the apportionment of the overall CDQ groundfish reserves by TAC category, and (C)(2) addresses how to modify the CDQ reserves if overall TACs are split or combined during the final harvest specifications. NMFS has operated such that if a new groundfish TAC is established, the CDQ Program receives its 7.5% allocation, unless a species is explicitly allocated at a different percentage (e.g., pollock under the AFA) or explicitly not allocated to the program. Note that the Magnuson Stevens Act was recently reauthorized. The reauthorization increased the CDQ Program Pacific cod allocation from 7.5 percent to 10.7 percent. Thus, if the BSAI Pacific cod TAC is split into BS and AI subarea TACs, under the status quo allocations, the CDQ Program would receive 10.7% of the BS TAC and 10.7% of the AI TAC. For illustrative purposes, the remainder of this paper uses a 10.7% CDQ allocation, as this increase is expected to be implemented in 2008, per the Magnuson-Stevens Act.

¹ Accounts for the 3% deduction for State water AI Pacific cod fishery.

III. LLP area endorsements by sector

Groundfish licenses are currently required to participate in the BSAI groundfish fisheries in Federal waters. Groundfish licenses contain endorsements that define what the vessel using the license is allowed to do. Area endorsements define the geographic locations the licenses allow a vessel to fish. Under the groundfish LLP, separate BS subarea and AI subarea endorsements were issued and earned based on historic fishing patterns. Looking just at BSAI, licenses may contain endorsements for both subareas (BS and AI), one of the two subareas, or neither of the subareas. Gear endorsements define what type of gear may be used: non-trawl, trawl, or both. Further, cod gear endorsements are required for non-trawl vessels $\geq 60'$ to participate in the BSAI fixed gear Pacific cod fishery: hook-and-line catcher processors, pot catcher processors, hook-and-line catcher vessels, and pot catcher vessels. As stated previously, vessels fishing with jig gear in the BSAI are exempt from the LLP, provided they comply with gear limitations. Table 1 shows the number of groundfish LLPs with a Bering Sea and/or Aleutian Islands endorsement by sector, as of December 2006. Generally, this table shows the number of licenses associated with each eligible sector that may currently fish in the Federal BS and AI management areas for Pacific cod. Regardless of whether the BSAI TAC is split into separate subarea TACs, only those vessels with an AI endorsement may fish in Federal waters in the AI.

In the trawl CP sectors, the majority of licenses are endorsed for the BSAI, with few vessels endorsed in only one area. In the non-AFA trawl CP sector, 6 LLPs are endorsed only for the BS, while only one LLP is endorsed only for the AI. In the AFA trawl CV sector, more than half of the total LLPs (60) are endorsed only for the BS; the remaining licenses (51) are endorsed for the BSAI. None are endorsed only for the AI. The AFA sectors also benefit to some degree from the cooperative structure in place under the AFA. The non-AFA trawl CP sector will also potentially benefit from a similar structure under Amendment 80. Thus, it is possible that these sectors could have some limited ability to manage their allocations internally with the existing LLP area endorsements.

In the non-AFA trawl CV sector, the majority (44 of 50) of eligible licenses are endorsed only for the BS. Four are endorsed for the BSAI and two are endorsed for the AI only. Thus, only six LLPs in this sector can be used to fish in the AI. Note that three of these vessels harvested more than half of the total non-AFA trawl CV sector Pacific cod catch during 1995 to 2003, so any alternative that would apportion a majority of the sector's BSAI Pacific cod in the AI, these three vessels would be substantially affected. Under that scenario, these vessels would need to purchase an LLP with an AI endorsement in order to continue their historical level of Pacific cod catch.

In the hook-and-line sectors, the majority of the eligible vessels (CP and $\geq 60'$ CV) are endorsed for the BSAI, with only 2 CPs and 1 CV endorsed only in the BS, and only 1 CV endorsed only for the AI. In the pot CP sector, there are only 8 eligible LLPs, 5 of which are endorsed for the BSAI and 3 for the BS only. In the $\geq 60'$ pot CV sector, the great majority (47 of 52) of licenses are endorsed only for the BS, with only 5 licenses endorsed for the BSAI. In the $< 60'$ fixed gear sector, of the 115 total licenses being used on $< 60'$ vessels, 89 are endorsed only for the BS, 2 only for the AI, and 24 for the BSAI.

Table 1 shows that only six licenses are endorsed for the AI subarea only. Note that because a vessel is not limited to participating in one sector if it has the appropriate license and/or permit, the number of licenses across sectors is not necessarily additive nor does it represent the number of unique vessels. The number of LLPs is higher than the number of unique vessels, as one vessel may carry more than one license or a vessel may not yet have been designated for use on a license. Regardless of the resulting BS and AI sector allocations established under this part, only the vessels with AI endorsements in each sector are allowed to fish in that Federal management area.

Overall, about 46% of the licenses endorsed for trawl gear are endorsed to fish both subareas. About 36% of the non-trawl gear licenses are endorsed to fish both subareas. About half of the licenses (58%) are endorsed for the BS subarea only.

For those sectors with a majority of participants that hold only a BS endorsement, a relatively small proportion of the sector would be allowed to harvest the AI sector cod allocation. Based on the table below, this appears to be an issue primarily for the non-AFA trawl CV sector, ≥60' pot CV sector, and <60' fixed gear sector. Of these three sectors, however, only the non-AFA trawl CV sector has had a substantial percentage of its overall Pacific cod catch in the AI in recent years. Thus, the possibility that a substantial portion of a sector's overall BSAI allocation is attributed to the AI allocation but only a small portion of the eligible vessels in the sector have AI endorsements appears primarily an issue for the non-AFA trawl CV sector.

Table 1 Number of BS, AI and BSAI LLPs in the BSAI Pacific cod sectors

Sector	Permit required and/or eligibility criteria per statute	BS only LLP	AI only LLP	BSAI LLP	Total # of valid LLPs
AFA Trawl CP	AFA CP permit/listed in 208(e)(1)-(20); trawl LLP (CP/BSAI)	1	0	19	20
Non-AFA Trawl CP	CP; must have harvested with trawl gear and processed no less than 150 mt of non-pollock groundfish during 1997 through 2002.	5 (1 interim)	1	23 (2 interim)	29 LLPs (on 26 vessels) ¹
AFA Trawl CV	AFA CV permit; trawl LLP (CV/BSAI) ²	60	0	51 (1 interim)	111
Non-AFA Trawl CV	trawl LLP (CV/BSAI)	44 (2 interim)	2	4	50
Hook-and-line CP	non-trawl LLP (BSAI/H&L CP cod endorsement)	2	0	42 (5 interim)	40
Hook-and-line CV > 60'	non-trawl LLP (BSAI/H&L CV cod endorsement)	1	1	7	9
Pot CP	non-trawl LLP (BSAI/pot CP cod endorsement)	3	0	5 (2 interim)	8
Pot CV > 60'	non-trawl LLP (BSAI/pot CV cod endorsement)	48 (2 interim)	0	24 (3 interim)	53
Hook-and-line/Pot < 60'	non-trawl LLP (CV/BSAI)	90 (3 interim)	2	N/A	116
Jig CV	LLP is not required for <60' jig CV in the BSAI	N/A	N/A		N/A
Total Endorsements		254	6	175	435

¹Note that 44 BSAI trawl CP licenses exist (that are not associated with AFA vessels), but only 26 vessels (on which 29 LLPs are used) qualify under the eligibility criteria to participate in the non-AFA trawl CP sector for BSAI groundfish authorized in the Consolidated Appropriations Act of 2005. Of the remaining 15 trawl CP licenses currently being used on vessels ineligible for the non-AFA trawl CP sector, 9 are being used on AFA CVs and 5 others have a BSAI hook-and-line CP cod endorsement and are accounted for in the hook-and-line CP sector.

²Note that the 111 total LLPs held by this sector, there are 102 trawl CV LLPs and 9 trawl CP LLPs (all 9 are transferable; 8 are endorsed for the BSAI and 1 is endorsed for the BS).

Note that a vessel is not limited to participating in one sector if it has the appropriate license and/or permit; thus the sum of the number of licenses does not represent the number of unique vessels. Note also that the number of LLPs is higher than the number of unique vessels, as one vessel may carry more than one license or vessel may not yet have been designated for use on a license.

Note that this situation, in which only a subset of the sector (vessels with AI endorsements) could fish a portion of the TAC that is established only for the AI, is a factor of the decision to split the BSAI TAC by subarea. That decision is not part of this action, as it is part of the annual specifications process. Unless the LLP program is modified, only those vessels with an AI endorsement will continue to be able to fish in the AI in Federal waters. The Council's decision under this action is limited to determining how to apportion each sector's BSAI allocation into the BS and AI subareas, should the TAC split occur in the future. Recall, however, that the AI endorsements are based on an individual's history in the AI. Thus, if the BS and AI sector allocations are based on actual harvest history (as proposed under Alternative 4), this alternative should serve to mirror actual harvest history by sector in the AI subarea. Recall that LLPs

are not required to fish within State waters, thus, all eligible vessels would continue to be allowed to fish in the BS or AI in the parallel Pacific cod fishery within 3 nm and/or in the State water AI Pacific cod fishery for specific gears and vessel sizes.

In October 2006, the Council added a new option to each of the alternatives that would make separate BS and AI LLP area endorsements a single BSAI area-wide endorsement for the Pacific cod fishery. This option would give all groundfish vessels that have historically operated only in the BS, an AI endorsement, despite the lack of catch history in the AI. It would also give groundfish vessels with an AI only endorsement and BS endorsement, again despite the lack of catch history in the BS. The purpose of this option is to allow sectors with Pacific cod apportionment in the AI, but have limited AI endorsements, the ability to harvest their AI apportionment. In addition, some industry participants are also concerned that with separate BS and AI TACs, the BS Pacific cod fishery could potentially close earlier than it would under a combined TAC. For those Bering Sea participants that historically fished for Pacific cod later in the year, an early closure could potentially result in some participants reexamining their fishery options.

In general, the most obvious effect of this option would be to increase the number of AI endorsements by 254 and the number of BS endorsements by 6 (see Table 1). Currently 181 licenses have AI endorsements. The sectors that will receive the most new AI endorsements are the AFA trawl CV sector at 60 new endorsements, non-AFA Trawl CV sector at 44 new endorsements, pot CV > 60' at 48 new endorsements, and the hook-and-line/pot < 60' at 89 new endorsements.

As noted above, one of the reasons the Council added the new option was because of concerns that some sectors could be constrained in their ability to harvest their AI sector cod allocation. However, the new option may only be necessary to addressing the Council's concern if Alternative 3 were selected. Alternative 2 would have separate TACs for the BS and AI, but apportionments at the sector level would remain BSAI area-wide. In contrast, area apportionments for Alternative 4 would be based on historic catch patterns in each of the areas, so sectors would be apportioned Pacific cod based on their past harvest. However, under Alternative 3, sector allocations of Pacific cod would **not** be apportioned based on historic fishing in the AI or BS, but instead would be based on an equal percentage in both BS and AI of the sector's combined BSAI Pacific cod allocation. In other words, if the Pot CV $\geq 60'$ sector allocation of BSAI Pacific cod is 8.4%, then the sector would be apportioned 8.4% of the AI TAC and 8.4% of the BS TAC despite the sector having very limited catch history in the AI.

In the Trawl Latent License action, the Council is currently considering creating new endorsements for the Aleutian Islands on trawl catcher vessel licenses that have landings in the parallel or State water fisheries in the Aleutian Islands. This action is intended to address a perceived shortage of trawl catcher vessel licenses in the Aleutian Islands, particularly for the Pacific cod fishery. The number of potential new AI LLPs created under this action is estimated at most to be 21. In general, if the Council perceives there is a shortage of trawl catcher vessel licenses in the AI, this option could more effectively address those concerns, rather than giving all groundfish vessels with only a BS endorsement an AI endorsement, due the potential effects created from this action.

Giving all groundfish vessels with only a BS endorsement an AI endorsement (and vice versa) could have impacts on those participants with existing AI endorsements and on the AI fishing environment. One potential effect of this option could be a reduction in the market value of the existing AI endorsements. Given there is 184 AI endorsements currently, the supply of AI endorsements will more than double if this option is selected. Ultimately, the decline in the market price for AI endorsement depends on the demand for the new AI endorsements in each sector. An increase in AI endorsement could also potentially result in more gear conflicts on the fishing grounds and shorter AI openings brought about from a race for fish. The extent of the potentially increase in fishing in the AI cannot be determined with

any certainty, but if a sector is apportioned Pacific cod in the AI and if individual participants perceive the benefits of fishing for AI Pacific cod greater than the costs of fishing in that area, then individuals, in general, will enter the AI Pacific cod fishery.

Another potential effect could be an increase in the number of vessels fishing in the AI. An action that could increase the intensity of effort in the Aleutian Islands area could be considered a departure from the fishing conditions that existed at the time of the last FMP level Section 7 consultation under the Endangered Species Act. When the FMP Biological Opinion was prepared in 2000, the Pacific cod fishery was part of a jeopardy determination, and as a consequence the Council and NMFS developed additional restrictions for that fishery (and the pollock and Atka mackerel fisheries) to remove the jeopardy determination, as provided for in the 2001 BiOp. Under the 2001 BiOp, SSL protection measures were established for the Pacific cod fishery based on how that fishery was prosecuted at that time. If those conditions change substantively, such as allowing an increase in effort in the Pacific cod fishery in the AI, this could be considered a change in the action that was considered in the 2001 BiOp and this might trigger a new consultation. A new FMP level consultation is under way at this time, and a draft BiOp is expected in June 2007 based on how all groundfish fisheries are currently prosecuted. If Pacific cod fishing conditions change appreciably in the AI region, such an action could be folded into that ongoing consultation.

Finally, the new AI endorsements could create latent AI endorsements, running counter to the Council's action to reduce latent licenses in the BSAI. Recall, the Council is currently proposing an action that would make changes to the License Limitation Program to reduce latent capacity in the BSAI and GOA trawl sectors. The main focus of the latent license reduction amendment is to reduce the future potential for increases in trawl groundfish fishing effort from currently unused or underutilized LLPs, although the action does have an option to increase the number of endorsements in the Aleutian Islands area for the non-AFA trawl CV sector. Ultimately, if the Council removes latent licenses from the AI as part of the BSAI and GOA trawl LLP recency action, but then adds additional AI endorsements in this action, it is likely the Council will have increased the potential for even greater numbers of latent licenses in the AI Pacific cod fishery. Under the BSAI and GOA trawl LLP recency amendment, approximately 5 non-AFA trawl CV AI endorsements and 3 to 22 AFA trawl CV AI endorsements could be removed depending on which options were selected. Those same AI endorsements removed in that action would be recreated in the BSAI Pacific cod area apportionment action, thus creating fundamental inconsistencies between the two actions.

If the Council retains the option to change separate BS and AI LLP area endorsements into BSAI area-wide endorsements for the Pacific cod fishery, the Council may want to amend the problem state to explicitly address the need for creating area wide endorsements.

IV. State water Aleutian Islands Pacific cod fishery

At its December 2005 meeting, the Alaska Board of Fisheries (Board) generated a proposal (BOF proposal 399) to create a new regulation establishing a State waters Pacific cod fishery in the Aleutian Islands west of 170° W longitude. In the past, the BSAI Pacific cod fishery in State waters has been managed as a parallel fishery to the Federal fishery; the Federal government manages all harvests (inside or outside State waters) against the Federal BSAI Pacific cod TAC and allocations, opens and closes seasons, establishes gear restrictions, etc. Upon request of the Council, the Board and the Council met jointly to discuss the proposal on February 3 in Anchorage, and the Board approved this proposal during its February 23–25, 2006 meeting in Ketchikan. The existing State water AI Pacific cod fishery was modified by the Board at its October 14 and 15, 2006 meeting. Among other adjustments to the regulations, the Board modified the opening date and vessel length restrictions for trawl and fixed gear vessels. The primary elements of the fishery include:

1. The guideline harvest level (GHL) for the state waters fishery will be an amount calculated as 3% of the Federal BSAI Pacific cod ABC. The future calculation (the "source" of the GHL) will be the Council's decision should the BSAI ABC be split into separate AI and BS ABCs in a future TAC specifications process. The State water fishery, however, would remain the equivalent of 3% of the combined BS and AI ABC.
2. The fishery may occur only from four days after the initial BSAI parallel catcher-vessel trawl fishery is closed through December 31 each year, or until the GHL is taken. All parallel Pacific cod fishery sectors are closed during the state-waters fishery.
3. Legal fishing gear will be pot, jig, hand troll, non-pelagic trawl, and longline gear.
4. Vessels used to harvest Pacific cod with non-pelagic trawl gear in state-waters fishery are restricted to 100 feet in overall length or less. Vessels used to harvest Pacific cod with mechanical jig and longline gear in the state-waters fishery are restricted to 58 feet in overall length or less.
5. A maximum of 70% of the GHL may be harvested prior to June 10. Any unharvested GHL that has not been harvested by April 1, then on that day the state-waters fishery will close and the parallel fishery will open. If adequate state-waters GHL remains after the closure of the parallel fishery that began on April 1, then the state-waters fishery may reopen prior to June 10.
6. Any unharvested 'A' season GHL will be rolled into the second season. A total of 30% of the GHL plus the unharvested amount from the prior season up to a maximum of 70% will be available for the second season.
7. During the year, the Commissioner of ADF&G may determine that a portion of the GHL may be left unharvested. The Commissioner will notify NMFS and the Council of that amount so that it may be reallocated to the Federal fisheries that are still open at that time.
8. The fishery requires registration with ADF&G of the type of gear to be used.
9. The daily trip limit is 150,000 lbs of Pacific cod; there is also a limit of up to 300,000 lbs of unprocessed Pacific cod onboard the vessel. A vessel may not have more processed fish onboard than the round weight equivalent of the fish reported on ADF&G fishtickets during the AI state waters Pacific cod fishery. Participants must notify ADF&G daily of the amount harvested and the total amount on board.
10. All Pacific cod harvested must be retained. If a participant harvests an amount in excess of the daily trip limit, that excess amount of product must be forfeited to the State. No penalty for overages will be assigned to a participant who immediately reports the overage.
11. The Commissioner of ADF&G may impose bycatch limitations or retention requirements.

The State regulations authorizing this fishery were changed in October 2006 to allow the fishery to begin four days after the initial BSAI parallel trawl CV fishery is closed, which coincides with the closure of the Federal BSAI CV cod A season. The Board's action in October also removed the sunset data (initially 2007) on this fishery.

This action affects all sectors, as well as the BSAI Pacific cod CDQ reserve, as that allocation is calculated as a percentage of the BSAI Pacific cod TAC. Thus, all sectors realized a proportional

reduction of 3% of their current Federal allocations as a result of this action. Three percent of the 2007 ABC of 176,000 mt represents about 5,280 mt (or 11,640,288 lbs). Note that the State fishery is limited to 70% of the total GHL in the first half of the year (prior to June 10) and any unharvested quota from the first season is rolled over to the second season (on or after June 10). For 2007 season, the 5,280 mt GHL, equates to 3,696 mt in the first season and 1,584 mt in the second season. This provision mirrors the overall Pacific cod seasonal apportionments in place under the current Steller sea lion mitigation measures.

