7.0 OTHER GROUNDFISH, OTHER PROHIBITED SPECIES & FORAGE FISH

The Bering Sea pollock fishery, and potential changes to the prosecution of the pollock fishery to reduce salmon bycatch under the alternatives, impacts other groundfish species, other species classified as prohibited species, and forage fish. This chapter analyses the impacts to these other fishery resources.

7.1 Other groundfish

Alaska groundfish fisheries are managed based on species quotas using the best scientific data available to determine the status of the stocks. Each year, the Council recommends, and the Secretary of Commerce publishes, harvest specifications for the Bering Sea and Aleutian Islands (BSAI) groundfish fisheries. Harvest specifications establish specific limits on the commercial harvest of groundfish and are used to manage the fisheries. Harvest specifications include the establishment of an individual overfishing level (OFL), acceptable biological catch (ABC), total allowable catch (TAC) for each species or species group, and prohibited species catch (PSC) limits. The ABC is a description of the acceptable harvest for a given stock or stock complex. Its derivation focuses on the status and dynamics of the stock, environmental conditions, other ecological factors, and prevailing harvest characteristics of the fishery. Conservative fishing mortality rates are used to calculate ABC. The OFL is defined as any amount of fishing in excess of a prescribed maximum allowable rate. Fishing at or above the OFL is considered to damage the capacity of the stock to replenish. This maximum allowable rate is prescribed through a set of six tiers. The tiers correspond to information availability. Generally, the least preferable tier utilizes the least amount of information and results in the most restrictive harvest level. Stock management centers on the ABC and OFL. The ABC is lower in amount than the OFL. By convention the individual TACs can equal but do not exceed the individual ABCs.

The objective for NMFS inseason managers is to limit catch to the TAC and or ABC. NMFS prohibits retention if the total TAC is caught before the end of the year. Retention prohibition removes any incentive to increase incidental catch as a portion of other fisheries. If the ABC is taken and the trajectory of catch indicates the OFL may be approached, NMFS imposes additional closures. To prevent overfishing, NMFS closes specific fisheries, identified by gear and area, that incur the greatest incidental catch. NMFS expands the closures to other fisheries if the rate of take is not sufficiently slowed. Over fishing closures are rare because NMFS takes these preventative measures.

Table 7-1 identifies groundfish catch in the Bering Sea pollock fishery for 2003 through 2007. The pollock fishery includes all catch by pelagic trawl gear that is greater than 95% pollock (P target) or is a majority of pollock but less than the 95% mark (B target). The table combines catch from all three sectors of the fishery (catcher/processors, motherships, and inshore catcher vessels). The table shows catch is about 99% pollock. Because of the high volume of pollock, the incidental catch rate of other groundfish species is relatively low. Pacific cod is caught at the highest rate relative to the remaining groundfish species at roughly a half a percent of the total catch. The remaining flatfish species are taken in declining amounts along with more minor components in volume.

Incidental catch of some species may be significant relative to their ABCs and OFLs while small relative to the pollock catch. For example, the 2003 catch of 927 mt of Pacific ocean perch is 38% of that year's Bering Sea subarea ABC of 2,410 mt but on the average is a minimal rate (0.047%) relative to the total groundfish catch in the target. The 2006 catch of 1,396 mt of squid is 66% of an ABC of 1,970 mt. Should catch of these species in other fisheries combine to approach the OFL, management actions would be taken that may impact the pollock fishery. Historically, closures to prevent overfishing are relatively rare but they have occurred and have impacted management of the pollock fishery and incidental catch of groundfish and prohibited species.

Table 7-1 Groundfish catch estimates (in metric tons) by species, in the Bering Sea pollock fishery, including CDQ, for years 2003-7 with a five-year average.

Species/ Species Group	2003	2004	2005	2006	2007	Five-year average	Average percentage by species
Pollock	1,305,228	1,435,936	1,446,199	1,454,514	1,321,788	1,392,733	
Pacific cod	5,526	6,409	7,366	7,270	5,566	6,427	0.46
Flathead sole	1,498	2,104	2,325	2,858	4,213	2,599	0.18
'Other species'	821	1,181	1,022	1,973	1,686	1,337	0.09
Rock sole	1,269	2,549	1,089	1,302	449	1,332	0.09
Squid	1,226	976	1,148	1,396	1,168	1,183	0.08
Arrowtooth	416	555	617	1,078	2,723	1,078	0.08
Atka mackerel	751	1,051	677	786	315	716	0.05
Pacific ocean perch	927	393	652	733	624	666	0.05
'Other flatfish'	137	345	363	463	523	366	0.03
Yellowfin sole	185	821	15	247	85	271	0.02
Shortraker rockfish		54	67	16	73	53	0.00
Northern rockfish	35	50	42	97	24	50	0.00
Greenland turbot	24	18	31	65	108	49	0.00
'Other rockfish'	21	16	15	39	91	36	0.00
Sablefish	42	17	11	8	12	18	0.00

7.2 Impacts on other groundfish

7.2.1 Alternative 1 Status Quo

Pollock catch has remained fairly consistent from year to year in the selected data. A review of Table 7-1 shows under the status quo (for the last five years) some what stable incidental catches of most species in relationship to the pollock target catch. Pacific cod has consistently numbered in the thousands of metric tons. Pacific Ocean perch in the hundreds and species at the declining end of the incidental catch distribution have remained at amounts generally less than 100 mt. Some species show fairly dramatic variation from year to year. Yellowfin sole catch has ranged from 821 mt in 2004 to 15 mt in the following year. Some species have shown an increasing trend. Arrowtooth flounder has increased from more than 400 mt in 2003 to over 2,700 mt in 2007. 'Other flatfish' has likewise shown yearly increases.

During the time period covered in Table 7-1, the pollock fleet has sought to minimize salmon bycatch with increasing focus culminating in the ICA in the late summer of 2006 and into 2007. The ICA allowed vessels to fish in areas that would otherwise been closed due to salmon bycatch. Some groundfish incidental catch has increased over the last several years. Explicitly attributing arrowtooth flounder or 'other flatfish' catch increases to only a change in behavior of the pollock fleet in response to salmon avoidance would entail an involved analysis though they are likely linked.

The incidental catch estimation process includes extrapolations based on partial observer coverage within the inshore catcher vessel fleet. Conditions affecting estimates of incidental groundfish catch include fleet distribution, vessel behavior, habitat and relative abundance, and the estimation process. Depending on how the observer estimates are incorporated into the estimation algorithm, catch estimates for species that are generally caught at relatively low rates can be based on relatively low number of observations. If an observed vessel among several unobserved vessels incurs high incidental catch that rate is extrapolated to the unobserved vessels. Such an extrapolation can be based on very few observer estimates and result in relatively high estimates of catch

Under the status quo, incidental catch of groundfish could be expected to continue roughly at the amounts identified in Table 7-1. Bycatch of other groundfish species in the pollock fishery will not significantly impact those stocks because incidental catch in the pollock fishery accrues towards each species or species group OFL, and NMFS closes all fisheries in which a species is caught before its OFL is reached. Therefore, the pollock fishery would be closed prior to contributing to significant impacts to other groundfish stocks.

7.2.2 Alternative 2

Alternative 2 would apply a hard cap of Chinook salmon which would close the Bering Sea pollock fishery when reached. The alternative does not include an exemption from that cap as with the ICA under status quo. Sub options include sector splits of the hard cap.

The hard cap would not be expected to drastically change the footprint of the fishery from the status quo. Groundfish fishery management that maintains harvests at the TAC and prevents overfishing would remain the same under Alternative 2. The rate and type of incidentally caught groundfish are expected to vary largely in the same manner as they do under the status quo. While the status quo does have an area closure, the ICA exemption allows the fishery to continue to some extent in that area. To the extent that Alternative 2 would not allow additional fishing after a cap was reached, the incidental catch of groundfish could diminish in relative amounts and perhaps in numbers of species. Under Alternative 2 the fleet would not be expected to fish for extended periods in areas marginal for pollock and incur radically different incidental catch. Further, the seasonal distribution of the Chinook hard cap can affect the rate of groundfish incidental catch.

Table 7-2 shows the seasonal difference between incidental groundfish catch in the pollock fishery. To the extent the distribution of the Chinook salmon bycatch caps constrict pollock fishing in one season and shift effort to the other season, the table may provide an index of the shift in incidental groundfish catch. For species such as Pacific cod, flathead sole, and rock sole seasonal shifts in catch are not likely to incur management implications. For species where catch is typically a relatively high percentage of their ABC and that have relatively small tolerance between the ABC/OFL, an additional catch of small tonnage could exceed the ABC and generate management actions to prevent attaining the OFL. Conversely, a relative distribution of Chinook salmon that limited pollock catch in a season where a vulnerable species incidental rate was relatively higher could decrease the potential for actions to prevent overfishing.

Table 7-2 Groundfish catch estimates (in metric tons) by species, in the Bering Sea pollock fishery average for years 2003-2007, by A season and B season, including CDQ catch.

Species/Species Group	A Season			B Season	
	2003-2007 catch average	Percentage relative to pollock		2003-2007 catch average	Percentage relative to pollock
Alaska plaice	4	0.00		1	0.00
Arrowtooth	332	0.06		745	0.09
Atka mackerel	68	0.01		648	0.08
Flathead sole	1,475	0.26		1,124	0.13
Greenland turbot	9	0.00		40	0.00
Northern rockfish	1	0.00		48	0.01
'Other flatfish'	112	0.02		254	0.03
'Other rockfish'	24	0.00		12	0.00
'Other species'	546	0.10		790	0.09
Pacific cod	4,128	0.74		2,299	0.28
Pacific ocean perch	154	0.03		512	0.06
Pollock	558,908			833,827	
Rock sole	1,297	0.23		40	0.00
Rougheye rockfish	1	0.00		0	0.00
Sablefish	3	0.00		8	0.00
Shortraker rockfish	52	0.01		1	0.00
Squid	403	0.07		779	0.09
Yellowfin sole	262	0.05		8	0.00

If a hard cap closes the pollock fishery especially early in the fishery year, the fleet may increase focus on alternate fisheries to attempt to make up for lost catch. Under the structure of Amendments 80 and 85, AFA vessels are able to target primarily Pacific cod and yellowfin sole as an alternate to pollock. If the pollock fleets' participation in alternate fisheries, especially yellowfin sole, increases more than their current substantial involvement, groundfish incidental catch in the yellowfin fishery especially will likely increase as a result of Alternative 2. However the amount of yellowfin sole and Pacific cod apportioned to the pollock fleet is limited by regulation. The amount of that apportionment they can harvest can be limited by crab and halibut PSC limits.

