Gulf of Alaska Halibut Prohibited Species Catch Limit Discussion Paper

Addendum to June 2010 Draft
December 2010

PART 1. Near Term and Long Term Management Approaches

The Council identified a two-prong approach for determining whether and how to take potential action to revise Gulf of Alaska (GOA) halibut Prohibited Species Catch (PSC) limit(s) during its review of a June 2010 Draft Halibut PSC Limit discussion paper (Attachment 1):

1) **simple measures to reduce halibut bycatch in near term and**
2) **an action list of industry approaches to reduce halibut bycatch in the long term.**

Near term approaches

In terms of process, a February 2010 NMFS discussion paper described the different management processes the Council could pursue to revise halibut PSC limits (Attachment 2). The Council could choose the status quo approach to modify PSC limits as part of the annual harvest specifications process based on specified criteria in regulations and the FMP, or amend the GOA Groundfish FMP to place the PSC limits in regulation. Information identified under existing FMP criteria to determine whether a change the PSC limits is warranted was presented for Council consideration in the June 2010 discussion paper.

Step 1. Decide on the process

Step 1a. Status quo approach (continue halibut PSC limits under the groundfish specifications process)

As the status quo is described therein, the GOA Groundfish FMP and implementing regulations authorize the Council to recommend, and NMFS to approve, annual halibut mortality PSC limits as a component of the proposed and final groundfish harvest specifications. The final harvest specifications summarize the Council and NMFS's findings with respect to each of these FMP considerations. Section 679.21(d) already authorizes the apportionment of annual halibut PSC limits to GOA trawl and hook-and line gear fisheries and allows the establishment of apportionments for pot gear.

The current 2,000 mt halibut PSC limit for the GOA trawl groundfish fisheries has remained unchanged since 1986. The 300 mt halibut PSC limit for the non-trawl groundfish fisheries has remained unchanged since 1995, when the IFQ sablefish fishery was exempted from the PSC limit and the PSC limit was reduced by 450 mt. Halibut PSC limits for GOA trawl and non-trawl fisheries and associated catch mortality since 1995 are listed in Attachment 2, Table 1.

Separate but related criteria are set forth in the GOA Groundfish FMP for the seasonal distribution of the halibut PSC limits (Attachment 2, Appendix 1), as well as in regulations at §679.21(d)(5). The paper describes the schedule for an analysis that would need to coincide with the annual harvest specifications process so that harvest specifications are not delayed (see Figure 1 in Attachment 2). In summary, under the status quo (i.e., GOA Groundfish FMP) the timing of periodic changes in halibut PSC limits may not dovetail simultaneously with periodic environmental assessments prepared for the harvest specifications process. This year is a case in point, during which the information required by the FMP has been presented for Council review but not analyzed *per se* (either in the previous harvest specifications EA or any other type of formal analysis).

Step 1b. Amend the GOA Groundfish FMP (set halibut PSC limits in regulations)

While the harvest specifications EIS/FRFA does contain a summary of social and economic effects of the alternative harvest strategies for GOA groundfish considered by the Council. It does not contain an assessment of alternative PSC limits and the types of socio-economic analyses contained in the regulatory impact review or regulatory flexibility analysis that would be required to accomplish a change in PSC limits that typically are required to implement regulatory amendments. Changing the GOA halibut PSC limits as a component of the annual harvest specifications would require that this analysis be prepared.

Therefore, the Council would have the greatest (future) flexibility by first amending the GOA Groundfish FMP to remove the FMP authority to set halibut PSC limits annually as part of the annual harvest specifications process and amend the FMP to authorize the establishment of halibut PSC limits in federal regulations; this first step would require an EA/RIR/IRFA to remove halibut PSC limits from the FMP. The effect of such an action is to have the two groundfish FMPs operationally similar.

The Council could adopt a *problem statement* that addressed the need for increased flexibility (i.e., timing not dependent upon that for the harvest specifications EA/EIS) and additional analytical requirements (RIR/IRFA) for setting the halibut PSC limits in regulations, which better inform the public.

To mirror the BSAI Groundfish FMP, *plan amendment language* could be revised to reflect the BSAI FMP text in the box (right).

BSAI FMP Pacific Halibut PSC Limit Specifications

Annual BSAI-wide Pacific halibut bycatch mortality limits for trawl and non-trawl gear fisheries will be established in regulations and may be amended by regulatory amendment. When initiating a regulatory amendment to change a halibut bycatch mortality limit, the Secretary, after consultation with the Council, will consider information that includes:

1. estimated change in halibut biomass and stock condition;
2. potential impacts on halibut stocks and fisheries;
3. potential impacts on groundfish fisheries;
4. estimated bycatch mortality during prior years;
5. expected halibut bycatch mortality;
6. methods available to reduce halibut bycatch mortality;
7. the cost of reducing halibut bycatch mortality; and
8. other biological and socioeconomic factors that affect the appropriateness of a specific bycatch mortality limit in terms of FMP objectives.

Step 2. Decide on appropriate halibut PSC limits

Step 2a. Status quo (no change(s) to halibut PSC limits in the GOA)

A second, coincident step would be to decide whether to set the status quo (rollover) halibut PSC limits (or alternative limits) in regulation; this step would require an EA/RIR/IRFA. Under this proposed scenario, the total PSC limits and sector allocations (trawl and non-trawl sectors) would be set in regulation.

Step 2b. Revise the halibut PSC limits

At this point the Council has yet to decide if there is a problem in its management of groundfish or halibut fisheries regarding halibut PSC limits. Should the Council identify a problem, it must identify both potential management alternatives to address the problem AND the process for implementing the change(s) to the fisheries (i.e., under the GOA Groundfish FMP or regulations).

A contract report by Northern Economics, Inc. provides additional information on GOA halibut mortality in the groundfish fisheries for the years 2000 – 2009 (Attachment 3). This report can be used by the Council to identify alternative halibut PSC limits (in total or by fishery, target, and/or regulatory area), if so desired, for potential action.

Long term approaches

The Council identified an interest in halibut bycatch avoidance techniques that could reduce incidental harvests in groundfish fisheries. Long term approaches would be the subject of future, separate regulatory action(s) or voluntary industry efforts.

PART 2. Response to Issues Identified in June 2010 for Additional Clarification

The Council requested additional information on the following topics during its review of the June 2010 Halibut PSC Limit discussion paper. Staffs of the Council, NMFS AKRO, IPHC, and ADF&G responded to the requests for additional information.

1. The amount of halibut bycatch reduction projected from the June 2010 preferred alternative for the GOA Rockfish Program.

Halibut prohibited species catch allowances will be made to the program in an amount equal to 87.5 percent of the annual average usage of halibut in the target fishery during the qualifying period (2000-2006) by both sectors. The remaining 12.5 percent would remain unavailable for use in any fishery. This program allowance is then divided between and within the sectors based on qualifying primary rockfish species histories. The resulting calculation results in a 74.1 mt limit for catcher processors, 117.3 mt limit for the catcher vessels, and 27.4 mt remaining unavailable for use in any fishery. In addition, to create an incentive for further halibut mortality reductions, 55 percent of any cooperative's unused halibut allowance would be available for use in the 5th season trawl fisheries. The remaining halibut allowance would remain unused for that fishing year.

The Council may wish to revise total GOA halibut PSC limits to document the reduced allocation of PSC limits to component fisheries[1].

2. Basis for original PSC limits

Beginning in 1985, annual halibut bycatch limits were implemented for the GOA groundfish trawl fisheries, attainment of which triggered closure of the GOA to bottom trawl gear. In 1990, regulatory authority was also implemented to limit GOA halibut bycatch in fixed-gear fisheries. Seasonal allocations of halibut PSC limits also are authorized.

In order to provide opportunity for development of a fully domestic fishery and protection for the halibut resource, the FMP specified halibut bycatch limits for a domestic fishery. The limits applied to domestic trawling conducted between December 1 and May 31 and were specified at 29 mt (48,000 pounds) for the Western area and 52 mt (86,000 pounds) for the Central area. The limits were based on the assumption of a one percent bycatch rate, or roughly equal to one percent of the domestic harvest of Pacific cod expected in 1979 or soon thereafter. When the limits were reached, further domestic trawling during the December-May period in that area was prohibited. Fishing conducted outside this period was

[1] The Council also may wish to revise total BSAI halibut PSC limits to better document reduced PSC limit allocations to BSAI groundfish fishery sectors (e.g., Amendment 80 halibut PSC limit reductions), in a separate action.

unencumbered by limits. These limits were in addition to various halibut bycatch restrictions in place for foreign and joint venture fisheries.

The domestic groundfish fishery grew more quickly than anticipated and by the mid-1980s, the bycatch limits began to seriously restrict the fishery. For the 1984 and 1985 fisheries, the Council requested NMFS to enact Emergency Rules increasing the bycatch limits to 270 mt (0.45 million pounds) in the Western area and 768 mt (1.27 million pounds) in the Central area to prevent domestic on-bottom trawling from being excessively restricted. Also, additional Emergency Rules were implemented for the 1984 and 1985 fisheries to exempt midwater trawls from any fishery closure because of the inherently low halibut bycatches. This was done in recognition of the valuable pollock fishery in Shelikof Strait, which was conducted with midwater trawls.

3. Whether the Council can set PSC limits by area.

Yes. The Council has the authority to recommend that NMFS allocate PSC limits by area, but inseason management may have difficulty insuring area PSC limits are not exceeded if these limits are in areas where open access fisheries occur and the areas are of small size. The primary reason for difficulty is that PSC rates change as information collected by observers enters the catch accounting system and more landing information is obtained. Thus, inseason managers make closure decisions that require forecasting when a PSC limit will be reached based on PSC estimates that can change. This issue is exacerbated when the PSC limits are small given that each vessel's PSC is proportionally a larger part of the total PSC limit.

A PSC limit specific to an area smaller than a federal reporting area requires consideration as to whether the PSC information needs to be area specific. If so, then observer coverage must be available to provide an area-specific estimate. For smaller areas this usually requires 100 percent observer coverage on vessels. In addition, regardless of whether a PSC rate is area-specific, a trip-specific method is required to determine the total amount of groundfish caught in the special PSC area. For example, vessels could be prohibited from fishing both inside and outside a special area on a single trip, or required to carry 100 percent observer coverage on a trip that occurs in the special area.

In designing the new deployment model for the observer program, consideration of PSC limits will be required, such that observer coverage is able to complement management needs. Matching observer coverage to management needs likely becomes more difficult with small PSC limits.

4. In-depth historical discussion of halibut discard mortality rates and all ongoing studies.

A summary of historical rates and ongoing studies was provided in the June 2010 paper. Additional descriptions may be provided in future analyses, pending Council action. Additional information on halibut bycatch avoidance may be requested of the industry. An in-depth summary of halibut bycatch mortality in groundfish fisheries is presented under Attachment 3.

5. Description of general management and regulatory requirements that affect mortality rates and amounts

Access to unsorted catch is critical for observers to collect unbiased samples from which robust estimates of catch can be made and biological information used. Federal regulations support this need by stipulating that observers must have access to unsorted catch. For example, specific regulation referencing the ability for observers to obtain unsorted catch is found in general prohibitions (679.7[g][2]), equipment and operational requirements (679.28), IRIU (679.27), Groundfish and CDQ catch monitoring (679.32), Groundfish Observer Program (679.50), Rockfish Pilot Program (679.84), and Amendment 80 program (679.93).

Within a sampled haul or set, observers weigh and count all halibut within a species composition sample, take length measurements and record halibut viability. Length measurements and estimates of viability may come from inside or outside of the random species composition samples. Obtaining representative viability estimates requires observers to assess viability at the point of discard and account for the time on deck for non-sampled halibut. Halibut sampled for viability do not have a higher mortality than unsampled halibut discarded by crew. http://www.afsc.noaa.gov/FMA/Manual_pages/MANUAL_pdfs/manual2010.pdf.

6. Description of use of hook strippers (i.e., crucifiers) by fishery over time; is there a direct correlation to mortality (e.g., P cod)

Hook strippers, also called crucifiers, speed up the process of removing hooks by stopping the fish but allowing the longline gear to proceed thereby tearing the hook out of the fish's mouth. Crucifiers are mounted near the roller on longliners and consist of a pair of parallel bars spaced just far enough apart to allow gangions and hooks to pass, but not hooked fish. This technique increases mortality on fish which are to be discarded, compared with careful release techniques. Increasing the mortality of discards has the effect of decreasing the fishery catch limits.

A review of mortality associated with fishery sectors (www.fao.org/docrep/008/y6981e/y6981e07.htm) reported that all major fishing gear types involve some degree of injury to fish through internal and external wounding, crushing, scale loss and hydrostatic effects, with the severity of the injury depending on the gear type and its operation. Susceptibility to injury varies with species and type of stressor. There have been several investigations on the survival of fish released from the hook in various longline fisheries. Generally, it appears that hook penetration depth, hooking location and the technique used to remove fish from the hook have major impacts on subsequent survival. A swallowed hook may induce a substantially greater injury than a hooked mouth (e.g., through the jaw, lips or operculum). Fish removed from hooks automatically (e.g., by a crucifier or gaff) experience a significantly higher mortality than fish removed manually. Both manual and automatic release methods have the potential to inflict severe injuries to the mouth parts of the fish. Fish that were released by a gaff suffered also from punctures to the body wall and damage to the abdomen and intestines. It is worth noting that a gaff can be used to remove the hook without handling the fish, and this is likely to result in minimal injury.

Several IPHC papers and studies address the careful release of halibut in the IFQ and Pacific cod fisheries (Kaimmer 1994, Kaimmer and Trumble 1998, and Trumble, Kaimmer, and Williams 2000). Kaimmer (1994) reported that setline vessels in the North Pacific began using automated gear retrieval systems incorporating hook strippers to remove unused bait and caught fish from the hooks during gear retrieval. Pacific halibut removed by these automated systems suffer a handling mortality which is as much as nine times that experienced by fish removed carefully by the more traditional manual method of rolling the hook out of the mouth using a gaff. This increased mortality results from more severe injuries in the mouth area associated with the automated removal. Fish receiving sublethal injuries as a result of automated removal experience a significantly reduced growth rate in subsequent years.

Kaimmer and Trumble (1998) reported that Pacific halibut caught as bycatch or intended for discard by longline vessels in U.S. and Canadian waters of the north Pacific must be removed from the hook using careful release techniques required by regulation. In many fisheries, trained observers subsample the released halibut for fish condition. These condition codes are used to track cumulative bycatch mortality in these fisheries. Tag return rates of halibut released from longline gear near Kodiak Island, Alaska, were used to estimate relative and absolute mortalities of fish by release method, hook removal injury, and condition code. Generally, the proper application of the careful release techniques result in only minor hook removal injuries. Mortality rates of moderately and severely injured halibut are 1.5–2 times higher than previously assumed. One result of our study is the finding that not all fish judged at tagging as likely

to die, actually die. They recommended a reworking of the condition code methodology, which subsequently occurred in 2000

Trumble et al. (2000) noted that mandatory release of halibut incidental catches in groundfish fisheries has the potential to close fisheries managed with PSC limits, when those PSC limits are reached. His study demonstrated that halibut with similar types of injuries experienced lower mortality following release from small circle or autoline hooks than from larger circle hooks and led to revised criteria to determine viability (reducing discard mortality rates in longline fisheries by 20 percent).

Trumble et al. (2000) summarized the earlier IPHC studies that suggested that Pacific halibut are very hardy fish that have high survival rates, when handled appropriately, following capture and discard to sea from longline vessels. He reported that most longline fishermen use circle or semi-circle autoline hooks which hook the fish in the mouth and cause little damage. Almost all halibut are hooked with the bend of the hook circling the jaw and the point protruding through a hole in the cheek. Removal of the hook requires either backing the hook out around the jaw (generally with low mortality) or tearing the hook out through the jaw (generally with increased mortality. A later study found that survival by injury type with the smaller hooks was much greater than than with larger hooks.

Adlerstein and Trumble (1998) reported on mortality of discarded Pacific halibut bycatch from Pacific cod fisheries in the Bering Sea leads to significant losses in the halibut setline and in the Pacific cod fisheries. The commercial halibut fishery loses yield because of fishery catch limit reductions to compensate the resource for lost spawning potential and because halibut killed as bycatch will not be available for subsequent harvest, and the cod fisheries may lose harvest if they reach a bycatch mortality limit before reaching allowed catch. In this study, significant differences in Pacific halibut bycatch rates and associated yield losses were found among months and areas of the Bering Sea in the longline and trawl fisheries for Pacific cod in 1990–1992. Bycatch rates were usually highest in late spring and early summer and in areas close to the Unimak Pass. With the exception of 1992, yield loss in the longline fishery was around 1 kg per kg of bycatch mortality, irrespective of where or when bycatch occurred. In the trawl fishery, loss of halibut yield varied from 1 to 4 kg per kg of bycatch mortality. Highest halibut net yield losses per ton of groundfish harvest usually coincided with highest bycatch rates. When both fisheries operated in one area, trawl bycatch often imposed higher yield losses than longline bycatch, despite lower bycatch rates. Bycatch was affected by the strong 1987 halibut year class. Highest bycatch and yield loss rates occurred in the trawl fishery in 1990 and 1991 when the population was dominated by halibut age-3 and age-4, and in the longline fishery in 1992 as fish reached age-5.

Heery and Bellman (2009) reported that when Pacific halibut are caught by trawl vessels fishing off the US west coast, they are always brought on-board the vessel, ensuring the observer can randomly select a subsample for length and viability sampling. On hook-and-line vessels, crew members have the ability to "shake" or use other means (cutting of gangions, straightening of hooks) to discard the halibut without having to bring it onboard. This type of crew behavior normally occurs before or as the Pacific halibut reaches the "roller", which prevents the fish from hitting the "crucifier" (being torn from the hook) and lying on deck for any period of time. This is generally considered good handling practice that reduces potential mortality. However, at this time west coast groundfish fishery regulations do not have 'careful release' requirements.

Hooking mortality is variable and is affected by many factors, for example, the size and shape of the hook. Trumble et al., (2000) conducted a large-scale tagging experiment on Pacific halibut released from longline gear; halibut experienced lower mortality following release from small circle or autoline hooks than from large circle hooks.

Crucifiers were prohibited by IPHC regulation beginning in 1987 (Hoag et al. 1993), so their use was illegal aboard halibut longliners prior to the implementation of the IFQ program in 1995. Their use was reinstated by IPHC after the Council adopted the IFQ program for halibut. At that time the focus of the regulations shifted from prohibiting the gear to prohibiting the effects of the gear, i.e., damaging jaws. The use of hook strippers started on the bigger vessels fishing sablefish, as they were very handy for the close-spaced gear commonly used in that fishery. In the preparatory work for implementing the IFQ program, a multiagency group that worked on 'harmonizing' the regulations for halibut and sablefish resolved the inconsistency by recommending that IPHC drop the prohibition and instead prohibit the injuries caused by hook strippers. Currently, the North Pacific hook-and line and halibut fisheries have specific careful release handling techniques for Pacific halibut that are defined in regulation (CFR 679.7):

> *(1) All halibut that are caught and are not retained shall be immediately released outboard of the roller and returned to the sea with a minimum of injury by*
>
> *(a) hook straightening;*
>
> *(b) cutting the gangion near the hook; or*
>
> *(c) carefully removing the hook by twisting it from the halibut with a gaff.*
>
> *(2) Except that paragraph (1) shall not prohibit the possession of halibut on board a vessel that has been brought aboard to be measured to determine if the minimum size limit of the halibut is met and, if sublegal-sized, is promptly returned to the sea with a minimum of injury.*

A 2009 proposal to the IPHC by the U.S. sport charter sector called for a renewed ban on the use of crucifiers on commercial halibut vessels, unless the vessel was equipped with an EM system. The proposal was ultimately withdrawn, as IPHC had no authority to require vessels to use EM. Consequently, the IPHC took no action..

The impact of hook strippers on released halibut may also be tracked through information on Prior Hook Injuries (PHI) collected by IPHC on its annual halibut setline assessment survey (Kaimmer and Leickly 2010). The survey consists of approximately 1,250 stations laid out on a systematic grid on the continental shelf, from 20-275 fathoms, and employs chartered commercial longline vessels. One of the duties of on-board samplers is to record the presence of PHI in the halibut brought on board for sampling. Data collection follows a set of prescribed criteria in which severity of prior injury is noted. While the precise cause of the PHI cannot be determined, IPHC has noted that the occurrence of PHI tends to be concentrated in areas which groundfish longline fisheries target Pacific cod.

7. Description of Canadian IBQ trawl fishery

A PowerPoint presentation by the DFO Pacific Region Groundfish Management staff provided to the IPHC and halibut industry at the January 2010 IPHC Annual Meeting is provided under Attachment 4. Canada DFO staff may be invited by the Council to provide additional information at a future meeting depending on Council interest, possibly February 2011. The (DFO) Pacific Region Integrated Fisheries Management Plan for 2010/2011 is available at:

> http://www.scribd.com/doc/34285199/Integrated-Fisheries-Management-Plan-for-Southern-B-C.

8. Effects of restructured observer program

The current federal groundfish observer program in Alaska is structured by vessel size. As such, groundfish vessels less than 60' are not required to carry observers; vessels 60' – 125' length overall (LOA) are required to carry and pay for their own observers 30 percent of their fishing days, regardless of gear type or target fishery; vessels greater than 125' LOA are required to carry observers 100 percent of the time. Vessels in the 30 percent coverage category select when to carry observers and are constrained in this self-selection by regulatory requirements for quarterly coverage levels. The two size categories with less than 100 percent observer coverage comprise the majority of vessels fishing in the Gulf of Alaska (GOA) and out of ports other than Dutch Harbor and Akutan in the Bering Sea and Aleutian Islands (BSAI).