The overall effect of a State waters Pacific cod fishery in the Aleutian Islands west of 170° W longitude is that all sectors, including the CDQ fishery, will realize a proportional reduction of 3% of their current Federal allocations. Because the same gear types are allowed to fish the GHL as are allowed in the Federal fishery, recognizing the limitation on vessel size in the State water fishery, it is not clear to what extent each sector will participate in and benefit from the State water fishery in the Aleutians. The first 2006 season of the fishery opened on March 15 and ended on March 24, 2006. Twenty-six vessels registered and participated in the fishery, including one large trawl CP, five hook-and-line CPs, one pot CV $\geq 60'$, sixteen trawl CVs $\geq 60'$, and three trawl CVs $< 60'$. In addition, two floating processors and two shorebased processors (located in Dutch Harbor and Adak) participated. About 94% of the first season GHL of 8.98 million pounds was harvested.

It is anticipated that while the intent is to allow additional harvests by the identified sectors in State waters west of 170° W longitude, the overall effect will be a redistribution of cod harvests and associated revenues from vessels of all gear types that fish in Federal waters in the AI or in the Bering Sea (within Federal or State waters) and from ports east of 170° W. Thus, there will likely be a disproportionate negative effect on those participants that do not desire to fish in State waters in the Aleutian Islands, compared to those participants that have harvested and want to continue to harvest Pacific cod in the Aleutians and within State waters. In general, the fixed gear and jig gear sectors have reduced the AI share of their total BSAI Pacific cod harvest in recent years, while the trawl sectors have generally increased the AI share of their total BSAI Pacific cod harvest.

The press release announcing the AI State Pacific cod fishery states that bycatch limits that apply in the parallel fishery will apply in the State waters fishery (ADF&G news release, 3/1/06). Halibut mortality from a State waters groundfish fishery cannot be deducted from a Federal fishery category, thus, the PSC allowances for the Federal Pacific cod fisheries will not be modified as a result of this action. The State could choose to enforce Federal closures that result from reaching PSC limits in State waters, but that decision is at the Commissioner's discretion. Pot and jig gear are exempt from PSC limits due to very low bycatch rates. However, the A season GHL was harvested in ten days, primarily by trawl vessels. The B season, which started on June 10 with a GHL of a little over 4 million pounds, closed on September 1. The State held back 0.5 million pounds for a possible reopening later in the year.

Note that observer coverage is not required under a State water fishery. However, it is assumed that this fishery will operate similarly to the Gulf of Alaska State Pacific cod fishery, in that if the vessel in the State fishery has a Federal Fisheries Permit (FFP), then any time the vessel operates in the State fishery it is subject to observer coverage requirements, and any time an observer is onboard in the State fishery can be counted toward the Federal observer coverage requirements. One presumes that this is based on the premise that any time a vessel has an FFP, it is authorized to fish in the EEZ when the fishery is open. When the Federal GOA Pacific cod fishery closes, generally, the majority of the fleet surrenders the FFP in order to relieve itself of observer coverage requirements. A few vessels, however, sometimes choose to continue to keep their FFP and carry observers in the State water cod fishery, in order to satisfy their observer coverage requirements. In the fishery's first season, six vessels voluntarily carried a Federal observer.

V. Data used in discussion paper

The data in this analysis are retained harvests from 1995 through 2005 with and without cod destined for meal production. Retained harvest data for CPs are from NMFS Weekly Production Reports; retained harvest data for CVs are from Alaska Department of Fish and Game electronic fish tickets.

The Council's intent in Amendment 85 was to allocate Pacific cod based upon retained harvest, as its retention is required in both the directed fishery and up to the maximum retainable allowance when the directed cod fishery is closed. However, the 100% retention requirement did not begin until January 3, 1998, so that in the years 1995-1997 Pacific cod could be (and were) legally discarded.

What has occurred after the 100% retention standards for Pacific cod were in effect is less clear-cut. For example, some catcher vessel deliveries contained fish in poor condition which could not be processed for human consumption. Often, these fish were processed into fish meal, as the fish could not be discarded.

Among the CPs, the inclusion/exclusion of Pacific cod meal products affects the AFA trawl CP sector, as a large portion of the Pacific cod harvested by this sector is taken incidentally in the BSAI pollock fishery. There are some AFA CPs whose sole Pacific cod product has been meal, so that if meal were included, the number of vessels contributing to the harvest would increase.

Only a portion of the AFA trawl CP sector process meal, as the processing infrastructure (and space on board) required for this type of product is substantial. None of the non-AFA trawl CP sector have meal plants onboard. Of the existing alternatives, only Alternative 4 would be impacted by the inclusion of fish meal in the catch data as it slightly shifts the distribution of catch for the AFA trawl CP sector from the AI to the BS. To get an indication of the extent of Pacific cod destined for meal production, separate tables with and without meal have been included in the analysis where appropriate.

VI. Harvest distribution between BS and AI by sector

In considering the division of the BSAI Pacific cod sector allocations between BS and AI management areas upon a TAC split, it is useful to consider the historic harvests from those areas. This section provides a general description of historic harvests from 1995 to 2005. Table 2 shows the amount and division of retained catch between the BS and AI subareas during 1995–2005 without meal, and Table 3 shows that same information with meal included. The data shows that retained catch from the Aleutian Islands fluctuated from 1995 through 1997, then stabilized from 1999 through 2004 at between 15% and 20% of the combined BSAI retained catch, and then in 2005 catch from the Aleutian Islands declined to 12.6%. From 2000 to 2005, approximately 16.4% of the BSAI retained harvests were from the Aleutian Islands area. The effect of including meal in the catch statistics increases the BS history one or two tenths of a percent while decreasing the AI history the same percent.

Table 2 Pacific cod retained catch in the Aleutian Islands and Bering Sea from 1995 to 2005 without meal (in metric tons and percent of total)

Area		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Aleutian Islands	Retained catch	9,782	21,603	13,169	25,187	24,441	29,793	30,410	27,442	29,384	34,027	26,365	271,601
	Percent of BSAI	5.5%	11.2%	6.2%	15.3%	17.0%	18.5%	19.9%	16.5%	16.2%	15.8%	12.6%	13.7%
Bering Sea	Retained catch	167,255	171,798	200,245	139,382	119,643	131,434	122,141	138,795	151,496	180,751	182,800	1,705,741
	Percent of BSAI	84.5%	88.8%	93.8%	84.7%	83.0%	81.5%	80.1%	83.5%	83.8%	84.2%	87.4%	86.3%
BSAI	Retained catch	177,037	193,402	213,414	164,569	144,084	161,228	152,551	166,236	180,880	214,778	209,165	1,977,343

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located at (Tables 2 and 3 Jan 2007.xls)

Table 3 Pacific cod retained catch in the Aleutian Islands and Bering Sea from 1995 to 2005 with meal (in metric tons and percent of total)

Area		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Total
Aleutian Islands	Retained catch	9,782	21,603	13,169	25,226	24,475	29,832	30,412	27,445	29,387	34,036	26,365	271,732
	Percent of BSAI	5.5%	11.1%	6.2%	15.1%	16.7%	18.3%	19.7%	16.2%	16.0%	15.6%	12.4%	13.6%
Bering Sea	Retained catch	167,632	172,324	200,365	141,330	121,913	133,517	123,930	141,903	153,739	183,587	186,444	1,726,684
	Percent of BSAI	94.5%	88.9%	93.8%	84.9%	83.3%	81.7%	80.3%	83.8%	84.0%	84.4%	87.6%	86.4%
BSAI	Retained catch	177,414	193,928	213,534	166,556	146,388	163,349	154,342	169,347	183,126	217,623	212,809	1,998,416

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located at (Tables 2 and 3 Jan 2007.xls)

Table 4 shows, for each sector, the average annual retained catch, without meal, in each subarea and the BSAI as a whole, the percent of the sector's catch from each subarea, and the number of unique vessels with Pacific cod catches in each subarea and in the BSAI as a whole for two time periods, 1995–1999 and 2000–2005. In general all sectors for which allocations are being considered under this action have some history in both the Aleutian Islands and Bering Sea Pacific management areas. For the non-AFA trawl CV sector, sub-area retained catch data is not shown for the period 1995–1999 because of confidentiality limitations.

A summary of Table 4 shows overall harvest by AFA trawl CP and AFA trawl CV sectors has decreased since 1999, but the AFA trawl CV sector has more than tripled its annual catch from the Aleutian Islands during the 2000 to 2005 period. The non-AFA trawl CP sector has increased its annual catch slightly in the Bering Sea from the first to the second period, but has more than doubled its Aleutian Islands catch. Annual Pacific cod harvest by the hook-and-line CP sector and the ≥60' pot CV sector are stable and largely from the BS in both time periods. Pacific cod harvest by the jig CV sector and ≥60' hook-and-line CV sector are relatively small in both areas. Catches in these sectors are heavily weighted toward the BS. Harvest by fixed gear vessels <60' has increased substantially across the two periods (likely due to the separate allocation established for this sector in 2000), but are predominantly from the Bering Sea in both periods.

Table 4 Retained Pacific cod catch (without meal) in the Bering Sea and Aleutian Islands by sector and percent of each sector's catch by area, 1995–1999 and 2000–2005

Sector	Area	1995-1999			2000-2005		
		Average annual catch (mt)	Percent of sector BSAI catch	Unique vessels	Average annual catch (mt)	Percent of sector BSAI catch	Unique vessels
Hook and Line and Pot CVs < 60'	AI	26	10.0%	19	40	2.2%	29
	BS	235	90.0%	70	1,803	97.9%	98
	BSAI	261		79	1,843		116
AFA Trawl CPs	AI	2,519	62.6%	9	1,620	68.8%	3
	BS	1,505	37.4%	18	734	31.2%	13
	BSAI	4,025		20	2,354		17
AFA Trawl CVs	AI	2,589	6.0%	40	9,643	30.4%	42
	BS	40,406	94.0%	108	22,062	69.6%	104
	BSAI	42,995		109	31,705		107
Jig CVs	AI	21	7.4%	6	14	10.1%	12
	BS	259	92.6%	67	125	89.9%	54
	BSAI	280		73	139		63
Longline CPs	AI	5,967	6.9%	33	5,446	6.0%	29
	BS	80,248	93.1%	55	85,016	94.0%	48
	BSAI	86,215		56	90,462		49

Sector	Area	1995-1999			2000-2005		
		Average annual catch (mt)	Percent of sector BSAI catch	Unique vessels	Average annual catch (mt)	Percent of sector BSAI catch	Unique vessels
Longline CVs	AI	9	28.6%	12	38	3.2%	21
	BS	22	71.4%	25	1,144	96.8%	33
	BSAI	31		32	1,182		43
Non-AFA Trawl CPs	AI	3,676	18.9%	21	9,952	30.8%	15
	BS	15,814	81.1%	39	22,333	69.2%	25
	BSAI	19,491		40	32,285		25
Non-AFA Trawl CVs	AI	*	*	2	2,137	50.8%	21
	BS	*	*	31	2,068	49.2%	32
	BSAI	2,579		32	4,205		44
Pot CPs	AI	1,283	26.9%	12	250	9.0%	9
	BS	3,491	73.1%	22	2,543	91.1%	10
	BSAI	4,774		24	2,793		13
Pot CVs	AI	848	5.8%	42	431	3.1%	34
	BS	13,684	94.2%	183	13,409	96.9%	121
	BSAI	14,532		189	13,839		139

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located at (Tables 4 and 5.xls).
*Not shown due to restrictions on confidential data

Table 5 Retained Pacific cod catch (with meal) in the Bering Sea and Aleutian Islands by sector and percent of each sector's catch by area, 1995-1999 and 2000-2005

Sector	Area	1995-1999			2000-2005		
		Average annual catch (mt)	Percent of sector BSAI catch	Unique vessels	Average annual catch (mt)	Percent of sector BSAI catch	Unique vessels
Hook and Line and Pot CVs < 60'	AI	26	10.0%	19	41	2.2%	30
	BS	235	90.0%	70	1,822	97.8%	101
	BSAI	261		79	1,864		116
AFA Trawl CPs	AI	2,519	54.2%	9	1,620	48.6%	3
	BS	1,505	45.8%	18	1,714	51.4%	17
	BSAI	4,025		20	3,334		17
AFA Trawl CVs	AI	2,589	6.0%	40	9,650	29.1%	42
	BS	40,406	94.0%	108	23,499	70.9%	107
	BSAI	42,995		109	33,149		107
Jig CVs	AI	21	7.4%	6	14	10.0%	12
	BS	259	92.6%	67	127	90.0%	54
	BSAI	280		73	141		63
Longline CPs	AI	5,967	6.9%	33	5,446	6.0%	29
	BS	80,248	93.1%	55	85,017	94.0%	48
	BSAI	86,215		56	90,463		49
Longline CVs	AI	9	28.6%	12	39	3.3%	22
	BS	22	71.4%	25	1,145	96.7%	35
	BSAI	31		32	1,184		43
Non-AFA Trawl CPs	AI	3,676	18.9%	21	9,952	30.8%	15
	BS	15,814	81.1%	39	22,333	69.2%	25
	BSAI	19,491		40	32,285		25

Sector	Area	1995-1999			2000-2005		
		Average annual catch (mt)	Percent of sector BSAI catch	Unique vessels	Average annual catch (mt)	Percent of sector BSAI catch	Unique vessels
Non-AFA Trawl CVs	AI	*	*	2	2,137	50.4%	21
	BS	*	*	31	2,102	49.6%	33
	BSAI	2,579		32	4,238		44
Pot CPs	AI	1,283	26.9%	12	250	8.9%	9
	BS	3,491	73.1%	22	2,543	91.1%	10
	BSAI	4,774		24	2,793		13
Pot CVs	AI	848	5.8%	42	431	3.1%	34
	BS	13,684	94.2%	183	13,551	96.9%	122
	BSAI	14,532		189	13,982		139

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located at (Tables 4 and 5.xls)

*Not shown due to restrictions on confidential data

The existing alternatives and options developed do include harvest data beyond 2003, but the Council requested 2004 and 2005 data. Table 6 and Table 7 below provide retained catch by sector with and without meal for 2004 and 2005. Note that confidential data for the AFA trawl CP sector, jig gear sector, longline CV sector, and pot CP sector are not provided.

Table 6 below indicates that about 15.8% and 12.6% of the total BSAI Pacific cod harvest was taken in the AI in 2004 and 2005, respectively. Note that Table 2 from the previous section showed that from 1999 to 2005, approximately 16.4% of the BSAI retained harvests were from the AI. Thus, it appears that the Pacific cod harvest in the AI is a slightly smaller share of the overall BSAI Pacific cod harvest than realized in 1999 - 2003. In addition, including fish meal, reduces the percent of the AI harvest relative to the BS.

Table 6 Pacific cod retained catch by sector without meal in the BS, AI, and BSAI areas for 2004 and 2005

2004						
Sector	BS (mt)	BS (%)	AI (mt)	AI (%)	BSAI	% of total BSAI
<60 HAL/Pot CVs	3,133	98.3%	53	1.7%	3,186	1.5%
AFA Trawl CPs	*	*	*	*	*	*
AFA Trawl CVs	25,468	69.3%	11,304	30.7%	36,771	17.1%
Jig CVs	*	*	*	*	*	*
Longline CPs	101,648	96.7%	3,451	3.3%	105,099	48.9%
Longline CVs	*	*	*	*	*	*
Non-AFA Trawl CPs	32,094	68.6%	14,715	31.4%	46,808	21.8%
Non-AFA Trawl CVs	1,555	39.0%	2,433	61.0%	3,988	1.9%
Pot CPs	3,970	100.0%	0	0.0%	3,970	1.8%
Pot CVs	11,593	100.0%	0	0.0%	11,593	5.4%
Total	180,751	84.2%	34,027	15.8%	214,778	100.0%

2005						
Sector	BS (mt)	BS (%)	AI (mt)	AI (%)	BSAI	% of total BSAI
<60 HAL/Pot CVs	3,305	99.5%	16.99	0.5%	3,322	1.6%
AFA Trawl CPs	*	*	*	*	*	*
AFA Trawl CVs	23,992	76.6%	7317.34	23.4%	31,309	15.0%
Jig CVs	*	*	*	*	*	*
Longline CPs	105,052	98.0%	2152.576	2.0%	107,204	51.3%
Longline CVs	4,630	99.9%	6.63	0.1%	4,637	2.2%
Non-AFA Trawl CPs	26,811	67.8%	12721.64	32.2%	39,533	18.9%
Non-AFA Trawl CVs	1,500	71.7%	592.84	28.3%	2,093	1.0%
Pot CPs	*	*	*	*	*	*
Pot CVs	11,457	100.0%	0	0.0%	11,457	5.5%
Total	182,800	87.4%	26364.8	12.6%	209,165	100.0%

Source: : NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located at (Pcod tables Jan 07.xls)
 *Not shown due to restrictions on confidential data

Table 7 Pacific cod retained catch by sector with meal in the BS, AI, and BSAI areas for 2004 and 2005

2004						
Sector	BS (mt)	BS (%)	AI (mt)	AI (%)	BSAI	% of total BSAI
<60 HAL/Pot CVs	3,184	98.1%	62	1.9%	3,246	1.5%
AFA Trawl CPs	*	*	*	*	*	*
AFA Trawl CVs	27,279	70.7%	11,304	29.3%	38,584	18.1%
Jig CVs	*	*	*	*	*	*
Longline CPs	101,657	96.7%	3,451	3.3%	105,108	49.3%
Longline CVs	*	*	*	*	*	*
Non-AFA Trawl CPs	32,094	68.6%	14,715	31.4%	46,808	21.9%
Non-AFA Trawl CVs	1,563	39.1%	2,433	60.9%	3,996	1.9%
Pot CPs	3,970	100.0%	0	0.0%	3,970	1.9%
Pot CVs	11,687	100.0%	0	0.0%	11,687	5.5%
Total	181,433	85.0%	31,965	15.0%	213,399	100.0%
2005						
Sector	BS (mt)	BS (%)	AI (mt)	AI (%)	BSAI	% of total BSAI
<60 HAL/Pot CVs	3,329	99.5%	17	0.5%	3,346	1.7%
AFA Trawl CPs	*	*	*	*	*	*
AFA Trawl CVs	26,271	78.2%	7,317	21.8%	33,589	16.6%
Jig CVs	*	*	*	*	*	*
Longline CPs	105,052	98.0%	2,153	2.0%	107,204	53.1%
Longline CVs	4,634	99.9%	7	0.1%	4,641	2.3%
Non-AFA Trawl CPs	26,811	67.8%	12,722	32.2%	39,533	19.6%
Non-AFA Trawl CVs	1,520	71.9%	593	28.1%	2,113	1.0%
Pot CPs	*	*	*	*	*	*
Pot CVs	11,608	100.0%	0	0.0%	11,608	5.7%
Total	179,225	88.7%	22,808	11.3%	202,034	100.0%

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located at (Pcod tables Jan 07.xls)
 *Not shown due to restrictions on confidential data

The data in Table 6 and Table 7 are important in determining whether the distribution of harvest by sector in the two subareas has changed in two recent years. The overall trend discussed previously in this section is that the trawl sectors have generally increased the percentage of their Pacific cod harvest in the AI

compared to the BS over time, while the fixed gear sectors have generally decreased their share harvested in the AI. **The data provided for 2004 and 2005 follows this trend, as the trawl sectors appear to continue to take more of their total harvest in the AI than they did in 1995 – 1999.**

The data shows that the Non-AFA trawl CP sector harvested about 31% and 32% of their total BSAI Pacific cod harvest in the AI in 2004 and 2005, respectively. This can be roughly compared to about 32% of their total BSAI Pacific cod harvest taken in the AI during 2000 – 2003. The AFA trawl CV sector harvested about 31% and 23% of their total BSAI Pacific cod harvest in the AI in 2004 and 2005, respectively. This can be roughly compared to about 34% of their total BSAI Pacific cod harvest taken in the AI during 2000 – 2003.