The size of the Chinook salmon hard cap relative to the pollock TAC can drive incidental catch as well. Within the last several years the Bering Sea pollock ABC has varied from 990,000 mt in 1999 to 2,560,000 mt in 2004. A Chinook cap may not restrict or change the relative incidental catch of groundfish if the pollock TAC is low enough relative to recent years. The incidental catch of groundfish would be expected to generally increase with increasing pollock TAC until (if) the Chinook hard cap became a restriction.

Under Alternative 2, four options are under considerations for seasonal distribution of caps. Option 1-2 is most consistent (2000-2007 average distribution of Chinook bycatch) with the years averaged in Table 7-1. Option 1-1 envisions a 70/30 relative split of the cap. If the fishery utilized 70% of the cap in the A season and consequently limited pollock catch in the B season, incidental catch of groundfish could be expected to decline at the B season rates. Catch of species that are assigned relatively small ABCs and are caught at relatively low levels but at higher rates in the A season could generate management concerns. For example shortraker rockfish are caught at slightly higher rates in the A season. In 2007 shortraker catch was within about 100 mt of the ABC. With the variable nature of the incidental catch of rockfish in all fisheries, changes in the 'normal' patterns can generate higher catches and therefore management concerns. Option 1-3 is only a few percentage points different from and is consistent with option 1-2.

Option 1-4 could decrease the amount of pollock taken in the A season since its apportionment results in an eight point decrease in the A season allocation from the average use identified in option 1-2. The remaining A season allocation of pollock would be available in the B season fishery and increase the incidental catch of groundfish. Of concern for example could be 'other rockfish', rougheye rockfish, and shortraker rockfish which generally have low ABC/OFL limits and are currently caught at levels that are less than 100 or 50 mt of their ABCs.

Under Alternative 2, two options are under consideration for sector allocations of the hard cap, with one option having four sub options. Sector allocations are not expected to affect the major incidental groundfish species. To the extent an allocation of Chinook salmon bycatch drives the ability of a sector to catch its apportionment of the pollock allocation, the incidental catch would vary somewhat in the proportions identified in Table 7-3. Table 7-3 shows the five-year average catch of groundfish in the pollock targets by sector in the Bering Sea. The estimates of incidental catch rates of Pacific cod and flathead sole are somewhat different between the processing components but not largely so. Catcher vessels in the mothership and inshore catcher vessel components have slightly higher rates for Pacific cod relative to catcher processors and the CDQ component. Fishing by CDQ vessels generally follows the seasonal patterns of catcher/processor fleet. A close study of the more minor components of groundfish catch indicates small differences in the hierarchy of incidental groundfish species. If Chinook salmon bycatch is allocated on the basis of the pollock allocations rather than historic bycatch rates and transfers are allowed between the sectors, the incidental catch rates of groundfish are expected to be consistent with the historic patterns. If the flexibility of transfers are not allowed the incidental groundfish catch may shift slightly in favor of the processing sector most favored by the limitation.

Table 7-3 likewise addresses the question of a shift in incidental catch due to transfers of Chinook salmon incidental catch apportionment between sectors of the pollock fishery. Shifts of allocations may drive relatively small fluctuations of incidental catch but not to a large divergence from the general rates identified in Table 7-3.

Table 7-3 Average groundfish catch estimates (in metric tons) by sector and species or species group, in the Bering Sea pollock fishery for years 2003-2007.

	Catcher/processors		Motherships		Inshore CV		CDQ	
	2003-2007 catch average (mt)	Percentage relative to pollock	2003-2007 catch average (mt)	Percentage relative to pollock	2003-2007 catch average (mt)	Percentage relative to pollock	2003-2007 catch average (mt)	Percentage relative to pollock
Alaska plaice	3	<0.01	9	<0.01	1	<0.01	1	<0.01
Arrowtooth	353	0.07	177	0.03	637	0.10	137	0.09
Atka mackerel	35	0.01	36	<0.01	677	0.11	148	0.10
Flathead sole	1,085	0.21	543	0.17	1,126	0.18	212	0.14
Greenland turbot	31	0.01	25	<0.01	8	<0.01	1	<0.01
Northern rockfish	12	<0.01	17	<0.01	36	0.01	4	<0.01
Other flatfish	73	0.01	138	0.01	261	0.04	7	<0.01
Other rockfish	18	<0.01	1.7	<0.01	15	<0.01	1	<0.01
Other species	545	0.11	272	0.10	559	0.09	66	0.05
Pacific cod	2,306	0.45	1,153	0.50	3,031	0.48	553	0.38
Pacific ocean perch	277	0.05	101	0.02	368	0.06	12	0.01
Pollock	515,073	**	515,073	**	631,288	**	147,124	**
Rock sole	707	0.14	353	0.10	373	0.06	18	0.01
Rougheye rockfish	1	<0.01	0.6	<0.01	0.4	<0.01	0.1	<0.01
Sablefish	2	<0.01	6.2	<0.01	15	<0.01	1	<0.01
Shortraker rockfish	50	0.01	1.0	<0.01	1	<0.01	0.3	<0.01
Squid	301	0.06	16	<0.01	706	0.11	106	0.07
Yellowfin sole	202	0.04	151	0.02	34	0.01	2	<0.01

7.2.3 Alternative 3

Alternative 3 proposes fixed closure areas once threshold incidental catch amounts are reached. In contrast to Alternatives 1, 2, and 4, Alternative 3 has a higher potential for changes to the incidental groundfish catch. Many of the options under Alternative 3 regarding transfers would have similar result as the options discussed in this section under Alternative 2.

Assuming that closures are driven by an association of a high concentration of pollock and Chinook salmon, displacing the fleet from that area and allowing the fishery to continue elsewhere may shift incidental groundfish catch from the patterns identified in the tables in this section. The degree to which incidental groundfish catch will vary in relation to status quo depends on the selected closed areas and the duration of the closures. Groundfish do have preferred habitat that may not be associated with the center of abundance for pollock. Habitat characteristics influencing incidental catch may be geographic, depth driven, or include features such as seasonal effects, temperature, currents, salinity and prey species availability. To the extent that Alternative 3 displaces the pollock fleet away from the center of pollock concentration and into the other groundfish preferred habitat, change would occur in incidental groundfish species catch.

During the 2008 A season, under the status quo fishery, an area that has been closed under the ICA as a 'salmon conservation area' is the same area closure proposed under Alternative 3. Salmon bycatch has been significantly reduced in both the Chinook and non-Chinook categories from about 43,000 Chinook in 2007 A season to about 16,500 in 2008 A season. Whether the closure is directly responsible for the dramatic decrease in Chinook bycatch is difficult to determine given the myriad influences on incidental catch. However incidental catch of rocksole, yellowfin sole, and skates (a component of the 'other species' category) increased in the 2008 A season on the order of several hundred tons per category. The amount of increase is not significant in the case of the ABC and OFL for rocksole and yellowfin sole but has a higher proportional impact on the 'other species' category.

The Council is currently considering splitting the 'other species' category into its constituent species groups (sharks, skates, octopus, sculpins). Management concerns exist over approaching an OFL level especially for sharks and octopus, which are evaluated at a tier 6 stock assessment level. The combined impacts of the increase in bycatch under Alternative 3 trigger closures and OFLs defined for smaller species groups may result in an increase likelihood of pollock fishery closures to prevent reaching the OFL for those species groups.

7.2.4 Alternatives 4 and 5

Alternatives 4 and 5 contain two different annual scenarios that would establish caps to limit the amount of Chinook salmon that could be caught in the Bering Sea directed pollock fishery each year. The annual Chinook salmon cap differs under each Alternative and scenario. Alternative 4 includes a high annual hard cap of 68, 392 Chinook salmon, but is conditional upon an ICA to reduce salmon bycatch being developed by the pollock industry. Alternative 5 includes a high annual hard cap of 60, 000 Chinook salmon, but is conditional upon an IPA to reduce salmon bycatch being developed by the pollock industry Vessels that do not participate in the ICA or IPA would be subject to a backstop cap. Both Alternatives 4 and 5 include a lower annual cap on 47,591 Chinook salmon that would be effective either as the only cap or in the absence of a NMFS-approved ICA or IPA. These caps may influence the mortality of other groundfish species through (1) an increased incentive to harvest non-pollock in directed fisheries, (2) changes in the pollock fleet to avoid salmon bycatch, and (3) changes in incidental groundfish catch caused by reducing the amount of pollock harvested and subsequent duration of the pollock fishery.

7.2.4.1 Chinook Salmon Cap

The environmental issues associated with Alternatives 4 and 5 are very similar to those described under Alternative 2. As discussed in Alternative 2, if a hard cap constrains pollock harvest, the fleet may increase its focus on alternate fisheries in an attempt to make up for lost pollock catch. Under the structure of Amendments 80 and 85, AFA vessels are able to target primarily Pacific cod and yellowfin sole as an alternate to pollock. The yellowfin sole and Pacific cod fisheries are both valuable directed fisheries that may be an attractive source of revenue to offset losses due to decreased pollock harvest and early closure of the pollock fishery.