Observers estimate total catch for a portion of hauls or sets, and sample hauls or sets for species composition, including PSC. These data are extrapolated in the Alaska Region Catch Accounting System (CAS) to make estimates of total PSC halibut catch on both observed and unobserved vessels. Observer data are assumed to be representative of the activity of all vessels and are used to estimate total halibut PSC. The ratio estimator is derived from a set of covariates that match both observer and groundfish landing/production information. A detailed description of this process is presented in Cahalan et al. (2010).

Regulations governing observer deployment (i.e., observer coverage requirements) introduces the potential of bias in observer data by using a non-random deployment model which may facilitate non-representative fishing. Given the use of observer data in CAS, and the subsequent use of CAS estimation in stock assessments and quota management, this issue can undermine the data used to manage halibut PSC (among other species) in the North Pacific groundfish fisheries. In response to these issues, the Council took action at its October 2010 meeting to recommend that NMFS restructure the observer program to address multiple issues with the current program, including bias (NPFM 2010). The recommended restructuring preferred alternative provides NMFS with flexibility to place observers onboard vessel using accepted statistical practices so that coverage gaps and vessel-trip selection bias is addressed (http://www.alaskafisheries.noaa.gov/npfmc/current_issues/observer/ObserverMotion1010.pdf).

The preferred alternative is likely to influence estimation most in sectors currently with 30 percent or less coverage. Past analytical examinations of the North Pacific Groundfish Observer Program have dealt with such issues as sampling protocols, reducing bias, estimate expansion, and the statistical properties of estimates (e.g. Jensen et al. 2000, Volstad et al. 1997, Pennington 1996, and Pennington and Volstad 1994). These and other studies suggest bias is likely reduced by changing from the current system, in which 30 percent coverage vessels can choose when and where to take observers, to a new system in which NMFS is responsible for distributing observers among vessels using statistically robust methods.

The extent to which random deployment influences PSC halibut estimates is related to current efforts by the fleet to manipulate PSC rates as well as the magnitude of bias caused by quarterly deployment regulations and timing of observer coverage. Work presented in the restructuring analysis (NPFMC 2010) suggests evidence of a deployment effect, but the magnitude of this bias on PSC estimates is not known. Improvements in the statistical properties of observer samples and estimates will result in many data improvements, including improved spatial coverage as smaller vessels that fish in inshore areas receive coverage; a reduction in the ability for vessels to "game" coverage by not taking an observer to certain areas of known high bycatch or attempting to manipulate PSC rates; CAS estimates may better reflect sector-specific PSC halibut catch due to a consistent amount of observer data available throughout the year; and finally a more representative sample of halibut viability may be obtained.

The potential changes in PSC halibut estimation described in the preceding paragraph will most influence groundfish fisheries that currently have a large amount of effort from 30 percent or unobserved vessels. Fisheries currently with a 100 percent or more of coverage will continue to receive vessel specific rates, which is the most accurate and precise estimate available. Fisheries currently with a mixture of 100 percent and 30 percent vessels receive PSC estimates that are vessel-specific for observed vessels and PSC halibut rates derived from observer information collected onboard a mixture of 100 percent and 30 percent vessels. PSC estimates in a fishery may change depending on the direction of deployment bias and the amount of 30 percent coverage relative to 100 percent coverage under the current observer deployment model. Fisheries with both levels of coverage, but historically operated under high levels of 30 percent coverage, may experience a larger reduction in bias (and subsequent change in PSC) than those with a large amount of 100 percent coverage. Further, the amount of variation associated with PSC rates and estimates may also change due to a representative sample better reflecting true variation of halibut catch in the fishery, as well as additional vessels (those 40-60' LOA) being sampled by observers.

9. Information on (exempted) jig fisheries (P cod and rockfish), with ramp up levels

NMFS uses the Catch Accounting System to estimate the amount of halibut PSC in the parallel fisheries, which occur in State waters. Because the system is set up to make the estimates in State waters, PSC in the GHL fisheries is estimated as well. In the GOA, halibut PSC started accruing in 2009 when the State allowed longline gear to fish its Prince William Sound (PWS) fishery. Before 2009, no halibut mortality accrued to the federal PSC limits from the GOA State GHL fishery since the allowed gears, pot and jig, are exempt from halibut mortality limits. The method of estimating PSC is the same in State waters fisheries as in federal fisheries. PSC is estimated on unobserved trips by matching observer-based rates with the groundfish catch based on year, week ending date, trip target, gear, and FMP area. In 2009 and 2010, the halibut mortality rates were derived from observer data on hook-and-line catcher/processors in the Western and Central Pacific cod fisheries, since no observer coverage is required in the State's PWS fishery. In 2009 and 2010, the estimate of halibut PSC was 3 mt (per year) out of the 290 mt annual limit. In the Aleutian Islands, halibut PSC has accrued since 2006 from hook-and-line and trawl gear effort in the State waters GHL fishery. The halibut PSC from the State's Aleutian Islands Pacific cod fishery are: 20 mt in 2006, 46 mt in 2007, 10 mt in 2008, 2 mt in 2009, and 10 mt in 2010 (through September 25, 2010).

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HALIBUT PROHIBITED SPECIES CATCH LIMIT DISCUSSION PAPER[1]
June 2010

Prepared by North Pacific Fishery Management Council staff[2]

Executive Summary: The incidental catch of halibut has been a major bycatch issue in the Gulf of Alaska (GOA) for the North Pacific Council since the 1960s. During the last several annual groundfish specification cycles, the Council has discussed the procedure for setting halibut prohibited species catch (PSC) limits in the GOA and Bering Sea/Aleutian Islands (BSAI) management areas. Halibut PSC limits are specified by gear and may be apportioned by season, regulatory area, and/or target fishery. A PSC limit is an apportioned, non-retainable amount of fish provided to a fishery for bycatch purposes. The attainment of a PSC limit for a species results in the closure of the appropriate fishery.

In February 2010 the Council reviewed a NMFS discussion paper that identified the different procedures for setting halibut PSC limits under each FMP. While halibut PSC limits in the BSAI are set in federal regulation, GOA PSC limits are set under the authority of the GOA Groundfish FMP in rulemaking for the annual specifications process. Therefore the Council may continue to this process or it may choose to amend the GOA Groundfish FMP to mirror the process for BSAI groundfish fisheries, whereby halibut PSC limits may be revised through a regulatory amendment.

During its review of the NMFS paper the Council requested that its staff prepare this discussion paper for review in June 2010, which would address the criteria required by the GOA Groundfish FMP for setting halibut PSC limits. The Council also requested a paper on revising the BSAI halibut PSC limits in federal regulations, but did not identify a schedule for its review. This paper addresses the following criteria for GOA PSC limits in a general manner: 1) estimated change in biomass and stock condition of halibut; 2) potential impacts on halibut stocks; 3) potential impacts on the halibut fisheries; 4) estimated bycatch in years prior to that for which the halibut PSC mortality limit is being established; 5) expected change in target groundfish catch; 7) estimated change in target groundfish biomass; 8) methods available to reduce halibut bycatch; 9) the cost of reducing halibut bycatch; and 10) other biological and socioeconomic factors that affect the appropriateness of specific bycatch measures in terms of objectives.

After reviewing this information, the Council may choose to 1) take no action; 2) initiate an amendment (EA) to the GOA Groundfish FMP to revise the PSC setting process to mirror the regulatory process (RIR/IRFA) as in the BSAI, as needed; 3) initiate an analysis of halibut PSC limits to support the harvest specifications EA for 2012; or 4) include an analysis of halibut PSC limits in the next harvest specifications EA. The earliest that GOA halibut PSC limits could be revised is coincident with rulemaking for the annual groundfish specifications for 2012. The next step under any action alternative, *if that is the Council's intent,* would be for the Council to identify 1) a problem in the fishery, 2) goals and objectives for addressing the problem, and 3) management alternatives. If the Council chose to take no action to initiate a separate analysis, it always has the option to incorporate halibut PSC limit reductions in other proposed actions, as it did with BSAI Amendment 80. Even under no action, more widespread (mandatory or voluntary) use of halibut excluder devices would continue to result in a "win/win" situation whereby less halibut are taken as bycatch in groundfish fisheries thus leading to 1) potential increases in halibut abundance and commercial longline fishery catch limits and 2) increased GOA groundfish target harvests.

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[1] Future analyses will review groundfish and halibut catch data by target fishery and sector.
[2] Based on source material from NPFMC, NMFS Sustainable Fisheries Division, & Int. Pacific Halibut Commission

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A brief history of halibut bycatch policy in the Gulf of Alaska

Section 3.6.2.1 of the GOA Groundfish FMP states the following Council policy on halibut bycatch in GOA groundfish fisheries.

> *"The Council believes that discarding incidental catches of fish is wasteful and should be minimized. However, recognizing that in the groundfish fisheries halibut incidentally caught are managed outside this FMP, the treatment of halibut as a prohibited species is appropriate in the short term. Except as provided under the prohibited species donation program, retention of prohibited species captured while harvesting groundfish is prohibited to prevent covert targeting on these species. The prohibition removes the incentive that groundfish fishers might otherwise have to target on the relatively high valued prohibited species, and thereby, results in a lower incidental catch. It also eliminates the market competition that might otherwise exist between halibut fishers and groundfish fishers who might land halibut in the absence of the prohibition.*
>
> *Halibut that are taken as bycatch in the trawl and fixed gear fisheries result in fishing mortality even though the FMP requires that these species be discarded. Bycatch survival rates of halibut are typically less than 100 percent and may approach zero for some fisheries and some gear.*
>
> *When a PSC limit is reached, further fishing with specific types of gear or modes of operation during the year is prohibited in an area by those who take their PSC limit in that area. All other users and gear would remain unaffected.*
>
> *However, when the fishery to which a PSC limit applies has caught an amount of prohibited species equal to that PSC limit, the Secretary may, by notice, permit some or all of those vessels to continue to engage in fishing for groundfish in the applicable regulatory area, under specified conditions. These conditions may include the avoidance of certain areas of prohibited species concentrations and will be determined on a case-by-case basis."*

The proposed rule for GOA FMP Amendment 21 summarizes the issue of bycatch management being considered by the Council in 1990; which, to some degree, is still applicable 20 years later. It states,

"*The use of trawl, hook-and-line, and pot gear in the groundfish fisheries are to varying degrees non-selective harvesting techniques in that incidental (bycatch) species, including crabs and halibut, are taken in addition to target groundfish species. A conflict occurs when the bycatch in one fishery measurably or potentially impacts the level of resource available to another fishery. Bycatch management is an attempt to balance the effects of various fisheries on each other. It is a particularly contentious allocative issue because groundfish fishermen value the use of crabs and halibut very differently than do crab and halibut fishermen. . . . The prohibition on retention of prohibited species or the establishment of PSC limits eliminates the incentive that the groundfish fleets might otherwise have to target on crabs and halibut, but this prohibition does not provide a substantial incentive for them to avoid or control bycatch.*"

Alaska Sea Grant sponsored a 3-day national workshop in 1995[3] to review recent developments in bycatch reduction and promote dialogue on research and policy goals for the future.[4] A number of papers remain relevant to the Council's future considerations of ecological and economic implications of allocation decisions, observer requirements for the GOA groundfish and halibut fleets, and innovative gear to reduce halibut bycatch. One of the conclusions of the proceedings included, "regulatory schemes that encourage innovation and responsibility through incentives for bycatch reduction, and discourage those who jeopardize personal and collective fishing opportunities through disincentives, must be implemented." To that end, the Council has adopted catch share programs in the GOA that include bycatch reduction elements (halibut and sablefish individual fishing quota (IFQ) program, GOA rockfish pilot program). While primarily in the Bering Sea/Aleutian Islands, the commercial groundfish industry

[3] A 1992 work shop identified and defined the problems of bycatch: Proceedings of the National Industry Bycatch Workshop, Feb 4-6, 1992, Newport, OR. Natural Resources Consultants, Inc. Seattle, WA

[4] Solving Bycatch: Considerations for Today and Tomorrow. Alaska Sea grant College Program report No. 96-03, University of Alaska Fairbanks

has responded to known ecological impacts and public perception and image of bycatch by cooperative research with NMFS on gear modifications for reducing bycatch of halibut, salmon, and crab.

Current interest in halibut bycatch reductions

As part of its deliberations in February 2010 to request a Council staff discussion paper on current GOA halibut PSC limits, the Council noted that it would need to identify a problem in the fishery goals and objectives, and proposed alternatives to take a management action to revise the current halibut PSC limits. The Council is often faced with conflicting goals and objectives, and the management of halibut as bycatch in directed groundfish fisheries (both trawl and fixed gear) is no exception.

February 2010 Council motion

Council staff should bring back a discussion paper that develops the background information and clarifies the nature of the problem that needs to be addressed in context of considerations set forth in the GOA FMP for the establishment of halibut PSC limits, (Appendix 1 to the February discussion paper.) This paper would inform a subsequent decision to pursue an analysis to adjust halibut PSC limits under either an FMP amendment or the annual specification process for the GOA.

Bycatch issues, which have been raised during public testimony and deliberations of both the Council and International Pacific Halibut Commission (IPHC), have focused on the biological impacts on the affected fisheries and the fishery resources. The IPHC has stated its intent to reconvene the Bycatch Work Group, that had met in 1991, to examine how impacts of bycatch can best be incorporated into halibut assessment and management, as well as to review progress on bycatch reduction and the target levels for reduction identified in 1991 (Salveson et al. 1992). Bycatch of halibut is not believed to be a conservation issue because the IPHC sets commercial halibut fishery catch limits at levels that account for bycatch mortality of adult and juvenile halibut. However, bycatch of juveniles reduces the recruitment of fish to the adult stock and, because juveniles are still highly migratory, the distribution of impacts differs from the distribution of bycatch. The means by which the IPHC compensates the stock for the effects of bycatch are complex and the relatively recent finding that migration continues well into adult ages further complicates matters. The IPHC seeks to prevent additional mortality above target harvest levels, which are computed after factoring expected annual bycatch levels.

In summary, the IPHC has identified the following biological impacts to the halibut resource due to halibut bycatch in both commercial groundfish trawl and fixed gear and commercial halibut longline fisheries:

1. Reduced yield, due to reduced recruitment and mortality of adults, which results in lower halibut commercial and sport fishery catch limits (i.e., yield) in U.S. and Canadian waters;
2. Out-of-area (or, "downstream") impacts of halibut bycatch, where the take of bycatch in one area reduces recruitment and available yield to other areas.
3. Reduced spawning biomass and egg production, due to reduced recruitment and mortality of adults.

With the management authority for conservation assigned to the IPHC, problems that have been raised in Council discussions predominantly address the effects on the directed halibut fishery of bycatch in non-directed fisheries. *Proponents of directed halibut fixed gear (IFQ) fisheries may point to declining halibut biomass and halibut fishery CEYs, particularly for the eastern segments of the halibut population, in addition to decreased size at age of halibut, as reasons to decrease the halibut PSC limits (for either the trawl, fixed gear, or both apportionments). They could identify that trawlers in the BSAI and GOA take 4 lb of halibut bycatch for every 1 lb longliners and pot fishermen take. They could point to reductions in halibut bycatch in recently rationalized fisheries as a source for potential PSC limit reduction(s).*

Conversely, proponents of rationalized trawl fisheries can point to their halibut bycatch reductions as a source of halibut PSC amounts (under the cap) that be reallocated to underutilized groundfish fisheries that could allow them to better achieve optimum yield in other fisheries for which the halibut PSC limit(s) have constrained the harvests of target groundfish stocks (e.g., shallow water flatfish trawl fishery).

In its discussion related to the development of this paper, the Council noted other actions at various stages of analysis that directly or indirectly address halibut bycatch in GOA groundfish fisheries. These include, but are not limited to, observer program restructuring and the GOA rockfish program. Both of these

management issues are on the Council's June 2010 meeting agenda, and proposed actions are subject to revision per Council direction, on halibut PSC limits or any other management context. They are used as case studies in this paper for assessing potential impacts of potential changes to GOA halibut PSC limits.

Background on Process for Changing Current Halibut PSCs

The GOA Groundfish FMP notes that halibut PSC limits that are already in effect will remain so in the absence of a new recommendation for setting PSC limits by December 15 each year. A NMFS discussion paper in February 2010 (http://www.alaskafisheries.noaa.gov/npfmc/analyses/GOAHalibutPSCmod210.pdf) reviewed the process for amending halibut PSC limits. The FMP and implementing regulations authorize the Council to recommend, and NMFS to approve, annual halibut mortality PSC limits as a component of the proposed and final groundfish harvest specifications. Halibut PSC limits are separately set for trawl and fixed gear, which may further be apportioned by season, regulatory area, and/or target fishery. A PSC limit is an apportioned, non-retainable amount of fish provided to a fishery for bycatch purposes. The attainment of a PSC limit for a species will result in the closure of the appropriate fishery. Changes to the GOA PSC limits would require that an analysis be prepared within a timeframe that allows for final Council action in December and implementation through the harvest specification process. Alternatively, an FMP amendment could be considered that authorizes the establishment of modified PSC limits in regulations, similar to the BSAI.

Prior to 2007, the environmental and socioeconomic effects of the annual harvest specifications, including the PSC limits, were considered in annual environmental assessments (EA) prepared each year for the harvest specifications process. Preparation of annual EAs ceased in 2007 with the development of an environmental impact statement (EIS) prepared for the groundfish harvest strategy supporting the annual harvest specifications. The EIS did not address the process for setting annual PSC limits and likely will be updated with a supplemental EIS in 2011. A new analysis would be needed if the Council chooses to revise the GOA halibut PSC limits because the harvest specifications EA does not contain a specific discussion of changing the halibut PSC limit. Or the Council could amend the Groundfish FMP to specify the halibut PSC limits in regulations.

NMFS outlined a number of approaches that the Council could have selected in April 2010. By not initiating a new analysis at that time, a problem statement and alternatives, or a timeline for selecting a preliminary preferred alternative in October 2010, the Council is not in a position to recommend changes to the halibut PSC limits during the annual specifications process for 2011. Instead, it may wish to recommend that NMFS expand the supplemental EIS in 2011 to include a range of alternatives for halibut PSC limits that could be selected during the annual specifications process for 2012.

The FMP stipulates that the Council consider the following criteria for setting or amending apportionments of halibut PSC limits. While it is not clear what aspect of halibut PSC limit in the GOA that the Council may intend to modify in the future, a summary treatment of these issues is addressed below.

- estimated change in biomass and stock condition of halibut;
- potential impacts on halibut stocks;
- potential impacts on the halibut fisheries;
- estimated bycatch in years prior to that for which the halibut PSC mortality limit is being established;
- expected change in target groundfish catch;
- estimated change in target groundfish biomass;
- methods available to reduce halibut bycatch;
- the cost of reducing halibut bycatch; and
- other biological and socioeconomic factors that affect the appropriateness of specific bycatch measures in terms of objectives.

While the Council requested a separate discussion paper to address halibut PSC limits under the BSAI Groundfish FMP, information on the BSAI in some instances is included here for broader context for the Council to identify a problem statement, management goals, and alternatives for analysis.

Use of Halibut Bycatch Limits and Related Measures[5]

Bycatch limits have been used by the Council to control the bycatch of halibut, king crab, Tanner crab, and salmon in the groundfish fisheries off Alaska since the initial groundfish FMPs were developed. Previously, bycatch management measures used in the foreign groundfish fisheries were limited to closures of specific areas during selected times of the year. Bycatch limits were a relatively new tool devised to control the bycatch or bycatch mortality not only in the foreign fisheries, but also in the joint venture and fully domestic fisheries. As these latter fisheries have evolved, the use of time/area closures as the sole means of controlling bycatch has been reduced, and bycatch limits have been used with increasing frequency. This section provides background on the use of PSC limits and the method for choosing the limits that were adopted.

Halibut Bycatch Controls Prior to MFCMA[6]

Control of foreign bycatch of halibut. Halibut bycatch was recorded in late 1950s and early 1960s with expansion of foreign fishing (primarily USSR, Japan targeting flounders) off Alaska after World War II. Bycatch increased further with the expansion of foreign fishing by Korea, China, East Germany and Poland in the 1970s. During the late 1960s and early 1970s, regulation of foreign fishing fleets resulted from bilateral agreements between the United States and the national government of the foreign fleet, e.g., Japan, U.S.S.R., etc. The agreements identified specific areas and time periods when the foreign fishery was not allowed to operate. This often resulted in a "patchwork" of areas within the GOA and the BSAI closed to groundfish fishing at various times of the year. Agreements formulated in the late 1960s were directed at reducing gear conflicts between the North American halibut longline fishery and foreign trawl operations. Typically, foreign trawling was prohibited during the 5-15 day period surrounding the halibut fishery seasons established by IPHC (Fredin 1987). Time/area closures, another tool used by the U.S., may have provided some unintended but minor reduction in the halibut bycatch by those fisheries.