While the fixed gear sectors have not harvested a significant amount of cod in the AI during any of the years considered, they continue to harvest less of their total cod share in the AI in the most recent years. The hook-and-line CP sector harvested about 3% and 2% of its total cod catch in the AI during 2004 and 2005, respectively. This compares to an estimated 8% in 2000 – 2003. Hook-and-line and pot catcher vessels of any length, as well as jig vessels, harvested little to none of their total BSAI Pacific cod harvest in the AI in 2004 and 2005, and less than was harvested on average in 2000 – 2003.

VII. Alternative 1: No action

Under Alternative 1, a methodology to apportion the BSAI Pacific cod allocations to the jig, trawl, and fixed gear sectors between the BS and AI subareas would not be selected. Note that selecting no action under Alternative 1 does not mean that the BSAI TAC will not be split into the BS and AI subareas in a future specifications process, however, the likelihood of the Council recommending this split without having a methodology to apportion the numerous industry sector allocations by subarea is uncertain. As noted above, the only approach that could be implemented without a new regulatory amendment is an equal percentage of both the BS and AI subarea TAC by sector. The implications of that potential action are described under Alternative 3.

Alternative 1 effectively means that the Council would explicitly not select a method of apportioning by subarea the numerous sector allocations determined under Amendment 85 that were established for the entire BSAI area. In the event the BSAI TAC is split by subarea in the future, it is likely that NMFS would implement equal percentages of each sector's BSAI allocation in each area (e.g., if a sector receives a 40% BSAI allocation, it would receive 40% in the BS and 40% in the AI upon a TAC split) under the current regulations. It is likely that this management system would not be satisfactory to most participants, as it would not reflect each sector's recent harvest history by subarea (see Table 4 above). In general, the trawl sectors have increased the percentage of their total harvest taken from the AI in recent years, and the fixed gear sectors have reduced their share in the AI.

Thus, Alternative 1 may effectively mean that a separate, new regulatory amendment would be initiated following the TAC split, in order to allocate each sector's BSAI allocation by subarea in a manner that reflects recent harvest patterns. The primary intent of the proposed action is provide direction in the regulations prior to separate TACs being issued in the annual specifications process, in order to avoid expediting an analysis to mitigate these circumstances. As the action would require notice and comment rulemaking under the current amendment process, it would likely require a minimum of six months to a year to implement new subarea sector allocations.

VIII. Alternative 2: Sector allocations remain BSAI

Under Alternative 2, sectors would not be allocated a specific percentage of the individual AI subarea TAC or BS subarea TAC. Instead, sectors would continue to be issued an overall amount of the BSAI

Pacific cod TAC as determined in Amendment 85. In effect, a sector's allocation could be fished from either the BS or AI subarea, as long as TAC was available in that subarea and the area was open to directed Pacific cod fishing. Once the Pacific cod TAC for either the BS or AI was reached, NMFS would issue a closure notice and all sectors would be required to stop directed Pacific cod fishing in the closed subarea. The sectors would then only be permitted to continue directed fishing in the open subarea.

This alternative provides the greatest flexibility for sectors and may be the simplest alternative for inseason management to monitor. NMFS would not be required to manage two separate subarea allocations for each of the nine non-CDQ sectors. They would instead be required only to monitor each sector's overall BSAI allocation and a single harvest limit for each subarea, using the existing tools to open and close fisheries. Alternative 2 would also provide maximum flexibility to the fleet since the sectors would be able to fish in either subarea if it was open. Thus, regardless of historical harvest patterns, sectors could move in and out of a subarea as desired on an inseason or annual basis, and focus their efforts in the area in which they can optimize their harvest at that point in time. Thus, while some sectors have not had substantial participation in the AI in the past, if this area became more advantageous due to shifts in the stock or a desire to deliver to a new port, these sectors would be able to shift more of their fishing to the AI. Note, however, that only vessels with an AI endorsement earned on their LLP would be eligible to fish in the AI under any of the alternatives.

Under Alternative 2, it is assumed that each sector would attempt to fish in its preferred area first, especially if that area is the most constrained by TAC, such as the Aleutian Islands. A possible disadvantage of this alternative is that it could cause sectors (both within sectors and among sectors) to race for Pacific cod in the subarea they expect to close first. This could affect a sector's ability to rationalize their harvest, especially if some members of the sector wanted to fish the subarea that is expected to close later in the year. The sectors that operate under a cooperative structure (e.g., the AFA sectors and in the future, the non-AFA trawl CP sector) will manage their sector's Pacific cod harvest through internal agreements and thus will be much better positioned to strategize and fish in the subarea they expect to close first.

The level of risk in creating a race for fish in the AI under Alternative 2 is difficult to characterize; it is speculative and dynamic, depending on each sector's participation in the AI each year. As stated previously, the best estimate of long-term average biomass distribution is 85% in the BS and 15% in the AI. During the past eleven years for which data is available (1995–2005), the AI share of BSAI Pacific cod retained harvest was 13.7%, and the BS share was 86.3%. Under this long-term average, it does not appear that a race for fish in the AI would be inevitable. However, if the time frame is shortened to the most recent years (2000–2005), the share percentages change to 16.4% in the AI and 83.6% in the BS. In addition, the annual share taken in the AI has ranged from a low of 5% (1995) to a high of 20% (2001) during 1995–2005 (see Table 2). Thus, while the long-term average share taken in the AI does not exceed the 15% projected, the average of a subset of the most recent harvest years slightly exceeds 15%. In addition, each individual year, except 2005, during the past five years (1999–2005) also exceeded 15%.

Generally, the trawl sectors have increased their share of AI harvest as a percentage of their overall BSAI harvest and the fixed gear sectors have decreased their share of AI harvest as a percentage of their overall BSAI harvest, in the past several years. As stated above, because three of the four trawl sectors (AFA and non-AFA CP sectors) operate, or will operate, under a cooperative structure, these sectors should be better positioned to manage their harvest between subareas within their respective sectors. If the AI subarea is expected to close first, Alternative 2 may result in the trawl sectors fishing first in the AI, in order to ensure their historical level of harvest in the AI. Since the trawl sectors generally have been increasing their harvest in the AI, this may mean that the race for fish in the AI may be an issue among the trawl sectors more so than with or among the fixed gear sectors. At the same time, with the exception of the

non-AFA trawl CV sector, the trawl sectors are better able to plan their fishing year and react to closures than the sectors operating under a limited access regime.

Additionally, NMFS has expressed some concern with this alternative relative to the 2001 Biological Opinion. Because Alternative 2 does not establish sector allocations in each subarea, there are thus no gear specific seasonal apportionments by subarea. While the overall guideline for the BSAI in the 2001 Biological Opinion is a 70%–30% seasonal split, the seasonal apportionments vary by gear type. Thus, absent specific sector allocations in the AI, if any gear type was allowed to fish in the AI until the TAC was taken, this approach risks harvesting all of the AI TAC in the first half of the year. No guidelines currently exist for establishing AI seasonal apportionments by gear type or overall. Thus, NMFS is concerned that this alternative deviates from what was consulted on in the 2001 Biological Opinion.

Note that NMFS initiated another ESA Section 7 consultation on the BSAI and GOA groundfish FMPs in 2006. The process should provide additional information on guidelines for managing the BSAI fisheries in such a manner that does not adversely affect Steller sea lions or their habitat.

Overall, Alternative 2 is likely to be the least disruptive to the BSAI Pacific cod fleet compared to Alternatives 3 and 4. Alternative 2 provides maximum flexibility for the sectors to change their fishing patterns in reaction to a shifting stock, preferable fishing location, or market conditions. This alternative would also not apportion Pacific cod to the extent as Alternatives 3 and 4. As sector allocations are apportioned into separate subareas and then further divided into seasons, flexibility declines and the potential for sector disruption increases.

IX. Alternative 3: Equal percentages in BS and AI subareas

Under Alternative 3, NMFS would be directed to allocate sectors the same percentage of the BS subarea and AI subarea TACs, as determined by the BSAI sector allocations determined in Amendment 85. For example, if the hook-and-line CP sector is allocated 48.7% of the BSAI Pacific cod ITAC under Amendment 85, this sector would be allocated 48.7% of the BS ITAC and 48.7% of the AI ITAC. Note that this alternative also reflects the default scenario under the current regulations, should the Council choose to take no action (Alternative 1).

Table 8 shows the range of BSAI allocations proposed under Amendment 85 for each sector, and the annual average of each sector's BSAI harvest that was taken in the BS and AI subareas during 2000–2005. **In effect, under Alternative 3 and a BSAI TAC split, each sector would be allowed 85% of its BSAI Pacific cod allocation in the Bering Sea and 15% of its BSAI Pacific cod allocation in the AI, using the stock assessment projections of an 85%–15% split between areas.** Refer to the last two columns in Table 8 to compare the proposed split and each sector's historical split as a percentage of its annual average BSAI Pacific cod harvest.

Table 8 Percentage of BSAI Pacific cod harvest taken in BS and AI subareas by sector, average 2000–2005

Sector	BSAI allocations under AM 85 (% of P. cod ITAC)	% of sector's BSAI cod allocation allocated to BS	% of sector's BSAI cod allocation allocated to AI	% of sector's BSAI cod harvest in BS, Avg. 2000–2005	% of sector's BSAI cod harvest in AI, Avg. 2000–2005
AFA trawl CP	2.3%	85%	15%	31.2%	68.8%
Non-AFA trawl CP	13.4%	85%	15%	69.2%	30.8%
Hook-and-line CP	48.7%	85%	15%	94.0%	6.0%
Pot CP	1.5%	85%	15%	91.1%	9.0%
Trawl CV	22.1%	85%	15%	67.0%	33.0%

Sector	BSAI allocations under AM 85 (% of P. cod ITAC)	% of sector's BSAI cod allocation allocated to BS	% of sector's BSAI cod allocation allocated to AI	% of sector's BSAI cod harvest in BS, Avg. 2000–2005	% of sector's BSAI cod harvest in AI, Avg. 2000–2005
Hook-and-line CV ≥60'	0.2%	85%	15%	96.7%	3.20%
Pot CV ≥60'	8.4%	85%	15%	96.9%	3.1%
<60' fixed gear	2.0%	85%	15%	97.9%	2.2%
Jig CV	1.4%	85%	15%	89.9%	10.1%

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located at (Pcod tables Jan 07.xls)

Table 8 shows that most sectors' recent harvest patterns in the BS and AI do not exactly mirror an 85% (BS) and 15% (AI) split. The fixed gear sectors harvested 90% to 98% of their harvest in the BS during the past several years (2000–2005). However, the trawl sectors harvested noticeably less than 85% of their total harvest in the BS during this time period: AFA trawl CP sector – 30%; non-AFA trawl CP sector – 69%; trawl CV sector – 67%. In general, the individual trawl sectors have increased the percentage of their total retained BSAI cod catch harvested in the AI in recent years, and the fixed gear sectors have taken less of their total retained BSAI cod catch from the AI.

Table 9 provides the potential BS and AI allocations by sector, by converting percentage allocations to metric tons, based on the 2007 BSAI Pacific cod ITAC and the projected split of 85% (BS) and 15% (AI). The first data column provides the BSAI allocations to each sector from Amendment 85. These represent percentage shares of the BSAI Pacific cod ITAC. The next column provides the projected BS allocation to that sector under Alternative 3, followed by the average annual BS Pacific cod harvest by that sector in 2000–2005. Finally, the last two columns show the same information by sector for the AI.

Table 9 Projected BS and AI allocations by sector under Alternative 3, using the 2007 BSAI Pacific cod ITAC and the range of allocations from Amendment 85

Sector	Allocation under AM 85 (% of BSAI Pcod ITAC)	Estimation of BS allocation using 2007 ITAC (mt)	Average annual BS cod retained harvest (mt) 2000-2005	Estimation of AI allocation using 2007 ITAC (mt)	Average annual AI cod retained harvest (mt) 2000-2005
AFA trawl CP	2.3%	2,980	734	526	1,620
Non-AFA trawl CP	13.4%	17,364	22,333	3,064	9,952
Hook & line CP	48.7%	63,108	85,016	11,137	5,446
Pot CP	1.5%	1,944	2,543	343	250
Trawl CV	22.1%	28,638	24,130	5,054	11,780
Hook & line CV>60'	0.2%	259	1,144	46	38
Pot CV>60'	8.4%	10,885	13,409	1,921	431
<60' fixed gear	2.0%	2,592	1,803	457	40
Jig CV	1.4%	1,814	125	320	14

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located Pcod tables Jan 07.xls)

Note: The 2007 BSAI Pacific TAC = 170,720 mt. Applying a 10.7% CDQ allocation results in a BSAI ITAC = 152,453 mt. The BS/AI TAC split is projected to be 85% and 15% AI, which means the projected BS ITAC = 129,585 mt and the AI ITAC = 22,868 mt.

Note that Table 9 uses the 2007 BSAI Pacific cod TAC of 170,720 mt, and assumes the 85% (BS) and 15% (AI) split occurs in the future to determine the projected BS and AI TACs. This table also assumes that the CDQ Pacific cod allocation is 10.7%. In effect, 10.7% is removed from the BS and AI TACs to determine the subarea ITACs allocated among the various (non-CDQ) sectors.

Table 9 compares the potential BS and AI allocations to each sector under Alternative 3 to each sector's average annual harvest in the BS and AI. With the exception of the Pot CP and hook and line CV > 60' sectors, the remaining fixed sectors estimated allocation would be more than 50% higher than the annual average harvest by sector in the AI (2000–2005). In hook-and-line CP sector, for example, the AI allocation would be more than 200% higher, and in the pot CV sector the AI allocation would be more than 400% higher than the recent harvest. In the trawl sectors, the opposite is true; generally, the AI allocation to each sector is more than 50% lower than the annual average harvest by trawl sector in the AI (2000–2005). In the non-AFA trawl CP and trawl CV sectors in particular, the estimate of the AI allocation would be 69% and 57% lower than the recent harvest in that area.

The problem statement for the proposed action references the need to recognize differences in dependence among gear groups and sectors that harvest Pacific cod in the BS and AI management areas. While Alternative 3 would mitigate the problem of disproportionate impacts that result from TAC fluctuations, it may force vessels to fish in areas they have very limited historical participation and do not want to fish. This issue impacts all sectors, but would likely be most onerous on the sectors comprised of smaller vessels, as they would be required to travel greater distances to fish in conditions that may not be well suited for their vessels.

In general, Alternative 3 is likely to be the most disruptive to the BSAI Pacific cod fleet of the alternatives considered in this action. The alternative would apportion Pacific cod into subarea and seasonal bins thus reducing the flexibility of the fleet. In addition, Alternative 3 does not result in an allocation scheme between the two subareas that reflects current harvest patterns by sector. In general, Alternative 3 would allocate a lower share of the trawl sectors' BSAI allocations to the AI than has been harvested in the AI in the recent past. In contrast, Alternative 3 would allocate a higher share of the fixed gear sectors' BSAI allocations to the AI than has been harvested in the AI in recent years. In sum, Alternative 3 does not appear to meet the concerns described in the problem statement.

X. Alternative 4: AI allocation based on historic harvest

In February 2006, the Council identified Alternative 4 as the preliminary preferred alternative for how to apportion the various BSAI Pacific cod allocations from Amendment 85 between the BS and the AI. Alternative 4 would define the sector allocations for the AI based on the relative percentages of Pacific cod that were harvested by the sectors in the AI during the identified series of years. Thus, the overall sector splits determined at the combined BSAI level in Amendment 85 remain in place, and the AI sector allocations are then calculated based on AI harvest history. The remainder of each sector's overall BSAI allocation is allocated in the Bering Sea, after accounting for the respective allocation for the Aleutian Islands.

This alternative allows the BSAI sector allocations to be maintained, but sectors would be allocated different percentages of each area based on their historic harvest patterns in the AI. It also allows the overall BSAI allocations to each sector to be based on a different series of years than the years on which the AI allocations are based. This is because the Council may want to base the AI subarea sector allocations on a smaller subset of (recent) years than the overall BSAI sector allocations, in order to reflect the fact that sectors generally tended to fish more or less in the AI in recent years.

The general intent under Alternative 4 is thus to base the percentage AI allocations for each sector on recent harvest shares in the AI. **Thus, in the case that the Council chooses an option under Alternative 4 as its preferred alternative, and a BSAI TAC split between the BS and AI subareas does not occur for several years, it may be preferable at that time to consider whether the preferred alternative continues to reflect recent AI harvest shares by sector.** For instance, if the harvest distribution between

the BS and AI changes dramatically for one or more sectors between now and when a TAC split occurs, the Council may want to consider initiating a new amendment to revise the sector AI allocations resulting from this part.

The original year combination options from Amendment 85 for determining each sector's allocation in the AI were as follows:

Option 1	1995–2002
Option 2	1997–2003
Option 3	2000–2003
Option 4	2002–2003

As stated in earlier sections, the trawl sectors have generally increased their share of AI harvest as a percentage of their overall BSAI harvest in the past several years. By contrast, the fixed gear sectors have generally decreased their share of AI harvest as a percentage of their overall BSAI harvest in the past several years. Because of this variation in AI harvest by sectors, the time period selected for the allocations largely determines whether certain fixed gear sectors, primarily the pot sectors and the hook-and-line CV sector, will be significant participants in the AI Pacific cod fishery in the future. Other sectors would also be impacted by the years selected as the historic base period, but in most cases would be less likely to be effectively excluded from the AI fishery.

The calculations for the AI harvest by sector under Alternative 4 are made using the four options above. In completing the allocation calculations, it was necessary to make several adjustments to overcome potential problems with confidential data. It was necessary to combine the <60' hook-and-line and pot catcher vessel sector with the jig catcher vessel sector. The estimates for all other sectors are unaffected, as this calculation was only undertaken for the AFA trawl catcher processor and non-AFA trawl catcher vessel sectors.