The harvest of Pacific cod and yellowfin sole is limited by Federal regulations that are specific to the AFA sectors and species. The Alternative 2 discussion provides a detailed description of these fisheries and the sector-specific limits. In summary, the harvest of Pacific cod by the AFA inshore CV sector is limited by regulations while AFA CPs are limited to an annual allocation. The harvest of yellowfin sole is limited by regulations when the aggregate ITAC of yellowfin sole assigned to the Amendment 80 sector and BSAI trawl limited access sector is less than 125,000 metric tons. In 2008 and 2009, the CP and CV sectors are exempted from yellowfin sole limits due to the ITAC being greater than 125,000 mt and are limited by the BSAI trawl limited access allocation. The CDQ sector is limited to species-specific allocations made to CDQ groups. In addition to groundfish harvest limits specific in regulation, the harvest of yellowfin sole and Pacific cod species may be limited by crab and halibut PSC limits.

In addition to directed fishing for non-pollock groundfish, the size of the Chinook salmon hard cap relative to the size of the pollock TAC could change incidental catch in the pollock fishery. In general, the amount of non-pollock groundfish incidentally caught under Alternatives 4 and 5 would likely correspond with constraints on pollock harvest resulting from the Chinook salmon cap. The amount of incidental groundfish catch would not be allowed to exceed sustainable mortality levels specified in federal regulation. However, incidental groundfish catches could change as vessels attempt to maximize pollock harvest under a constraining Chinook cap.

One important difference between Alternative 4 and Alternative 2 is that incidental catches of Chinook salmon for both non-ICA and ICA vessels would accrue to the non-ICA backstop Chinook cap, while catch from ICA vessels only accrues to the higher ICA Chinook cap. The dual accounting could result in non-ICA vessels reaching the Chinook backstop cap before ICA vessels reach the high cap, which may result in forgone pollock and early closure of the fishery for those non-ICA vessels. To offset lost revenue due to early closure and forgone pollock, vessels constrained by the non-ICA cap may increase the harvest of non-pollock groundfish. This incentive would likely be driven by a number of factors, including groundfish prices, abundance, and the amount of forgone pollock. This potential impact is mitigated under Alternative 5 by the modification that only bycatch by vessels fishing under the backstop cap accrue towards that cap.

The nature of the Alternative 4 high hard cap and dual accounting between non-ICA and ICA vessels may create a "race for fish" situation as vessels race to harvest pollock prior to the Chinook cap being exceeded. During years when the Chinook caps constrain pollock harvest, the incentive to race for pollock could be particularly strong for non-ICA vessels as they attempt to maximize pollock harvest prior to the lower cap being met. Further, the "race for fish" for non-ICA participants may be amplified because the backstop cap would not be sector allocated, thus leaving non-ICA participants in an open competition for Chinook salmon. The ICA participants would have a lower incentive to race for fish given the caps would be sector allocated and monitored/controlled by the ICA.

A race to fish may result in fishing behavior changing in a manner that increases incidental catch rates of non-pollock groundfish species. Historically the pollock industry has low levels of incidental groundfish catch per mt of pollock. However, as vessels attempt to maximize pollock by fishing "faster", they may fish in a manner that would increase incidental groundfish catch. A higher level of incidental groundfish catch may result in groundfish species with relatively low catch limits requiring management action before reaching overfishing levels (e.g., squid, rockfish, and shark). In the past, closure of the pollock fishery has been avoided because the fleet voluntarily ceased operations in areas with high incidental catch rates (e.g., squid). A race to fish may change the willingness of vessels to leave areas with high incidental catch rates.

However, given the potential changes in the incentive structure from status quo, predicting whether the incidental catch of groundfish species would increase under Alternative 4 or 5 due to a race for fish is speculation. Further, some of the increase would likely be offset by reduced levels of pollock harvest, which may reduce overall fishing effort and subsequent incidental catch.

Regardless of whether incidental catch increases, the amount of groundfish incidentally caught is constrained by regulations that set catch limits. Federal regulations authorize NMFS management action to close all groundfish fisheries that harvest a specific species or species group prior to that species reaching an overfishing condition. These catch limits protect the sustainability of non-pollock species. Alternatives 4 and 5 do not change the regulations governing catch limits for non- pollock species and are thus not expected to have a significant adverse impact on the sustainability of these species.

7.2.4.2 Seasonal Split and Transferability

Alternatives 4 and 5 would create a 70/30 relative split of the Chinook salmon caps between the A and B seasons. If the fishery utilized 70 percent of the cap in the A season and consequently limited pollock catch in the B season, the incidental catch of groundfish could be expected to decline at the B season rates. Catch of non-pollock species with relatively small TACs are generally caught at low levels; however, higher incidental catch rates in the A season could generate management concerns. For example, compared with the B season, shortraker rockfish are caught at higher rates in the A season. In 2007 shortraker catch was within about 100 mt of the ABC. With the variable nature of the incidental catch of rockfish in all fisheries, changes in historical fishing patterns can generate higher catches and therefore management concerns. Management concerns could result in the closure of the pollock fishery to avoid overfishing of species with small TACs.

Under Alternative 4, NMFS would roll-over up to 80 percent of the unused salmon bycatch transferrable allocation or sector level cap from the A season to the B season. Under Alternative 5, NMFS would roll-over 100 percent of the unused salmon bycatch transferrable allocation or sector level cap from the A season to the B season. Thus, additional Chinook salmon could be made available for the B season. In years with constraining Chinook salmon caps, the rollover would allow more pollock to be harvested in the B season. An increase of pollock in the B season fishery could increase the incidental catch of groundfish. Of concern, for example, could be other rockfish, rougheye rockfish, and shortraker rockfish. These species generally all have low allowable catch limits, with current catch levels less than 100 mt to 50 mt of their ABCs. Roll-overs would not be allowed under the backstop cap.

7.2.4.3 Sector Allocations

Sector allocations are not expected to affect the major incidental groundfish species due to catch limits. Alternatives 4 and 5 would allocate the Chinook salmon high and low caps to the mothership, inshore CV, CDQ, and at-sea sectors based on historical Chinook salmon catch (Section 2.4 and Section 2.5). The amount of incidental groundfish catch depends on the level at which Chinook limits constrain pollock harvest. Further, the mothership sector has not historically taken directed deliveries of non-pollock groundfish. The backstop cap would not be allocated by sector.

In years with high salmon bycatch levels (e.g., levels similar to 2006 and 2007), the A and B pollock season would likely be shortened by several weeks for the at-sea sectors and more than a month for the inshore CV sector (Table 5-31). The shortened season results in forgone pollock as well as increased down time between fisheries, with the inshore CV sector potentially experiencing the greatest amount of forgone pollock and fishing down-time.

In an effort to compensate for lost pollock revenue, the offshore and inshore CV AFA sectors would likely have different levels of involvement in the Pacific cod and yellowfin sole fishery. The incentives to fish Pacific cod and yellowfin sole would likely be greatest for the inshore CV fleet due to the predicted early closure of the pollock fishery. Approximately 12 at-sea pollock vessels would likely have limited involvement in non-pollock groundfish fisheries in Alaska due to their involvement with the Pacific hake (aka whiting) fishery off the coast of Washington and Oregon. However, regulations are currently being discussed that would govern the Pacific hake fishery as a limited access privilege program (LAPP). The timing of the hake fishery may change if a LAPP is promulgated.

Even with increased effort for non-pollock species, the directed harvest of non-pollock groundfish species would be governed by catch limits specified in Federal regulation.

Alternatives 4 and 5 provide for transferability between sector entities. Transferability generally reduces that amount of forgone pollock by allowing the redistribution of Chinook caps among sectors (assuming enough sector entities formed). The economic incentives associated with pricing and bycatch availability as well as the relationships between entities will influence the redistribution of Chinook salmon among sectors. Details about these factors are discussed in the RIR. In general, the increased pollock utilization is expected to have no effect to a marginally small increase of incidental groundfish catch over options that do not allow transferability.

7.2.4.4 Summary

In summary, the caps proposed in Alternatives 4 and 5 are not expected to significantly change the footprint of the pollock fishery in the Bering Sea. To the extent that Alternative 4 or 5 would not allow additional fishing after a cap was reached, the incidental catch of groundfish could diminish in relative amounts and perhaps in numbers of species. A potential for a race for fish under the Alternative 4 backstop cap could increase the incidental catch of groundfish in the pollock fishery. In years with both high pollock abundance and Chinook salmon abundance, the fleet would likely have larger amounts of forgone pollock. The pollock fleet may attempt to offset lost revenue due to forgone pollock by targeting non-pollock species. However, because the amount of directed harvest and incidental catch of non-pollock groundfish is limited through regulation, neither Alternative 4 or Alternative 5 is expected to significantly impact the sustainability of non-pollock groundfish stocks.

7.3 Other prohibited species

Prohibited species are defined in the groundfish FMPs as species and species groups the catch of which must be avoided while fishing for pollock as well as other groundfish, and which must be returned to sea with a minimum of injury except when their retention is authorized by other applicable law. Prohibited species include all Pacific salmon species and stocks (Chinook, coho, sockeye, chum, and pink), steelhead trout, Pacific halibut, Pacific herring, and red king crab, Tanner crab, and snow crab. The impacts of salmon bycatch management on Chinook salmon are discussed in Chapter 5 and non-Chinook salmon are discussed on Chapter 6. This section analyses the impacts on the other prohibited species besides Chinook and non-Chinook salmon.

The most recent information on the life history, stock assessment, and management of the directed fisheries targeting these species in Alaska may be found at the following websites:

- Alaska Department of Fish and Game: http://www.adfg.state.ak.us
- International Pacific Halibut Commission: http://www.iphc.washington.edu
- 2007 SAFE report for BSAI king and Tanner crabs (NPFMC 2007): http://www.fakr.noaa.gov/npfmc/SAFE/SAFE.htm.

The effects of the Bering Sea pollock fishery on prohibited species are primarily managed by conservation measures developed and recommended by the Council over the history of the groundfish FMPs, and implemented by federal regulation. These measures can be found at 50 CFR 679.21 and include prohibited species catch (PSC) limitations on a year round and seasonal basis, year round and seasonal area closures, and gear restrictions.