The first direct attempt to control the halibut bycatch in a foreign fishery began in 1973, when the IPHC proposed to its member governments that foreign trawling be prohibited in certain areas of the Bering Sea when the incidence of halibut was high (Skud 1977). Japan responded by voluntarily refraining from trawling in certain areas within the eastern Bering Sea from December 1, 1973 through November 31, 1974 in an effort to reduce the bycatch of halibut. These time/area closures, and similar measures for the GOA, were part of subsequent bilateral agreements between the U.S. and Japan, the U.S.S.R., the Republic of Korea, and Poland during 1975 and 1976 (Fredin 1987).

Up to this point only time/area closures were used to control halibut bycatch. Bycatch limits were not part of the measures employed, probably because of the lack of a comprehensive observer program which is needed to monitor compliance. A few observers had been placed on foreign vessels as part of a joint program by IPHC, NMFS, and the International North Pacific Fisheries Commission (INPFC) to obtain better information on the magnitude of the halibut bycatch (Hoag and French 1976), but coverage was limited. Managing bycatch with limits would have been impractical at that time.

Halibut Bycatch Controls After MFCMA

Following the enactment of the MFCMA in 1977, the Council included many of the time/area closures in its groundfish FMPs as bycatch control measures for the foreign fisheries. The Council has since developed other measures, such as bycatch limits and gear limitations, which are discussed in the following section.

Control of domestic bycatch of halibut. Regulations to control halibut bycatch in domestic groundfish fisheries were implemented initially as part of the GOA groundfish fishery management plan (FMP). These regulations reflected some of the time-area closures in effect for foreign trawl operations. The

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[5] This section is taken from Williams (1992).

[6] Source: http://www.iphc.washington.edu/halcom/pubs/techrep/tech0025.pdf and http://www.iphc.washington.edu/halcom/research/sa/BycatchWorkshop/Bycatch%20History.pdf

GOA fisheries were also monitored under halibut bycatch limits. Restrictions on domestic operations were relaxed and revised as the domestic groundfish fishery developed, consistent with the desire to enhance development of this fishery. Beginning in 1985, annual halibut bycatch limits were implemented for the GOA groundfish trawl fisheries, attainment of which triggered closure of the GOA to bottom trawl gear. In 1990, regulatory authority was also implemented to limit GOA halibut bycatch in fixed-gear fisheries. Seasonal allocations of halibut PSC limits also are authorized. Their attainment will close the GOA to further fishing with the applicable gear type for the remainder of the season.

Industry funded domestic observer program. Regulations require operators of catcher vessels and catcher/processor vessels to obtain either 100, 30, or 0 percent observer coverage during each calendar quarter, depending on size of vessel. Shoreside and mothership processors are required to have either 100, 30, or 0 percent observer coverage during a month, depending on the weight of groundfish received during that month. The small catcher vessel fleet and the entire halibut longline fleet is unobserved. While the amount of halibut bycatch can be estimated, the variances surrounding those estimates cannot be estimated under current levels of observer coverage, which according to the Council staff analysis is not likely to improve until the program is restructured in 2013 at the earliest. More information on halibut bycatch in the observed (and unobserved) groundfish fisheries can be found at http://www.alaskafisheries.noaa.gov/npfmc/current_issues/observer/ ObserverRest510.pdf and is the subject of Council consideration under June 2010 agenda Item C-4.

Vessels less than 60 ft length over all (LOA) and mothership and shoreside processors that receive less than 500 mt groundfish during a month are not required to obtain an observer unless specifically requested to do so by NMFS. Observer data on halibut bycatch rates are applied against industry reported groundfish catch to derive estimates of halibut bycatch amounts each week. Actual procedures used by NMFS to calculate halibut bycatch amounts may be obtained from the Sustainable Fisheries Division, Alaska Region.

As noted in the observer program restructuring analysis,[7] there is no observer coverage in the halibut fisheries. Halibut fisheries are only minimally observed incidental to groundfish operations. In 2008, 3,141 permit holders fished halibut and sablefish IFQ using 1,157 vessels.[8] There are a number of potential bycatch issues pertaining to the halibut fleet. Most of the information gathered for management of halibut vessels (and groundfish vessels <60') currently takes place at shoreside processors, which may provide adequate catch accounting for target species and retained incidental catch species. However, discards are self-reported for all vessels in these sectors. NMFS does not currently have a verifiable measure to account for these discards, nor does it have a method for assessing the accuracy of its management decisions. Additionally, current self-reporting requirements do not include information about vessel fishing behavior. The IPHC port sampling program collects data needed for halibut stock assessment, including fishing effort and age/size composition of the landed catch.

Bycatch limits. Halibut bycatch mortality limits (round weight) for trawl, hook-and-line, and pot gear may be specified annually. Mortality limits specified are 2,000 mt (3.3 million pounds, net wgt.) for trawl gear (first implemented in 1985) and 750 mt (1.2 million pounds, net wgt.) for fixed gear (first implemented in 1990; and reduced to 300 mt (0.5 million pounds, net wgt.) in 1995 through the FMP's framework process). Groundfish pot gear is exempted from halibut bycatch restrictions because (l) halibut discard mortality rate and total mortality associated with this gear type is relatively low; and (2) existing pot gear restrictions are intended to further reduce halibut bycatch mortality.

[7] http://www.alaskafisheries.noaa.gov/npfmc/current_issues/observer/ObserverRest510.pdf

[8] NMFS and the IPHC are funded under an NPRB grant to evaluate the potential for EM systems on these vessels.

Current season allowances of halibut PSC limits

Final 2009 and 2010 GOA Pacific halibut PSC limits, allowances, and apportionments (all values are in metric tons)

Trawl gear		Hook-and-line gear [1]			
		Other than DSR		DSR	
Season	Amount	Season	Amount	Season	Amount
January 20–April 1	550 (27.5%)	January 1–June 10	250 (86%)	January 1–December 31	10 (100%)
April 1–July 1	400 (20%)	June 10–September 1	5 (2%)		
July 1–September 1	600 (30%)	September 1–December 31.	35 (12%)		
September 1–October 1	150 (7.5%)	n/a	n/a		
October 1–December 31	300 (15%)	n/a	n/a		
Total	2,000 (100%)	n/a	290 (100%)		10 (100%)

[1] The Pacific halibut PSC limit for hook-and-line gear is allocated to the demersal shelf rockfish (DSR) fishery and fisheries other than DSR. The hook-and-line sablefish fishery is exempt from halibut PSC limits.

Final 2009 and 2010 apportionment of GOA Pacific halibut PSC trawl limits between the trawl gear deep-water species complex and the shallow-water species complex (values are in metric tons)

Season	Shallow-water species complex	Deep-water species complex [1]	Total
January 20–April 1	450	100	550
April 1–July 1	100	300	400
July 1–September 1	200	400	600
September 1–October 1	150	Any remainder	150
Subtotal January 20–October 1	900	800	1,700
October 1–December 31 [2]	n/a	n/a	300
Total	n/a	n/a	2,000

[1] Vessels participating in cooperatives in the Central Gulf of Alaska Rockfish Pilot Program will receive a portion of the third season (July 1–September 1) deep-water category halibut PSC apportionment. At this time, this amount is unknown but will be posted later on the Alaska Region Web site at *http://www.alaskafisheries.noaa.gov* when it becomes available.
[2] There is no apportionment between shallow-water and deep-water fishery complexes during the 5th season (October 1–December 31).

Season delays. While the FMP allows the Council to set the season start dates to accommodate fishery interests, it has relied on the seasonal apportionment to take advantage of seasonal differences in halibut and some groundfish fishery species distributions.

Gear restrictions. Gear restrictions are specified to reduce bycatch or bycatch mortality of halibut. Restrictions include (a) requiring biodegradable panels on groundfish pots, (b) requiring halibut exclusion devices on groundfish pots, and (c) revised specifications for pelagic trawl gear that constrain the pelagic trawl fisheries for groundfish to a trawl gear configuration designed to enhance escapement of halibut.

Vessel Incentive Program A vessel incentive program (VIP) designed to reduce the rate at which halibut are incidentally in specified groundfish trawl fisheries became effective May 6, 1991. Individual trawl vessels became accountable for their observed halibut bycatch rates when they participated in GOA Pacific cod fishery and bottom rockfish fishery (as well as the BSAI Pacific cod fishery and BSAI flatfish fishery). If a vessel's bycatch rate at the end of a month exceeded a specified bycatch rate standard, the vessel owner/operator will be subject to prosecution. Halibut bycatch rate standards are specified annually, based on criteria set forth in regulations. The bycatch rate standards specified were based on average bycatch rates exhibited by vessels. However the program did not perform as intended because the costs associated with enforcement and the relatively small number of vessels impacted by the regulation resulted in withdrawal of the VIP from federal regulations in 2008.

Fishery Management Plans and Amendments

One of the tasks required of each regional fishery council by the MFCMA was the preparation of FMPs for all fisheries within a council's jurisdiction which require management. Preparation of the GOA groundfish FMP was quickly initiated following MFCMA implementation and drafting of the BSAI groundfish FMP followed soon thereafter. The GOA FMP became effective on December 11, 1978 and the BSAI FMP was effective on January 1, 1982. The initial GOA FMP contained halibut bycatch limits for the fully domestic fishery, whereas the BSAI FMP did not. Each FMP has been amended several

times since implementation, with several of the amendments containing provisions regarding halibut bycatch limits. This section provides an overview of these bycatch limit measures.

GOA Groundfish Fishery Management Plan

The Council identified the GOA groundfish fishery as one requiring immediate attention so it was the first of two groundfish FMPs it implemented (Larkins 1980). The urgency to implement a FMP in the GOA may have been due to (1) the large number of foreign nations participating in the GOA fishery and resultant lack of control by the U.S., (2) the lack of information on the condition of the groundfish resources, (3) the low abundance of halibut, and (4) the relatively low catch limits imposed on the halibut fishery. Two management objectives for the groundfish fishery were adopted, the first of which sought to rebuild the halibut resource, while the second sought to maximize the opportunity for the development of a domestic groundfish fishery (Larkins ibid). The Council chose to give highest priority to rebuilding the halibut stock.

In order to provide opportunity for development of a fully domestic fishery and protection for the halibut resource, the FMP specified halibut PSC (bycatch) limits for a domestic fishery. The limits applied to fishing conducted between December 1 and May 31, and were specified at 29 mt (48,000 pounds) for the Western area and 52 mt (86,000 pounds) for the Central area. The limits were based on the assumption of a one percent bycatch rate, or roughly equal to one percent of the domestic harvest of Pacific cod expected in 1979 or soon thereafter (NPFMC 1985). When the limits were reached, further domestic trawling during the December-May period in that area was prohibited. Fishing conducted outside this period was unencumbered by limits.

The domestic groundfish fishery grew more quickly than anticipated and by the mid-1980s, the bycatch limits began to seriously restrict the fishery. For the 1984 and 1985 fisheries, the Council requested NMFS to enact Emergency Rules increasing the bycatch limits to 270 mt (0.45 million pounds) in the Western area and 768 mt (1.27 million pounds) in the Central area to prevent domestic on-bottom trawling from being excessively restricted (NPFMC ibid.). Also, additional Emergency Rules were implemented for the 1984 and 1985 fisheries to exempt midwater trawls from any fishery closure because of the inherently low halibut bycatches. This was done in recognition of the valuable pollock fishery in Shelikof Strait, which was conducted with midwater trawls.

Amendment 3

The original FMP subdivided the Chirikof statistical area into two segments at 157° W. The total allowable level for foreign fishing (TALFF) for Pacific cod in the entire Chirikof area was established at 1,500 mt, which was further split to 600 mt and 900 mt for the western and eastern subdivisions, respectively. Amendment 3 was intended to allow an increase in the amount of Pacific cod taken by foreign longliners, within the confines of the overall quota for Chirikof. Since longline gear is more selective than trawl gear, allowing an increase in longline harvest was expected to reduce the amount taken by trawlers, and thus reduce the incidental catch of halibut and shellfish.

Amendment 14

The growth of the domestic, including joint venture, groundfish fishery and the expected continued use of Emergency Rules to overcome the halibut bycatch limits specified in the GOA FMP led to Amendment 14 in 1985. It provided a framework for the Council to annually set a halibut PSC limit based on consideration of a set of factors (outlined above) separately for domestic and joint venture fisheries in each area. The framework process, which became effective in1986, allows the NMFS Alaska Regional Administrator flexibility to permit those fisheries with low bycatch potential to continue after fisheries and areas have been closed by attainment of the limit.

The halibut bycatch framework process worked to limit the bycatch from bottom trawling of both domestic and joint venture (foreign) fisheries. For instance, all bottom trawling was closed for the remainder of the year when the halibut bycatch limit for the GOA was reached, however, other gears could continue to fish, such as the longline fisheries for sablefish and Pacific cod.

Regulations implementing the FMP contained restrictions on foreign and domestic fishermen in the western and central GOA that were designed to minimize the taking of halibut. Foreign fishermen were restricted to the use of off-bottom gear when trawling in the western and central GOA regulatory areas from December 1 through May 31, a period when juvenile halibut are subject to high rates of incidental capture. Domestic fishermen were allowed to use on-bottom trawl gear during this period, but all trawling by domestic fishermen was prohibited until June 1 if the incidental harvest of halibut by domestic trawlers in those areas reached 29 or 52 mt in the western or central GOA, respectively. These PSCs were implemented in 1978 and approximated one percent of the weight of Pacific cod expected to be taken by domestic fishermen in 1979 or soon thereafter. Domestic groundfish catches were increasing as market opportunities developed. Most of the increase was attributed to large amounts of pollock taken in joint venture fisheries operating in the Shelikof Strait region of the central GOA. Relatively few halibut were taken in this fishery because only off-bottom gear was used. For example, only about 4 mt of halibut was taken incidental to a pollock catch of 132,000 mt in 1983. At the same time, domestic catches of other groundfish species (primarily cod and flounder) that have significant halibut bycatch were also increasing.

Regulations at 50 CFR 672.20(d) still? Require that all trawl caught halibut be released. While some halibut survive, that survival varies with the type of operation. Observer data in the 1980s suggested very low survival of halibut in operations that involve the transfer of codends at sea and where halibut cannot be released immediately – these were typically JV or large freezer/processor operations. Halibut survival was relatively high (~50 percent) on smaller shore-based trawl operations where the trawl catch is sorted on deck and the halibut can be immediately released.

Halibut bycatch fluctuates with abundance of both halibut and groundfish target species. In 1984, the Council requested an emergency rule to raise the halibut PSC limit to 270 mt in the western GOA and 768 mt in the central GOA during the December through May fisheries. The Council also requested that users of off-bottom gear be exempted from PSC limits in recognition that few halibut were caught by that gear. A second ER for the same halibut PSC limits was implemented again in 1985.

The Council became aware that halibut were vulnerable to trawls during periods other than the December-May period specified in the FMP, which led to an annual PSC limit that would provide protection for halibut all year. The Council determined that imposing limits on the amounts of halibut that could be taken incidentally by domestic and foreign fishermen will convey a benefit to halibut fishermen, as well as for groundfish fishermen who would benefit from the best available information each year regarding the abundance of halibut and the distribution of the expected groundfish harvest. Therefore the groundfish fisheries would run less risk of being terminated as a result of outdated PSC limits.

The Council identified the following five problems in the fishery in the 1985 plan amendment.

1) The Shelikof Strait joint venture pollock fishery is jeopardized by the 52 mt PSC in the Central area even though the halibut bycatch is very low in this highly productive fishery.
2) The PSC limits for the Western and Central Area jeopardize the maintenance and further development of domestic trawl fisheries for cod, flounders, and other groundfish species that are targeted with bottom gear.
3) The bycatch of halibut by domestic trawlers during the six months for which there are no restrictions on the use of bottom gear has increased significantly.
4) Although the PSC limits are for all domestic trawlers, only the bycatch of the joint ventures is monitored because bycatch cannot be extensively monitored without extensive onboard observer coverage of wholly domestic operations.
5) With respect to regulating the bycatch of halibut in groundfish trawl fisheries, the FMP has not been flexible enough to remain effective as conditions in the fisheries change.

Amendment 18

In June 1989, the Council approved Amendment 18 to the GOA Groundfish FMP, which sought to correct the perceived inequity of closing one fishery when bycatch limits were reached but allowing others to continue. Amendment 18 specified interim fixed halibut bycatch mortality limits of 2,000 mt (3.3 million pounds) for the GOA trawl fishery and 750 mt (1.2 million pounds) for all GOA longline fisheries for one year (1990). The purpose of the action was that there was to allocate specific amounts of

PSC limits to the two gear types for the 1990 fishing year so that PSC amounts and closures for the two gear types would be independent of each other. The intent was for a regulatory amendment to follow this action in 1990 that would further prohibit further fishing by hook-and-line gear fishermen as well as trawl fishermen if they were to reach a PSC limit. The FMP would retain the framework procedure then used to establish PSC limits.

The combined trawl/longline bycatch mortality limits represented an increase in the PSC limits from earlier years. The trawl bycatch limit increased from the limit applied in previous years, because only trawl bycatch mortality would be tallied against the trawl bycatch mortality limit. The longline fishery, however, had never operated under a bycatch limit. The sablefish fishery, the largest non-halibut longline fishery in the GOA, had also never been observed, so the magnitude of halibut bycatch and bycatch rates in this fishery was relatively unknown. The data required to monitor halibut bycatch was to be collected by a comprehensive observer program, also required under Amendment 18.

Industry representatives requested the Council divide the bycatch mortality limits for each fishery into quarterly allotments, or apportionments, in an effort to avoid taking the entire limit early in the year, thus prohibiting fisheries which might occur late in the year.

The limits specified by Amendment 18 had a significant effect on the 1990 GOA groundfish fisheries. The trawl fishery was closed from May 29 through June 30 because the portion of the limit allocated to the second quarter of 1990 had been taken. The fishery continued uninterrupted from the July 1 reopening until November 21, when observer data indicated the annual limit of 2,000 mt (3.32 million pounds) had been reached. NMFS estimated that halibut mortality in all trawl fisheries totaled 2,139 mt (3.55 million pounds) for the year.

The bycatch limit, however, had a much greater impact on the longline fishery. Longline effort in the first quarter was low, which resulted in only a small amount of halibut bycatch. High bycatch rates in the sablefish fishery, which opened on April 1, caused bycatch to accrue quicker than could be monitored by NMFS. Consequently, the limit was exceeded by the time longlining was closed on May 29. NMFS estimated the longline fishery bycatch mortality reached 1,004 mt (1.66 million pounds) in 1990. The trend was similar in 1991, although total mortality had reached 826 mt (1.37 million pounds) by the date NMFS closed the fishery.

Amendment 21

The Council expanded and revised the provisions of earlier bycatch-related amendments with Amendment 21. Approved in June, 1990, the amendment included the following:

(1) Allowed the bycatch mortality limits to be divided by time period;

(2) Divided the "fixed gear" limit into separate limits for longline and groundfish pot fisheries;

(3) Implemented a vessel incentive program which allowed NMFS to penalize vessels with bycatch rates exceeding predetermined standards; and

(4) Required that groundfish pots have biodegradable panels and halibut excluder devices.

The vessel incentive program as originally designed could not be implemented for 1991 by NMFS. Substantial revision of the program occurred in late 1990, replacing an in-season program with one that entailed a post-season examination of bycatch rates and comparison with established standards. The Council approved the new incentive program during a conference call in November, 1990. Actual implementation of the program did not occur until May, 1991, although it was retroactively applied to fishing beginning on April 1, 1991. Halibut bycatch rate standards used for 1991 were based on rates observed in previous years.

Amendment 20

An Individual Fishing Quota Program was implemented for the Pacific halibut (via regulatory amendment) and sablefish fixed gear fisheries in the federal waters of the BSAI and GOA in1995. Bycatch reduction was inherent in the program, due to the close interaction between sablefish and halibut

fisheries. Much of the longline bycatch of halibut occurred in the sablefish fisheries, and many fishermen fish for both (and received IFQ for both). To the extent sablefish fishermen have halibut IFQ, this halibut is now retained and counted against the target quotas, as opposed to being caught as bycatch and discarded (by regulation it previously had to be discarded). This resulted in an immediate reduction of the GOA halibut Prohibited Species Catch limit from 750 mt annually to around 150 mt annually (Oliver and Pautzke 1997). In the annual specifications process for 1995, the halibut PSC apportionment to the longline sector was reduced from 750 to 300 mt.

Amendment 24

The purpose of this amendment in 1992 was to further address bycatch issues that were raised under Amendment 21. This amendment was aimed to control and reduce halibut bycatch mortality in the Alaska groundfish fisheries in response to the international, social, and economic conflicts between U.S. and Canadian halibut fishermen and U.S. groundfish fishermen that take halibut as bycatch. It implemented three management measures. Since the amendment was approved, bycatch of crab and halibut has been controlled to stay within the PSC limits.

(1) Delay the season opening date of the GOA groundfish trawl fisheries to January 20 of each fishing year to reduce salmon and halibut bycatch rates;

(2) Further delay the season opening date of the GOA trawl rockfish fishery to the Monday closest to July 1 to reduce halibut and chinook salmon bycatch rates;

(3) Change directed fishing standards to further limit halibut bycatch associated with bottom trawl fisheries:

(4) Expand the vessel incentive program to address halibut bycatch rates in all trawl fisheries.

Estimated change in biomass and stock condition of halibut[9]

Since 2006, the International Pacific Halibut Commission (IPHC) stock assessment has been fitted to a coastwide dataset to estimate total exploitable biomass. Coastwide exploitable biomass at the beginning of 2010 is estimated to be 334 million pounds. The halibut stock is considered healthy but is experiencing an ongoing decline in size at age for all ages in all areas. Projections based on the currently estimated age compositions suggest that the exploitable and female spawning biomasses will increase over the next several years as a sequence of strong year classes recruit to the over 32 inch (O32) component of the population.