The first step in evaluating the Aleutian Islands and Bering Sea allocations resulting from the options under Alternative 4 was to calculate each sector's AI historic retained Pacific cod harvest share, as a percentage of the historical AI harvests for all sectors, during the years identified. These estimates are shown in Table 10. Table 11 shows the same data but includes fish meal destined for production. The first column for each option shows the retained catch of Pacific cod in the Aleutian Islands by each sector during the years specified in the options, while the second column shows the percent of the total Aleutian Islands retained catch by the sector during that period.

Table 10 Aleutian Islands Pacific cod catch (mt) and percent of the total Aleutian Islands allocation to each sector under Alternative 4, Options 1–4 (meal not included)

Sector	1995-2002		1997-2003		2000-2003		2002-2003	
	mt	percent	mt	percent	mt	percent	mt	percent
<60 HAL/Pot CVs and Jig CVs	456	0.26%	468	0.3%	237	0.2%	64	0.1%
AFA Trawl CPs	15,704	9.10%	12,063	6.9%	4,111	3.5%	1,856	3.3%
Trawl CVs	45,158	26.17%	60,986	35.1%	49,029	41.9%	32,122	56.5%
Longline CPs	56,230	32.59%	49,059	28.2%	27,072	23.1%	2,515	4.4%
Longline CVs	261	0.15%	245	0.1%	218	0.2%	5	0.0%
Non-AFA Trawl CPs	39,979	23.17%	41,956	24.1%	32,275	27.6%	20,253	35.6%
Pot CPs	7,912	4.59%	3,753	2.2%	1,500	1.3%	*	*
Pot CVs	6,825	3.96%	5,226	3.0%	2,585	2.2%	*	*
Denominator	172,526		173,757		117,028		56,825	

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located (Pcod tables Jan 07.xls)
 *Not shown due to restrictions on confidential data

Table 11 Aleutian Islands Pacific cod catch (mt) and percent of the total Aleutian Islands allocation to each sector under Alternative 4, Options 1–4 (meal included)

Sector	1995-2002		1997-2003		2000-2003		2002-2003	
	mt	percent	mt	percent	mt	percent	mt	percent
<60 HAL/Pot CVs and Jig CVs	456	0.26%	471	0.3%	240	0.2%	66	0.1%
AFA Trawl CPs	15,756	9.13%	12,115	7.0%	4,111	3.5%	1,856	3.3%
Trawl CVs	42,221	24.46%	61,051	35.1%	49,072	41.9%	32,126	56.5%
Longline CPs	56,230	32.57%	49,059	28.2%	27,072	23.1%	2,515	4.4%
Longline CVs	264	0.15%	247	0.1%	221	0.2%	5	0.0%
Non-AFA Trawl CPs	39,979	23.16%	41,956	24.1%	32,275	27.6%	20,253	35.6%
Pot CPs	7,912	4.58%	3,753	2.2%	1,500	1.3%	*	*
Pot CVs	6,825	3.95%	5,226	3.0%	2,585	2.2%	*	*
Denominator	172,643		173,878		117,076		56,832	

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located (Pcod tables Jan 07.xls)
 *Not shown due to restrictions on confidential data

Recall that each sector's overall BSAI allocation is maintained under Alternative 4. Thus, to represent the AI percentage estimates above as a potential allocation to each sector requires the use of a BSAI allocation. The BSAI Pacific cod allocation recommendation by the Council in Amendment 85 are used in these tables.

Table 12, Table 13, Table 14, and Table 15 show estimated allocations with and without meal using Option 1 and 2 together with Amendment 85 allocation percentages. The first column of Table 12 shows the BSAI allocation to each sector, as a percent of the BSAI ITAC. The second column shows the estimated allocation to each sector in metric tons, based on a 2007 BSAI ITAC of 152,453 mt. The third column shows the Aleutian Islands allocation to each sector, as a percent of the Aleutian Islands ITAC, based on Option 1. The third column shows each sector's Aleutian Islands allocation in metric tons, based on a projected Aleutian Islands ITAC of 22,868 mt. The fourth column shows each sector's remaining Bering Sea allocation in metric tons (i.e., each sector's overall BSAI allocation minus its AI allocation). The last two columns show the respective percentages of each sector's total BSAI allocation that is from the BS subarea and the AI subarea, based on the previous estimates. In reviewing this table, it is important to bear in mind that the division of a sector's allocation between the BS and AI will vary annually with the respective ITACs.

Table 12 Example of BSAI, AI, and BS allocations by sector without meal using 1995–2002 catch history

Sector	BSAI allocation (as percent of ITAC)	BSAI allocation (mt)	AI allocation (as percent of ITAC -1995-2002)	AI allocation (mt)	BS allocation (mt) (remaining portion of sector's allocation)	BS allocation (as percent of sector BSAI allocation)	AI allocation (as percent of sector BSAI allocation)
<60 HAL/Pot CVs and Jig CVs	3.4%	4,406	0.3%	60	4,345	98.6%	1.37%
AFA Trawl CPs	2.3%	2,980	9.1%	2,082	899	30.2%	69.84%
Trawl CVs	22.1%	28,638	26.2%	5,986	22,653	79.1%	20.90%
Longline CPs	48.7%	63,108	32.6%	7,453	55,655	88.2%	11.81%
Longline CVs	0.2%	259	0.2%	35	225	86.6%	13.36%
Non-AFA Trawl CPs	13.4%	17,364	23.2%	5,299	12,065	69.5%	30.52%
Pot CPs	1.5%	1,944	4.6%	1,049	895	46.0%	53.95%
Pot CVs	8.4%	10,885	4.0%	905	9,980	91.7%	8.31%

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located (Pcod tables Jan 07.xls) Example assumes a projected 2007 BS ITAC of 129,585 mt and AI ITAC of 22,868 mt.

Table 13 Example of BSAI, AI, and BS allocations by sector with meal using 1995–2002 catch history

Sector	BSAI allocation (as percent of ITAC)	BSAI allocation (mt)	AI allocation (as percent of ITAC - 1995-2002)	AI allocation (mt)	BS allocation (mt) (remaining portion of sector's allocation)	BS allocation (as percent of sector BSAI allocation)	AI allocation (as percent of sector BSAI allocation)
<60 HAL/Pot CVs and Jig CVs	3.4%	4,406	0.3%	60	4,345	98.6%	1.37%
AFA Trawl CPs	2.3%	2,980	9.1%	2,087	893	30.0%	70.02%
Trawl CVs	22.1%	28,638	24.5%	5,593	23,046	80.5%	19.53%
Longline CPs	48.7%	63,108	32.6%	7,448	55,660	88.2%	11.80%
Longline CVs	0.2%	259	0.2%	35	224	86.5%	13.47%
Non-AFA Trawl CPs	13.4%	17,364	23.2%	5,296	12,069	69.5%	30.50%
Pot CPs	1.5%	1,944	4.6%	1,048	896	46.1%	53.92%
Pot CVs	8.4%	10,885	4.0%	904	9,981	91.7%	8.31%

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located (Pcod tables Jan 07.xls) Example assumes a projected 2007 BS ITAC of 129,585 mt and AI ITAC of 22,868 mt.

Table 14 Example of BSAI, AI, and BS allocations by sector without meal using 1997–2003 catch history

Sector	BSAI allocation (as percent of ITAC)	BSAI allocation (mt)	AI allocation (as percent of ITAC -1997-2003)	AI allocation (mt)	BS allocation (mt) (remaining portion of sector's allocation)	BS allocation (as percent of sector BSAI allocation)	AI allocation (as percent of sector BSAI allocation)
<60 HAL/Pot CVs and Jig CVs	3.4%	4,406	0.3%	62	4,344	98.6%	1.40%
AFA Trawl CPs	2.3%	2,980	6.9%	1,588	1,393	46.7%	53.27%
Trawl CVs	22.1%	28,638	35.1%	8,026	20,612	72.0%	28.03%
Longline CPs	48.7%	63,108	28.2%	6,457	56,651	89.8%	10.23%
Longline CVs	0.2%	259	0.1%	32	227	87.6%	12.44%
Non-AFA Trawl CPs	13.4%	17,364	24.1%	5,522	11,843	68.2%	31.80%
Pot CPs	1.5%	1,944	2.2%	494	1,450	74.6%	25.41%
Pot CVs	8.4%	10,885	3.0%	688	10,197	93.7%	6.32%

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located (Pcod tables Jan 07.xls) Example assumes a projected 2007 BS ITAC of 129,585 mt and AI ITAC of 22,868 mt.

Table 15 Example of BSAI, AI, and BS allocations by sector with meal using 1997–2003 catch history

Sector	BSAI allocation		AI allocation (as percent of ITAC - AI allocation)		BS allocation (mt) (remaining portion of sector's allocation)	BS allocation (as percent of sector BSAI allocation)	AI allocation (as percent of sector BSAI allocation)
	(as percent of ITAC)	BSAI allocation (mt)	percent of ITAC - 1997-2003)	AI allocation (mt)			
<60 HAL/Pot CVs and Jig CVs	3.4%	4,406	0.3%	62	4,344	98.6%	1.41%
AFA Trawl CPs	2.3%	2,980	7.0%	1,593	1,387	46.5%	53.46%
Trawl CVs	22.1%	28,638	35.1%	8,029	20,609	72.0%	28.04%
Longline CPs	48.7%	63,108	28.2%	6,452	56,656	89.8%	10.22%
Longline CVs	0.2%	259	0.1%	33	227	87.4%	12.55%
Non-AFA Trawl CPs	13.4%	17,364	24.1%	5,518	11,846	68.2%	31.78%
Pot CPs	1.5%	1,944	2.2%	494	1,450	74.6%	25.39%
Pot CVs	8.4%	10,885	3.0%	687	10,198	93.7%	6.31%

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located NPFMC database (Pcod tables Jan 07.xls)

Example assumes a projected 2007 BS ITAC of 129,585 mt and AI ITAC of 22,868 mt. This does not account for the 3% State water AI fishery.

Table 16, Table 17, Table 18, and Table 19 below show estimated allocations with and without meal under Options 3 and 4, respectively, using the same allocation example as shown in the above tables. Again, the selection of this example allocation option is for illustrative purposes only.

Table 16 Example of BSAI, AI, and BS allocations by sector without meal using 2000–2003 catch history

Sector	BSAI allocation		AI allocation (as percent of ITAC - AI allocation)		BS allocation (mt) (remaining portion of sector's allocation)	BS allocation (as percent of sector BSAI allocation)	AI allocation (as percent of sector BSAI allocation)
	(as percent of ITAC)	BSAI allocation (mt)	percent of ITAC - 2000-2002)	AI allocation (mt)			
<60 HAL/Pot CVs and Jig CVs	3.4%	4,406	0.2%	46	4,360	98.9%	1.05%
AFA Trawl CPs	2.3%	2,980	3.5%	803	2,177	73.0%	26.95%
Trawl CVs	22.1%	28,638	41.9%	9,581	19,058	66.5%	33.45%
Longline CPs	48.7%	63,108	23.1%	5,290	57,818	91.6%	8.38%
Longline CVs	0.2%	259	0.2%	43	217	83.5%	16.46%
Non-AFA Trawl CPs	13.4%	17,364	27.6%	6,307	11,058	63.7%	36.32%
Pot CPs	1.5%	1,944	1.3%	293	1,651	84.9%	15.08%
Pot CVs	8.4%	10,885	2.2%	505	10,380	95.4%	4.64%

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located (Pcod tables Jan 07.xls)

Example assumes a projected 2007 BS ITAC of 129,585 mt and AI ITAC of 22,868 mt.

Table 17 Example of BSAI, AI, and BS allocations by sector with meal using 2000–2003 catch history

Sector	BSAI allocation		AI allocation (as percent of ITAC - AI allocation)		BS allocation (mt) (remaining portion of sector's allocation)	BS allocation (as percent of sector BSAI allocation)	AI allocation (as percent of sector BSAI allocation)
	(as percent of ITAC)	BSAI allocation (mt)	percent of ITAC - 2000-2003)	AI allocation (mt)			
<60 HAL/Pot CVs and Jig CVs	3.4%	4,406	0.2%	47	4,359	98.9%	1.06%
AFA Trawl CPs	2.3%	2,980	3.5%	803	2,177	73.1%	26.94%
Trawl CVs	22.1%	28,638	41.9%	9,585	19,053	66.5%	33.47%
Longline CPs	48.7%	63,108	23.1%	5,288	57,820	91.6%	8.38%
Longline CVs	0.2%	259	0.2%	43	216	83.4%	16.63%
Non-AFA Trawl CPs	13.4%	17,364	27.6%	6,304	11,060	63.7%	36.31%
Pot CPs	1.5%	1,944	1.3%	293	1,651	84.9%	15.07%
Pot CVs	8.4%	10,885	2.2%	505	10,380	95.4%	4.64%

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is (Pcod tables Jan 07.xls)

Example assumes a projected 2007 BS ITAC of 129,585 mt and AI ITAC of 22,868 mt.

Table 18 Example of BSAI, AI, and BS allocations by sector without meal using 2002–2003 catch history

Sector	BSAI allocation		AI allocation (as percent of ITAC - AI allocation)		BS allocation (mt) (remaining portion of sector's allocation)	AI allocation (as percent of sector BSAI allocation)	
	(as percent of ITAC)	BSAI allocation (mt)	2002-2003)	(mt)		BS allocation (as percent of sector BSAI allocation)	percent of sector BSAI allocation)
<60 HAL/Pot CVs and Jig CVs	3.4%	4,406	0.1%	26	4,380	99.4%	0.58%
AFA Trawl CPs	2.3%	2,980	3.3%	747	2,234	74.9%	25.06%
Trawl CVs	22.1%	28,638	56.5%	12,927	15,711	54.9%	45.14%
Longline CPs	48.7%	63,108	4.4%	1,012	62,096	98.4%	1.60%
Longline CVs	0.2%	259	0.0%	2	257	99.3%	0.70%
Non-AFA Trawl CPs	13.4%	17,364	35.6%	8,150	9,214	53.1%	46.94%
Pot CPs	1.5%	1,944	.	.	.	.	.
Pot CVs	8.4%	10,885	.	.	.	.	.

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located (Pcod tables Jan 07.xls)

*Not shown due to restrictions on confidential data

Example assumes a projected 2007 BS ITAC of 129,585 mt and AI ITAC of 22,868 mt.

Table 19 Example of BSAI, AI, and BS allocations by sector with meal using 2002–2003 catch history

Sector	BSAI allocation		AI allocation (as percent of ITAC - AI allocation)		BS allocation (mt) (remaining portion of sector's allocation)	AI allocation (as percent of sector BSAI allocation)	
	(as percent of ITAC)	BSAI allocation (mt)	2002-2003)	(mt)		BS allocation (as percent of sector BSAI allocation)	percent of sector BSAI allocation)
<60 HAL/Pot CVs and Jig CVs	3.4%	4,406	0.1%	26	4,379	99.4%	0.60%
AFA Trawl CPs	2.3%	2,980	3.3%	747	2,234	74.9%	25.05%
Trawl CVs	22.1%	28,638	56.5%	12,927	15,711	54.9%	45.14%
Longline CPs	48.7%	63,108	4.4%	1,012	62,096	98.4%	1.60%
Longline CVs	0.2%	259	0.0%	2	257	99.3%	0.71%
Non-AFA Trawl CPs	13.4%	17,364	35.6%	8,149	9,215	53.1%	46.93%
Pot CPs	1.5%	1,944	.	.	.	.	.
Pot CVs	8.4%	10,885	.	.	.	.	.

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located (Pcod tables Jan 07.xls)

*Not shown due to restrictions on confidential data

Example assumes a projected 2007 BS ITAC of 129,585 mt and AI ITAC of 22,868 mt.

Because the fixed gear sectors have been taking less of their total Pacific cod harvest in the AI in the most recent years, and because all of the fixed gear sectors except for the hook-and-line CP sector receive a relatively small percentage of the overall BSAI ITAC, using 2002–2003 to determine the AI allocations will result in relatively small allocations to these sectors under every allocation scenario. This result may not represent a concern to these sectors, unless and until they desire to increase their Pacific cod share in the AI in the future. Note also that 2004 and 2005 data are provided in Table 6 and Table 7, in the case that the Council wants to add options under Alternative 4 using 2004 or 2005.

In summary, if the Council wants to mirror the most recent sector shares of the AI Pacific cod harvest, it may want to simply choose percentages that fall within the range provided under Options 1–4. Selecting AI percentage allocations to each sector that fall within the range analyzed would allow the Council to choose percentages that do not result in a negative BS allocation to each sector under the current projected TAC levels, but could also provide for an AI allocation that mirrors the most recent harvest levels by sector in that area. However, as pointed out at the April 2006 Council meeting, because 1) the BSAI TAC split has not yet occurred, 2) it is uncertain how TACs in the BS and AI would fluctuate relative to one another in the future, and 3) the subarea allocations under Alternative 4 are dependent first on maintaining the overall BSAI allocation to each sector, **it is possible that Alternative 4 could result in negative allocations in the BS subarea for one or more sectors in the future.** This is because the BSAI allocation by sector is implemented through rulemaking, and would not vary by year. Each sector's

percentage share of the AI ITAC also would be established in regulation. The actual allocation (in metric tons) would vary depending on the AI ITAC. **Thus, it is possible, depending on TAC fluctuations, that a sector could have an AI allocation that is greater (in mt) than its overall BSAI allocation.** If the Council wants to provide for this concern, the following language could potentially be added under Alternative 4:

If, in a particular year, the AI allocation to a sector is greater than the BSAI allocation to that sector, set the sector's AI allocation equal to the sector's BSAI allocation and set the BS allocation equal to zero. All other sector AI allocations would be adjusted (increased) proportionately to allocate the full AI ITAC.

Thus Alternative 4 could result in sectors having no allocation in the Bering Sea, and all of the allocation in the Aleutian Islands. Recall also from Table 1 that in many sectors, including the non-AFA trawl CV sector, the majority of the LLPs are endorsed only for the Bering Sea area. In the case of the non-AFA trawl CV sector, there are 50 valid LLPs, and only 6 have AI endorsements. Thus, selecting an allocation option that could result in no allocation in the Bering Sea could severely affect the ability of eligible vessels to continue participating in this sector for Pacific cod. While the tables indicate that other sectors, such as the smaller fixed gear sectors, could receive a relatively small BSAI allocation, there is less likely the possibility for a negative or zero BS allocation as a result of Alternative 4 since these sectors have taken very little of their overall harvest in the AI in 2002 and 2003.

In addition, the AI allocations would also be seasonally apportioned, resulting in extremely small AI seasonal allocations to some sectors. Thus, implementing BS and AI allocations for each of nine sectors of the Pacific cod fishery may be more difficult to manage than it appears on an aggregate gear level. However, in such case that (1) cod allocations are refined to three trawl sectors as opposed to the current two; (2) there exist relatively small allocations to most of the fixed gear sectors with the exception of the hook-and-line CP sector; and (3) seasonal apportionments of the AI allocations are implemented, the result is very small allocations to particular sectors (e.g., non-AFA trawl CV, <60' fixed gear, hook-and-line CV, and pot CP sectors). This effect is exacerbated as the overall BSAI TAC declines. **It is thus possible that some sector AI allocations may be so small that inseason management could not open a directed fishery. Staff will consult with inseason management during further development of this discussion paper.**

Overall, Alternative 4 is likely to be more disruptive to the BSAI Pacific cod fleet compared to Alternative 2, but less disruptive than Alternative 3. This alternative, much like Alternative 3, would apportion Pacific cod into subarea and seasonal bins thus reducing the flexibility of the fleet. However, all options under Alternative 4 are based on a sector's AI harvest history, so may more consistent with recent (but not necessarily future) harvest patterns.