7.3.1 Steelhead trout

Steelhead bycatch in the pelagic trawl pollock fishery is extremely rare. In 2003, one steelhead trout was observed taken in the Central Gulf of Alaska pollock fishery using pelagic trawl gear. In looking at observer data since 2002, no steelhead have been taken in the Bering Sea pollock trawl fishery. No specific management measures to prevent bycatch of steelhead trout exist beyond the prohibited retention that applies to all prohibited species under 679.21(b)(4). Because of the extreme rarity of occurrence, any potential effect of the pollock fishery, or changes to the pollock fishery to reduce salmon bycatch, on steelhead trout is very insignificant and will not be further analyzed in this EIS.

7.3.2 Halibut

7.3.2.1 Halibut Population Assessment

On an annual basis, the International Pacific Halibut Commission (IPHC) assesses the abundance of Pacific halibut and sets annual harvest limits for the fixed gear fishery (IFQ Program). The stock assessment is based on data collected during scientific survey cruises, information from commercial fisheries, and an area-specific harvest rate that is applied to an estimate amount of exploitable biomass. This information is used to determine a biological limit for the total area removals from specific regulatory areas. The biological target is known as the "Constant Exploitation Yield" (CEY) for a specific area and year. Removals from sources other than the IFQ Program are subtracted from the CEY to obtain the "Fishery CEY". These removals include legal sized bycatch (discard), legal-sized halibut (>32 inches in length) killed by lost and abandoned gear, sublegal-sized halibut discarded in the groundfish fisheries, halibut harvested for personal use, and sport catch (Table 7-4). Sublegal halibut bycatch is accounted for in the setting of the harvest rate, which is applied to the total exploitable biomass calculated by the IPHC on an annual basis. Finally, the amount of halibut allocated to the IFQ Program may be different from the Fishery CEY level due to IPHC recommendations.

Table 7-4 Total Area 4 halibut removals (thousand of pounds, net weight) by IPHC category: 1995–2007

Year	Commercial	Sport	Subsistence	Legal-size Bycatch	Legal-size Wastage	Total	Sublegal-size Bycatch	Sublegal-size wastage	IPHC Research
1995	4,735	55	94	3,210	24	8,118	5,516	36	0
1996	5,272	77	94	3,580	74	9,097	4,927	42	0
1997	8,466	69	94	3,800	79	12,508	4,080	74	280
1998	8,761	96	166	3,630	54	12,707	4,095	83	310
1999	11,589	94	170	3,460	93	15,406	3,712	115	268
2000	13,471	73	175	3,270	69	17,058	4,276	146	393
2001	13,229	29	192	3,380	88	16,918	3,445	158	222
2002	11,390	48	180	3,960	51	15,629	3,263	164	199
2003	11,976	31	120	3,241	49	15,417	3,560	171	168
2004	9,045	53	95	2,725	40	11,958	3,764	146	159
2005	8,711	50	128	2,950	31	11,870	3,897	152	149
2006	8,019	46	137	4,321	18	12,541	2,555	161	128
2007	7,984	46	137	2,880	21	11,068	4,200	224	91

Source: G. Williams, IPHC (March 2008)
Data compiled from IPHC Annual Reports and IPHC Report of Assessment and Research Activities (RARA)
Note: 2007 data are preliminary

The IPHC holds an annual meeting where IPHC commissioners review IPHC staff recommendations for harvest limits and stock status (e.g., CEY). The IPHC stock assessment model uses information about the age and sex structure of the Pacific halibut population, which ranges from northern California to the Bering Sea. The most recent halibut stock assessment was developed by IPHC staff in December 2007 for the 2008 commercial fishery. The stock assessment apportioned halibut biomass among IPHC regulatory areas (Fig. 7-1) using scientific survey estimates of relative abundance and migration information. The final assessment for 2008 resulted in a coast wide exploitable biomass of 361 million pounds, down from 414 million pounds estimated in 2007. Clark and Hare (2007) indicate that approximately half of the biomass decrease is from a change in parameterization of survey catchability and the other half is attributed to lower commercial and survey catch rates in 2007. The female spawning biomass remains far above the minimum which occurred in the 1970s.

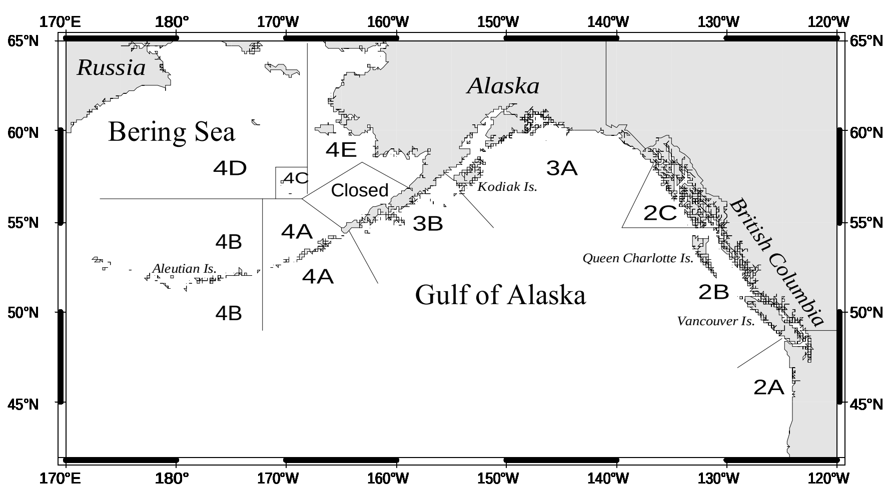

Fig. 7-1 IPHC regulatory areas in the northern Pacific Ocean and Bering Sea

The halibut resource is fully utilized. Recent average catches (1994-2006) in IFQ Program fisheries in waters off Alaska averaged 33,970 mt round weight. This catch level is 26% higher than the long-term potential yield for the entire halibut stock, reflecting the good condition of the Pacific halibut resource. In December 2007, the IPHC staff recommended commercial catch limits totaling 30,349 mt round weight for 2008, a 4% decrease from 31,667 mt in 2007. Through December 31, 2007, commercial hook-and-line harvests of halibut off Alaska totaled 29,844 mt round weight. This harvest occurred in the Gulf of Alaska (GOA) and Bering Sea/Aleutian Islands (BSAI).

The Bering Sea includes IPHC regulatory areas 4D, 4E, 4C, and part of 4A and 4B. Commercial catch limits are established by the IPHC for areas 4A, 4B, and a combined catch limit for 4C, 4D, and 4E. These areas, except area 4A, are located at the periphery of the halibut distribution. Because these areas are not inside the "core" halibut productivity region (areas 2 and 3A), limited stock information exists. Due to these limitations, the IPHC has taken a precautionary approach for managing halibut mortality. For example, a decline in biomass in area 4B prompted the commission to adopt a conservative harvest rate of 0.15 for area 4B. Further, because recruitment in area 4C, 4D, and 4E is poorly understood, a conservative harvest rate of 0.15 was adopted by the IPHC for those areas. This harvest rate represents the amount of biomass that may be exploited by all fisheries within a regulatory area.

7.3.2.2 Halibut PSC and Discard Mortality

Halibut discards are composed of sublegal halibut discarded in the IFQ fishery, halibut discarded as bycatch in groundfish fisheries, wastage of halibut caught in abandoned gear, and mortality resulting from discard. Halibut bycatch in the commercial groundfish fisheries is managed as a prohibited species as discussed in the BSAI groundfish FMP and Federal regulations at 50 CFR 679.21. These management measures are discussed further in the following documents:

- Sections 3.6.1 and 3.6.2 of the BSAI FMPs cover management of the bycatch of halibut in the groundfish fisheries. The FMPs are available at http://www.fakr.noaa.gov/npfmc/
- Section 3.5 of the PSEIS reviews the effects of the groundfish fishery on halibut. The PSEIS is available at http://www.fakr.noaa.gov/index/analyses/analyses.asp.
- Charter 7 of the Alaska Groundfish Harvest Specification EIS provides an overview of prohibition species catch management, including halibut bycatch, available at: http://www.fakr.noaa.gov/analyses/specs/eis/default.htm.

The 2008 halibut PSC limit for the entire BSAI is allocated between the trawl fishery and the non-trawl fisheries. The trawl fishery has a halibut PSC limit that may not exceed 3,675 mt (679.21(e)(1)(iv)), of which 275 mt is allocated to the CDQ sector. The non-trawl fishery has a halibut PSC limit that may not exceed 900 mt, of which 87 mt is allocated to the CDQ fishery.

The Bering Sea pollock fishery is currently exempted from fishery closures due to reaching a halibut PSC limit. Regulations at 50 CFR 679.21(e)(7)(i) exempt vessels using pelagic trawl gear and targeting pollock from being closed due to reaching their bycatch allowance or seasonal apportionment. This exemption allows the pollock fishery to continue fishing even if their allowance of halibut PSC has been reached. As a result, NMFS balances the halibut PSC limit in the pollock trawl fishery against halibut PSC limits in the non-pollock trawl fishery categories. This process ensures the overall BSAI trawl PSC limit is not exceeded.

7.3.2.3 Catch Accounting

Harvest in the IFQ Program is electronically monitored by NMFS. This system allows instantaneous tracking for halibut quota and the transfer of quota between participants in the IFQ Program. This high level of monitoring allows a count of all halibut harvest in the commercial halibut fishery and allows annual quota limits to be enforced. Thus, since the implementation of the IFQ Program in 1995, the annual harvest of halibut has been maintained at levels recommended by the IPHC.

Chapter 3 provides a detailed overview of the methods used to estimate bycatch in the GOA and BSAI groundfish fisheries. In general, halibut bycatch data collected by the North Pacific Groundfish Observer Program (NPGOP) is used by the NMFS to estimate halibut bycatch for the groundfish fisheries. NMFS's estimate of halibut bycatch includes information about the amount of halibut that will not survive after being released (discard mortality). Discard mortalities for certain targets and gear types are obtained from NPGOP estimates and published in the Stock Assessment and Fisheries Evaluation report and annual harvest specifications (Table 9 in the 2008 harvest specifications, www.alaskafisheries.noaa.gov). In 2008, the halibut discard mortality rate for the trawl non-pelagic pollock target is 74% and for the trawl pelagic pollock target is 88%. Thus, 74 or 88% of the halibut incidentally caught and discarded while targeting pollock in the BSAI is assumed to be dead.