Each year the International Pacific Halibut Commission (IPHC) staff assesses the abundance and potential yield of Pacific halibut using all available data from the commercial and sport fisheries, other removals and scientific surveys. A biologically determined level for total removals from each regulatory area is calculated by applying a fixed harvest rate to the estimate of exploitable biomass in that area. This level is called the "constant exploitation yield" or CEY for that area in the coming year. The corresponding level for catches in directed fisheries subject to allocation is called the fishery CEY. It comprises the commercial setline catch in all IPHC areas in Alaska. It is calculated by subtracting from the total CEY an estimate of all unallocated removals—bycatch of halibut over 32 inches in length (hereafter, "O32"), wastage of O32 fish in the halibut fishery, fish taken for personal use, and sport catch

For many years the staff assessed the stock in each regulatory area by fitting a model to the data from that area. This procedure relied on the assumption that the stock of fish of catchable size in each area was closed, meaning that net migration was negligible. A growing body of evidence from both the assessments (Clark and Hare 2007) and the ongoing mark-recapture experiment (Webster and Clark 2007, Webster 2010) shows that there is a continuing and predominantly eastward migration of catchable fish from the western area (Areas 3 and 4) to the eastern side (Area 2). The effect of this unaccounted for migration on the closed-area stock assessments was to produce underestimates of abundance in the western areas and overestimates in the eastern areas. To some extent this has almost certainly been the

[9] From http://www.iphc.washington.edu/halcom/research/sa/papers/sa09.pdf

case for some time, meaning that exploitation rates were well above the target level in Area 2 and a disproportionate share of the catches have been taken from there.

In order to obtain an unbiased estimate of the total exploitable biomass (EBio) beginning with the 2006 assessment, the staff built a coastwide data set and fitted the model to it. Exploitable biomass in each regulatory area was estimated by partitioning, or apportioning, the total in proportion to an estimate of stock distribution derived from the setline survey catch rates (WPUE). Specifically, an index of abundance in each area was calculated by multiplying survey WPUE (running 3-year average) by total bottom area between 0 and 400 fm (Hare et al. 2010). The logic of this index is that survey WPUE can be regarded as an index of density, so multiplying it by bottom area gives a quantity proportional to total abundance. This year several adjustments to the index for each area, derived on the basis of hook competition, survey timing and depth distribution of survey stations were examined. For apportionment purposes, the staff recommended that the survey index for each area be adjusted on the basis of hook competition and survey timing. The estimated proportion in each area is then the adjusted index value for that area divided by the sum of the adjusted index values.

The IPHC recommended total catch limits for 2010 totaling 50,670,000 pounds, a 6.3% decrease from the 2009 catch limit of 54,080,000 pounds. This estimate is based on the 2009 Pacific halibut stock assessment which implemented a coastwide estimation of biomass, with apportionment to regulatory biomass based on the data from the annual IPHC assessment survey. For 2010, the IPHC staff recommended a 20% harvest rate for use in Areas 2A through 3A. The IPHC staff expressed concern over continued declining catch rates in Area 3B and recommended a reduction of the harvest rate for this area to 15%, similar to that used for the Bering Sea (Areas 4A, 4B, and 4CDE). Catch limits adopted for 2010 were lower for most regulatory areas except Areas 4B and 4CDE, for which the recommended catch limits increased approximately 15 and 3 percent, respectively. Decreased catch limits reflect stock biomass declines as the exceptionally strong 1987 and 1988 year classes pass out of the fishery. Recruitment from the 1999 and 2000 year classes is estimated to be above average but the lower growth rates of fish in recent years means that these year classes are recruiting to the exploitable stock very slowly.

Apportioning the coastwide biomass among regulatory areas

Apportionment of the coastwide biomass among regulatory areas has proved controversial. The IPHC staff believes that survey WPUE-based apportionment is the most objective and consistent method of estimating the biomass distribution among areas and therefore the best distribution of total CEY to achieve the IPHC's goal of proportional harvest among areas. The validity of the survey WPUE apportioning requires that survey catchability – the relationship between density and WPUE – be roughly equal among areas. Over the past few years, several checks for area differences in catchability were made (Clark 2008a, Clark 2008b, Clark 2008c, Webster 2009b) but results were inconclusive in determining differences. This year, three factors were considered for adjusting survey WPUE. Methodologies and analyses of all three factors - in isolation and in combination - is contained in Webster and Hare (2010). A brief summary of the rationale behind the three factors is presented below but details, and the adjustments themselves, are not repeated here - see Webster and Hare 2010. Following (potential) adjustment of the annual survey WPUE values, the IPHC has usually averaged the last few years to smooth out annual variation in the survey. This year, an alternate weighting scheme for the averaging was also investigated to compute apportionments. Also new this year, at the request of industry, is the addition of a historical removals shares weighting factor.

Much greater detail on apportionments of halibut biomass can be found on the IPHC website, where a summary of a 2009 work shop and background material has been made available: http://www.iphc.washington.edu/halcom/meetings/workshops.htm#reports.

Estimated change in biomass and stock condition of halibut[10]

Since the 1960s, fisheries for groundfish other than Pacific halibut have caused an average of about 9,000 metric tons (mt, round weight) of halibut bycatch mortality every year, whereas annual directed catches of Pacific halibut have varied from 13,000 to almost 50,000 mt. About half of the bycatch consists of juvenile Pacific halibut caught in Alaska, some of which would otherwise migrate south and contribute to the fishery in British Columbia.

These interceptions have long been a difficult issue for the United States and Canada. At levels of high juvenile abundance in the 1990s, juvenile bycatch reduces coastwide recruitment by about 10%. The resulting yield loss, plus bycatch of adult fish, reduces yield to the directed fishery by about 11,000 mt per year. Migration modeling done in the 1990s indicated that the yield loss due to bycatch occurred almost entirely in the area where the bycatch is taken. In particular, bycatch in Alaska reduced Pacific halibut

yields in British Columbia by, at most, a few percent. During the 1980s and early 1990s, annual quotas in the directed Pacific halibut fishery were reduced by an amount equal to, or sometimes greater than, the total Pacific halibut bycatch mortality, and the quota reduction was distributed among regulatory areas in proportion to Pacific halibut exploitable biomass. In the late 1990s, the Pacific halibut quota in each regulatory area is reduced by the amount of adult Pacific halibut bycatch mortality in that area, and the target exploitation rate is adjusted downward (slightly) to offset the bycatch mortality of juveniles.

Bycatch in other groundfish fisheries substantially reduced yield to the directed Pacific halibut fishery over the last few decades, and it continues to do so. The IPHC staff has estimated the long term potential productivity of the stock as 30,000–40,000 mt/year, so at recent levels of bycatch the yield loss has amounted to about a fifth of potential production (7,200 mt/year).

The main advantage of accounting for sublegal bycatch by including that mortality in the population model used to choose the target harvest rate is that now the treatment of bycatch is an integral part of the harvest strategy. The effects of all sources of mortality on both biomass and yield are considered simultaneously, and the Commissioners can consider both when choosing a harvest rate that achieves the best balance of their management objectives, which include maintaining a healthy level of spawning biomass along with obtaining a high and stable yield. In equilibrium conditions, it can be expected that the addition of sublegal bycatch mortality to the population model would result in the choice of a slightly lower target harvest rate, but that might not happen when the stock is at a high level of abundance, as it is now.

Another advantage of the present procedure is that it does not explicitly reduce the setline quota in one regulatory area to account for bycatch in another regulatory area. The only explicit quota reduction is for the bycatch of legal-sized fish within each regulatory area. That avoids some controversy, even though changing the procedure has in no way reduced the yield loss resulting from sublegal bycatch.

This new finding of ongoing adult migration has re-opened the contentious debate as to the extent of the impact on Canadian halibut production losses from U32 bycatch in US groundfish fisheries. At present, the effect of U32 bycatch continues to be handled by adjusting the target harvest rate but this is under current review. Over 32 inch (O32) inch bycatch, which is on the order of 3000 mt continues to be handled by reducing CEY by an equivalent amount in the area where the bycatch takes place.

[10] From http://www.iphc.washington.edu/halcom/research/sa/papers/sa09.pdf and updated by Steven Hare, IPHC

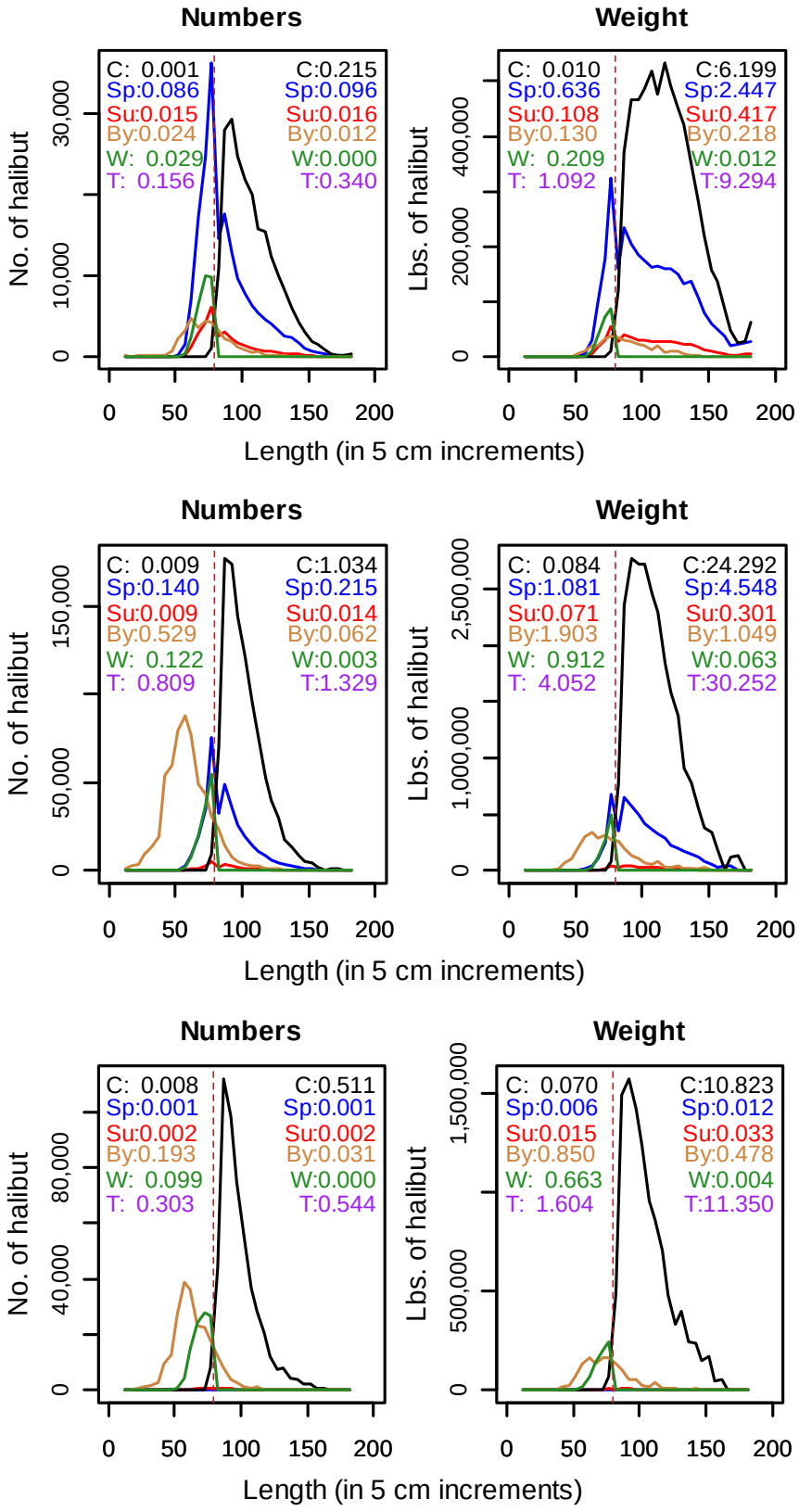

Figure 1. Total Removals in 2008 (2C top, 3A middle, 3B bottom) (best viewed in color)

Incidental catch and mortality of Pacific halibut, 1962-2008[11]

Area 2C Crab pot fishing and shrimp trawling occur in various locations and harvests have held steady over the years. Pot fishing for brown king crab (*Lithodes aequispina*) occurs in the deep waters of Chatham Strait during the winter months, and beam trawling occurs for shrimp and flounders in the inside waters of southeast Alaska. These fisheries have not been reviewed since the early 1990s, but these fisheries are small scale in nature, with low bycatch. It is assumed that mortality has been relatively stable since first examined.

Area 3 Bycatch mortality in Area 3 was estimated at 4.3 million pounds in 2008, an 8.7% increase from 2007. Slight decreases in trawl bycatch mortality were offset by increases in hook-&-line fishery bycatch mortality. The Rockfish Pilot Program (RPP), a study which permits a portion of the rockfish trawl fishery to operate as fishery cooperatives, continued in 2008. Vessels participating in the rockfish cooperatives were able to fish more off-bottom and at a slower pace offered by the cooperative structure. The RPP consisted of two catcher/processor (CP) cooperatives and five catcher vessel (CV) cooperatives, with each cooperative allocated its own halibut bycatch limit. The two CP coops had a total of 55 mt (91,000 lbs net) for their halibut mortality cap, while the CV coops were allocated 115 mt (190,000 lbs net). These halibut bycatch allocations were a part of the Gulf of Alaska trawl fishery bycatch limit of 2,000 mt. In other fisheries, pot effort for cod, which has lower bycatch properties than other gears, continues to be high. Within Area 3B, trawl and hook-&-line fishery bycatch both increased from 2007. The total 2008 Area 3 bycatch mortality is slightly below the 10-year average of 4.5 million pounds.

In 2010 the IPHC held a workshop[12] on halibut bycatch that had three goals: 1) Review history and treatment of halibut bycatch and treatment of fish < 32 inches (U32); 2) Review changes in understanding and potential treatment of bycatch impacts based on new understanding of halibut movements; and 3) Investigate options for future treatment of bycatch in halibut management. The workshop covered the following topics (many of the staff presentations are cited throughout this paper).

1. Historical methods by which the Commission has accounted for bycatch mortality in management of the halibut stock
2. Methods of estimation of bycatch mortality in non‐target fisheries
3. Incorporation and impacts of bycatch mortality estimates and noncommercial removals on halibut productivity and yield
4. Impacts of non‐local bycatch mortality on fisheries yield of individual IPHC Regulatory Areas
5. Progress on halibut bycatch control and management in other fisheries
6. Methods employed to reduce non‐target halibut bycatch mortality in the northeast Pacific Ocean
7. Future of halibut bycatch management

Potential impacts on the halibut fisheries

The Programmatic Groundfish EIS determined that the GOA halibut PSC limits (2,000 mt to trawl and 300 mt to longline) did not adversely affect the halibut stock or place an unfair burden on directed halibut fisheries. Any economic benefit to halibut fisheries would be offset by economic costs to groundfish fisheries.[13]

Having made the blanket statement that there are no NEPA concerns related to halibut bycatch management, the summary provided in an earlier section of this paper is repeated here. The IPHC has identified the following biological impacts to the halibut resource due to halibut bycatch in both commercial groundfish trawl and fixed gear and commercial halibut longline fisheries:

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[11] http://www.iphc.washington.edu/halcom/pubs/rara/2009rara/papers/389.pdf

[12] http://www.iphc.washington.edu/halcom/research/sa/BycatchWorkshop/Bycatch%20History.pdf

[13] http://www.fakr.noaa.gov/sustainablefisheries/seis/final062004/Appen/App_F/app_f5.pdf

1. Reduced yield, due to reduced recruitment and mortality of adults, which results in lower halibut commercial and sport fishery catch limits (i.e., yield) in U.S. and Canadian waters;
2. Out-of-area (or, "downstream") impacts of halibut bycatch where the take of bycatch in one area reduces recruitment and available yield to other areas.
3. Reduced spawning biomass and egg production, due to reduced recruitment and mortality of adults.

Table 1. Bycatch in the domestic Gulf of Alaska groundfish fishery since 1990. Source: IPHC

	Thousands of Pounds, net weight				***Metric Tons, round weight***			
Year	**Trawls**	**H&L**	**Pot**	**Total**	**Trawls**	**H&L**	**Pot**	**Total**
1990	4,331	2,012	52	6,395	2,612	1,214	31	3,857
1991	4,538	2,081	7	6,626	2,737	1,255	4	3,997
1992	4,060	2,684	26	6,770	2,449	1,619	16	4,083
1993	3,548	1,900	19	5,467	2,140	1,146	19	3,305
1994	3,619	1,512	23	5,154	2,183	912	14	3,109
1995	3,745	645	35	4,425	2,259	389	21	2,669
1996	3,890	498	11	4,399	2,346	300	7	2,653
1997	3,291	855	13	4,159	1,985	516	8	2,509
1998	3,042	705	19	3,766	1,835	425	11	2,272
1999	3,333	854	147	4,334	2,010	515	89	2,614
2000	3,416	718	17	4,151	2,060	433	10	2,504
2001	3,724	614	41	4,379	2,246	370	25	2,641
2002	3,193	615	4	3,812	1,926	371	2	2,299
2003	3,748	827	34	4,609	2,261	499	21	2,780
2004	3,899	710	52	4,661	2,352	428	31	2,811
2005	3,526	457	57	4,040	2,127	276	34	2,437
2006	3,265	778	27	4,070	1,969	469	16	2,455
2007	3,142	479	33	3,654	1,895	289	20	2,204
2008	3,043	912	45	4,000	1,835	550	27	2,413

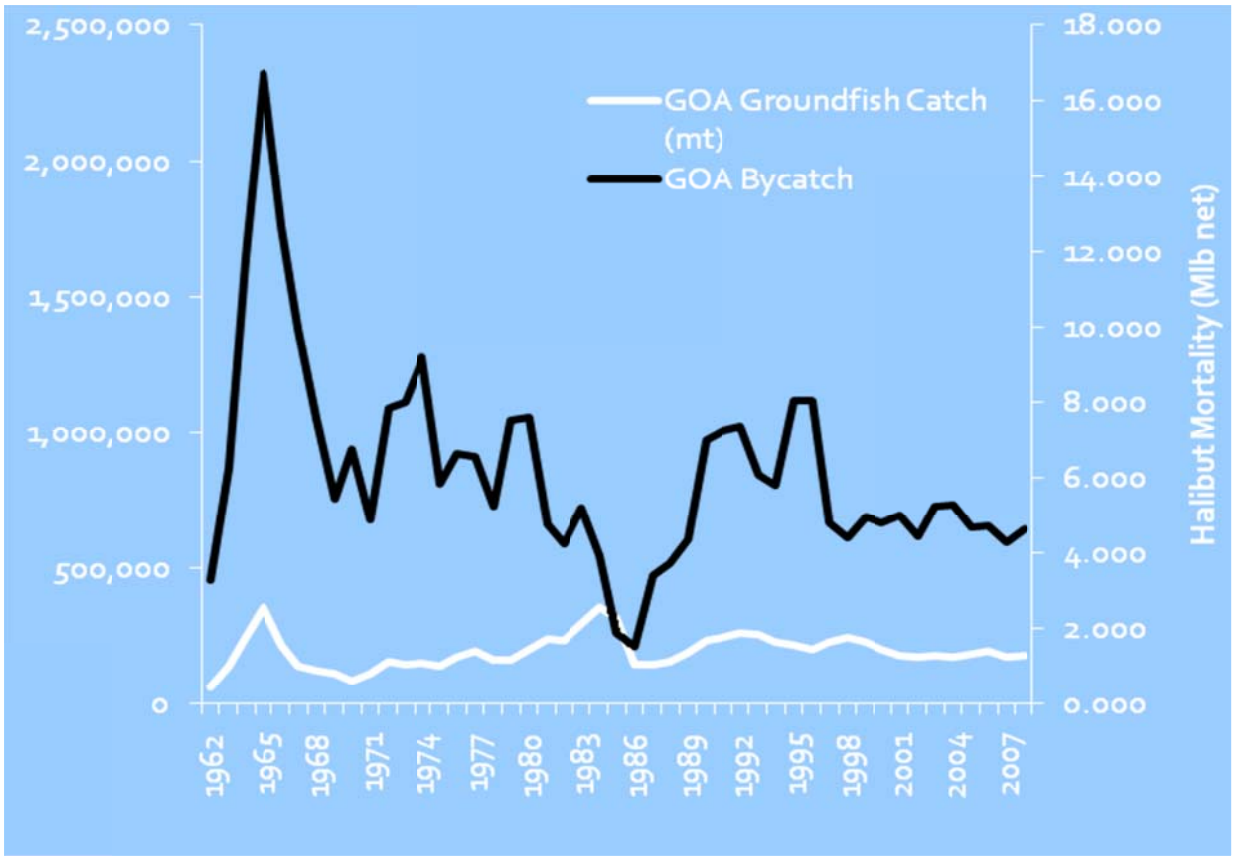


Figure 2. Groundfish Catch vs. Halibut Mortality (Source: IPHC)