XI. Other Alternative Approaches

In April 2006, the Council received extensive public testimony recommending that additional alternatives be developed for allocation of BSAI Pacific cod if TAC area split. The alternatives described above are the original alternatives from Amendment 85 prior to April 2006. These alternatives are the most obvious, but they are not the only alternatives. For example, an alternative approach could be some variation of Alternatives 2 thru 4. One simple approach would be to combine Alternatives 3 and 4 in equal proportions. Half of the allocation would be based on the sector's catch history in the Aleutian Islands and the other half would be based on equal percentages of BS and AI subareas TACs. The results of this alternative approach are shown in Table 12. With the exception of the hook and line CV >60' sector, sector allocations under this alternative would be at the mid-point between Alternative 3 and

Alternative 4. The effects of this alternative would be to dampen any disproportional allocation a sector would receive under either Alternatives 3 or 4.

Table 20 AI and BS allocations for 50% of Alternatives 3 and 4

	AI Allocation			BI Allocation		
	Alt 3	Alt 4	50% Alt 3/ 50% Alt 4	Alt 3	Alt 4	50% Alt 3/ 50% Alt 4
<60 HAL/Pot CVs and Jig CVs	778	46	412	4,406	4,360	4,383
AFA Trawl CPs	526	803	665	2,980	2,177	2,579
Trawl CVs	5,054	9,581	7,317	28,638	19,058	23,848
Longline CPs	11,137	5,290	8,213	63,108	57,818	60,463
Longline CVs	46	43	44	259	217	238
Non-AFA Trawl CPs	3,064	6,307	4,686	17,364	11,058	14,211
Pot CPs	343	293	318	1,944	1,651	1,797
Pot CVs	1,921	505	1,213	10,885	10,380	10,633

Source: NPFMC BSAI Pcod split database (1995-2005 NMFS WPR/ADFG fish ticket) Table is located (Pcod tables Jan 07.xls)

Other alternatives could be some variation of the above approach or an entirely new approach. For example, it might be possible to design an alternative that would allocate Pacific cod for a sector or a group of sectors using one approach, while using another approach for the remaining sectors as long as the overall BSAI allocations were maintained and the percent allocated in each area summed to 100%. If changing TACs for one subarea or both are a factor, it might be possible to design an alternative approach that shifts subarea allocations based on changing subarea TACs. In the end, there are likely a myriad of different alternative approaches the Council could consider for apportioning BSAI Pacific cod sector allocations to the BS and AI subareas.

XII. Summary

In April 2006, the Council removed the action addressing the apportionment of BSAI Pacific cod sector allocations between BS and AI from Amendment 85 and initiated a new, separate analysis that examines alternative approaches to apportion the BSAI Pacific cod sector allocations between the BS and AI subareas. Each of the existing alternatives triggered concerns such that the Council agreed that additional analysis is warranted. This discussion paper provides information on the existing alternatives for apportionment of BSAI Pacific cod sector allocations between the BS and AI, the historical background on this issue, and a summary of the impacts of each of the alternatives. At this meeting, the Council could adopt additional alternatives for analysis and/or give notice to the public that additional alternatives should be developed.

In summary, none of the existing alternatives appeared to be a good solution to the problem voiced in April 2006. The concern with Alternative 1 is that it does not reflect recent historical catch by sector in the Aleutian Islands subarea. Although Alternative 2 provides the greatest flexibility for sectors and may be the easiest for NMFS in season management to monitor, the alternative risks exacerbating a race for fish in one or both subareas. Additionally, there is no gear specific seasonal apportionment by subarea, which is an area of concern for NMFS. Similar concerns exist for Alternative 3 since it is virtually the same as Alternative 1. Finally, Alternative 4, identified as the preliminary preferred alternative in February 2006, also has a couple areas of concern. One concern is that TAC fluctuations will have disproportionate impacts on sectors that are allocated the greatest percentage of the subarea with the declining TAC. A related concern is that some of the resulting AI sector allocations may not be large enough to open a directed fishery in the AI.

Other alternatives or options could be developed to apportion BSAI Pacific cod sector allocations between the BS and AI. If more flexibility for the sectors is needed, an approach similar to Alternative 2 would be more in order. An alternative that is more dynamic in relation to changing TACs for the BS and AI could be developed by including an apportionment methodology that shifts sector allocations between subareas depending on the relative TAC in each subarea. Alternatives or options based on catch history in one or both subareas could be developed to fit with any of the above alternative approaches similar to the alternative in Table 20.

Report to the Science and Statistical Committee
North Pacific Fishery Management Council
January 26, 2007

Preliminary assessment of genetic stock structure in Pacific cod

Granting agency: Washington State Sea Grant

Project Number: R/F-147

Project Title: Genetic Stock Structure in Pacific Cod

Principal Investigator(s) and Affiliation:

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Michael Canino Alaska Fisheries Science Center

ACCOMPLISHMENTS

Approximately 4,200 fin clip samples from Pacific cod have been obtained from eight geographic locations: Gulf of Georgia (Puget Sound) and Neah Bay, Washington; Hecate Strait, BC; Kodiak Island, Unimak Pass, and central Aleutian Islands regions of Alaska; northern Japan (southern Okhotsk Sea), and South Korea (Japan Sea). Sampling was targeted for adult spawning aggregates in most locations, thus avoiding the collection of potential population mixtures outside the spawning season. Some collections consisted of both prespawning and postspawning adults, though no samples were taken between late spring and late fall. Replicate temporal samples were collected at three sites located near directed fisheries in Alaska (Fig. 1). These collections involved sampling by US state and federal agencies (NMFS, ADF&G, WDF&W), and the Canadian Department of Fish and Oceans (DFO) in addition to collaborative sample exchanges with scientists in Japan and Korea. To date, 914 samples from seven of these locations have been genotyped at 11 microsatellite loci, including nine loci developed by us specifically to conduct this project (Canino et al. 2005).

Major findings of the project are:

- A large genetic division between North American and Asian populations of Pacific cod is evident in the pattern of genetic divergence across the study range (Fig. 2). This result confirms a result reported in an earlier study of allozyme variation (Grant et al. 1987). Coincident geographic clines of allele frequencies in five microsatellite loci (Fig. 3), which are generally assumed to be selectively neutral, strongly indicate that North American and Asian populations of Pacific cod have come into secondary contact after a period of isolation, most likely following the end of Pleistocene glaciation. The data suggest a complete lack of trans-oceanic migration in Pacific cod and infer that the contact zone lies somewhere to the west of the central Aleutian Islands but its precise location and geographic extent are unknown. A recent phylogeographic analysis of walleye pollock (Grant et al. 2006) inferred that pollock at the western end of the Aleutian Islands archipelago were more closely related to Asian populations than to those of coastal North America.
- North American coastal populations of Pacific cod show a clear isolation-by-distance pattern of genetic divergence over moderate geographic distances (Fig. 4a),

potentially indicating a large stock complex on the continental shelf with limited dispersal (gene flow) among stock components. A similar pattern exists for samples taken within management areas in Alaska (Fig. 4b).

- Temporal samples taken at the three locations in Alaska (Kodiak Island, Unimak Pass, and the central Aleutian Islands) showed no significant interannual variation by location. When samples were pooled across years, resulting in sample sizes of approximately 180-200 individuals, significant differences in allelic heterogeneity and in genetic distances (F_{ST}) were observed, providing some evidence for genetic structure within and between the two recognized management units in Alaska.
- The sample taken in the Gulf of Georgia, WA in 2003 was clearly differentiated from all coastal populations, including one from Neah Bay, WA (Fig. 4a), indicating that more localized fjord or estuarine populations may exist, as has been documented in the congeneric Atlantic cod (Beacham et al. 2002).

SUMMARY:

The results represent the most geographically comprehensive and exhaustive survey of genetic variation in this important commercial species to date. The study has shown greater stock discretion in Pacific cod than previously recognized and thus represents a significant contribution towards developing appropriate harvest and conservation strategies. Strong genetic divergence between Asian and North American samples and the isolation-by-distance pattern exhibited by the latter group suggest restricted spatial dispersal by this demersal species. The sampling design has allowed powerful insights into the population structure of cod on a trans-Pacific scale as well as on more local spatial scales in North America and Alaska.

RECOMMENDATION:

Samples collected thus far do not facilitate addressing management issues of concern to the NPFMC with regard to finer geographic subdivision within the BSAI management area: more extensive geographical sampling would be required. We have been granted a no-cost extension of this Sea Grant project until May, 2007, which will enable us to process at least two samples of potential relevance for evaluating stock structure within the BSAI: one taken from the western Aleutian Islands in 2005 and another from the Pribilof Islands that is planned for this spawning season. Even these samples will be inadequate for fully characterizing the BS and AI regions at the appropriate spatial scales. A proposed continuation of this project as a component of the BSIERP under development for submission to NPRB would allow for more extensive, directed sampling within and between management regions. Supplemental samples from Pacific cod fisheries conducted in the Aleutian Islands and in Russian waters are also being sought.

At present, it would be premature to comment on harvest strategies that focus on specific spawning subgroups in the BSAI. Once more extensive geographic screening is complete, more specific recommendation regarding harvesting or targeted research will be possible.

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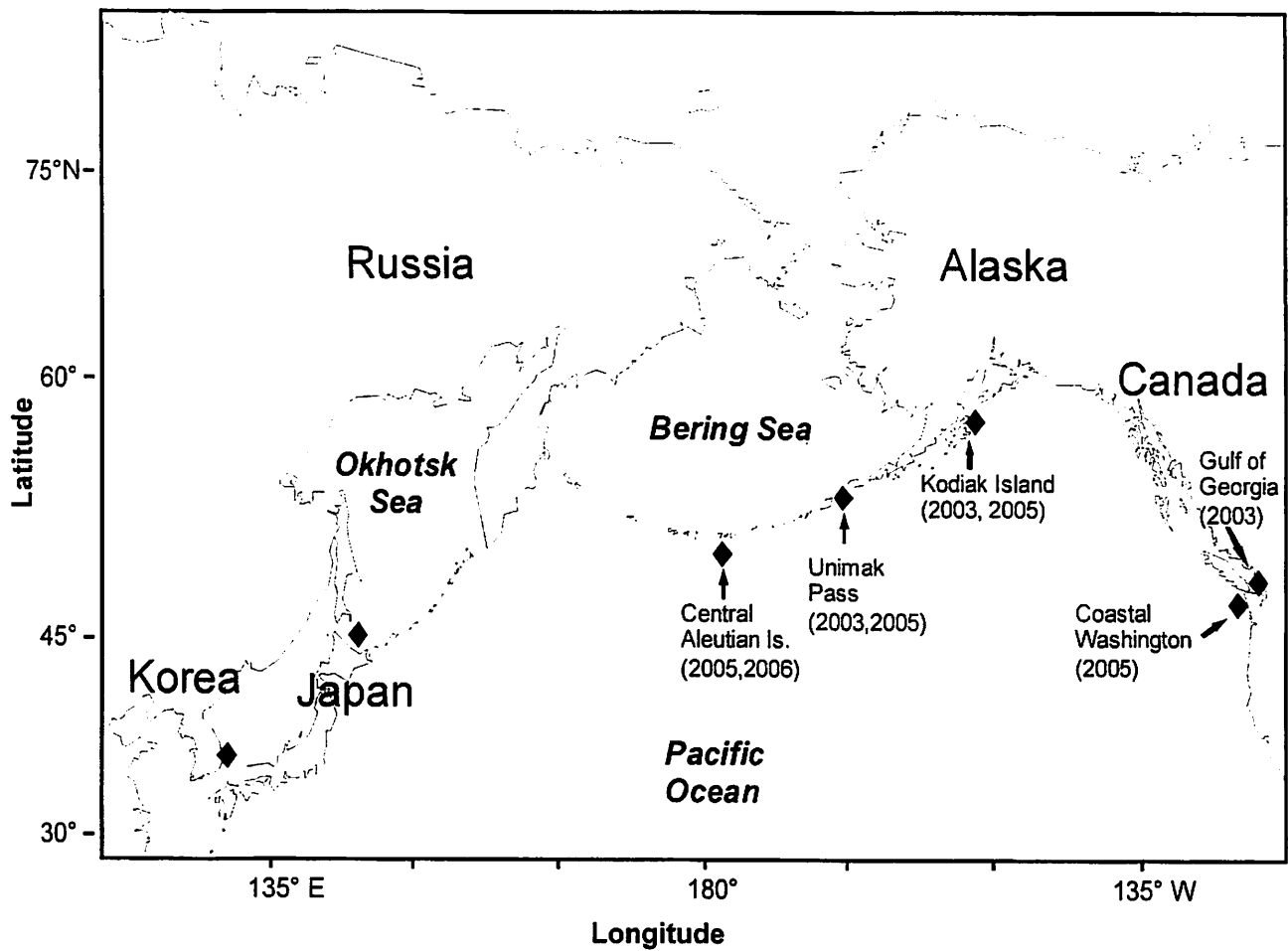


Figure 1. Sampling locations for Pacific cod. Collection years are given in parentheses.

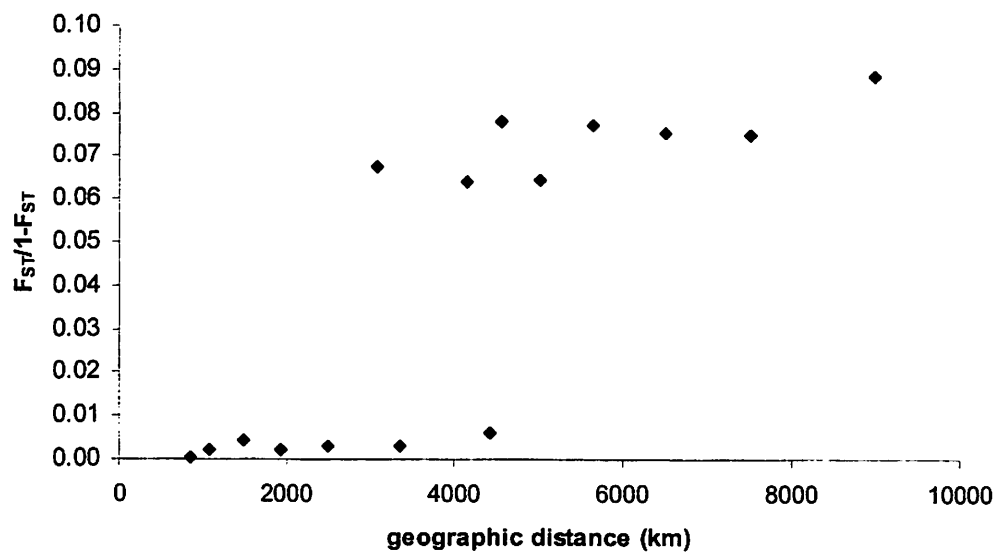


Figure 2. Genetic divergence ($F_{ST}/1-F_{ST}$) versus geographic distance in Pacific cod. The abrupt break in distribution largely represents comparisons between North American and Asian populations.

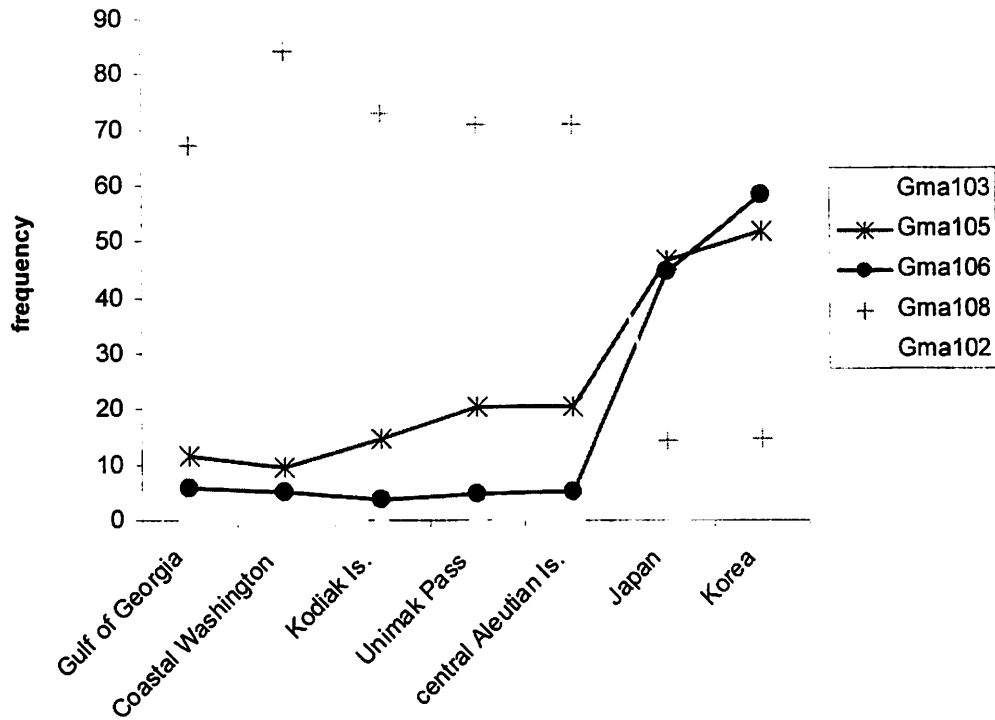


Figure 3. Frequency distributions of alleles with the highest estimates of allele-specific F_{ST} versus geographic location in Pacific cod for five microsatellite loci.

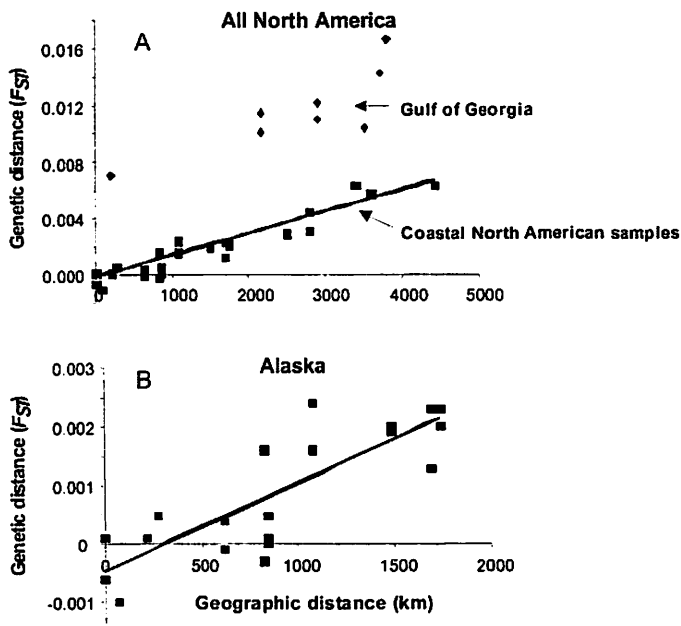


Figure 4. Genetic distance (F_{ST}) versus geographic distance between sample pairs: A) among North American coastal samples (squares) and the Gulf of Georgia (diamonds); B) among samples from Alaska (note different scales).