Other removal categories include sport, subsistence, wastage, research, and bycatch. Sport and subsistence removal categories are assessed using State of Alaska subsistence and sport fishing household surveys (Table 7-4). Wastage and bycatch is assessed using information from the NPGOP and IPHC scientific surveys.

7.3.3 Impacts on Halibut

The impacts of the PSC limits and the total halibut bycatch in the groundfish fisheries were analyzed in the Alaska Groundfish Harvest Specifications EIS (NMFS 2007). The EIS examines the impacts of the fisheries on bycatch mortality, genetic structure, reproductive success, prey availability, and habitat. The EIS concludes that the impacts of the groundfish fisheries on prohibited species are reduced by existing management measures that mitigate adverse impacts to prohibited species. The IPHC takes account of the halibut bycatch in the groundfish fisheries when setting the fishery CEY. Groundfish fishery categories are closed to directed fishing when halibut PSC limits are taken. Bycatch of halibut in the groundfish fisheries is not expected to interfere with sustainable management of halibut stocks.

Between 2003 and 2007, the amount of halibut and Chinook bycatch in the pollock fishery has increased (Table 7-5). Chinook bycatch increased during this time period, while non-Chinook bycatch has been variable, but is showing an overall decline. Except for 2007, the yearly increase for halibut bycatch has ranged between 7 and 20%. The largest increase occurred in 2007 when halibut bycatch increased by 135% from 2006 levels. Despite the increase in halibut bycatch, amounts are low relative to the size of the annual pollock catch and the trawl halibut PSC limit, at less than 1% of halibut per mt of pollock. On average, the catch comprises approximately 4% of the annual trawl limit.

Table 7-5 Total bycatch of Chinook, non-Chinook, and halibut, and total catch of pollock by trawl vessels in the BSAI

Year	Pollock (mt)	Chinook (#)	Non-Chinook (#)	Halibut
2003	1,305,228	46,993	195,135	91
2004	1,435,936	54,028	447,626	99
2005	1,446,199	67,890	705,963	121
2006	1,454,514	83,257	310,545	130
2007	1,321,788	121,964	94,071	306

Vessels fishing under Alternative 1 are exempted from the salmon savings area closures if they are members of an VRHS ICA, as described in Chapter 2. The VRHS encourages vessels to move from an area of high salmon bycatch to areas of lower salmon bycatch. The VRHS has been used by industry since 2001, with several modifications to the program after its inception. Since the program's inception, halibut bycatch has increased (Table 7-5). However, the relationship between the VRHS and an increase of halibut bycatch is unknown. The amount of halibut bycatch in the pollock fishery is likely influenced by a number of factors including halibut abundance, environmental factors, and changes in fishing behavior that may be associated with avoiding salmon bycatch or responding to changes in target species abundance.

If the current PSC trend continues, halibut PSC amounts would increase for AFA pollock vessels under Alternative 1. Prior to the large increase of halibut PSC observed in 2007, halibut catch increased between 7 and 20% per year. The increasing trend could change in response to the factors discussed in the previous paragraph. These factors create a high level of uncertainty with predicting future halibut PSC amounts in the pollock fishery. As a result, it is not known for certain if halibut PSC would continue to increase. Even with an increasing trend in PSC, the annual trawl limit would constrain halibut PSC and halibut stocks would be managed under the IPHC assessment process description in section 7.3.2.

Alternatives 2 and 3 could change halibut PSC for pollock vessels in the Bering Sea. A change in halibut PSC would be driven by vessel operators avoiding areas with high salmon bycatch, racing to harvest pollock before a fishery closure, or harvesting more non-pollock groundfish species. These behavior changes are associated with the relationship between the forgone benefit from not harvesting pollock and the costs associated with avoiding salmon or switching harvest effort to another species. Halibut bycatch may increase if vessel operators relocate fishing effort to areas or time periods that have greater halibut bycatch than what is typically caught under Alternative 1. Another possibility is that fishing methods change the gear selectivity for halibut. A regulatory prohibition on the use of non-pelagic trawl gear in the AFA pollock fishery currently exists. Thus, a major change in the type of gear used is not likely, but changes in the methods used to fish pelagic trawl gear could occur.

If a salmon hard cap (Alternatives 2, 4, and 5) constrains pollock harvest or a large area of the Bering Sea is closed (Alternative 3) to directed fishing for pollock, the pollock fleet may focus on alternate fisheries in an attempt to make up for lost revenue. Under the structure of Amendments 80 and 85, vessels fishing under the AFA qualifications are able to harvest primarily Pacific cod and yellowfin sole in addition to pollock. The harvest of yellowfin sole and Pacific cod would likely only offset some lost revenue, but would not mitigate substantial losses in the pollock fisheries. Targeting these species would change fishing methods typically used by vessels to target pollock and may result in an increase in halibut bycatch. Typically vessels targeting flatfish have higher rates of halibut bycatch than those targeting pollock.

Alternative 3 would result in area closures that were triggered when a certain limit was reached. The closure period would move fishing effort that would occur in the closed area under Component 5, to non-closed areas. The closure of these areas may result in lower catch rates for pollock. As a result, greater fishing effort may occur during periods when closures are not in effect, which may influence the amount of halibut bycatch. If the intensity of fishing substantially increased in the open area, then the associated increase in fishing effort may result in more halibut PSC within a shorter time period. However, the annual amount of halibut bycatch may not change due to decreased fishing activity during closed periods. Conversely, pollock vessels may increase the amount of yellowfin sole and Pacific cod. These targets typically have higher halibut bycatch rates.

Alternatives 4 and 5 would have similar impacts on incidental catch of halibut as Alternative 2. The primary differences between Alternatives 4 and 5 and Alternative 2 are the requirements for the ICA or IPA to provide incentives to avoid salmon bycatch and the provisions to encourage fishery participants to join the ICA or IPA.

In summary, the extent to which the alternatives would change halibut bycatch is not known for certain. If current trends continue, halibut PSC amounts would increase for AFA pollock vessels under Alternative 1. However, this trend could change in response to a number of factors, including changes in groundfish and halibut abundance, changes in fishing methods or fishing location, pollock abundance, and environmental factors. Thus, it is not known for certain if halibut PSC would continue to increase under Alternative 1. An increase in the halibut bycatch could occur if Alternatives 2, 3, 4, or 5 encourage pollock vessels to target non-pollock species or change fishing behavior.

However, the process used by the IPHC to specify annual quota for the IFQ Program considers removals of halibut in the trawl fishery. Because the annual amount of halibut PSC in the trawl fishery is limited by federal regulation, halibut mortality cannot be above biologically sustainable levels determined by the IPHC. Further, the IPHC adjusts catch in the IFQ program in accordance with other sources of halibut mortality such as trawl fishing (Section 7.3.2). Thus, the alternatives considered in this analysis are not expected to change the pollock fishery in a manner that would increase bycatch of Pacific halibut to the extent that they would impact the abundance of this specie.

7.3.4 Pacific Herring

Pacific herring are managed by the State of Alaska on a sustained yield principal. Pacific herring are surveyed each year and the GHLs are based on an exploitation rate of 20% of the projected spawning biomass. These GHLs may be adjusted in-season based on additional survey information to insure long-term sustainable yields. The ADF&G has established minimum spawning biomass thresholds for herring stocks that must be met before a commercial fishery may occur.

The most recent herring stock assessment for the EBS stock was conducted by ADF&G in December 2005. For 2008 and 2009, the herring biomass in the EBS is estimated to be 172,644 mt. Additional information on the life history of herring and management measures in the groundfish fisheries to conserve herring stocks can be found in Section 3.5 of the PSEIS (NMFS 2004).

In the BSAI, the herring PSC limit for the groundfish trawl fisheries is set at one percent of the estimated herring biomass. The annual herring PSC limit is published in the *Federal Register* with the proposed and final groundfish harvest specifications. The annual herring PSC limit is apportioned into herring PSC allowances, by trawl fishery categories. If NMFS determines that U.S. fishing vessels participating in any of the trawl fishery categories listed in the BSAI have caught the herring PSC allowance specified for that fishery category then NMFS will publish in the *Federal Register* the closure of the Herring Savings Area as defined in 50 CFR 679, Fig. 4 to directed fishing for each species and/or species group in that fishery category (Fig. 7-2).

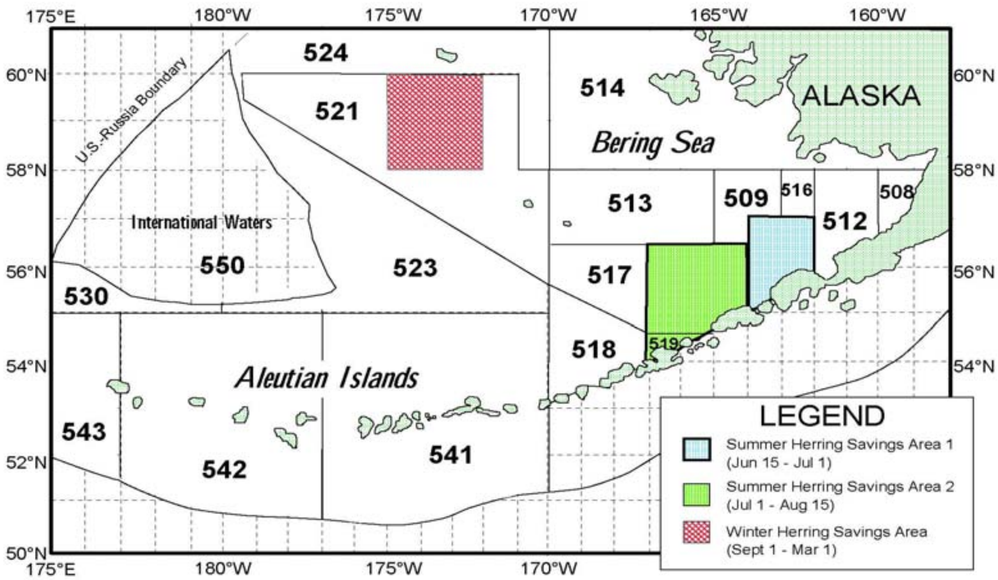

Figure 4 to Part 679. BSAI Herring Savings Areas
a. Map.