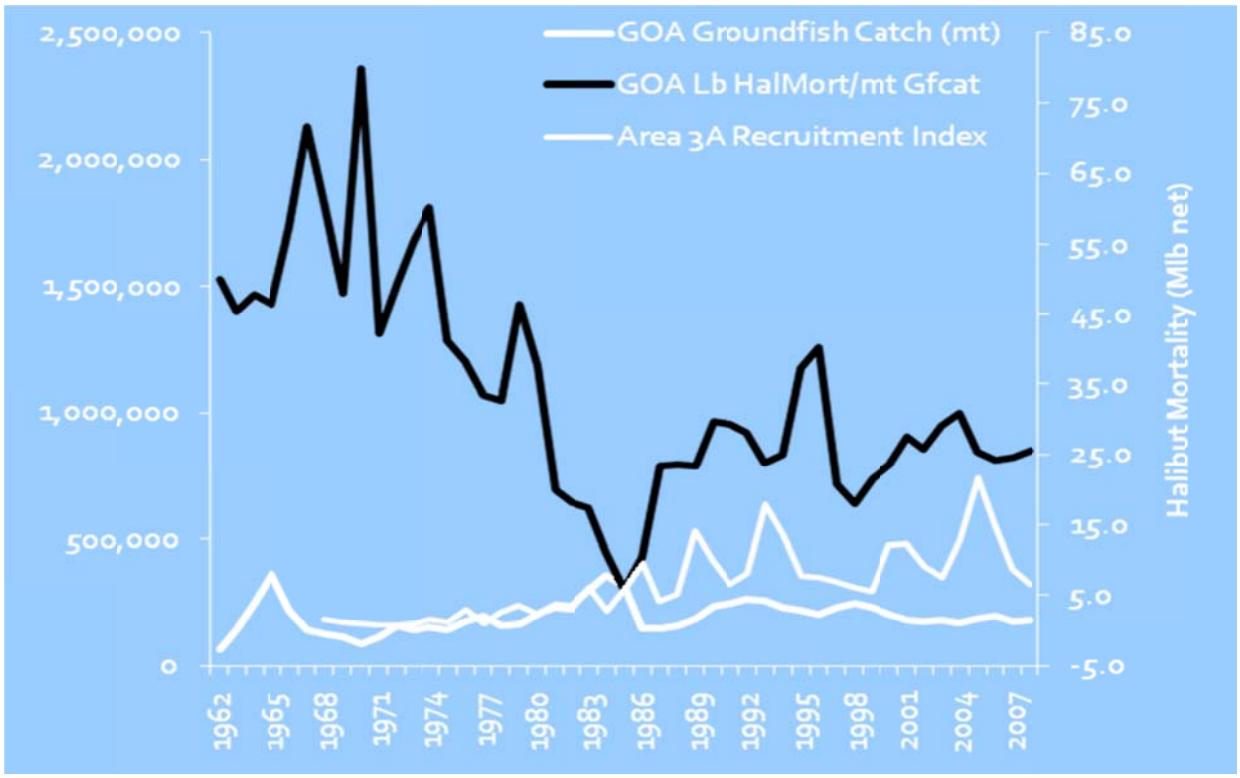


Figure 3. Groundfish Catch vs. Ratio of Halibut Mortality to Groundfish Catch (Source: IPHC)

Estimated bycatch in years prior to that for which the halibut PSC mortality limit is being established

The halibut PSC limit for the GOA is 2,300 mt. The 2,000 mt PSC limit for the GOA trawl fisheries has remained unchanged since 1989, and approximated this amount in the domestic and joint venture groundfish fisheries during 1986 – 1988 as well. The 300 mt PSC limit for the non-trawl fisheries has remained unchanged since 1995 when the IFQ sablefish fishery was exempted from the PSC limit and the PSC limit was lowered from 750 mt. Tables 2 – 5 present halibut bycatch mortality data by FMP area, IPHC area, gear type, and fishery. Total catch removals by category and IPHC regulatory area are presented in Appendix II.

Expected change in target groundfish catch

Figure 4 shows the history of GOA groundfish benchmarks and catches. Generally, (cumulative) groundfish catch has been about 75 percent of (cumulative) annual catch limits, capped by halibut PSC limits to some degree. Any future analysis to revise GOA halibut PSC limits (trawl v fixed gear, or total) would examine harvest information for each groundfish fishery (and halibut longline fishery).

A potential decrease in halibut PSC amounts would be linked to the sector to which it is applied. As a case study of potential trawl halibut PSC limit changes (Appendix III), the public review draft of the GOA Rockfish Program analysis points out that there may be reduced incentive to alter fishing behavior to accrue halibut PSC amount reductions in target groundfish (in this case, rockfish) fisheries without the ability to use the halibut PSC amounts in other directed groundfish fisheries (in this case through a proposed rollover to fourth quarter flatfish fisheries). The late season rollover was estimated to have generated between $1.4 million and $2.8 million in ex vessel gross revenues; conversely, the value of that amount of halibut if caught in the longline fishery is approximately $1.4 million (at $4.50/lb ex- vessel). The reapportionment of halibut PSC allowance (128 mt in 2007, 135 mt in 2008, and 139 mt in 2009) has clearly supported additional fishing activity, but the benefit derived from the rollover depends on target preferences and opportunities, which have varied year-to-year, as well as the impact of this additional halibut mortality on other fisheries (e.g., target halibut fisheries) and stock productivity. Reductions of halibut PSC amounts, however, demonstrate that fishing behavior may be altered with the appropriate incentives (either through voluntary efforts by industry or mandatory PSC limit reductions).

Additional information on GOA groundfish catch, both fleet-wide and by fishery, may be available at the June Council meeting or for future analyses.

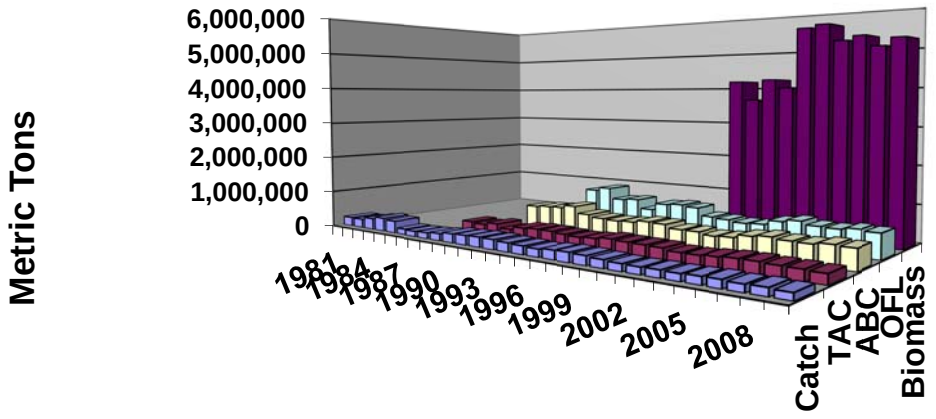


Figure 4. Cumulative estimates of biomass, overfishing level (OFL), acceptable biological catch (ABC), total allowable catch (TAC), and actual catch (all in million t) across all groundfish species in the Gulf of Alaska, 1981-2009.

Table 2. Estimates of halibut bycatch and mortality by IPHC Regulatory Sub-area and year (Source: IPHC)

	Thousands of Pounds, net weight					*Metric Tons, round weight*				
Year	Wash., Oreg., Calif.	B.C.	Gulf of Alaska	Bering Sea & Aleu.	Total	Wash., Oreg., Calif.	B.C.	Gulf of Alaska	Bering Sea & Aleu.	Total
1962	-	1,176	3,290	4,143	8,609	-	709	1,984	2,499	5,192
1963	-	1,077	6,308	2,038	9,423	-	649	3,805	1,229	5,683
1964	-	1,105	11,844	2,965	15,914	-	667	7,144	1,788	9,599
1965	-	1,435	16,744	3,182	21,361	-	866	10,100	1,919	12,884
1966	-	1,666	12,708	3,400	17,774	-	1,005	7,665	2,051	10,721
1967	-	1,652	9,967	4,718	16,337	-	996	6,012	2,846	9,854
1968	-	1,963	7,568	5,685	15,216	-	1,184	4,565	3,429	9,178
1969	-	2,183	5,448	7,599	15,230	-	1,317	3,286	4,584	9,186
1970	-	1,470	6,792	8,028	16,290	-	886	4,097	4,842	9,825
1971	-	1,745	4,880	13,095	19,720	-	1,052	2,943	7,899	11,894
1972	-	1,750	7,855	9,675	19,280	-	1,056	4,738	5,836	11,629
1973	-	1,509	7,995	8,029	17,533	-	910	4,822	4,843	10,575
1974	477	1,729	9,199	7,620	19,025	288	1,043	5,549	4,596	11,475
1975	477	1,909	5,870	3,650	11,906	288	1,151	3,541	2,202	7,181
1976	477	2,064	6,646	4,564	13,751	288	1,245	4,009	2,753	8,294
1977	477	1,817	6,568	2,914	11,776	288	1,096	3,962	1,758	7,103
1978	477	1,471	5,272	5,023	12,242	288	887	3,180	3,029	7,384
1979	476	1,852	7,536	5,419	15,282	287	1,117	4,545	3,269	9,218
1980	476	1,372	7,619	9,235	18,702	287	828	4,595	5,570	11,280
1981	475	1,188	6,789	6,408	14,859	287	716	4,095	3,865	8,963
1982	475	867	6,274	4,756	12,373	287	523	3,784	2,869	7,463
1983	476	943	5,196	4,269	10,883	287	568	3,134	2,575	6,564
1984	475	1,074	3,949	4,692	10,189	287	648	2,382	2,830	6,146
1985	475	1,139	1,879	4,207	7,700	287	687	1,133	2,538	4,644
1986	476	1,161	1,549	5,576	8,762	287	700	934	3,363	5,285
1987	476	1,649	3,416	5,738	11,279	287	995	2,060	3,461	6,803
1988	477	1,609	3,718	8,858	14,662	288	971	2,243	5,343	8,844
1989	477	1,498	4,388	7,282	13,646	288	904	2,647	4,393	8,231
1990	408	1,679	7,015	8,580	17,682	246	1,013	4,231	5,175	10,665
1991	408	1,992	7,247	10,022	19,669	246	1,202	4,371	6,045	11,864
1992	444	1,745	7,386	10,718	20,293	268	1,053	4,455	6,465	12,240
1993	444	1,661	6,095	7,764	15,964	268	1,002	3,676	4,683	9,629
1994	444	1,219	5,822	9,466	16,951	268	735	3,512	5,710	10,224
1995	614	1,522	5,071	8,726	15,933	370	918	3,059	5,263	9,610
1996	614	299	5,045	8,507	14,465	370	180	3,043	5,131	8,725
1997	614	215	4,805	7,880	13,514	370	130	2,898	4,753	8,151
1998	1,082	213	4,412	7,725	13,432	653	128	2,661	4,660	8,102
1999	987	193	4,980	7,684	13,844	595	116	3,004	4,635	8,350
2000	822	230	4,797	7,441	13,290	496	139	2,893	4,488	8,016
2001	837	177	5,025	7,120	13,159	505	107	3,031	4,295	7,937
2002	553	244	4,458	7,273	12,528	334	147	2,689	4,387	7,556
2003	503	244	5,255	6,822	12,824	303	147	3,170	4,115	7,735
2004	302	251	5,307	6,735	12,595	182	151	3,201	4,062	7,597
2005	459	346	4,686	7,692	13,183	277	209	2,826	4,640	7,952
2006	387	294	4,716	7,491	12,888	233	177	2,845	4,518	7,774
2007	298	319	4,300	7,262	12,179	180	192	2,594	4,380	7,346
2008	298	131	4,646	5,588	10,663	180	79	2,802	3,371	6,432

Table 3. Estimates of halibut bycatch and mortality by IPHC Regulatory Sub-area and year (Source: IPHC)

	Thousands of Pounds, net weight							*Metric Tons, round weight*						
	Area	Area	Area	Area	Area	Area		Area	Area	Area	Area	Area	Area	
Year	2A	2B	2C	3A	3B	4	TOTAL	2A	2B	2C	3A	3B	4	TOTAL
1962	-	1,176	207	1,919	1,164	4,143	8,609	-	709	125	1,157	702	2,499	5,192
1963	-	1,077	206	3,314	2,788	2,038	9,423	-	649	124	1,999	1,682	1,229	5,683
1964	-	1,105	205	9,370	2,269	2,965	15,914	-	667	124	5,652	1,369	1,788	9,599
1965	-	1,435	205	6,097	10,442	3,182	21,361	-	866	124	3,678	6,298	1,919	12,884
1966	-	1,666	213	4,513	7,982	3,400	17,774	-	1,005	128	2,722	4,815	2,051	10,721
1967	-	1,652	439	4,633	4,895	4,718	16,337	-	996	265	2,795	2,953	2,846	9,854
1968	-	1,963	515	5,476	1,577	5,685	15,216	-	1,184	311	3,303	951	3,429	9,178
1969	-	2,183	468	3,806	1,174	7,599	15,230	-	1,317	282	2,296	708	4,584	9,186
1970	-	1,470	562	3,389	2,841	8,028	16,290	-	886	339	2,044	1,714	4,842	9,825
1971	-	1,745	539	2,974	1,367	13,095	19,720	-	1,052	325	1,794	825	7,899	11,894
1972	-	1,750	756	5,406	1,693	9,675	19,280	-	1,056	456	3,261	1,021	5,836	11,629
1973	-	1,509	848	4,452	2,695	8,029	17,533	-	910	511	2,685	1,626	4,843	10,575
1974	477	1,729	532	5,247	3,420	7,620	19,025	288	1,043	321	3,165	2,063	4,596	11,475
1975	477	1,909	639	3,158	2,073	3,650	11,906	288	1,151	385	1,905	1,250	2,202	7,181
1976	477	2,064	708	3,495	2,443	4,564	13,751	288	1,245	427	2,108	1,474	2,753	8,294
1977	477	1,817	580	4,094	1,894	2,914	11,776	288	1,096	350	2,469	1,142	1,758	7,103
1978	477	1,471	377	3,055	1,840	5,023	12,242	288	887	227	1,843	1,110	3,029	7,384
1979	476	1,852	821	5,780	935	5,419	15,282	287	1,117	495	3,486	564	3,269	9,218
1980	476	1,372	520	5,852	1,246	9,235	18,702	287	828	314	3,530	752	5,570	11,280
1981	475	1,188	507	4,720	1,563	6,408	14,859	287	716	306	2,847	942	3,865	8,963
1982	475	867	302	3,797	2,175	4,756	12,373	287	523	182	2,290	1,312	2,869	7,463
1983	476	943	304	2,957	1,935	4,269	10,883	287	568	183	1,784	1,167	2,575	6,564
1984	475	1,074	302	2,140	1,507	4,692	10,189	287	648	182	1,290	909	2,830	6,146
1985	475	1,139	301	1,001	577	4,207	7,700	287	687	182	604	348	2,538	4,644
1986	476	1,161	303	836	410	5,576	8,762	287	700	183	504	247	3,363	5,285
1987	476	1,649	303	2,240	873	5,738	11,279	287	995	183	1,351	527	3,461	6,803
1988	477	1,609	303	3,365	50	8,858	14,662	288	971	183	2,030	30	5,343	8,844
1989	477	1,498	303	3,267	818	7,282	13,646	288	904	183	1,971	494	4,393	8,231
1990	408	1,679	856	4,114	2,045	8,580	17,682	246	1,013	516	2,481	1,233	5,175	10,665
1991	408	1,992	733	4,843	1,671	10,022	19,669	246	1,202	442	2,921	1,008	6,045	11,864
1992	444	1,745	736	4,668	1,982	10,718	20,293	268	1,053	444	2,816	1,195	6,465	12,240
1993	444	1,661	742	4,291	1,062	7,764	15,964	268	1,002	448	2,588	641	4,683	9,629
1994	444	1,219	528	3,907	1,387	9,466	16,951	268	735	318	2,357	837	5,710	10,224
1995	614	1,522	348	2,963	1,760	8,726	15,933	370	918	210	1,787	1,062	5,263	9,610
1996	614	299	345	2,743	1,957	8,507	14,465	370	180	208	1,655	1,180	5,131	8,725
1997	614	215	397	2,965	1,443	7,880	13,514	370	130	239	1,788	870	4,753	8,151
1998	1,082	213	361	2,662	1,389	7,725	13,432	653	128	218	1,606	838	4,660	8,102
1999	987	193	358	2,885	1,737	7,684	13,844	595	116	216	1,740	1,048	4,635	8,350
2000	822	230	395	2,892	1,510	7,441	13,290	496	139	238	1,744	911	4,488	8,016
2001	837	177	341	3,009	1,675	7,120	13,159	505	107	206	1,815	1,010	4,295	7,937
2002	553	244	340	2,194	1,924	7,273	12,528	334	147	205	1,323	1,161	4,387	7,556
2003	503	244	341	3,180	1,734	6,822	12,824	303	147	206	1,918	1,046	4,115	7,735
2004	302	251	362	3,671	1,274	6,735	12,595	182	151	218	2,214	768	4,062	7,597
2005	459	346	340	3,220	1,126	7,692	13,183	277	209	205	1,942	679	4,640	7,952
2006	387	294	341	2,975	1,400	7,491	12,888	233	177	206	1,794	844	4,518	7,774
2007	298	319	342	2,843	1,115	7,262	12,179	180	192	206	1,715	673	4,380	7,346
2008	298	131	344	2,964	1,338	5,588	10,663	180	79	207	1,788	807	3,371	6,432

Table 4. 1995 - 2009 trawl and hook-and-line halibut PSC mortality in the GOA; Trawl PSC limit is 2000 mt and Hook-and-Line PSC limit is 300 mt. (Source: IPHC)

Year	Trawl bycatch mortality	Hook and Line bycatch mortality	Total bycatch mortality
1995	2,152	377	2,529
1996	2,050	172	2,221
1997	1,946	125	2,071
1998	2,113	296	2,409
1999	2,028	348	2,376
2000	2,137	276	2,414
2001	1,888	285	2,173
2002	2,197	244	2,441
2003	1,995	290	2,286
2004	2,444	302	2,745
2005	2,108	208	2,316
2006	1,984	335	2,319
2007	1,948	294	2,242
2008	1,955	502[14]	2,458
2009	1,818	277	2,095

[14] Observer data with high halibut mortality rates from September (2-3 weeks late) for a hook-and-line catcher vessel increased halibut mortality rates and halibut mortality estimates, and resulted in an overage (Source: Mary Furuness).

Table 5. Estimates of halibut bycatch mortality (thousands of lb, net weight) for 1998-2008.

Estimates for 2008 are preliminary and subject to change. Source: IPHC

Region and Area	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AREA 2A										
Groundfish Trawl	946	781	796	512	462	261	418	346	257	257
Shrimp Trawl	25	25	25	25	25	25	25	25	25	25
Hook & Line	16	16	16	16	16	16	16	16	16	16
Total	987	822	837	553	503	302	459	387	298	298
AREA 2B										
Domestic Trawl	193	230	177	244	244	251	346	294	319	131
Total	193	230	177	244	244	251	346	294	319	131
AREA 2C										
Crab Pot/Shrimp Trawl	303	303	303	303	303	303	303	303	303	303
Groundfish Trawl	1	0	0	0	0	0	0	0	0	0
Hook & Line (non-IFQ)	18	56	2	1	2	23	1	2	3	5
Hook & Line (IFQ)	3	3	3	3	3	3	3	3	3	3
Chatham Str. Sablefish	8	8	8	8	8	8	8	8	8	8
Clarence Str. Sablefish	25	25	25	25	25	25	25	25	25	25
Total	358	395	341	340	341	362	340	341	342	344
AREA 2 Subtotal	**1,538**	**1,447**	**1,355**	**1,137**	**1,088**	**915**	**1,145**	**1,022**	**959**	**773**
AREA 3A										
Crab Pot/Shrimp Trawl	250	250	250	250	250	250	250	250	250	250
Groundfish Trawl	2,148	2,222	2,404	1,685	2,407	3,033	2,664	2,339	2,347	2,157
Hook & Line (non-IFQ)	317	281	203	128	389	244	149	239	102	408
Hook & Line (IFQ)	119	119	119	119	119	119	119	119	119	119
Groundfish Pot	41	10	23	2	5	15	28	18	15	20
Pr Wm Sd Sablefish	10	10	10	10	10	10	10	10	10	10
Total	2,885	2,892	3,009	2,194	3,180	3,671	3,220	2,975	2,843	2,964
AREA 3B										
Crab Pot/Shrimp Trawl	50	50	50	50	50	50	50	50	50	50
Groundfish Trawl	1,184	1,194	1,320	1,508	1,341	866	862	926	795	886
Hook & Line (non-IFQ)	281	143	171	248	198	205	69	299	136	261
Hook & Line (IFQ)	116	116	116	116	116	116	116	116	116	116
Groundfish Pot	106	7	18	2	29	37	29	9	18	25
Total	1,737	1,510	1,675	1,924	1,734	1,274	1,126	1,400	1,115	1,338
AREA 3 Subtotal	**4,622**	**4,402**	**4,684**	**4,118**	**4,914**	**4,945**	**4,346**	**4,375**	**3,958**	**4,302**
AREA 4										
Crab Pot/Shrimp Trawl	300	300	300	300	300	300	300	300	300	300
Groundfish Trawl	5,972	5,379	5,322	5,591	5,589	5,499	6,454	6,269	5,841	3,980
Hook & Line (non-IFQ)	982	1,508	1,300	1,058	556	617	666	593	659	1,064
Hook & Line (IFQ)	60	60	60	60	60	60	60	60	60	60
Groundfish Pot	11	24	13	17	28	6	2	8	7	10
CDQ Trawl	187	64	57	131	187	176	128	187	309	136
CDQ Hook & Line	172	106	68	116	102	77	82	74	86	38
AREA 4 Subtotal	**7,684**	**7,441**	**7,120**	**7,273**	**6,822**	**6,735**	**7,692**	**7,491**	**7,262**	**5,588**
GRAND TOTAL	**13,844**	**13,290**	**13,159**	**12,528**	**12,824**	**12,595**	**13,183**	**12,888**	**12,179**	**10,663**
Prct Chg from prev yr		**-4.0%**	**-1.0%**	**-4.8%**	**2.4%**	**-1.8%**	**4.7%**	**-2.2%**	**-5.5%**	**-12.4%**
AK GFISH TOTAL	**11,718**	**11,292**	**11,199**	**10,785**	**11,131**	**11,096**	**11,432**	**11,261**	**10,616**	**9,288**

Estimated change in target groundfish biomass

The Gulf of Alaska management area lies within the 200-mile U.S. Exclusive Economic Zone (EEZ) of the United States (Figure 1). Five categories of finfishes and invertebrates have been designated for management purposes. They are: target species, other species, prohibited species, forage fish species and non-specified species. Amendment 85 proposes to eliminate the other species assemblage and designate separate annual catch limits (ACLs) for sharks, sculpins, octopuses, and squids beginning in 2011. Also, the prohibited species category and forage fish category will be listed under a new ecosystem category, which will be exempt from ACL requirements. And reference to non-specified species will be removed from the FMP.