Summary of existing information comparing the biology of Pacific cod in the Eastern Bering Sea
and the Aleutian Islands

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Executive Summary

The North Pacific Fisheries Management Council is considering a proposal to assign separate catches to the Eastern Bering Sea (EBS) and Aleutian Islands (AI) subareas. The purpose of this paper is to synthesize the biological information currently available for cod in the EBS and AI. Much of this information is recent and has not yet been published in the peer-reviewed literature. Data regarding genetic differences are being treated separately and are not included here.

The following information may be of use in considering separate management in the AI:

- 1) Length at age is significantly higher in the AI than in the EBS for both female and male cod ($p < 0.0001$; Figs. 1-2 & 1-3). These results are based on sampling conducted in 2005. This difference is present at all ages.
- 2) Commercial trawls in the AI catch bigger female and male cod than do trawls in the EBS (Figs. 2-1, 2-2, 2-3). From 2004 to 2006, the mode for cod in the EBS occurred at 65-70 cm, while the mode for females in the AI occurred at 80-85 cm. Fish smaller than 50 cm were evident in EBS trawls, but were rare in the AI.
- 3) Estimates of age composition suggest that commercial trawls in the AI also catch older fish (Fig. 3-1). In particular, cod older than age 8 are largely absent from EBS trawls, while 8-11 year old fish were common in AI trawls. Age estimates were obtained by applying the growth models used in (1) above to the size composition in (2) above.
- 4) Length-weight relationships did not differ between the AI and EBS (Figs. 4-1 & 4-2). Length-ovary weight relationships (a proxy for reproductive output) did not differ between the two areas for pre-spawning female cod (Fig. 4-3). These results are based on sampling conducted in 2005.
- 5) Diet composition is different between the AI and EBS (Fig. 5-1), based on summer survey data from the early 1990s.
- 6) Cod appear to spawn in several locations in the AI and throughout the EBS (Fig. 6-1).
- 7) Tagged cod have moved between the EBS and AI, but such movements are limited relative to observed cod movement within the EBS.

Biological and ecological differences do exist between the AI and EBS. These results are consistent with some separation of adult cod between the two subareas, but it is still unclear whether there is exchange between the two regions at some stage of the life cycle or whether they should be treated as independent stocks. Cod in the AI and EBS have different diets and are exposed to dissimilar environmental conditions. Commercial fishing pressure, which can affect size and age composition among other things, is currently lower in the AI and the AI has historically been subject to much less fishing activity. Tagging studies suggest that movement of cod between the AI and EBS is limited, but interpretation of these results is hindered by the fact that the vast majority of releases of tagged fish have been within the EBS.

This information is distributed solely for the purpose of pre-dissemination peer review under applicable guidelines. It has not been formally disseminated by NOAA Fisheries Service and should not be construed to represent any agency determination or policy.

Introduction

Pacific cod (*Gadus macrocephalus*) in Alaska are currently managed as two stocks: a Gulf of Alaska (GOA) stock and a Bering Sea/ Aleutian Islands (BSAI) stock. The North Pacific Fisheries Management Council (NPFMC) assigns a total allowable catch (TAC) of Pacific cod for the entire BSAI stock that is subsequently assigned to various gear and vessel sectors. The NPFMC is considering a proposal to further divide cod catches by assigning separate cod TACs to the Eastern Bering Sea (EBS) and Aleutian Islands (AI) subareas. The basis for this proposal is the possibility that AI cod form an independent stock or stocks within the BSAI area, and that separate TACs for EBS and AI cod may provide for more effective management. In addition, the NPFMC has been exploring the possibility of managing the entire AI area as a separate ecosystem.

The purpose of this paper is to synthesize the biological information currently available for cod in the EBS and AI subareas. Much of this information is recent and has not yet been published in the peer-reviewed literature. Data regarding genetic differences are being treated separately and are not included in this paper. Here, we consider the following issues:

- 1) Length at age
- 2) Size composition
- 3) Estimated age composition
- 4) Other biological parameters
- 5) Ecological considerations
- 6) Spawning locations
- 7) Movement and migration

(1) Length at age

Methods

In January-March 2005, scientists from the Alaska Fisheries Science Center (AFSC) collected Pacific cod samples in the central and western AI and north of Unimak Island in the EBS (Fig. 1-1). Samples in the AI were collected by an AFSC scientist conducting research aboard a factory trawler during the course of normal commercial fishing operations. EBS samples were collected aboard chartered crab vessels during two pot surveys conducted by the Fisheries Interaction Team (FIT) at the AFSC. Because the collections were part of an ongoing study of cod reproduction, sexually mature females formed a greater part of the datasets in both areas (Table 1). Cod were selected randomly from the catch according to a schedule of length bins. Length was measured, and body and ovary (gonad) weight were measured using a motion-compensated scale. Otoliths were removed for age analysis, which was conducted by the Age and Growth laboratory at the AFSC.

Length at age was modeled using the Schnute parameterization of the von Bertalanffy growth model (Quinn and Deriso 1999):

$$Y(t) = \left\{ y_1 + (y_2 - y_1) \frac{1 - \exp[-\kappa(t - \tau_1)]}{1 - \exp[-\kappa(\tau_2 - \tau_1)]} \right\}$$

where $Y(t)$ is the length at age t , τ_1 and τ_2 are the youngest and oldest ages in the dataset respectively, and y_1 , y_2 , and κ are constants. Males and females were treated separately and

statistical differences between the AI and EBS areas were analyzed using likelihood ratio tests (Quinn and Deriso 1999).

Results

Length at age was greater in the AI subarea for female and male cod (Table 1-1; Figs. 1-2 & 1-3). This difference is present at all ages.

	Females			Males	
	AI	EBS		AI	EBS
y_1	43.26	37.79	y_1	48.43	46.45
y_2	116.06	110.57	y_2	109.26	95.97
κ	0.079	0.039	κ	0.099	0.092
τ_1	3	3	τ_1	4	4
τ_2	12	12	τ_2	11	11
N	256	305	N	66	153
X^2 statistic	199.97		X^2 statistic	68.00	
p-value	0.0000		p-value	0.0000	

Table 1-1. Growth model parameters and test results for male and female Pacific cod from the Aleutian Islands (AI) and Eastern Bering Sea (EBS).

(2) Size composition

Methods

The size composition of cod in the different regions was examined using data collected by the North Pacific Observer Program (AFSC FMA). Observers routinely collect length frequency data on target species and major components of the catch for selected hauls. From the observer database, we identified all of the observed hauls for which cod length frequency data were collected during the January-March cod 'A' Season in 2004, 2005, and 2006. Because pot and longline gear are known to be size-selective for larger fish, only hauls using bottom trawl gear were selected. Data from NMFS statistical area 509 (northeast of Unimak Pass) were selected to represent EBS cod. Data from each of the three AI statistical areas (eastern AI 541, central AI 542, western AI 543) were also selected.

Results

In each of the three years, there were differences in length frequency between the EBS and AI areas (Figs. 2-1, 2-2, 2-3). In each year, the mode of area 509 frequencies was between 65 and 70 cm, with a sharp drop-off above 75 cm and relatively few fish longer than 90 cm. In 2005 and 2006, there were clear secondary peaks at lengths of 35-40 and 45-50 cm, perhaps representing younger year classes. Length frequencies in the eastern AI (area 541) had modes in the 80-85 cm range, with smaller numbers of fish from 50-70 cm and a larger fraction in the 90-100 cm size range than in the EBS. Length frequencies for the central and western AI (areas 542 and 543) were similar to each other but very distinct from the EBS, with few fish under 70 cm and sizeable fractions of fish 100 cm or more.

The results show different size distributions in catches from the EBS and the AI. Because only the largest catcher-processors harvest fish in the central and western AI, it is possible that

differences in gear selectivity may affect these results. Length frequencies were examined using data only from vessels classified as catcher-processors (all over 100 ft), and patterns were similar to those in the figures presented.

(3) Estimated age composition

Methods

Section 1 of this report demonstrated significant differences in length at age among EBS and AI cod. To determine whether this growth difference alone accounted for the difference in observed length frequencies, we combined 2005 length-frequency data from section 2 with region- and sex-specific length-age curves to estimate age composition. Length-age curves for cod collected from FIT studies in the EBS in March 2005 were used to predict ages for fish from statistical area 509. Length-age curves for cod from the 2005 collection in the AI were used to predict ages for pooled length frequency data from statistical areas 542 and 542.

Results

For both sexes the estimated age frequencies differ between the EBS and the AI (Fig. 3-1). Both regions show relatively low numbers of 2 and 3 year old fish in the catch, probably due to low selectivity of these ages by trawl gear. The majority of the EBS catch is 5-8 year olds of both sexes. Numbers of age 9 and older cod are low for both males and females in the EBS. Catches in the AI are dominated by 6-10 year olds, with a substantial fraction of females 9-11 years old. In both regions the largest specimens have an estimated age of approximately 14 years.

While variability in length at age will result in some uncertainty in these age estimates, there does appear to be a difference in age composition between the two regions. For both sexes there is a larger proportion of older fish in the AI. The relative absence of younger fish in the AI may reflect different year-class structure or may result from the fact that commercial trawl grounds in the AI are further from inshore shallows and nursery grounds. The dominance of AI samples by older fish is also consistent with a pattern where the EBS would serve as a nursery ground for both subareas, with fish migrating to the AI at some stage of their life cycle.

(4) Other biological parameters

This section presents results from analyses of length-weight relationships for male and female cod and length-ovary weight relationships for pre-spawning female cod. Ovary weight is used here as an indicator of reproductive output.

Methods

The cod samples used in this analysis are identical to those used in (1) above. Somatic weight, determined by subtracting the weight of ovaries and stomach contents from total body weight, was used in the analysis of length-weight relationships. Weight and ovary weight were modeled using power curves of the form $y = \alpha x^\beta$ where y is weight or ovary weight, x is length, and α and β are constants. Males and females were treated separately and statistical differences between the AI and EBS areas were analyzed using likelihood ratio tests (Quinn and Deriso 1999).

Results

No statistically significant differences were observed in the length-weight relationships for male and female cod or in the length-ovary weight relationship for female cod (Table 4-1; Figs. 4-1, 4-2, 4-3).

length-weight, females			length-weight, males			length-ovary weight, females		
	AI	EBS		AI	EBS		AI	EBS
N	69	106	N	257	307	N	173	47
X ² statistic	5.35		X ² statistic	1.20		X ² statistic	5.88	
p-value	0.15		p-value	0.75		p-value	0.12	

Table 4-1. Sample size and test statistics for length-weight relationships in female and male cod and length-ovary weight relationship in female cod.

(5) Ecological considerations

Diet

Diet data from the early 1990s, gathered during summer surveys conducted by the AFSC, suggest that Pacific cod diets differ between the AI and EBS (Fig. 5-1; Thompson et al. 2006). In the EBS pollock were the largest diet component (25.9%). In the AI, shrimp (16.7%), Atka mackerel (15.3%), and sculpins (14.9%) were the main components.

Ecosystem aspects

It is beyond the scope of this paper to review ecosystem differences between the AI and EBS. We direct readers to the many discussion papers, reports, and peer-reviewed articles that have been published on this topic.

(6) Spawning locations

Very little is known about preferred spawning habitat for Pacific cod and about the spatial distribution of cod spawning in the BSAI. Spawning is known to occur in the southeast Bering Sea near Unimak Pass, and areas of high cod density (indicative of spawning aggregations) have been observed in the AI. In order to better document cod spawning locations, the FIT and the North Pacific Observer Program are conducting a special project using fishery observers to classify and record the gonad maturity of cod from selected hauls. This project is providing data regarding the date and location of hauls containing fish in ripe or near-ripe condition, which can be used to map putative spawning areas. Preliminary results suggest that cod spawn in several areas of the AI, as well as throughout the EBS (Fig. 6-1).

(7) Movement and migration

As part of field studies conducted in 2002-2004, FIT scientists tagged and released cod in the southeast Bering Sea between Cape Sarichef and Amak Island. These releases were primarily intended to develop methodology for spaghetti tagging of Pacific cod caught with pots and to gain some qualitative description of cod movement during and after the spawning season. The

majority of the tags were released in February 2003. Tag recovery has been solely through commercial fisheries.

Out of 5935 spaghetti tags released in the Bering Sea, 2331 (39%) have been recovered (as of Dec 2005). Of the recovered tags, the majority of the recoveries were from the Bering Sea. A total of 148 tags were recovered in the western GOA, indicating some movement of fish through Unimak Pass. Only two tags from the Fit Bering Sea releases were recovered in the AI. These results are consistent with an earlier study that demonstrated little movement of EBS cod to the AI (Shimada and Kimura 1994).

These data are difficult to interpret because the releases were not designed to look for movement between the regions. The small number of recoveries in the AI suggests that movement from the Bering Sea to the AI might be rare, but this may also be an artifact of the relatively small level of cod fishing effort in the AI. Fish released in the EBS were also adults; no information is available on movement of juvenile cod. FIT scientists are currently working on model and field study design for a more quantitative cod tagging study that will better characterize movement rates.

Literature Cited

Quinn, T.J. II and R.B. Deriso. 1999. Quantitative fish dynamics. Oxford University Press, New York.

Shimada, A. M., and D. K. Kimura. 1994. Seasonal movements of Pacific cod, *Gadus macrocephalus*, in the eastern Bering Sea and adjacent waters based on tag-recapture data. *Fish. Bull.* 92:800-816.

Thompson, G.G., M. Dorn, S. Gaichas, and K. Aydin. 2006. Assessment of the Pacific cod stock in the Eastern Bering Sea and Aleutian Islands area. In: Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands regions. NPFMC, Anchorage, AK.

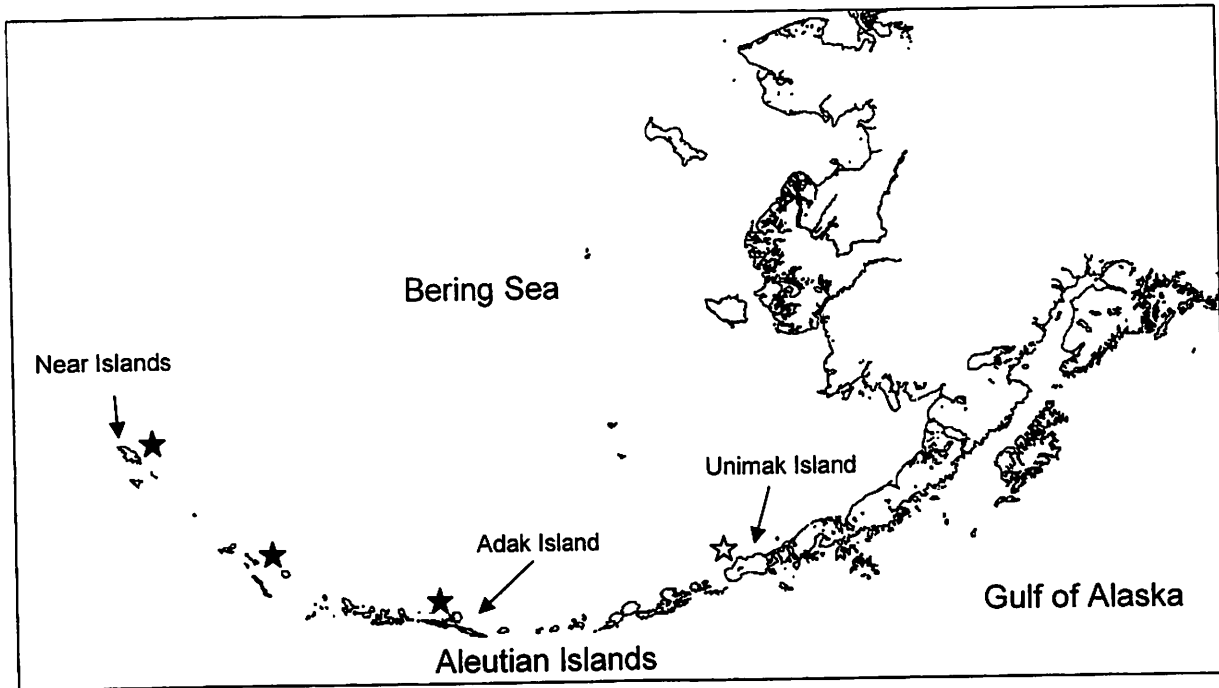


Figure 1-1. Map of the Bering Sea and Aleutian Islands. Solid stars = areas where Aleutian Islands samples were collected for analyses in sections 1 & 4; white star = area where Eastern Bering Sea samples were collected for analyses in sections 1 & 4.

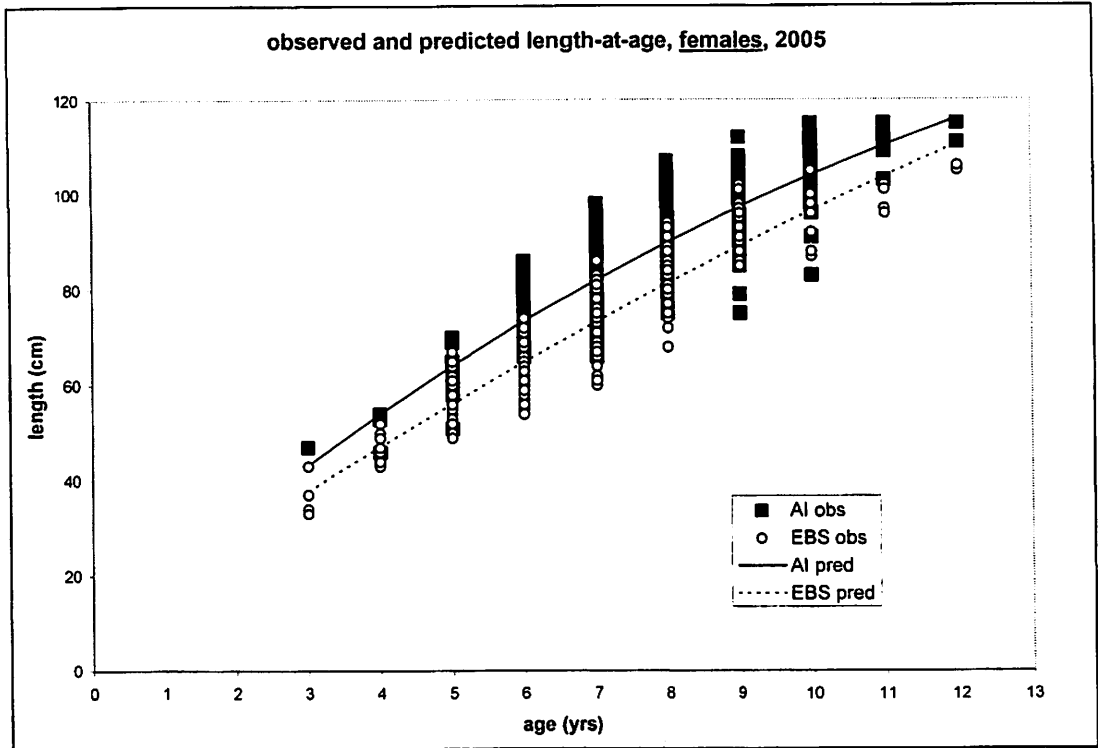


Figure 1-2. Observed and predicted length at age for female cod from the Aleutian Islands and Eastern Bering Sea.