Fig. 7-2 Herring Savings Areas in the BSAI

7.3.5 Impacts on Pacific Herring

The impacts of the PSC limits and the total pacific herring bycatch in the groundfish fisheries were analyzed in the Alaska Groundfish Harvest Specifications EIS (NMFS 2007). The EIS examines the impacts of the fisheries on prohibited species mortality, genetic structure, reproductive success, prey availability, and habitat. The EIS concludes that the impacts of the groundfish fisheries on prohibited species are reduced by existing management measures that mitigate adverse impacts to prohibited species. The amount of herring bycatch in the groundfish fisheries is so low that it would have minor impacts on the stocks of these species. The PSC limits for herring are never reached. When area PSC limits are reached, limits reduce adverse impacts to stocks by closing directed fishing in those areas.

Under Alternative 1, status quo, the pollock fishery's impacts will be less than those of all of the groundfish fisheries combined. In 2007, an estimated 341 mt of the 1,787 mt herring PSC limit was taken by the Bering Sea pollock fishery. Therefore, it is reasonable to assume that the amount of herring taken by the Bering Sea pollock fishery will remain very low and the impacts will remain minor. Changes in the pollock fishery resulting from Alternatives 2 through 5 are not expected to change typical levels of herring bycatch. Thus, the alternatives would likely not change the pollock fishery in a manner that would increase bycatch of herring to the extent that bycatch would impact abundance of these species.

7.3.6 Crab

Red king crab, Tanner crab, and snow crab caught as bycatch are treated as prohibited species in the Bering Sea pollock fishery. Regulations for prohibited species are defined in 50 CFR 672.21b. Crab bycatch in groundfish fisheries are enumerated by on-board observers and then returned to the sea. PSC limits are established for BSAI groundfish fisheries and specified by fishery categories. Once these PSC limits are reached as described below, the specified area closures are triggered for the fishery category.

7.3.6.1 Snow crab PSC limits

Pursuant to 679.21(e)(1)(iv), the PSC limit for snow crab is based on total abundance as indicated by the NMFS annual bottom trawl survey. Snow crab PSC limits are allocated among fishery categories in anticipation of their bycatch needs for the year. A PSC limit is established for snow crab in a defined area that fluctuates with abundance except at high and low stock sizes. The PSC limit is established at 0.1133% of the total Bering Sea snow crab abundance, with a minimum PSC of 4.350 million snow crabs and a maximum PSC of 12.850 million snow crabs. Snow crab taken within the "*C. opilio* Bycatch Limitation Zone" (COBLZ) accrue towards the PSC limits established for individual trawl fishery categories (Fig. 7-2). Upon attainment of a snow crab PSC limit allocated to a particular trawl fishery category, that fishery is closed to directed fishing within the COBLZ for the year, unless further apportioned by season. Based on the 2007 survey estimate of 3.33 billion animals, the calculated snow crab PSC limit is 4,350,000 animals. Of this PSC limit, 20,000 crabs are allocated to the pollock/atka mackerel/other species trawl fishery category.

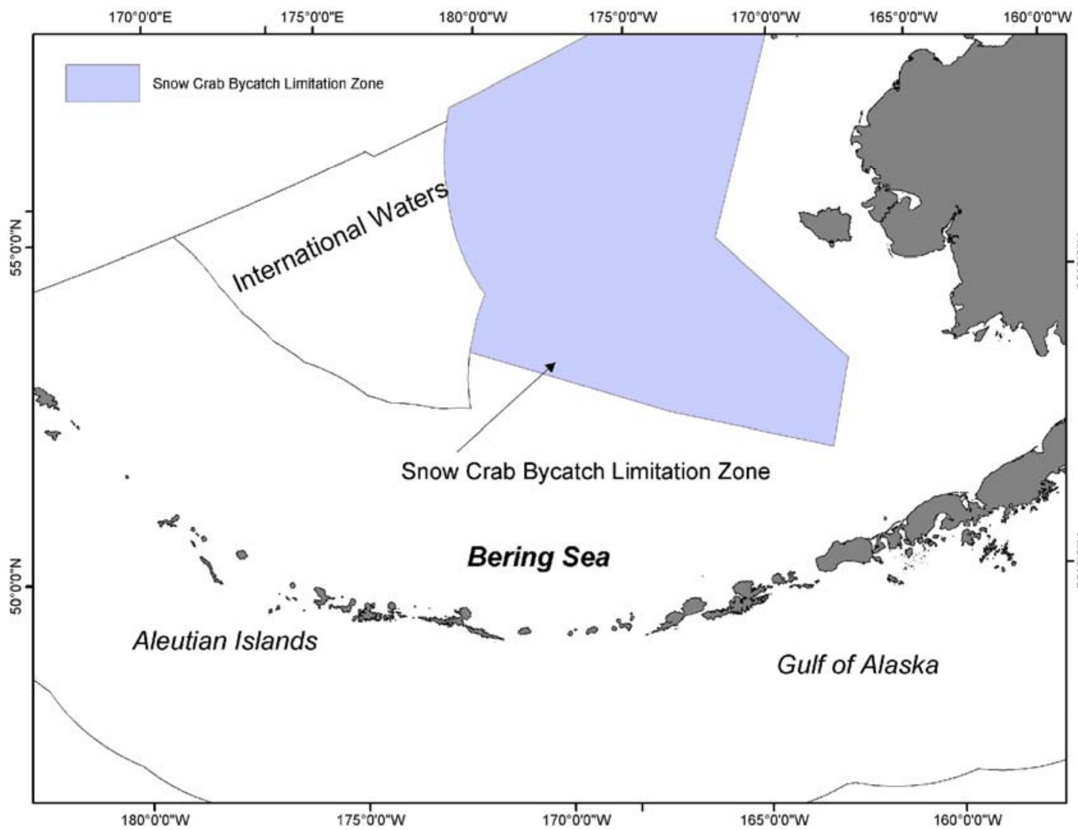

Fig. 7-3 *C. opilio* Bycatch Limitation Zone (COBLZ)

7.3.6.2 Red King Crab PSC limits

PSC limits are based on the abundance of Bristol Bay red king crab as shown in the adjacent box. In years when the abundance of red king crab in Bristol Bay is below the threshold of 8.4 million mature crabs, a PSC limit of 32,000 red king crabs is established in Zone 1 (Fig. 7-3). In years when the stock is above the threshold but below 55 million pounds of effective

PSC limits for Zone 1 red king crab:

Abundance	**PSC Limit**
Below threshold or 14.5 million lbs of effective spawning biomass (ESB)	32,000 crabs
Above threshold, but below 55 million lbs of ESB	97,000 crabs
Above 55 million lbs of ESB	197,000 crabs

spawning biomass, a PSC limit of 97,000 red king crabs is established. A 197,000 PSC limit is established in years when the Bristol Bay red king crab stock is rebuilt (above threshold and above 55 million pounds of effective spawning biomass). Based on the 2007 estimate of effective spawning biomass (73 million pounds), the PSC limit for 2008 was 197,000 red king crabs. The red king crab PSC limit has generally been allocated among the pollock/mackerel/other species, Pacific cod, rock sole, and yellowfin sole fisheries. Of this PSC limit, 400 red king crabs are allocated to the pollock/atka mackerel/other species trawl fishery category. Once a fishery exceeds its red king crab PSC limit, Zone 1 is closed to that fishery for the remainder of the year, unless further allocated by season.