The 2009 SAFE report (NPFMC 2009) describes stock status of target species and other species. Species or complexes included in the report are listed below.

Target Species	Other Species	Prohibited Species
Pollock	Octopus	Pacific halibut
Pacific cod	Squids	Pacific herring
Flatfishes	Sculpins	Pacific salmon
Rockfishes	Sharks	Steelhead trout
Sablefish		King crabs
Atka mackerel		Tanner crabs
Skates		

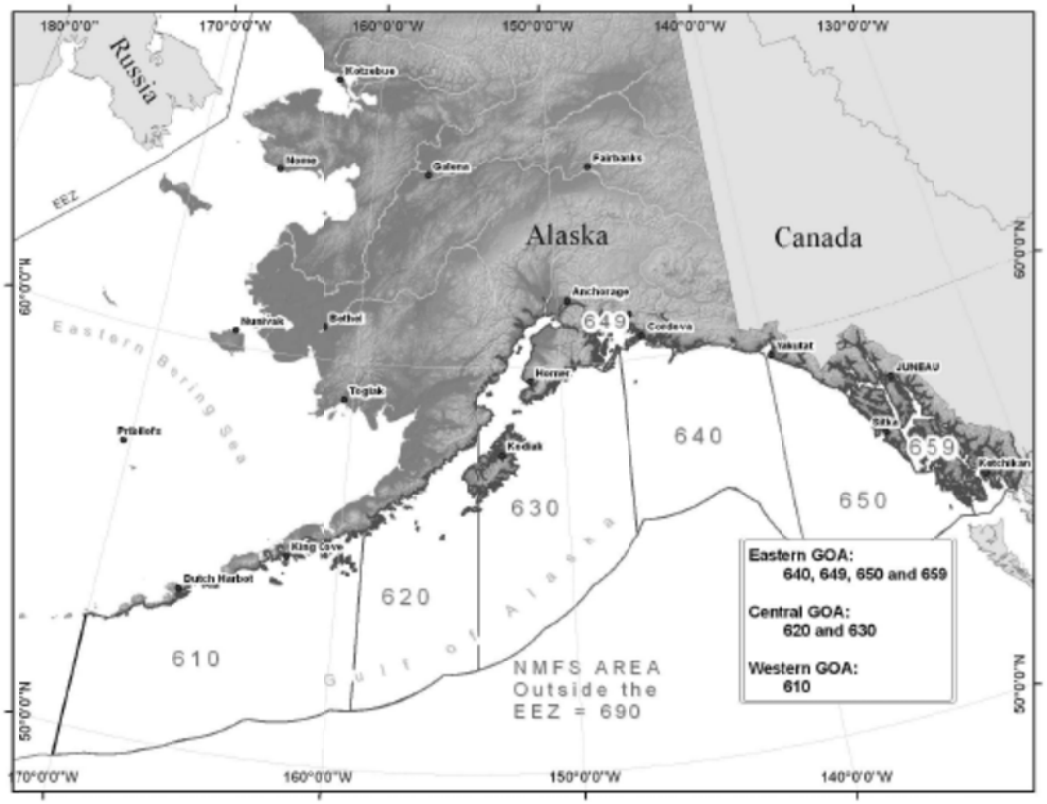


Figure 5. Gulf of Alaska regulatory areas.

The GOA Groundfish FMP recognizes single species and species complex management strategies. Single species specifications are set for stocks individually, recognizing that different harvesting sectors catch an array of species. In the Gulf of Alaska these species include Pacific cod, pollock, sablefish, Pacific ocean perch, flathead sole, rex sole, arrowtooth flounder, northern rockfish, shortraker rockfish, Atka mackerel, big skates, and longnose skates. Other groundfish species that are usually caught in groups have been managed as complexes (also called assemblages). For example, other slope rockfish, rougheye and blackspotted rockfish, pelagic shelf rockfish, demersal shelf rockfish, thornyhead rockfish, deep water flatfish, shallow water flatfish, other skates, and "other species" have been managed within complexes. The FMP authorizes splitting species, or groups of species, from the complexes for purposes of promoting the goals and objectives of the FMP.

Groundfish catches are managed against TAC specifications for the EEZ and near coastal waters of the GOA. The Plan Team has provided subarea ABC recommendations on a case-by-case basis since 1998.

The current status of individual groundfish stocks managed under the FMP is summarized in this section. The abundances of Pacific cod, Dover sole, flathead sole, arrowtooth flounder, Pacific ocean perch, rougheye and blackspotted rockfish, northern rockfish, and dusky rockfish are above target stock size. The abundances of pollock and sablefish are below target stock size (Figure 6). The target biomass levels for other deep-water flatfish, shallow-water flatfish, rex sole, shortraker rockfish, demersal shelf rockfish, other pelagic shelf rockfish, other slope rockfish, thornyhead rockfish, Atka mackerel, skates, sculpins, squid, octopus, and sharks are unknown.

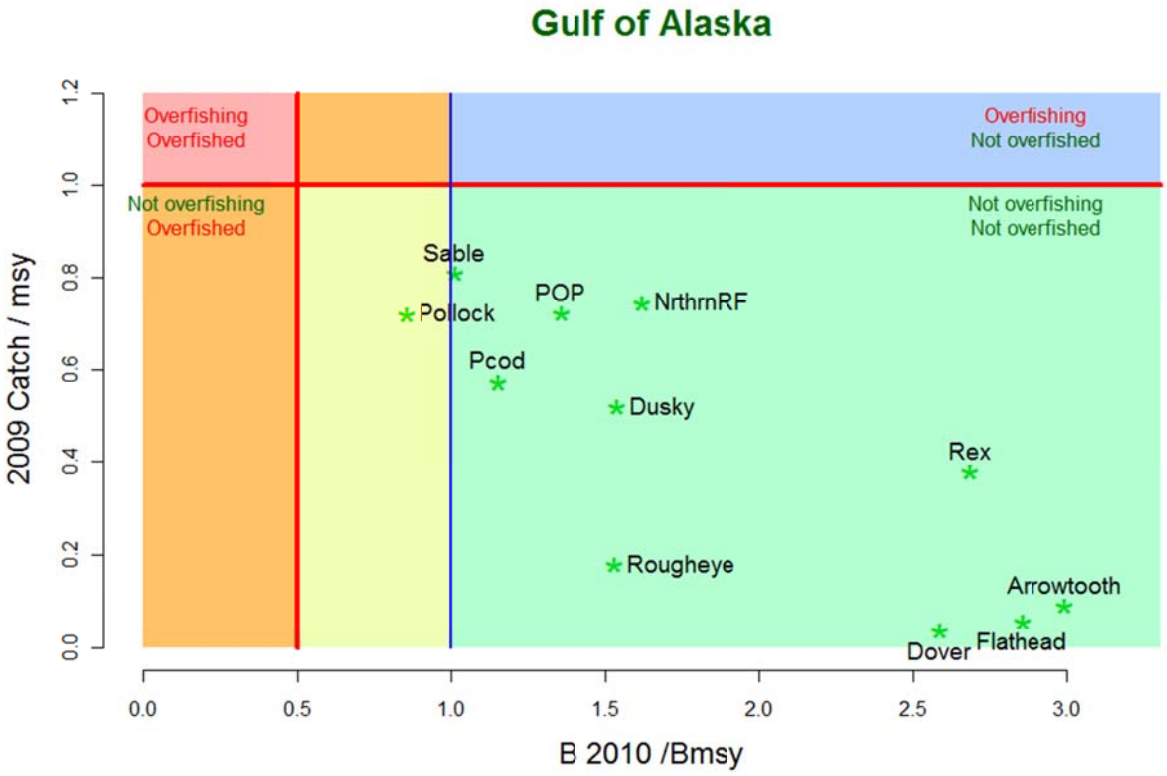


Figure 6. Summary status of age-structured GOA species relative to 2009 catch levels (vertical axis) and projected 2010 spawning biomass relative to Bmsy levels. Note that the 2009 MSY level is taken as the 2009 OFL (which is defined as the catch at F_{msy}) and overfishing and overfished status occurs at less than ½ B_{msy}.

The sum of the preliminary 2010, 2011 ABCs for target species are 565,501 t (2010), 605,088 t (2011) which are within the FMP-approved optimum yield (OY) of 116,000 - 800,000 t for the Gulf of Alaska. The sum of 2010 and 2011 OFLs are 693,253 t and 742,559 t, respectively. The Team notes that because of halibut bycatch mortality considerations in the high-biomass flatfish fisheries, an overall OY for 2010

will be considerably under this upper limit. For perspective, the sum of the 2009 TACs was 242,727 t, and the sum of the ABCs was 516,055 t.

Both GOA pollock and Pacific cod showed increases in 2009 bottom trawl survey biomass which were difficult to reconcile with size and age data within stock assessment models. 2009 size and age compositions indicated a full set of age groups comprised the increased biomass, not a single new strong year class. An increase in the availability of both species to the survey might explain this pattern, perhaps due to environmental factors. Gulf of Alaska rockfish also showed a synchronous pattern of reduced sampling error compared to other years indicating a possible shift in distribution/availability.

Halibut discard mortality rates (DMRs) are set by the Council on a 3-year cycle based on recommendations by International Pacific Halibut Commission staff. Current rates will expire at the end of 2009; new rates are needed for 2010 -2012. The recommended rates are based on an average of annual DMRs from the previous 10 years. The GOA Plan Team endorsed IPHC staff recommendations for DMRs for the GOA groundfish fisheries for 2010 - 2012. The Council i adopted these rates during its December 2009 meeting. This procedure will be repeated in 2012 for 2013-2015.

Table 6. Pacific halibut discard mortality rates (DMR) for 2010-2012 GOA groundfish fisheries.

Gear	Target	Recommendation
Trawl	Bottom pollock	59
	Pacific cod	62
	Deepwater flatfish	48
	Shallow water flatfish	71
	Rockfish	67
	Flathead sole	65
	Mid water pollock	76
	Sablefish	65
	Arrowtooth flounder	72
	Rex sole	64
Pot	Pacific cod	17
Longline	Pacific cod	12
	Rockfish	9

Methods available to reduce halibut bycatch

Several fleets have voluntarily modified their gear or fishing behavior to reduce halibut bycatch in order to increase their target fishery catches. These efforts are documented in the Pacific cod longline fishery, flatfish trawl fisheries, and rockfish trawl fisheries.

Flatfish trawl fisheries Craig Rose, NMFS AFSC, has worked for years with commercial trawl industry representatives to develop bycatch excluders for use in trawl fisheries for flatfish and Pacific cod trawl fisheries in the BSAI and GOA. Several halibut excluder devices have been developed by flatfish trawl fishermen. In an undated report to the Council, Dr Rose reported that halibut excluders developed for the flatfish fishery consisted of sloped panels across the intermediate section with holes (rigid squares or mesh) of a size that allowed the sole to pass through while directing the larger halibut to an escape opening at the top or bottom of the net. In some of the designs, there was a wide, compressed horizontal tunnel along the top (or bottom) of the net between the end of the slope and the escape opening. Large meshes between this tunnel and the main body of the net provided sole with more opportunities to remain in the catch.

Rose and Gauvin (2000) and Gauvin and Rose (2000) reported on a rigid grate system and escape panel, which are installed ahead of the trawl codend to avoid catching halibut. In test trials in the GOA

deepwater flatfish fishery because halibut and deep water flatfish are concentrated in the same areas and exclusion of halibut could dramatically increase harvest of the target species. Also the halibut caught in this fishery tended to be large, resulting in more halibut exclusion. The test gear excluded 94% of the halibut while releasing 38% of the target flatfish. Results of simulations of its use in the flatfish fishery estimated that fleet-wide use of the grate would result in a 171% increase in the duration of the fishery, a 61% increase in target flatfish catch, and a 71% reduction in overall halibut bycatch. Other simulations, however, demonstrated a high incentive for individual non-compliance without some type of rationalized fishery.

In a study of tradeoffs in target catch rates and halibut bycatch in Central Gulf of Alaska trawl fisheries Gauvin (2004) analyzed the spatial aspects of the Central Gulf of Alaska flatfish fisheries and historical halibut bycatch to assess impediments to increasing flatfish catches. He also examined the potential for gear modifications to reduce halibut bycatch rates to increase utilization of Gulf of Alaska flatfish resources within the available halibut bycatch allowance.

Gauvin (2004) determined differences in the target catch to halibut usage ratios for different GOA fishing areas within different target fisheries, with a strong seasonal component to the differences, with the relative strength and repeatability of between-area and within-season patterns still an open question for improving halibut PSC limit usage and flatfish yields. He drew some general observations from experience with the BSAI flatfish trawl fleet.

- The GOA flatfish fishery faces greater challenges in terms of finding areas where good tradeoffs between target and bycatch rates can be achieved. This observation is based primarily on the relative degree of consistency and predictability of target catch and halibut bycatch rates by area for the flatfish fisheries of the Bering Sea relative to the Central GOA.
- Catch and bycatch trends the Bering Sea flatfish fishery appears less-variable both in terms of the range of catch rates for target species and the range in halibut bycatch rates from season to season and year to year at the core fishing locations.
- The cod fishery in the GOA and Bering Sea appear more similar in several respects. For instance, the GOA and Bering Sea cod fisheries appear to have relatively similar catch and bycatch rates in terms of the range from high to low. Additionally, the Gulf and the Bering Sea cod fisheries both have a few core areas that tend to offer clearly better tradeoffs in terms catch rates and halibut bycatch usage. For the GOA cod fishery, however, fishing areas with a variety of rates for catch and halibut bycatch spread over a larger number of relatively small and discrete locations. This is not the case for the Bering Sea where, in fact, cod fishing tends to occur in three basic locations: Unimak Pass, the Slime Bank, and south and west of the Pribilof Islands. The differences in the catch rates and halibut bycatch rates between these areas are relatively small and generally predictable from year to year and within seasons.

Gauvin (2004) noted that Bering Sea flatfish and cod fisheries have reduced halibut bycatch rates through the use of a data-sharing program called Sea State. Under this system, fishermen share bycatch rate information depicted on charts detailing vessel-specific bycatch rates and “hotspots” on a daily basis. The small number of participants and the transparency of vessel-specific bycatch performance allow it to function reasonably well with only informal agreements between fishermen determining when they should leave a given area based on relative or absolute bycatch rates. The program works best with a limited number of entrants. Bycatch avoidance is reduced when peer pressure becomes more difficult as participants begin to doubt that the savings in terms of additional fishing opportunity from bycatch savings will accrue to the ones who incurred the sacrifices. This is a classic case where the lack of assigned rights to catch and bycatch tends to allow individual profit maximization incentives to prevail even when such behavior decreases total yields and overall revenue.

A critical factor in the success of bycatch management in the Bering Sea flatfish fishery is the relatively predictable and consistent spatial patterns in bycatch locations that emerge within seasons and annually that does not exist in the GOA. The system works overall, however, because there are generally reasonable alternative areas for fishermen to relocate fishing effort to reduce bycatch while achieving

acceptable target catch rates. So peer pressure works because fishermen are rarely faced with "no win" situations wherein to achieve lower bycatch rates they must necessarily accept lower target catch rates.

Gauvin (2004) predicted that halibut bycatch management in the Central Gulf of Alaska could reduce halibut bycatch and increase yields of flatfish with a change in the basic incentives of the fishery (as has been evidenced in the RPP and Pacific cod sector split). Without some form of catch share program, competition for cod TAC with the fixed gear sector could make redirection of the trawl cod fishery to areas with better tradeoffs in terms of bycatch management ineffectual. This is because the longer travel times to fishing grounds with better tradeoffs might not be worthwhile if it came with the cost of loss of target catch opportunities to the fixed gear sector. With such incentives he predicted that fishermen would change their behavior.

Gauvin reported that fishermen suggested that the winter months may hold some seasonal advantages for shallow-water flatfish and halibut bycatch reduction, and this has proven true under the RPP.

Gauvin (2004) also reviewed the halibut excluder devices tested in the Bering Sea and Gulf of Alaska for flatfish and cod fisheries. He concluded that use of soft halibut excluders on shoreside trawlers could increase under some type of catch share program, with potential for increases in flatfish yields as halibut bycatch rates declined. Remaining selectivity and usage issues could likely be overcome with additional field testing for some species, but fisheries for arrowtooth flounder and flathead sole continue to appear problematic for halibut bycatch reduction due to similar average size of arrowtooth flounder, flathead sole and halibut. He reports limited success with the use of spreading bars has provided some success for achieving the proper surface for sorting panels made of square mesh webbing. Alternative sorting panels could be more successful in these fisheries.

Dr Rose also has worked with industry to design a halibut excluder for the Pacific cod trawl fishery, based on the excluder designed for the flatfish fishery. The square openings were replaced with circular openings. This configuration was effective for large halibut, but it was necessary to add new components to exclude small halibut and skates.

The main challenge in applying the flatfish excluder device to cod fisheries was that cod are much more similar in size and swimming ability to halibut than are sole. Thus, a square hole or mesh large enough to allow all cod to pass would only exclude the very largest halibut. The different body shapes of these fish were considered a characteristic that could be exploited for separation. Excluders were constructed with rigid circular holes in the selection panels because rigid circular holes, sized for the largest cod, had the best chance of excluding smaller halibut (Rose undated). Gulf of Alaska tests released 80% of the halibut while retaining an average of 85% of the cod.

The efforts by the flatfish fleet were rewarded when on June 1, 2010, when all major flatfish fisheries off Alaska were certified under the Marine Stewardship Council (MSC) environmental standard for sustainable and well-managed fisheries. The certification applies to flathead sole, arrowtooth flounder, rex sole, northern rock sole; and southern rock sole trawl fisheries in designated areas in the GOA and BSAI.

Pacific cod longline fishery[15] The Freezer Longline Coalition has implemented a voluntary cooperative in the GOA since 2006. The FLCC formed a cooperative that negotiated which vessels could fish and what share of the halibut PSC limit each boat would be allocated to harvest. The suballocation of the PSC limit was determined by subtracting the estimated halibut needs of the shoreside hook-and-line sector from the remaining H&L cap amount prior to the fishery. During the fishery, each boat carried an observer and each observer sent data into the observer database daily.

The FLCC contracts with Fisheries Information Service (FIS) to administer a monitoring program to track and analyze trends in real-time target catch (usually cod) and halibut bycatch in the hook-and-line sector. An ancillary function is to collect and analyze halibut viability data. All federally permitted freezer-longliners participate in the program. All sets of raw data are developed by observer personnel

[1515] This summary was provided by Janet Smoker (FIS) and Kenny Down (FLC)

aboard boats, which send sampled set data, including species numbers and weight in kilograms, and halibut injury code data, to the NMFS observer database. This data transfer is at least twice a week, or daily under some circumstances- including Gulf coop monitoring. With permission of individual boats, FIS downloads this data from observer database and incorporates selected portions into excel spreadsheets.

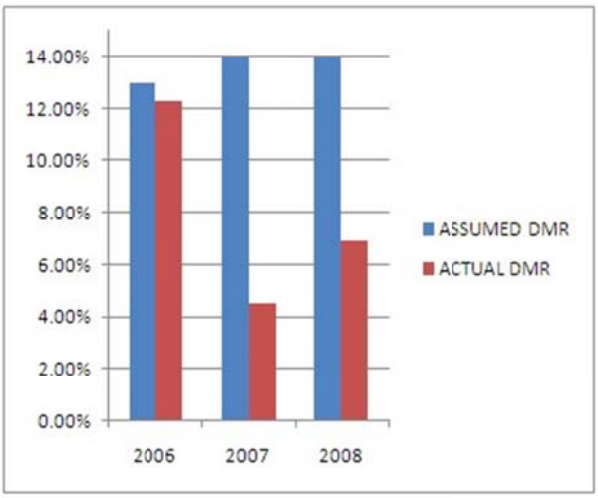
Observers do not sample all sets, so catch and bycatch in unsampled sets must be estimated for a complete accounting using procedures used by a NMFS model (based on ratios of total catch in adjacent sampled sets). For the Freezer Longline Coalition Cooperative (FLCC), FIS spreadsheets showed such calculations as well as totals (and halibut cap remainders) to-date, bycatch rates (ratio of halibut to cod), estimates of end-date based on recent catches, and a graphic showing progression of halibut catch toward the boat cap. These spreadsheets were sent to boat and/or boat manager on a daily basis. While each boat was free to share its own information with another, this was not done or facilitated by FIS.