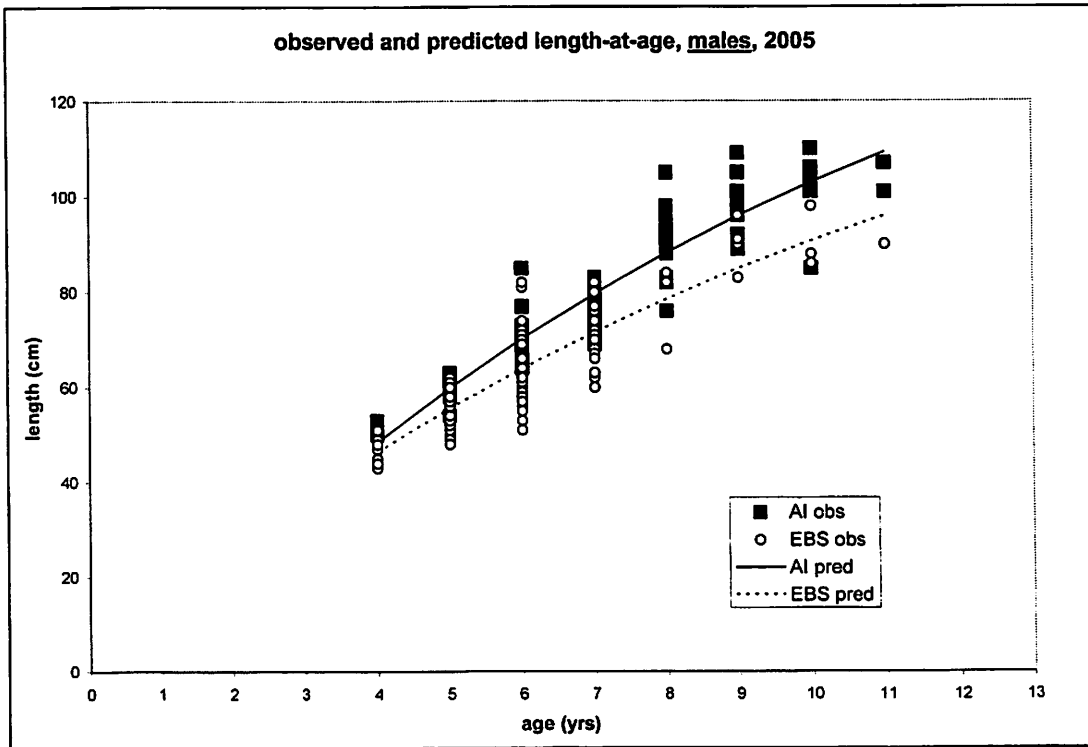


Figure 1-3. Observed and predicted length at age for male cod from the Aleutian Islands and Eastern Bering Sea.

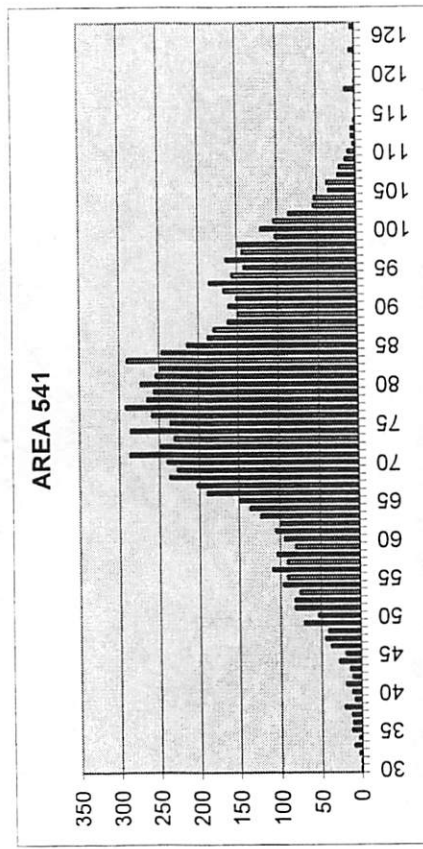
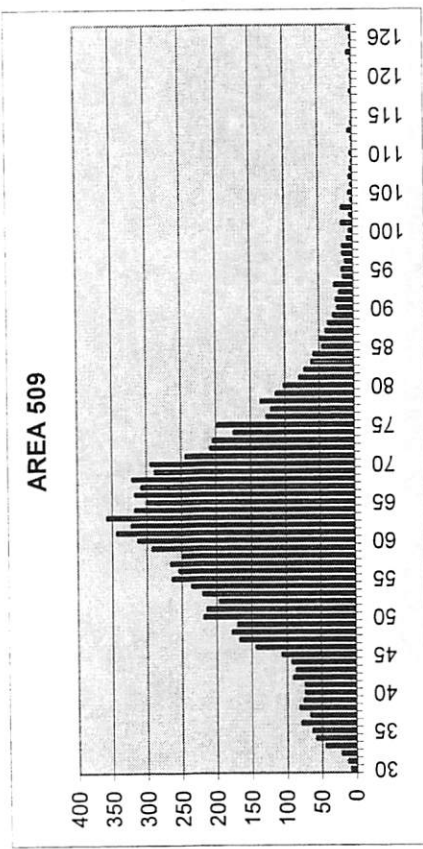
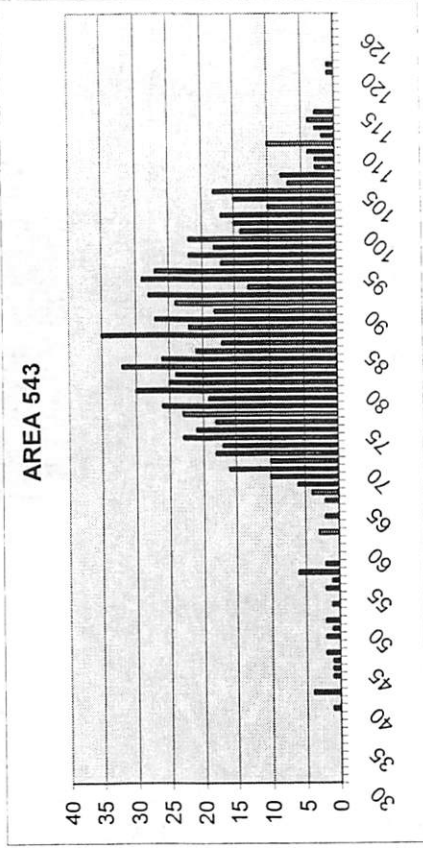
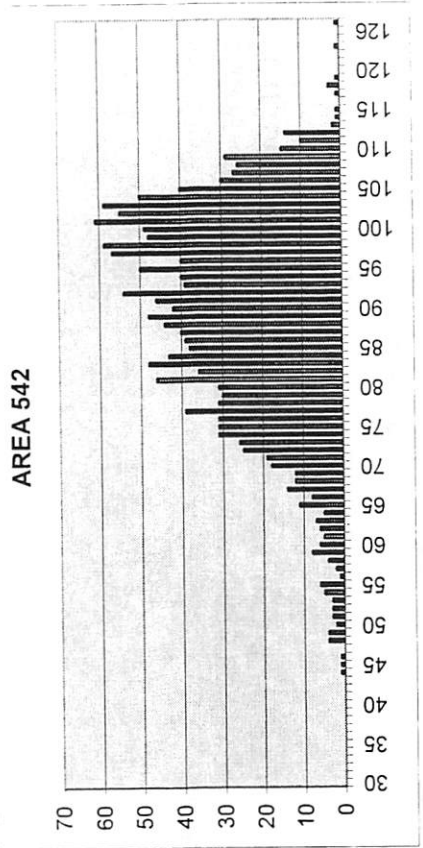


Figure 2-1. Length frequency of Pacific cod from all observed hauls using bottom trawl gear, January-March 2004. Both sexes of cod are included. Areas are NMFS statistical reporting areas: 509 Southeastern Bering Sea, 541 Eastern Aleutian Islands, 542 Central Aleutian Islands, 543 Western Aleutian Islands.

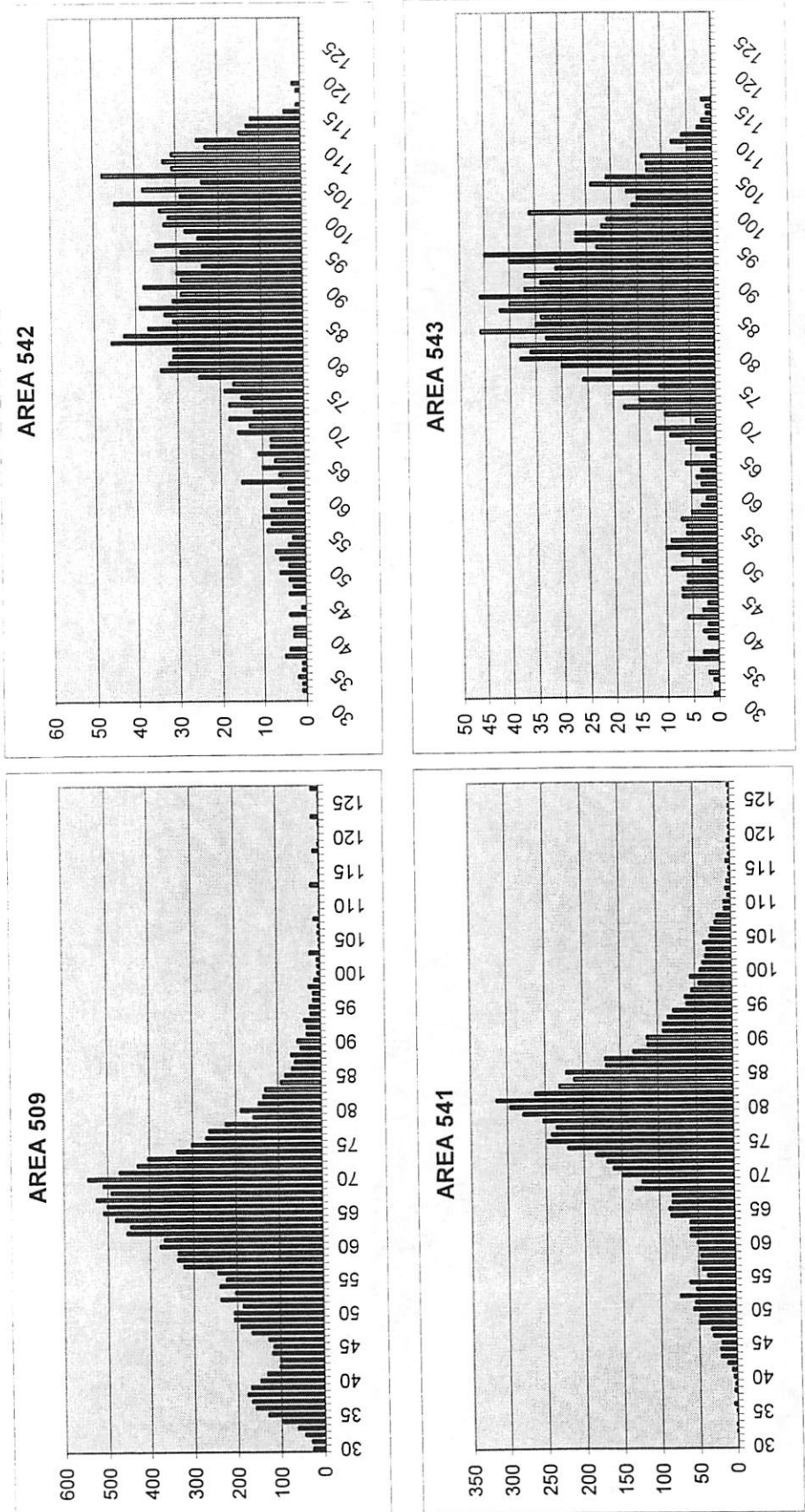


Figure 2-2. Length frequency of Pacific cod from all observed hauls using bottom trawl gear, January-March 2005. Both sexes of cod are included. Areas are NMFS statistical reporting areas: 509 Southeastern Bering Sea, 541 Eastern Aleutian Islands, 542 Central Aleutian Islands, 543 Western Aleutian Islands

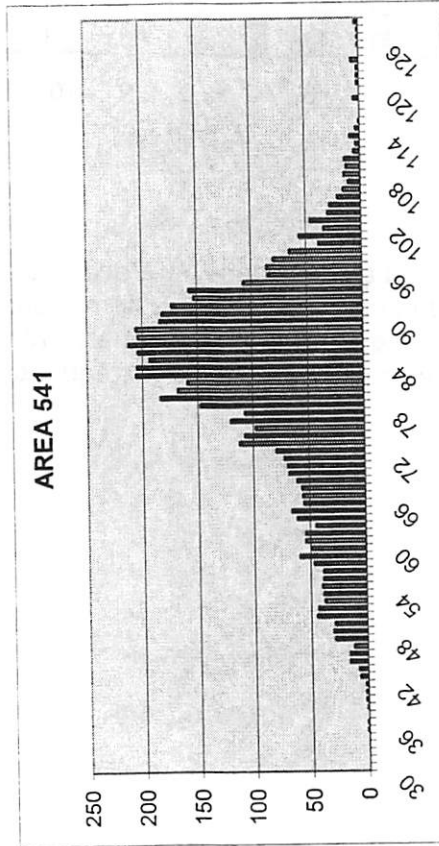
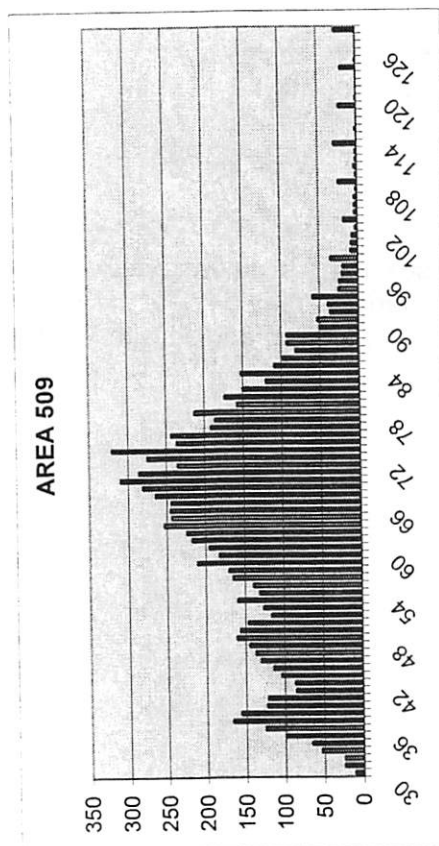
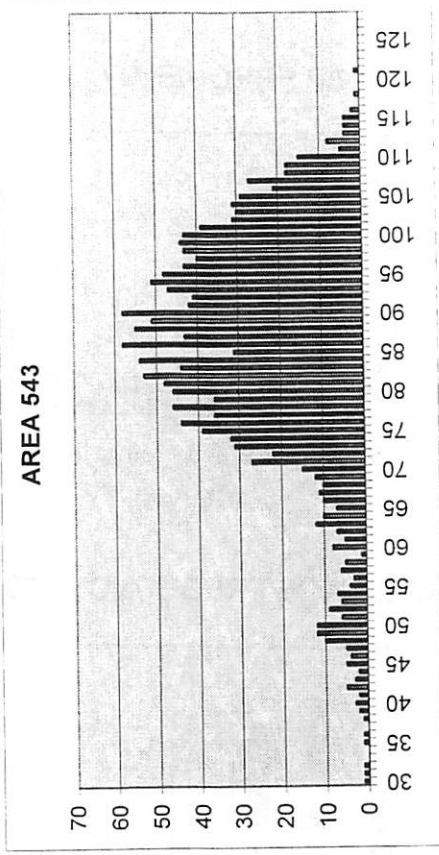
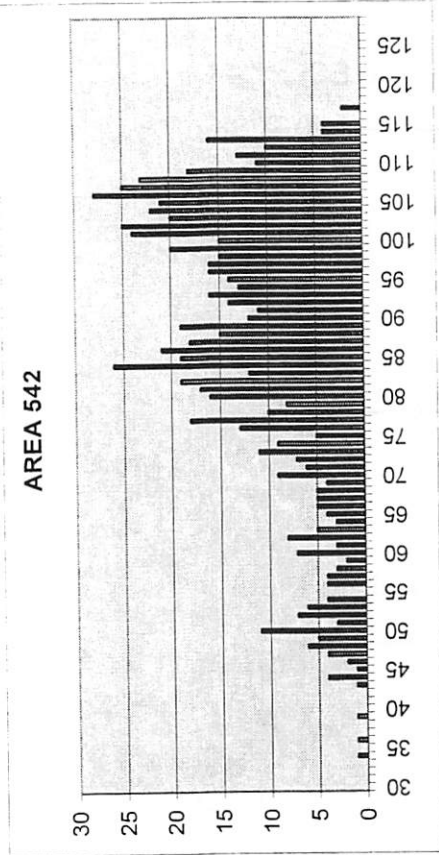


Figure 2-3. Length frequency of Pacific cod from all observed hauls using bottom trawl gear, January-March 2006. Both sexes of cod are included. Areas are NMFS statistical reporting areas: 509 Southeastern Bering Sea, 541 Eastern Aleutian Islands, 542 Central Aleutian Islands, 543 Western Aleutian Islands

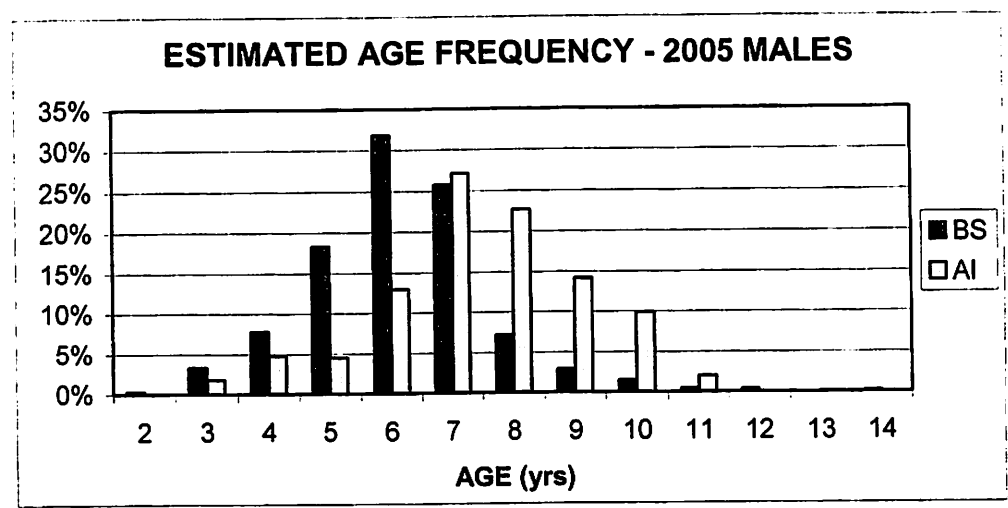
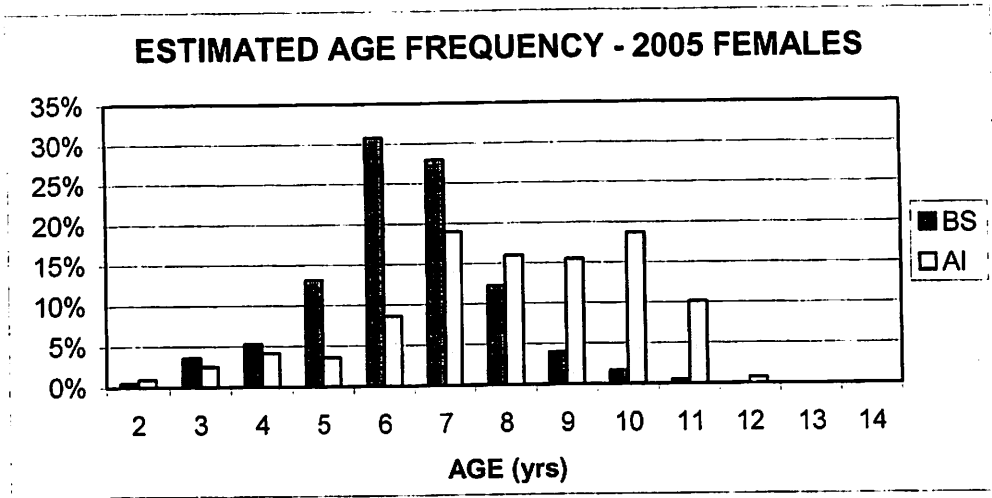


Figure 3-1. Estimated age frequency of Pacific cod by sex in the southeastern Bering Sea (area 509) and in the central and western Aleutian Islands (areas 542 and 543). Bottom trawl length frequency data for January –March 2005 was combined with length-age models fit in section 1 to produce age frequency.