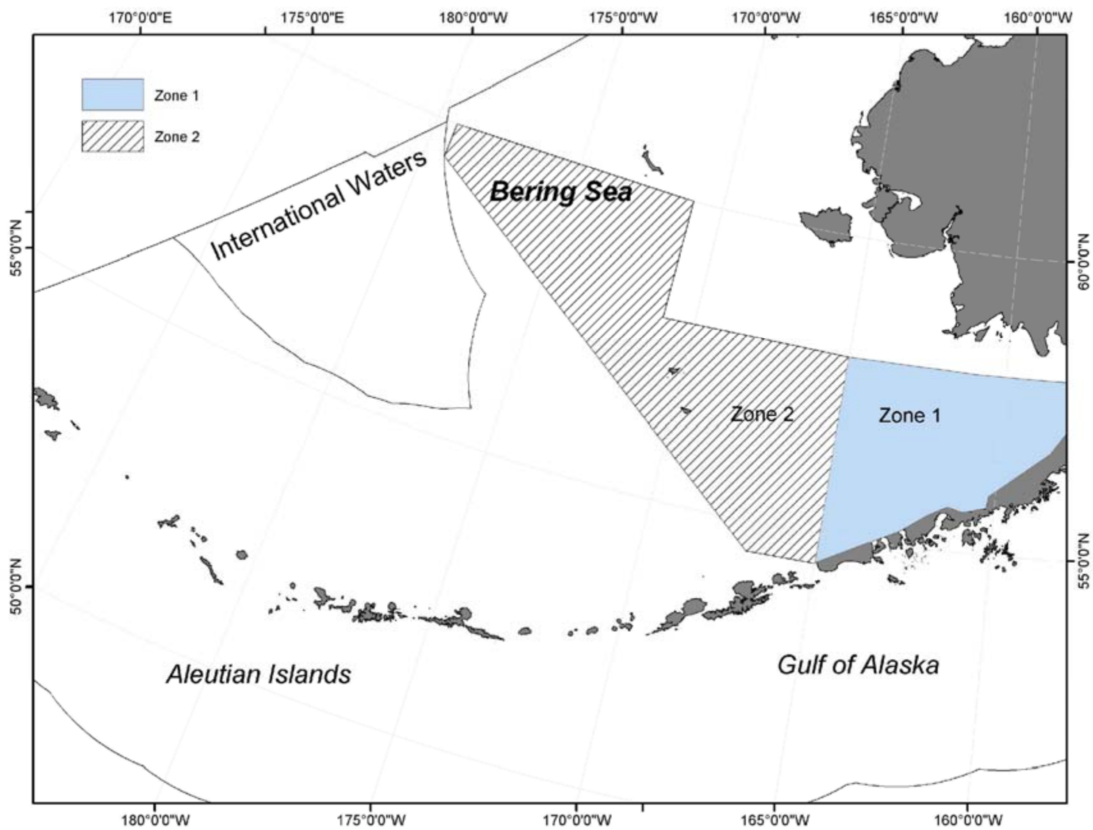

Fig. 7-4 Zones 1 and 2 for red king crab and Tanner crab

7.3.6.3 Tanner crab PSC limits

PSC limits for Tanner crab are established in Zones 1 and 2 (Fig. 7-4) based on total abundance (shown in adjacent box) of Tanner crab as indicated by the NMFS trawl survey. Based on 2007 survey data, Tanner crab abundance is estimated at 767 million animals. Given the criteria set out at 679.21(e)(1)(iii), the 2008 and 2009 Tanner crab PSC limit for trawl gear is 980,000 animals in Zone 1 and 2,970,000 animals in Zone 2. These limits derive from the Tanner crab abundance estimate of more than 400 million animals. The Tanner crab PSC limits have generally been allocated among the pollock/mackerel/other species, Pacific cod, rock sole, rockfish, and yellowfin sole fishery categories. Of

PSC limits for Tanner crab.

Zone	Abundance	PSC Limit
Zone 1	0-150 million crabs	0.5% of abundance
	150-270 million crabs	750,000
	270-400 million crabs	850,000
	over 400 million crabs	980,000
Zone 2	0-175 million crabs	1.2% of abundance
	175-290 million crabs	2,070,000
	290-400 million crabs	2,520,000
	over 400 million crabs	2,970,000

this PSC limit, 5,000 crabs are allocated to the pollock/atka mackerel/other species trawl fishery category for each zone. Once a fishery reaches its Tanner crab PSC limit, Zone 1 or Zone 2 is closed to directed fishing for that fishery for the remainder of the year, unless further allocated by season.

7.3.7 Impacts on Crab

The impacts of the PSC limits and the total crab bycatch in the groundfish fisheries on these crab species were analyzed in the Alaska Groundfish Harvest Specifications EIS (NMFS 2007). The EIS examines the impacts of the fisheries on prohibited species mortality, genetic structure, reproductive success, prey availability, and habitat. The EIS concludes that the impacts of the groundfish fisheries on crab prohibited species are reduced by existing management measures that mitigate adverse impacts to prohibited species. The crab bycatch in the groundfish fisheries is so low that it would have minor impacts on the stocks of these species. When area PSC limits are reached, limits help reduce adverse impacts to stocks by closing directed fishing in those areas.

The pollock fleet catches a very small portion of the total bycatch for red king crab, Tanner crab, and snow crab and a very small portion of the PSC cap allocated to the pollock/atka mackerel/other species trawl fishery category. Table 7-6 shows the total number of crab PSC caught in the Bering Sea pollock fishery. Under Alternative 1, this bycatch would remain low and the impact would remain negligible.

Table 7-6 Bering Sea pollock fishery total crab bycatch, by species, in numbers of crab

Year	Blue king crab	Tanner crab	Golden king crab	Snow crab	Red king crab
2003	9	1,119		865	54
2004	4	1,103	2	646	15
2005		607	1	1,950	
2006		1,129	3	2,640	28
2007		894	3	2,836	8
2008		434		400	25

Alternatives 2 through 5 are not expected to change the pollock fishery in a manner that would increase bycatch of crab species. If crab bycatch did increase in the pollock trawl fishery, bycatch would be constrained by the existing PSC limits. Therefore, Alternatives 2, 3, 4, and 5 are expected to have negligible impacts to crab stocks similar to Alternative 1.

7.4 Forage Fish

The BSAI FMP defines forage fish species as:

> *those species…which are a critical food source for many marine mammal, seabird, and fish species. The forage fish species category is established to allow for the management of these species in a manner that prevents the development of a commercial directed fishery for forage fish. Management measures for this species category will be specified in regulations and may include such measures as prohibitions on directed fishing, limitations on allowable bycatch retention amounts, or limitations on the sale, barter, trade, or any other commercial exchange, as well as the processing of forage fish in a commercial processing facility (NPFMC 2005a).*

Some species, identified as target and prohibited species in the FMPs, such as juvenile pollock and herring, are also important forage for many marine mammal, seabird, and fish species. However, this analysis focuses on the species identified as forage fish in the BSAI FMP. Forage fish species in the

FMPs include, but are not limited to, eulachon, capelin, other smelts, lanternfishes, deepsea smelts, Pacific sand lance, Pacific sandfish, gunnels, pricklebacks, bristlemouths, and krill.[48]

More information on the forage fish in Alaska's EEZ may be found in several NMFS and Council documents:

- The Council's Fishery Management Plan for the BSAI includes a discussion of forage species. As noted above, the FMP defines the species groups. Section 4.2.2 in each document describe essential forage fish habitat. Appendix D in each document provides some information on forage fish life history (NPFMC 2005a, 2005b). The FMPs are on the internet at: http://www.fakr.noaa.gov/npfmc/default.htm .
- Sections 3.5.4 and 4.9.4 of the Programmatic Supplemental Groundfish EIS discuss forage fish and the impacts of the preferred programmatic FMP alternatives (NMFS 2004). The groundfish PSEIS is on the internet at: http://www.fakr.noaa.gov/sustainablefisheries/seis/intro.htm .
- The Essential Fish Habitat/Habitat Areas of Particular Concern EIS and EA describe the forage fish species in the BSAI in Section 3.2.4.2. Appendix Section B.3.4 describes the impacts of fishing on essential fish habitat for forage species (NMFS 2005). The EFH EIS is on the internet at: http://www.fakr.noaa.gov/habitat/seis/efheis.htm .
- The SAFE Ecosystem Considerations Chapter for 2008 report has a section on forage fish and is available on the AFSC website at: http://access.afsc.noaa.gov/reem/ecoweb/Index.cfm.

Regulations at 50 CFR 679.20(i) prohibit directed fishing for forage fish species. The sale of forage fish species is limited to fish retained under the maximum retainable amount (MRA), which may be made into fishmeal. An aggregate MRA for forage fish species has been set at 2% of the retained catch in fisheries open to directed fishing (Tables 10 and 11 to 50 CFR 679).

Aggregate catches of forage fish species can be estimated from observer data. Fig. 7-5 summarizes the catch of forage fishes in the BSAI pollock fisheries, which ranged from 10 mt to 146 mt during the years 2003-2007. Most of this catch was eulachon (*Thaleichthys pacificus*). In the BSAI, where forage fish catch is much smaller than in the Gulf of Alaska, pollock trawlers accounted for about two-thirds of the incidental catch, and non-pelagic flatfish trawling accounted for about one-third.

[48] Under the FMPs, the forage fish category includes fish in the families Osmeridae, Myctophidae, Bathylagidae, Ammodytidae, Trichodontidae, Pholidae, Stichaeidae, Gonostomatidae, and the order Euphausiacea.

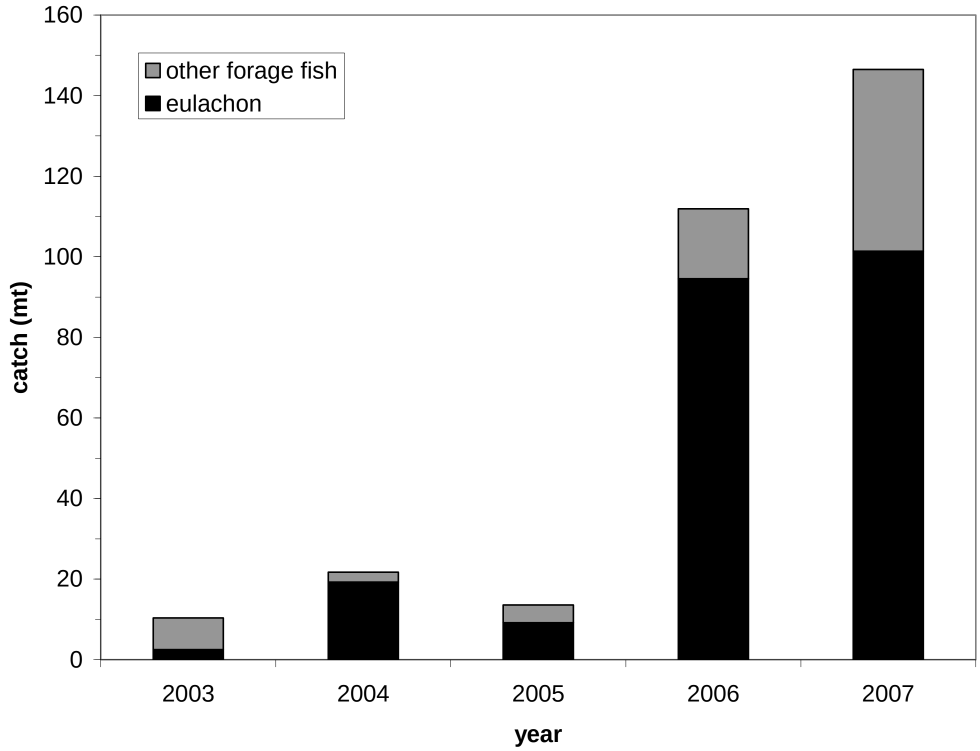

Fig. 7-5 Incidental catches of eulachon and other forage fishes in the commercial pollock fisheries of the BSAI. Data are from the Catch Accounting System database maintained by the Alaska Regional Office, National Marine Fisheries Service, Juneau, Alaska. Data were retrieved on August 25, 2008.