For fleet monitoring, all data was combined for totals of cod and halibut that were compared to weekly totals from NMFS public reports. Any discrepancies were resolved. These fleet-total spreadsheets were provided on a daily basis to members of the coop, and to NMFS inseason managers.

Halibut viability analysis is less critical since caps are not involved (NMFS uses an assumed halibut discard mortality rate -DMR- for each fishery). Nonetheless FIS looked at this at least once a week for each boat. FIS incorporates raw halibut injury data into IPHC's model to calculate a DMR for each set sampled for viability. Tables of these data, including running totals, are sent to boat/manager at least weekly. Rates higher than the "assumed" DMR rate or sudden increases in DMR rates are flagged.

	2006	2007	2008
assumed DMR	13.00%	14.00%	14.00%
Coop actual* DMR	12.30%	4.56%	6.94%
NMFS halibut mort. (metric tons)	113.95	49.99	72.73
Halibut mort. with actual DMR	107.79	16.28	36.07
Difference	6.16	33.71	36.66

*based on inseason observer data on sampled halibut condition



Prior to "B" season in 2007, substantial amounts of Pacific cod TAC, but a small amount of H&L halibut PSC limit, remained in the Gulf. NMFS managers agreed to leave the fishery open if a limited number of freezer-longliners entered the fishery, and if those boats were monitored and NMFS was kept updated daily. FLCC contracted with FIS to do the latter.

The efforts of the FLCC to assign direct responsibility for halibut bycatch reduction to individual vessels resulted in a reduced halibut discard mortality rate (DMR) from 13% to 11% for 2010 – 2012 for the Pacific cod longline fishery. The DMR is calculated by the IPHC and adopted by the Council every three years (and based on a ten-year moving average). Figure 7shows the difference in assumed rates vs. actual rates achieved by the FLC cooperative. Additional background on bycatch avoidance practices by the freezer longline fleet can be found in Smoker (1996).

Rockfish The Rockfish Pilot Program analysis summarized the reduction in halibut PSC in that program as follows (p.235). "*The drastic reduction in halibut mortality (particularly in the catcher vessel sector) likely arises from several factors. First, vessels have exclusive allocations, allowing them to move from areas of high halibut catch without risking loss of catch of the primary rockfish. Second, exclusive allocations also increase the incentive for participants to communicate with each other concerning catch rates, improving information concerning areas of high halibut incidental catch in the fleet, and preventing repeated high halibut mortality among vessels exploring fishing grounds. Third, several vessels have begun employing new pelagic gear that limits bottom contact and halibut incidental catch. These gear changes are apparent when comparing the percentage of catch using pelagic trawl gear and non-pelagic gear in the first two years of the program with catch by those gear types in the preceding years (see Table 3 12). In the second year of the program over 40 percent of primary rockfish catch was with pelagic trawl, in comparison to less than 25 percent in 2006 and 6 percent or less in the preceding years. In the second ear of the program, nearly 85 percent of the catcher vessel fleet used pelagic gear for some of its catch, in comparison to slightly more than half of that fleet in 2006 and less than 20 percent in the proceeding years. In the catcher processor sector, two of the four active vessels used pelagic gear in the first year of the program, in comparison to no pelagic trawl gear prior to implementation of the program. Catch data by gear type cannot be revealed for the catch processor sector because of confidentiality protections. Participants in the program report that a primary motivation for these changes in gear types is constraining halibut allocations, which could jeopardize cooperative catches in the event that halibut bycatch exceeds allocations.*"

Additional information extracted from the June 2010 Rockfish Program is provided in Appendix III.

Cost of reducing halibut bycatch

The current management regime for halibut that makes it a prohibited species in groundfish trawl and fixed gear fisheries creates inherent costs for bycatch avoidance and halibut bycatch mortality on fishermen and the Nation. Only when, and if, the benefits of gains in yield from the target fisheries outweigh the loss of revenue from costs incurred from avoiding halibut bycatch, whether from increased fuel use to move to grounds with lower halibut bycatch or new gear that avoid halibut bycatch. The costs associated with the intensive catch sampling and experimental design that is necessary to scientifically evaluate their performance is generally beyond what any single fishing operation could reasonably manage during an open fishery (Rose and Gauvin 2000).

Despite improvements to the selectivity of trawls, the potential for gear modifications is inherently limited when the species to be avoided is another flatfish of approximately the same size and characteristic as the target species (Gauvin et al. 1995). Avoiding halibut PSC imposes relatively high costs for fishermen because catch rates for target species can be relatively high in areas of high halibut abundance (Gauvin and Rose 2000). In addition to what may be considerable direct capital investments for new gear, costs of additional fuel, loss of product quality due to longer soak or towing times, the authors suggest that policy discussions on the use of bycatch reduction devices often overlook the "costs" of reducing bycatch, such as reduction in target catch rates and target catch itself that occur from the escapement of target groundfish. These potentially considerable losses (documented in numerous experimental fishing permit applications in the late 1990s) partly explain industry's resistance to their mandatory or voluntary use. Without individual accountability that occurs under different forms of catch share management, widespread use likely will not occur without ensuring compliance through monitoring and enforcement (the "free rider" effect).

Despite several failed attempts at mandatory individual bycatch accounting in open access fisheries (Vessel Incentive Program, Vessel Bycatch Account), the BSAI bottom trawl industry voluntarily uses the Sea State Program to identify bycatch hotspots. The program uses satellite transmissions of unprocessed observer data which are rapidly converted into plotted reports and bycatch rate assessments. The program allows the fleet to rapidly respond (both individually and collectively) to by avoiding areas of high bycatch rates, thereby leaving more of the cap(s) to harvest more of their target species (Gauvin et al. 1995).

Several catch share programs have intentionally included elements to reduce halibut bycatch (sablefish IFQ program, BSAI Amendment 80), while another employed voluntary measures that freed up unused halibut PSC amounts to be "rolled over" to an underutilized fourth quarter shallow water flatfish fishery (GOA Rockfish Pilot Program). Costs of gear modified to reduce halibut bycatch can be high. The mid-water trawl doors used by trawlers in GOA Rockfish Pilot Program to avoid halibut bycatch costs between $20,000 and $30,000, depending on the size of the doors. The rigging costs an additional $4,000 to $5,000 (J. Bonney, pers. commun.).

The Council and the public have voiced concerns regarding allocating bycatch limits to harvesters, as it may appear to, or in fact, reward "bad behavior." The Council mitigated this concern by allocating a portion of the cap to the Amendment 80 sector, with phased in reductions of the cap over five years. Halibut trawl bycatch amounts have been reduced by 300,000 lb between 2008 and 2012. Additional reductions of an additional five percent may occur if additional amounts of the cap are transferred from the trawl limited access sector to the Amendment 80 trawl sector.

In addition to costs of reducing halibut bycatch, two types of benefits are potentially available from the use of excluder devices. According to Gauvin and Rose (2000) increased harvest and revenues could increase economic performance from fishing with associated increases in product and consumer benefits from groundfish fisheries that are constrained by halibut bycatch caps. And reduction of halibut bycatch cicely would result in increased halibut abundance and catch limits. These benefits would accrue depending on which fisheries would be affected by rollovers of halibut bycatch caps or which fisheries would be allocated reduced halibut bycatch caps. Because halibut are valuable as a fishery commodity, as well as a component of a healthy marine ecosystem, avoiding bycatch creates benefits to the halibut (commercial, subsistence, personal use, and recreational) fisheries and the Nation.

Other biological and socioeconomic factors that affect the appropriateness of specific bycatch measures in terms of objectives

This section cannot be completed until the Council identifies both the specific bycatch measures and its objectives for the proposed action. The analysis of other biological and socioeconomic factors would be provided in the NEPA and Regulatory Flexibility Analyses (RFA), as needed, that are associated with either a plan amendment or annual catch specifications rulemaking.

Conclusions

After reviewing the information contained in this paper, the Council may choose to 1) take no action; 2) initiate an amendment (EA) to the GOA Groundfish FMP to revise the PSC setting process to mirror the regulatory process (RIR/IRFA) as in the BSAI, as needed; 3) initiate an analysis of halibut PSC limits to support the harvest specifications EA for 2012; or 4) include an analysis of halibut PSC limits in the next harvest specifications EA. The earliest that GOA halibut PSC limits could be revised is coincident with rulemaking for the annual groundfish specifications for 2012. The next step under any action alternative, if that is the Council's intent, would be for the Council to identify 1) a problem in the fishery, 2) goals and objectives for addressing the problem, and 3) management alternatives.

If the Council chose to take no action to initiate a separate analysis, it always has the option to incorporate halibut PSC limit reductions in other proposed actions, as it did with BSAI Amendment 80. Even under no action, more widespread (mandatory or voluntary) use of halibut excluder devices would continue to result in a "win/win" situation whereby less halibut are taken as bycatch in groundfish fisheries thus leading to 1) potential increases in halibut abundance and commercial longline fishery catch limits and 2) increased GOA groundfish target harvests.

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Appendix I. GOA FMP policy regarding halibut PSC limits

(Section 3.6.2.1.1 Apportionment and Seasonal Allocation of Pacific Halibut)

Apportionments of PSC limits, and seasonal allocations thereof, will be determined annually by the Secretary of Commerce in consultation with the Council. Separate PSC limits may be established for specific gear. PSC limits, apportionments, and seasonal allocations will be determined using the following procedure:

1. Prior to the October Council meeting. The GOA Groundfish Plan Team will provide the Council the best available information on estimated halibut bycatch and mortality rates in the target groundfish fisheries. [16]

2. October Council meeting. While developing proposed groundfish harvest levels under Section 3.2.3, the Council will also review the need to control the bycatch of halibut and, if necessary, recommend proposed halibut PSC mortality limits and apportionments thereof. The Council will also review the need for seasonal allocations of the halibut PSC. The Council will make proposed recommendations to the Secretary about some or all of the following:

a. the regulatory areas and districts for which PSC mortality limits might be established;
b. PSC for particular target fisheries and gear types;
c. seasonal allocations by target fisheries, gear types, and/or regulatory areas and district;
d. PSC allocations to individual operations; and
e. types of gear or modes of fishing operations that might be prohibited once a PSC is reached.

The Council will consider the best available information in doing so. Types of information that the Council will consider relevant to recommending proposed PSCs include:

a. estimated change in biomass and stock condition of halibut;
b. potential impact on halibut stocks;
c. potential impacts on the halibut fisheries;
d. estimated bycatch in years prior to that for which the halibut PSC mortality limit is being established;
e. expected change in target groundfish catch;
f. estimated change in target groundfish biomass;
g. methods available to reduce halibut bycatch;
h. the cost of reducing halibut bycatch; and
i. other biological and socioeconomic factors that affect the appropriateness of specific bycatch measures in terms of objectives.

Types of information that the Council will consider in recommending seasonal allocations of halibut include:

a. seasonal distribution of halibut;
b. seasonal distribution of target groundfish species relative to halibut distribution;
c. expected halibut bycatch needs on a seasonal basis relevant to changes in halibut biomass and expected catches of target groundfish species;
d. expected bycatch rates on a seasonal basis;
e. expected changes in directed groundfish fishing seasons;
f. expected start of fishing effort; and
g. economic effects of establishing seasonal halibut allocations on segments of the target groundfish industry.

3. As soon as practicable after the Council's October meeting, the Secretary will publish the Council's recommendations as a notice in the Federal Register. Information on which the recommendations are based will also be published in the Federal Register or otherwise made available by the Council. Public

[16] *Staff discontinued appending this information to the GOA SAFE Report in 2004 (see Appendix 1B below to advise staff whether the Council wishes to continue to see this information in future GOA SAFE Reports).*

comments will be invited by means specified in regulations implementing the FMP for a minimum of 15 days.

4. Prior to the December Council meeting. The Plan Team will prepare for the Council a final Stock Assessment and Fishery Evaluation (SAFE) report under Section 3.2.3 which provides the best available information on estimated halibut bycatch rates in the target groundfish fisheries and recommendations for halibut PSCs. If the Council requests, the Plan Team also may provide PSC apportionments and allocations thereof among target fisheries and gear types, and an economic analysis of the effects of the apportionments.

5. December Council meeting. While recommending final groundfish harvest levels, the Council reviews public comments, takes public testimony, and makes final decisions on annual halibut PSC limits and seasonal apportionments, using the factors set forth under (2) above relevant to proposed PSC limits, and concerning seasonal allocations of PSC limits. The Council will provide recommendations, including no change for the new fishing year, to the Secretary of Commerce for review and implementation.

6. As soon as practicable after the Council's December meeting, the Secretary will publish the Council's final recommendations as a notice of final harvest specifications in the Federal Register. Information on which the final harvest specifications are based will also be published in the Federal Register or otherwise made available by the Council.

APPENDIX I.B.

HALIBUT PROHIBITED SPECIES CATCH LIMITS

Updated

by

Diana Stram

North Pacific Fishery Management Council

This chapter presents information on halibut bycatch in the groundfish fisheries conducted in the Gulf of Alaska (GOA). It is intended for use by the Council to determine the halibut bycatch framework measures. Domestic groundfish fisheries for halibut, sablefish, pollock, flounder, rockfish, and Pacific cod are all currently managed by species or complex, and yet most species are caught together to some extent. This is true for all gear types. Under the current management scheme, fisheries directed at one species often discard other species, resulting in some discard mortality. Discard mortality of several species may be significant. The incidental catch and mortality of halibut in bottom trawl and longline groundfish fisheries are of principal concern in the Gulf.

Bycatch has in the past been controlled by reducing the total allowable catch (TAC) of other target species through the use of Prohibited Species Catch (PSC) limits, season delays, or some combination of these measures. Since 1995, an Individual Fishing Quota (IFQ) program has been in place in Gulf of Alaska, Bering Sea, and Aleutian Islands which allows the concurrent landing of both species with appropriate quota share holdings. Halibut discard mortality was reduced by 450 mt when the sablefish IFQ fishery was exempted from setting halibut PSC limits in 1995.

The Framework Process

Regulations require the Secretary of Commerce, after consultation with the Council, to propose the PSC limits as soon as practical after October 1 for the next fishing year. Thus, when the Council meets during October, it must decide what recommendations it will provide to the Secretary.

The Council can make recommendations for PSC mortality limits as follows:

1. Among trawl, hook-and-line, and pot gear.
2. Among fisheries complexes (i.e., shallow water trawl and deep water trawl complexes).
3. By season, which may be quarterly, semiannually, or any other reasonably configured period.
4. Gulf-wide or between the Western and Central Regulatory Areas and among the Districts of the Eastern Regulatory Area.

The Secretary will propose the PSC mortality limits in the *Federal Register* and request comment for 30 days from the date of filing with the Office of the Federal Register. The Council will review comments and will make final recommendations on PSC mortality limits at its December meeting. The Secretary will publish final PSC mortality limits again in the *Federal Register* to be used to manage halibut bycatch mortality in the bottom trawl, hook-and-line, and/or pot fisheries in the Gulf of Alaska during that following fishing year.

The Council is not constrained to any particular PSC limit. The International Pacific Halibut Commission (IPHC) has recommended that halibut bycatch mortality not exceed 6,000 mt in the North Pacific, and has further recommended that halibut bycatch mortality in the Bering Sea/Aleutian Islands and GOA be limited to 4,000 mt and 2,000 mt, respectively. In 1996, the IPHC requested that the Council further decrease PSC caps by 10 percent in 1998, further reduce bycatch in 1999, and divide the savings between lower halibut bycatch limits and increased groundfish harvest.

During each year between 1986-89, the Council recommended a 2,000 mt bycatch mortality limit in the GOA, with only the bottom trawl fishery being affected if this limit had been reached. Between 1990-94, the Council has recommended an additional bycatch mortality limit of 750 mt for fixed gear fisheries. Since 1995, the Council reduced the PSC cap for hook-and-line gear to 300 mt by exempting the IFQ sablefish fishery from halibut PSC restrictions. Pot gear was exempted from closures under the fixed gear cap, so all of the 750 mt was allocated to hook-and-line gear.

Establishing PSC limits for the Gulf of Alaska

Bycatch mortality of Pacific halibut in the Gulf of Alaska groundfish fisheries (trawl and hook & line) is shown below for the last twenty years (in mt, based on IPHC and NMFS estimates). The amounts of halibut bycatch mortality shown for 1980-1986 reflect estimates of halibut bycatch and mortality from primarily foreign and joint-venture fisheries. The fishing practices currently in use by the fully domesticated fishery may produce very different bycatch estimates. Therefore, data gathered under the domestic observer program beginning in 1990 probably present a more realistic picture of the current groundfish fishery in the Gulf of Alaska. The Plan Team feels that this is the best information available upon which to base decisions regarding the setting of PSC limits for halibut in the Gulf of Alaska.

Year	Bycatch (mt)
1980	4,596
1981	4,096
1982	3,785
1983	3,134
1984	2,382
1985	1,134
1986	935
1987	2,061
1988	2,243
1989	2,646
1990	3,936
1991	3,700
1992	3,383
1993	3,244
1994	2,973
1995	2,449
1996	2,118
1997	2,228
1998	2,319
1999	2,526
2000	2,128
2001	2,485
2002	2,172
2003*	2,286

November 15, 2003

Halibut Bycatch Management in the Gulf of Alaska

Definition of terms:

- Bycatch rate - kg/mt of halibut caught in total groundfish catch.
- Mortality rate - that % of halibut bycatch that die after being caught.
- Bycatch mortality rate - kg/mt of halibut that are killed in total groundfish catch.

The NMFS Alaska Region manages the groundfish fisheries using halibut bycatch rates from the NMFS Alaska Fishery Science Center's Observer Program Office. The Alaska Region also used assumed mortality rates, which were recommended by the IPHC and reviewed by the Council. These mortality rates were based on a study of release condition factors. The 2003 fishery-specific discard mortality rates used were as follows:

GOA Trawl fisheries:

Atka mackerel	70%
Bottom trawl pollock	61
Pacific cod	61
Deepwater flatfish	60
Shallow water flatfish	69
Rockfish	69
Flathead Sole	58
Other species	14
Pelagic pollock	72
Sablefish	66
Arrowtooth flounder	62
Rex Sole	61

GOA Hook and Line fisheries:
(under mandatory Careful Release Measures)

Pacific cod	14
Rockfish	8
Sablefish	24
Other Species	14

GOA Pot fisheries:

Pacific cod	14
Other Species	14

Seasonal Apportionments of the Halibut PSC Limit

Under Amendment 21, the halibut PSC limits can be seasonally apportioned. These limits were apportioned quarterly to trawl and hook-and-line gear beginning in 1991. Hook-and-line apportionments were charged to trimesters under Amendment 45 beginning in 1996. Halibut are expected to be in shallow water during summer months (June through September), and fisheries for Pacific cod and shallow water flatfish require larger shares of the PSC mortality limit during this time to preclude a premature fishery closure. Fisheries for sablefish and deepwater flatfish require larger shares of the PSC mortality limit during January through May and during October through December for similar reasons. Since 1995, the sablefish IFQ hook-and-line fishery has been conducted from March 15 to November 15, coincident with the halibut IFQ fishery

Total halibut PSC limits for all fisheries and gear types in the Gulf of Alaska equals 2,300 mt. This cap was reduced from 2,750 mt after the sablefish IFQ fishery was exempted from the halibut PSC requirements in 1995. The following 2004 halibut PSC apportionments were instituted for the Gulf of Alaska groundfish:

2003 Trawl		**2003 Hook and Line**		
Jan 1 – Apr 1	550 mt	1st trimester:	Jan 1 – Jun 10	250 mt
Apr 1 – Jun 29	400 mt	2nd trimester:	Jun 10 – Sep 1	5 mt
Jun 29 – Sep 1	600 mt	3rd trimester:	Sep 1 – Dec 31	35 mt
Sep 1 – Oct 1	150 mt			
Oct 1 – Dec 31	300 mt	DSR	Jan 1 – Dec 31	10 mt
Total	2,000 mt			300 mt

One of the Council's objectives is to promote harvest of as much of the groundfish optimum yield (OY) as possible with a given amount of halibut PSC. If some gear types have excessively high bycatch rates during a given season, the Council may consider withholding halibut PSC in order to promote other gear types, which otherwise might be closed prematurely, thereby promoting harvest of the OY.

A regulatory amendment implemented in 1994 set up shallow water and deep water fishery complex categories. The shallow water complex includes pollock, Pacific cod, Atka mackerel, shallow water flatfish, flathead sole, and other species. The closures do not apply to fishing for pollock by vessels using pelagic trawl gear in those portions of the GOA open to directed fishing for pollock. The deep water complex includes deep water flatfish, rex sole, arrowtooth flounder, sablefish, and rockfish. The bycatch trawl limit for the first three quarters was subdivided between shallow water and deep water complexes. The remaining 400 mt trawl limit is not apportioned.