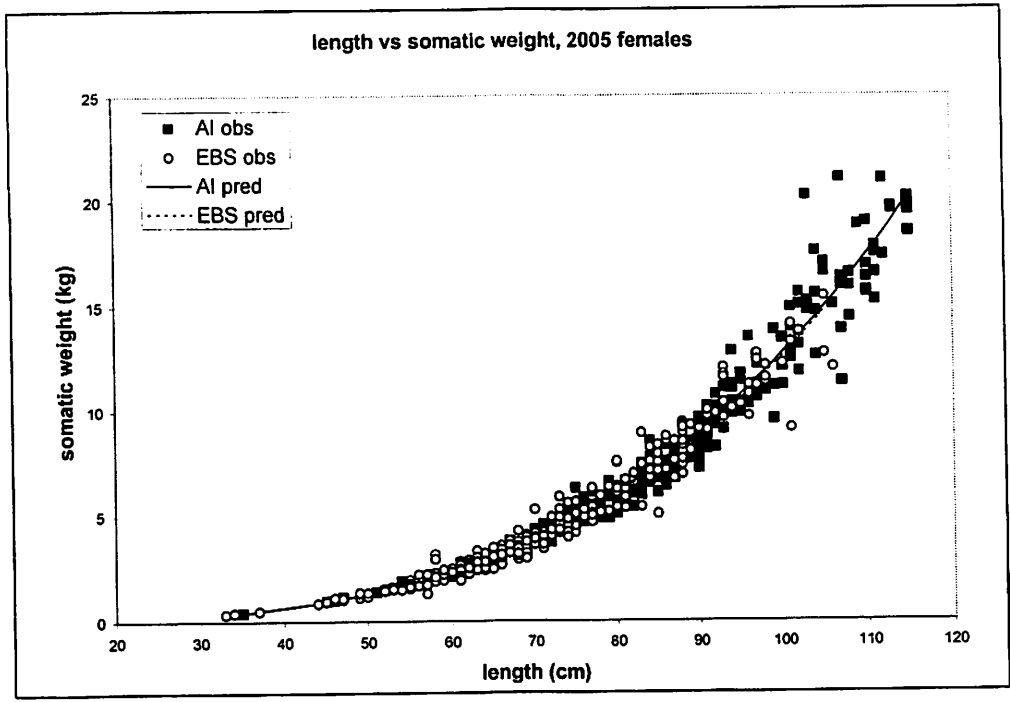


Figure 4-1. Observed and predicted somatic weight for female cod from the Aleutian Islands (AI) and Eastern Bering Sea (EBS).

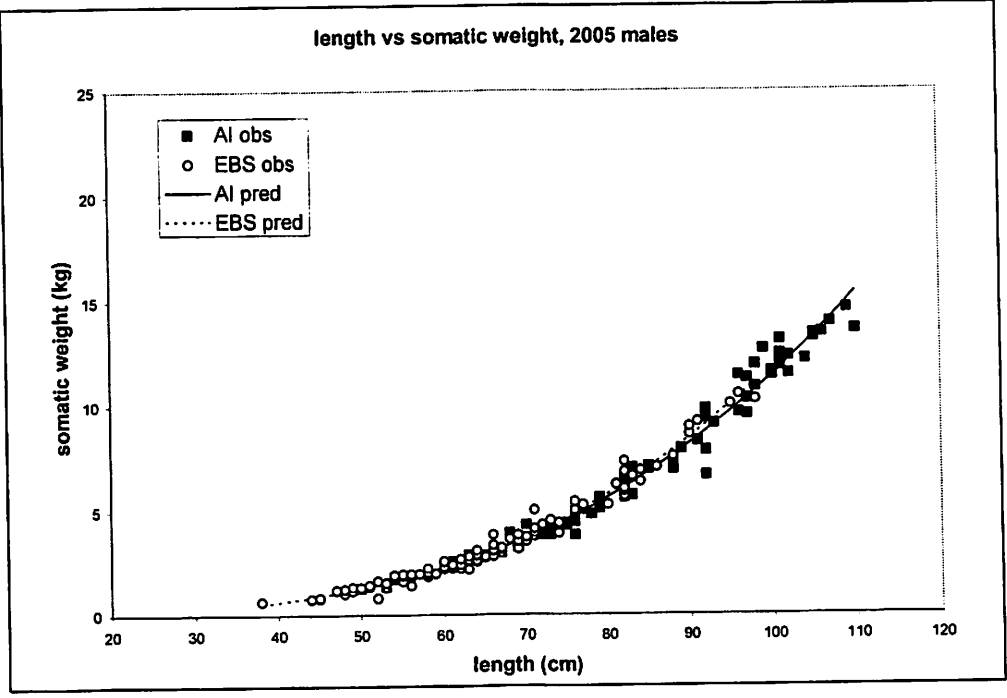


Figure 4-2. Observed and predicted somatic weight for male cod from the Aleutian Islands (AI) and Eastern Bering Sea (EBS).

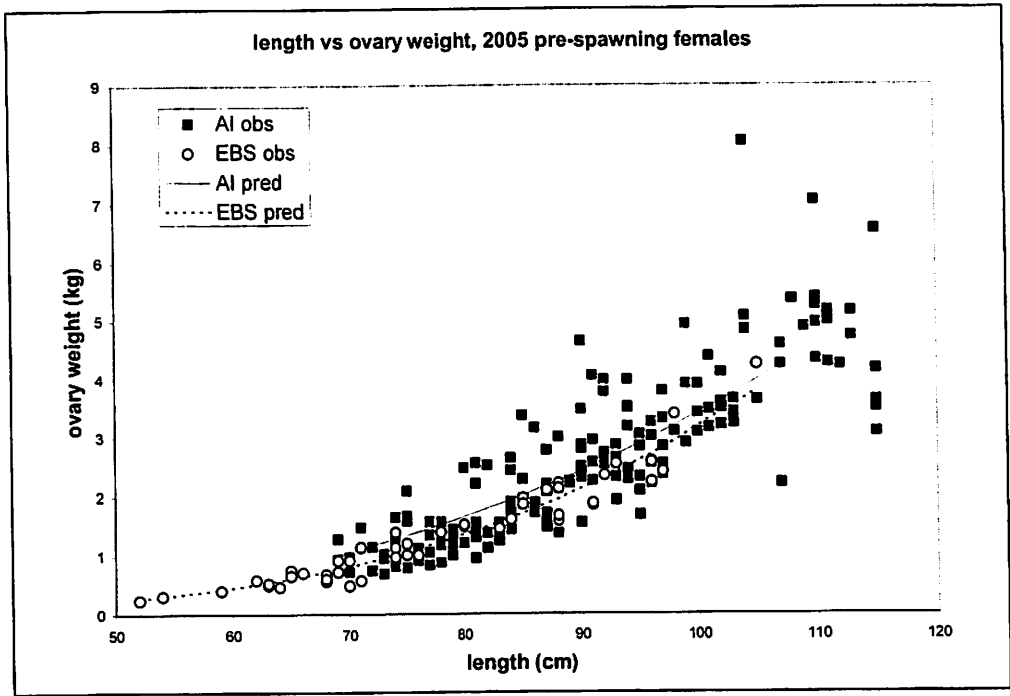
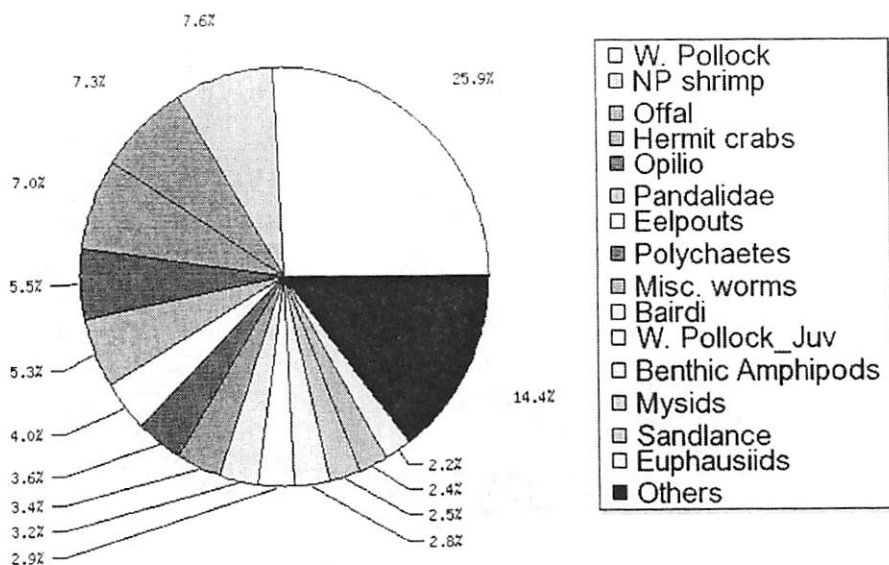


Figure 4-3. Observed and predicted ovary weight for female cod from the Aleutian Islands and Eastern Bering Sea.

BS P. Cod diet



AI P. Cod diet

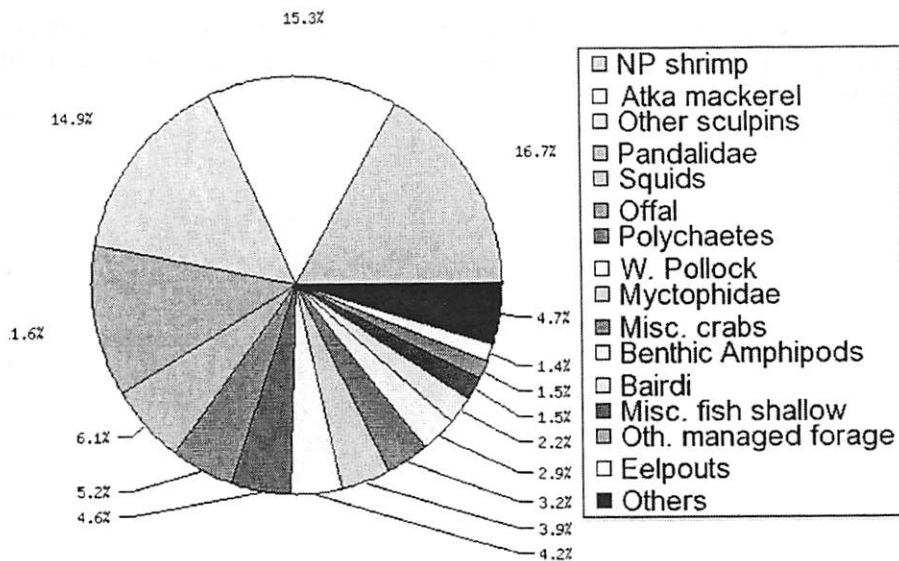


Figure 5-1. Diets of Pacific cod in the Aleutian Islands (AI) and Eastern Bering Sea (BS).

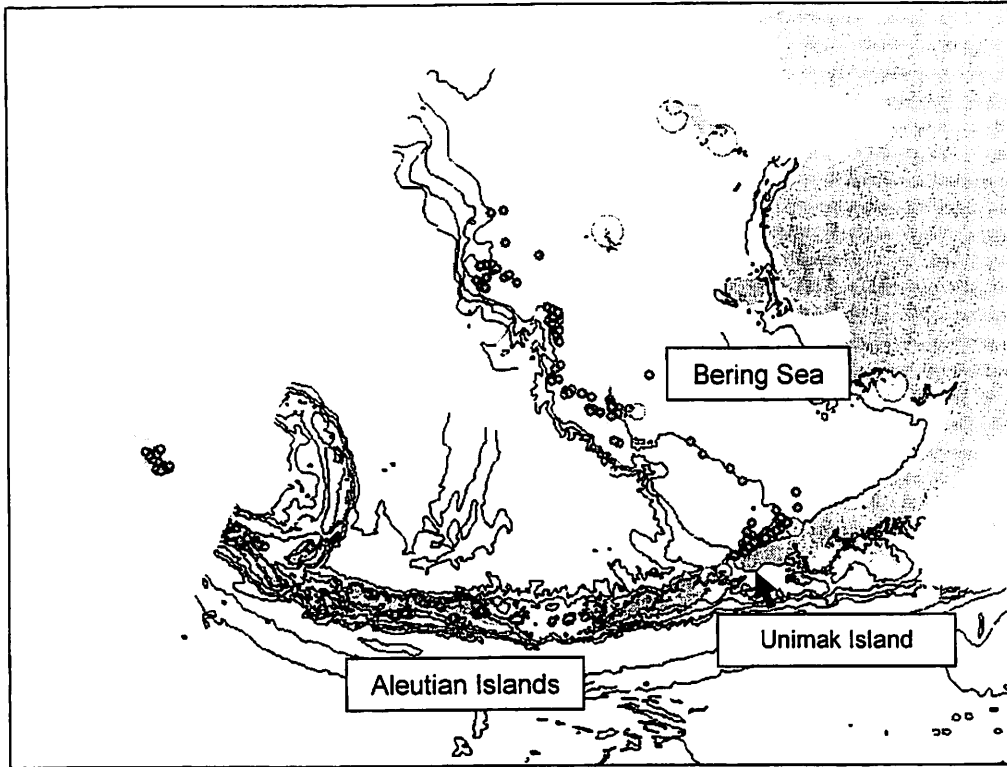


Figure 6-1. Locations in the AI and EBS where females in spawning condition have been observed in commercial fishery hauls. Red (or gray) dots indicate catch locations of spawning female cod.

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C-6

The following tables provide comparisons of 2006 SAFE total catch with the total retained catch (plus meal) from table 3 of the discussion paper
From 95-00 there was a 31% difference between SAFE and table 3 for the AI, but just a 16% difference in the BS. This is more likely to reflect lack of MS fish tickets than different discard rates.

Year	Total catch data from 2006 SAFE				
	BSAI total	AI SAFE	BS SAFE	AI %	BS %
1995	245,030	16,534	228,496	6.7%	93.3%
1996	240,673	31,609	209,064	13.1%	86.9%
1997	257,762	25,164	232,598	9.8%	90.2%
1998	193,252	34,726	158,526	18.0%	82.0%
1999	173,995	28,130	145,865	16.2%	83.8%
2000	191,056	39,684	151,372	20.8%	79.2%
2001	176,659	34,207	142,452	19.4%	80.6%
2002	197,353	30,801	166,552	15.6%	84.4%
2003	209,114	32,455	176,659	15.5%	84.5%
2004	213,810	28,865	184,945	13.5%	86.5%
2005	205,434	22,627	182,807	11.0%	89.0%

Year	Retained Catch (with meal) data from Discussion Paper - Table 3				
	BSAI total	AI	BS	AI %	BS %
1995	177,414	9,782	167,632	5.5%	94.5%
1996	193,928	21,603	172,325	11.1%	88.9%
1997	213,534	13,169	200,365	6.2%	93.8%
1998	166,556	25,226	141,330	15.1%	84.9%
1999	146,388	24,475	121,913	16.7%	83.3%
2000	163,349	29,832	133,517	18.3%	81.7%
2001	154,342	30,412	123,930	19.7%	80.3%
2002	169,347	27,445	141,902	16.2%	83.8%
2003	183,128	29,387	153,741	16.0%	84.0%
2004	217,623	34,036	183,587	15.6%	84.4%
2005	212,809	26,365	186,444	12.4%	87.6%

Year	Comparison of SAFE catch versus Discussion Paper Retained Catch							
	AI "Missing" relative TAC % points	% of AI Catch "Missing"	Total difference	difference as % of SAFE BSAI total	AI difference	difference as % of SAFE AI total	BS difference	difference as % of SAFE BS total
1995	-1.2%	-22.7%	67,616	27.6%	6,752	40.8%	60,864	26.6%
1996	-2.0%	-18.3%	46,745	19.4%	10,006	31.7%	36,739	17.6%
1997	-3.6%	-57.5%	44,228	17.2%	11,995	47.7%	32,233	13.9%
1998	-2.9%	-19.0%	26,696	13.8%	9,500	27.4%	17,196	10.8%
1999	0.5%	3.2%	27,607	15.9%	3,655	13.0%	23,952	16.4%
2000	-2.5%	-13.5%	27,707	14.5%	9,852	24.8%	17,855	11.8%
2001	0.3%	1.7%	22,317	12.6%	3,795	11.1%	18,522	13.0%
2002	0.6%	3.7%	28,006	14.2%	3,356	10.9%	24,650	14.8%
2003	0.5%	3.0%	25,988	12.4%	3,068	9.5%	22,918	13.0%
2004	2.1%	13.5%	-3,813	-1.8%	-5,171	-17.9%	1,358	0.7%
2005	1.4%	11.2%	-7,375	-3.6%	-3,738	-16.5%	-3,637	-2.0%
95-00 av				18.1%		30.9%		16.2%