Exploitation rates (catch/biomass) are a useful measure for considering catch data relative to the size of the stock. For forage fishes in the BSAI, however, biomass estimates are sufficiently unreliable that no exploitation rates are included here. Biomass estimates from the eastern Bering Sea (EBS) shelf bottom-trawl survey conducted by the AFSC are available for several forage fish species and species groups (Table 7-7). These estimates are considered unreliable for at least two reasons: (1) forage fishes are small and are likely to easily escape through net meshes and (2) most forage fishes are pelagic and unlikely to be well sampled by bottom gear. Therefore, shelf survey estimates may be viewed as minimum biomass estimates. The extent to which they may underestimate biomass is demonstrated by comparison to biomass estimates from ecosystem modeling (Table 7-7). Model estimates are based on the survey biomass of forage fish predators as well as diet composition data and assumptions regarding consumption rates, and the estimates shown here used information from the early 1990s. There is considerable uncertainty in these estimates, but they do endeavor to show the amount of forage-fish biomass that must be present in the ecosystem to support the estimated level of predation. In all cases they are several orders of magnitude higher than the survey figures, and the discrepancy is particularly large for sandlance.

The available information on biomass indicates that fishing rates on eulachon and capelin, which account for most forage fish catch, are low. Based on biomass estimates prepared from bottom trawl surveys, it appears that in a typical year, exploitation rates are less that one percent of estimated biomass. Because smelts are pelagic, biomass estimates based on trawl data are believed to be low, so that true exploitation rates may be even lower. The catch of forage fishes may also be considered in light of the pollock-fishery catch of all nontarget fish species including cephalopods (octopus and squids; Table 7-7). These catches are one to two orders of magnitude higher than the forage-fish catches.

Table 7-7 Biomass estimates and catches of nontarget fishes in the BSAI. Survey biomass estimates are from the Resource Assessment and Conservation Engineering division of the Alaska Fisheries Science Center (B. Lauth, AFSC, pers. comm.). Ecosystem model estimates are from Aydin et al. 2007, NOAA Technical Memorandum NMFS-AFSC-178. Catch data are from the CAS database maintained by the NMFS Alaska Region, Juneau, Alaska. CAS data were retrieved on August 25, 2008. No Myctophidae or Bathylagidae were observed in survey trawls.

	EBS survey biomass estimates (mt)					**Ecosystem model biomass estimates (mt)**
	2003	**2004**	**2005**	**2006**	**2007**	
eulachon	2,535	3,141	1,738	2,044	4,136	273,583
capelin & other smelts	2,565	6,095	469	2,445	367	860,853
sandlance	3	7	8	11	7	1,229,948
other forage fishes	6,799	1,790	2,641	314	175	521,895
Myctophidae	N/A	N/A	N/A	N/A	N/A	394,664
Bathylagidae	N/A	N/A	N/A	N/A	N/A	80,047
total forage fishes	11,902	11,033	4,857	4,815	4,685	3,360,990

total forage fish catch in pollock fishery (mt)	10	22	14	112	146
catch of all nontarget fishes and cephalapods in pollock fishery (mt)	2,149	2,170	2,301	3,663	3,390

Ecopath food web models suggest that arrowtooth flounder, pollock, and squid are the three top predators of both capelin and eulachon (Conners and Guttormsen 2005). Juvenile pollock compete with capelin for food, and adult pollock are important predators of capelin. Because of this, indirect effects of pollock harvest on forage fish may occur, but their exact nature is impossible to predict.

7.5 Impacts on Forage Fish

The impacts of the salmon bycatch management measures alternatives on forage fish are evaluated using the following factors: (1) mortality, (2) genetic structure of the population, (3) reproductive success, (4) prey availability, and (5) habitat.

Almost all forage fish bycatch mortality is capelin and eulachon (smelt species), taken as bycatch in pollock fisheries. Bycatches in recent years have been between 10 mt and 146 mt in the BSAI. Status quo fishing rates in the Bering Sea are believed to be very low, on the order of 1% or less of smelt biomass. Bering Sea pollock TACs decline in 2008, potentially further reducing forage fish mortality and mortality rates. Therefore, under Alternative 1, the pollock fisheries have a very minor direct impact on forage fish mortality. As noted above, pollock compete with smelts for food, and are important smelt predators. Therefore, the pollock harvests may have an unpredictable indirect impact on smelt mortality.

No information is available on the genetic structure of forage fish stocks. Regulations disperse the pollock fishery in space and time. This, combined with the low forage fish mortality rate believed to be associated with status quo levels of harvest, suggest that pollock fishing is having a small impact on the genetic structure of forage fish populations.

Many forage fish species spawn in shallow, intertidal, or river waters; others are broadcast spawners and their eggs are pelagic. Regardless of their spawning method, pollock fishing is expected to have little impact on the spawning, nursery, or settlement habitat of forage fish species. The EFH EIS describes the impact of fishing activity on forage fish spawning habitat as having minimal, temporary, or no effect (NMFS 2005). This, combined with low harvest rates, may mean that pollock fishing under the status quo has little impact on reproductive success.

Most forage fish feed on copepods and euphausiids which are unlikely to be directly affected by pollock fishing, or they feed in shallow water where there is relatively little fishing activity. In general, there is likely to be little direct impact of fishing activity of forage fish prey availability. While direct impacts of this alternative generally appear to be small, there may be some more complicated indirect impacts. Capelin are believed to directly compete for prey with juvenile pollock. Fishing induced declines in numbers of small pollock may increase available capelin prey. However, the size of the pollock fishing impact on capelin prey, and even its direction, are not known. The pollock fishery harvests adult pollock, which themselves prey on juvenile pollock. Thus, pollock harvests may increase prey for capelin by reducing pollock stock sizes, or may reduce prey by reducing the stock of predators of juvenile pollock.

Forage fish are primarily pelagic, using shallow waters, intertidal zones, and rivers for spawning habitat. In general, the EFH EIS (NMFS 2005) finds that habitat impacts from fishing activity have minimal, temporary, or no effect on forage fish.

The Alternative 2 hard caps, to the extent that they prevent the pollock fleet from harvesting the pollock TAC and therefore reduce pollock fishing effort, would reduce the pollock fisheries impacts on forage fish from Alternative 1. The RIR provides a discussion of the ability of the pollock fleet to harvest the TAC under the hard cap options. It is not possible to predict how much less fishing effort would occur under Alternative 2 because the fleet will have strong incentives to reduce bycatch through other means, such as gear modifications, to avoid reaching the hard cap and closing the fishery. And, depending on the extent vessels move to avoid salmon bycatch or as pollock catch rates decrease, pollock trawling effort may increase even if the fishery is eventually closed due to a hard cap. The impacts of Alternatives 4 and 5 on forage fish would be similar because Alternatives 4 and 5 are a more complex form of a hard cap that encourages avoiding salmon bycatch at all levels of salmon and pollock abundance.

The Alternative 3 trigger closures would close identified areas when a specific cap level is reached. The area closure would reduce the pollock fisheries impacts to forage fish in the closed area, but it would increase the fishing effort and therefore the impacts in the adjoining areas. Since the total amount of pollock harvested and the total effort would not change under Alternative 3, it is reasonable to conclude that the overall impacts on forage fish would be similar to Alternative 1. As with Alternative 2, fishing effort may increase as vessels move to avoid salmon bycatch or as pollock catch rates decrease.

7.6 Consideration of future actions

The following reasonably foreseeable future actions may have a continuing, additive, and meaningful relationship to the direct and indirect effects of the salmon bycatch management alternatives on other groundfish, other prohibited species, and forage fish.

7.6.1 Ecosystem-sensitive management

Ecosystem research and increasing attention to ecosystem issues, should lead to increased attention to the impact of fishing activity on non-target resource components, including prohibited species and forage fish. This is likely to result in reduced adverse impacts. AFSC scientists are developing procedures for more accurate GOA capelin biomass estimates based on acoustic surveys. It may be possible to make these estimates within one to two years. Research is also continuing on using acoustic survey information to make biomass estimates of eulachon, but this work is not as advanced (E. Conners, pers. comm., June 13, 2006).

7.6.2 Traditional management tools

The number of TAC categories with low values of ABC/OFL are increasing which tends to increase the likelihood that closures of directed fisheries to prevent overfishing will occur. In recent years management of species groups has tended to separate the constituent species into individual ABCs and OFLs. For example, in 1991 the category 'other red rockfish' consisted of four species of rockfish. By 2007, one of those species (sharpchin rockfish) had been moved to the 'other rockfish' category and northern, shortraker, and rougheye are now managed as separate species. While managing the species with separate ABCs and OFLs reduces the potential for overfishing the individual species, the effect of creating more species categories can increase the potential for incurring management measures to prevent overfishing, such as fishery closures. Managers closely watch species with fairly close amounts between the OFL and ABCs during the fishing year and the fleet will adjust behavior to prevent incurring management actions. Currently the NPFMC is considering separating components of the 'other species' category (sharks, skates, octopus, sculpin). Should that occur, incidental catch of sharks for example could impact management of the pollock fishery. As part of the 2006 'other species' incidental catch of 1,973 mt in the pollock fishery, 504 mt were shark. The tier 6 ABC for shark as part of the 'other species' category in 2006 was 463 mt and OFL 617 mt. If sharks were managed as a separate species group under their current tier, the pollock fishery would likely have been constrained in 2006.

Future harvest specifications will affect fishing mortality other groundfish, other prohibited species, and forage species. Thus, future pollock TACs in some years may be larger and may have a greater impact on these non-pollock resources than the historic catch analyzed for this action.

7.6.3 Private actions

Ongoing pollock fishing activity will continue to take other groundfish, prohibited species, and forage fish species as bycatch. Likewise, most of these species support directed fisheries that will continue. Ongoing economic development of coastal Alaska, and increasing levels of marine transportation activity may interact adversely with these species. Development that may impact coastal and riverine spawning habitat may have the greatest potential for affecting forage fish. However, development in Alaska remains small compared to development in other coastal states. Subsistence harvests of eulachon ("hooligan") occur in Alaskan waters.

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