Seasonal Halibut Bycatch Mortality Caps

Since 1993, halibut PSC mortality has applied only to the bottom trawl and hook-and-line fisheries. The midwater trawl fishery (targeting on pollock) has been exempt from bycatch-related closures. The pot fishery (primarily for Pacific cod), was exempted from fixed gear PSC limit due to minimal bycatch mortality. Descriptions of halibut bycatch management in the 2003 trawl and hook-and-line fisheries follow.

The Gulf of Alaska Trawl Fisheries

Trawl gear was used to harvest pollock, flatfish, rockfish, Pacific cod, sablefish, and arrowtooth flounder. The 2003 mt PSC halibut bycatch mortality limit has been unchanged since 1989, and has been apportioned quarterly such that 28%, 22%, 35%, and 15% (or 600 mt, 400 mt, 600 mt, and 400 mt) are apportioned during the first, second, third, and fourth quarters, respectively.

Trawl fishery categories

Season	**Shallow Water**	**Deep Water**	**Total**
Jan 1 - Apr1	450 mt	100 mt	550 mt
Apr 1 - Jun 29	100 mt	300 mt	400 mt
	200 mt	400 mt	600 mt
Sep 1 - Oct 1	150 mt	any rollover	150 mt
Oct 1 - Dec 31	no apportionment		300 mt
TOTAL	900 mt	800 mt	2,000 mt

Trawling for the deep-water fishery complex were closed in each quarter on May 16, and October 15 to prevent exceeding the halibut bycatch limit. The shallow-water fishery was closed in each quarter on June 19, September 12, and October 15. All trawling in the GOA closed (with the exception of pelagic trawl gear targeting pollock) on October 15.

Through November 15, 2003 total halibut bycatch mortality from trawl gear was 1,900 mt (Table 1). A summary of trawl halibut bycatch in the Gulf of Alaska for shallow water and deep water complexes by season is shown in Table 2.

The Gulf of Alaska Hook-and-Line Fisheries

The hook-and-line fisheries are directed primarily at sablefish and Pacific cod, with minor effort on rockfish. The PSC halibut mortality limit of 300 mt for the hook-and-line fisheries was apportioned seasonally by trimester. The 300 mt allocation included 10 mt for the demersal shelf rockfish fishery in Southeast Alaska. For the first trimester, 250 mt was allocated. For the second trimester, 5 mt was allocated. The remaining 35 mt was allocated to the rest of the fishing year. The sablefish hook-and-line fishery is managed as an IFQ fishery. The season runs from March 15 to November 15, simultaneous with the halibut IFQ fishery.

Through November 15, 2003, total halibut bycatch mortality from hook-and-line gear was 296 mt (Table 1). The breakdown of hook and line halibut bycatch rates by season is provided in Table 2.

The Gulf of Alaska Pot Fishery

Pot gear was used to harvest mostly Pacific cod. Total mortality attributed to pot gear was approximately 13 mt in 2003, 2 mt in 2002, 4 mt in 2001, and 7 mt in 2000. Pot gear has been exempted from PSC mortality limits since 1993.

Expected Changes in Groundfish and Halibut Stocks

Given the preceding review of the bycatch situation in the Gulf for 1999, it may be useful to examine possible changes in the levels of biomass for target groundfish species and Pacific halibut. Some changes in the expected catch of groundfish for the upcoming fishing year will follow from the biomass estimates reported elsewhere in this SAFE report for GOA groundfish species as a result of the TACs established by the Council. Groundfish catch for most species will equal the TACs, tempered only by the PSC limits imposed by the Council. Lack of interest by industry in harvesting low value species, such as flatfish, may moderate this assumption to some degree. In general, it is apparent that changes in groundfish catch can have no effect on halibut bycatch once a PSC is established; rather, the PSC drives the formula and dictates the catch of groundfish. The Team recommended an ABC of 508,010 mt for 2004. The 2003 ABC was 414,820 mt. The catch in the GOA fisheries was only 173,590 mt (as of November 15, 2003) of the total 2003 TAC of 236,440 mt (73 %) due to PSC limitations and lack of interest in low value species.

In 1997, the IPHC revised its stock assessment methodology for setting annual catch limits for Pacific halibut. As a result, catch limits for the GOA has increased from 19,730 mt in 1995, peaked at 29,270 mt in 1999, and dropped to 28,010 mt in 2003. The higher catch limits reflect healthier stock conditions. IPHC staff report no significant change to the Pacific halibut stock assessment or quotas for 2004 for the Gulf of Alaska. Catch limits for 2004 will be decided in late January 2004.

Potential methods for bycatch reduction

With the implementation of an individual fishing quota system for halibut and sablefish longline fisheries in 1995, bycatch and waste were reduced because the race for fish was eliminated, allowing for more selective fishing practices and significant reductions in actual gear deployment/loss. As a result of the IFQ halibut and sablefish program, the halibut bycatch limit for non-trawl fisheries was reduced by 450 mt in Gulf of Alaska.

Since 1991, NMFS has implemented numerous management measures that reduce halibut bycatch in the groundfish fleet. The Council is developing a vessel bycatch allowance program, but further development has been stalled by the press of other Council business. In the interim, management options such as

bycatch incentive programs, timing of groundfish seasons, and seasonal apportionments of the halibut PSC limits probably represent the most realistic methods of reducing halibut bycatch. In addition to bycatch limits, gear restrictions and other regulatory changes have also been implemented to reduce bycatch and waste. Biodegradable panels are required for pot gear to minimize waste associated with so-called ghost fishing of lost gear. Tunnel openings for pot gear are limited in size to reduce incidental catch of halibut and crabs. Gillnets for groundfish have been prohibited to prevent ghost fishing and reduce bycatch of non-target species.

Several possible methods exist which could contribute to a reduction in halibut bycatch by the groundfish fisheries. One method would be to set the TACs for groundfish at a level which would preclude excessive bycatch. Based on prevailing bycatch rates and mortality rates for each gear group, TACs can be back-calculated and set at levels to attain the desired level of bycatch. The economic tradeoffs associated with this method are discussed in the EA/RIR for Amendment 18. The current halibut bycatch limits amount to approximately 1% of halibut total biomass.

Gear modifications are a potential method of reducing the bycatch rates in the groundfish fisheries. The Council has examined the voluntary use of grid sorting to reduce halibut mortality and is currently reviewing the results of an experimental fishing permit for the use of a halibut excluder device in trawl gear. Any of these options would impose some kind of costs to the fishery which may or may not be offset by the potential benefits of the option chosen.

Gulf of Alaska Trawl Fisheries

Pacific cod	Bycatch rates have been lower from February through mid April compared to rates from late April through early August.
Pollock	Bycatch rates are lowest during the periods when pelagic gear is used.
Flatfish	Bycatch rates have been low in February and high from late March through mid May. However, differences in rate may be due to species composition. Dover sole, rex sole, and flathead sole are considered deep water flatfish species. Others are considered to be shallow water flatfish species.
Rockfish	Bycatch rates have been high from March through mid May and lower from late May through mid August. If trawling for rockfish were directed at slope species, then the lower rates during summer may be the result of halibut moving into shallower water, thereby escaping the deep water rockfish fishery.
Sablefish	Sablefish is limited to bycatch status for trawl gear. NMFS assumes that any catches occurs as a result of incidental catches in other directed groundfish fisheries.
Arrowtooth flounder	This species is considered to be a deep water flatfish species, although they may occur in shallow water, also. Few data exist to indicate a trend. High bycatch rates have occurred from late June through mid August as a result of trawling for arrowtooth in shallow water.

Gulf of Alaska Hook-and-Line Fisheries

Pacific cod	Bycatch rates have been lower from January through mid-April and in the past, have been relatively high from late April through May, likely as a result of halibut moving into shallow water where Pacific cod are found.

Gulf of Alaska Pot Fishery

Pacific cod	Bycatch rates generally have been low year-round due to regulations limiting the size of tunnel openings.

Seasonal distribution of halibut and target groundfish

Halibut bycatch rates for trawl, hook-and-line, and pot gear vary seasonally. Much of the information on the seasonal distribution of halibut can be drawn from the commercial fishery and research surveys. These

sources indicate that adult halibut undertake a seasonal migration related to a winter spawning period and a summer feeding period. Spawning generally takes place between 230 and 450 m in depth during November through March, but is greatest during December and January. During April and May, the fish can be found moving up through the gullies and onto the offshore banks, typically 135 to 270 m. During the summer months of June through August, halibut are found shallow, up to 45 m or less in some cases, but generally less than 135 m. Halibut are occasionally found in bays feeding on salmon and other fish. In September and October, halibut begin their movement back to deeper water for spawning. Thus, the spring months of April/May and fall months of September/October can be considered transition periods.

Trawl surveys have yielded information on the distribution of juvenile halibut (ages 2 through 4). Fish of this age are distributed throughout the entire Gulf during the year out to a depth of 180 m and occasionally deeper. However, abundance is greatest at depths of 100 meters or less. Little, if any, seasonal migration is observed in halibut of this size.

The seasonal distribution of the major groundfish species in the Gulf should be considered relevant to the distribution of halibut in efforts to minimize halibut bycatch. Walleye pollock, a pelagic species in all life stages, have probably the least interaction with halibut, in terms of physical location, of all the target groundfish species in the Gulf. Seasonal movements do occur with the fish moving to shallower water in the spring and summer. In the fall and winter months they return to deeper water. There may be vertical movement in the water column associated with feeding and diurnal patterns. Typically, they are found throughout the water column from shallow to deep water, frequently forming large schools at depths of 100-400 m along the outer continental shelf and slope.

Pacific cod are a widespread demersal species found along the continental shelf from inshore waters to the upper slope with adults commonly found at depths of 50-200 m. During the winter and spring cod appear to concentrate in the canyons that cut across the shelf and along the shelf edge and upper slope at depths of 100-200 m where they overwinter and spawn. Most spawning occurs in the spring at depths of 150-200 m along the outer continental shelf off Kodiak Island and in the Shelikof Strait area, as well as Prince William Sound. In the summer, they shift to shallower depths, usually less than 100 m.

The flatfish group, which are all demersal but have varying depth ranges, includes arrowtooth flounder, starry flounder, flathead sole, rock sole, Dover sole, yellowfin sole, and rex sole. Arrowtooth flounders are abundant over a depth range of 100-500 m and aggregate in the deeper portion of that range during the winter months. High densities have been indicated by resource surveys in the waters off southeastern Alaska at depths of 200-400 m. Most occurrences of starry flounder in the Gulf have been at depths less than 150 m while flathead sole are typically found at depths less than 250 m. Rock sole are more of a shallow water species and are most abundant in the Kodiak and Shumagin areas at depths of less than 100 m. Dover sole and rex sole are found throughout the northeastern Pacific and Bering Sea at depths usually less than 275 m. Yellowfin sole are a relatively abundant species in Cook Inlet and are also found in Prince William Sound.

The rockfish group includes four assemblages separated on the basis of habitat and behavioral characteristics - slope rockfish, pelagic shelf rockfish, demersal shelf rockfish, and thornyhead rockfish. Little information is available on life history and distribution patterns of demersal and pelagic shelf rockfish.

Little is known of the slope assemblage, except for Pacific ocean perch (POP). POP are found over a wide range of depths, usually between 100 and 450 m, with the adults performing seasonal bathymetric migrations associated with reproduction and feeding. They apparently migrate into deep water during fall and winter to spawn and then move to shallower depths to feed in the spring and summer. Separate schools of males and females have been observed migrating from feeding grounds at depths of 150-185 m in the Unimak Pass region to spawning areas at depths of 350-400 m in the Yakutat Bay area. Thornyhead rockfish are benthic and seldom venture off the bottom where they occur at depths of 100-1,500 m.

Sablefish occur in the outer shelf, slope, and abyssal habitats over a depth range of 200-1,200 m with the centers of abundance occurring from 400-1,000 m along the continental slope, especially in or near submarine canyons. Sablefish spawn during late winter to early spring along the continental slope at

depths exceeding 400 m. Sablefish spend their first year in estuarine areas, after which their depth distribution increases with age and some fish reach depths of 300 m by their third year. Some research evidence points to migratory movements by sablefish during different life stages, while other research indicates that sablefish remain in the same general bottom area where they settle as sub-adults.

Economic effects of groundfish seasons and seasonal halibut PSCs

An alteration of any species/gear type fishing season will impose some types of costs on certain segments of the fishing industry as well as result in benefits to the same or other segments of the industry. A delay in the season opening could impose costs in the form of foregone revenues. For instance, a delay in the season may shift effort, resulting in less of the PSC limit being available to a higher valued fishery.

Seasonal allocations of the PSC limits will likely have the same potential effects on the fishery as outlined above. The setting of the seasonal apportionments of the PSC limits will be directly related to any season changes adopted by the Council. The way in which these PSC limits are seasonally apportioned will affect the character of the fisheries for each major gear group throughout the year. A change in fishing seasons would require a corresponding shift in the PSC apportionments to accommodate the new season. The result is a tradeoff that must consider the relative values of the different groundfish species harvested and the relative values of halibut bycatch to those fisheries. Ideally, the seasonal apportionment of halibut PSC limits will provide the mechanism for each fishery to fully exploit the available resource without exceeding the PSC limits for each gear group. Fishermen and other industry representatives may be in the best position to provide the relevant information upon which to base the decisions regarding the seasonal apportionment of these halibut PSC limits.

Fishing seasons have been modified as a result of management measures required to minimize fishing impacts on endangered Steller sea lions. Further, changes to season start dates will be examined in a proposed plan amendment to revise the annual specification-setting process.

Table 1: 2003 Annual halibut mortality by gear type (through November 15, 2003)

Gulf of Alaska Prohibited Species Report

Through: 15-NOV-03

National Marine Fisheries Service
Alaska Region, Sustainable Fisheries
Catch Accounting

Chinook Salmon

Trawl Gear

Sea-sons	Account	Units	Total Catch	Limit	Remaining	% Taken	Last Wk Catch
	Chinook Salmon	Count	15,097	0			0
Total:			**15,097**	**0**			**0**

Halibut Mortality

Non-Trawl Gear

Sea-sons	Account	Units	Total Catch	Limit	Remaining	% Taken	Last Wk Catch
X	Other Hook-and-Line Fisheries	MT	296	290	-6	102%	0
Total:			**296**	**290**	**-6**	**102%**	**0**

Trawl Gear

Sea-sons	Account	Units	Total Catch	Limit	Remaining	% Taken	Last Wk Catch
	Trawl Fishery	MT	1,990	2,000	10	100%	0
Total:			**1,990**	**2,000**	**10**	**100%**	**0**

No PSC Limits apply to salmon in the GOA.

Other hook-and-line fisheries means all hook-and-line fisheries except sablefish and demersal shelf rockfish in the Southeast District. The hook-and-line sablefish fishery is exempt from halibut bycatch restrictions.

Halibut mortality for the demersal shelf rockfish fishery, Southeast District is not listed due to insufficient observer coverage.

Data is based on observer reports, extrapolated to total groundfish harvest. Estimates for all weeks may change due to incorporation of late or corrected data.

Report run on: November 20, 2003 6:31 AM

Table 2: 2003 Seasonal halibut mortality by gear type (through November 15, 2003)

Gulf of Alaska Halibut Mortality Report

Through: 15-NOV-03

National Marine Fisheries Service
Alaska Region, Sustainable Fisheries
Catch Accounting

Trawl Fisheries

Deep Water Species Complex

Season	Begin	End	Total Catch	Limit	Limit Remaining	% Taken
1st Season	20-JAN-03	01-APR-03	105	100	-5	105%
2nd Season	01-APR-03	29-JUN-03	290	300	10	97%
3rd Season	29-JUN-03	01-SEP-03	310	400	90	77%
4th Season	01-SEP-03	30-SEP-03	34	0	-34	0%
Total:			**740**	**800**	**60**	**92%**

Shallow Water Species Complex

Season	Begin	End	Total Catch	Limit	Limit Remaining	% Taken
1st Season	20-JAN-03	01-APR-03	274	450	176	61%
2nd Season	01-APR-03	29-JUN-03	314	100	-214	314%
3rd Season	29-JUN-03	01-SEP-03	127	200	73	64%
4th Season	01-SEP-03	30-SEP-03	282	150	-132	188%
Total:			**998**	**900**	**-98**	**111%**

Year-To-Date

Account	Total Catch	Limit	Limit Remaining	% Taken	Last Wk Catch
Trawl Fishery	1,990	2,000	10	100%	0

Other Hook-and-Line Fisheries

Season	Begin	End	Total Catch	Limit	Limit Remaining	% Taken
1st Season	01-JAN-03	10-JUN-03	233	250	17	93%
2nd Season	10-JUN-03	01-SEP-03	33	5	-28	655%
3rd Season	01-SEP-03	31-DEC-03	30	35	5	86%
			296	**290**	**-6**	**102%**

Deep-water species complex: sablefish, rockfish, deep-water flatfish, rex sole and arrowtooth flounder. Shallow-water species complex: pollock, Pacific cod, shallow-water flatfish, flathead sole, Atka mackerel, and 'other species'.

No apportionment between shallow-water and deep-water fishery complexes during October 1 to December 31 (300 mt allocated).

Other hook-and-line fisheries means all hook-and-line fisheries except sablefish and demersal shelf rockfish in the Southeast District. The hook-and-line sablefish fishery is exempt from halibut bycatch restrictions.

Halibut mortality for the demersal shelf rockfish fishery, Southeast District is not listed due to insufficient observer coverage.

Note: All weights are in metric tons.

Report run on November 20, 2003 6:33 AM

Appendix II. Total removals by category, 1996-2008 (Source: IPHC)

Total	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
1996	0.296	9.545	8.872	19.693	3.663	1.699	2.069	1.506	47.343
1997	0.413	12.421	9.918	24.628	9.072	2.908	3.318	2.519	65.197
1998	0.460	13.172	10.196	25.698	11.161	3.417	2.901	2.752	69.757
1999	0.450	12.705	10.143	25.316	13.835	4.369	3.571	3.916	74.305
2000	0.483	10.811	8.445	19.273	15.413	5.155	4.692	4.018	68.290
2001	0.680	10.288	8.403	21.539	16.336	5.015	4.468	3.970	70.699
2002	0.851	12.073	8.602	23.131	17.313	5.091	4.080	3.518	74.659
2003	0.819	11.789	8.410	22.748	17.231	5.024	3.863	3.257	73.141
2004	0.884	12.162	10.234	25.167	15.460	3.561	2.719	2.923	73.110
2005	0.803	12.331	10.625	26.033	13.171	3.404	1.975	3.482	71.824
2006	0.830	12.005	10.492	25.714	10.791	3.332	1.590	3.227	67.981
2007	0.789	9.772	8.473	26.493	9.249	2.828	1.416	3.849	62.869
2008	0.707	7.794	6.209	24.376	10.893	3.011	1.765	3.871	58.626

Sport	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
1996	0.229	0.887	2.129	4.740	0.021	0.077	0.000	0.000	8.083
1997	0.355	0.887	2.172	5.514	0.028	0.069	0.000	0.000	9.025
1998	0.383	0.887	2.501	4.702	0.017	0.096	0.000	0.000	8.586
1999	0.338	0.859	1.843	4.228	0.017	0.094	0.000	0.000	7.379
2000	0.344	1.021	2.258	5.305	0.015	0.073	0.000	0.000	9.016
2001	0.446	1.015	1.925	4.675	0.016	0.029	0.000	0.000	8.106
2002	0.399	1.260	2.090	4.202	0.013	0.048	0.000	0.000	8.012
2003	0.404	1.218	2.258	5.427	0.009	0.031	0.000	0.000	9.347
2004	0.487	1.613	2.937	5.606	0.007	0.053	0.000	0.000	10.703
2005	0.484	1.841	2.798	5.672	0.014	0.050	0.000	0.000	10.859
2006	0.516	1.773	2.526	5.337	0.014	0.046	0.000	0.000	10.212
2007	0.504	1.556	3.049	6.283	0.025	0.044	0.000	0.000	11.461
2008	0.457	1.520	3.083	5.629	0.018	0.043	0.000	0.000	10.750

Bycatch (legal-sized)	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
1996	0.473	0.166	0.233	1.403	0.960	0.594	0.459	2.991	7.279
1997	0.473	0.109	0.240	1.549	0.729	0.844	0.198	2.964	7.106
1998	0.834	0.117	0.238	1.471	0.731	1.193	0.327	2.725	7.636
1999	0.761	0.107	0.230	1.283	0.743	0.909	0.336	2.642	7.011
2000	0.634	0.128	0.254	1.286	0.646	0.808	0.580	2.279	6.615
2001	0.645	0.149	0.184	1.617	0.632	0.574	0.387	2.900	7.088
2002	0.382	0.152	0.166	1.073	0.719	0.534	0.196	2.735	5.957
2003	0.355	0.133	0.144	1.177	0.500	0.515	0.219	2.105	5.148
2004	0.323	0.140	0.149	1.520	0.393	0.516	0.294	1.915	5.250
2005	0.183	0.191	0.144	1.321	0.360	0.456	0.279	2.206	5.140
2006	0.177	0.151	0.214	1.062	0.508	0.649	0.231	2.136	5.128
2007	0.177	0.154	0.215	0.989	0.451	0.656	0.324	1.895	4.861
2008	0.141	0.067	0.216	1.058	0.485	0.496	0.211	1.552	4.226

Personal use and subsistence

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
1996	0.015	0.300	0.000	0.097	0.037	0.094	0.000	0.000	0.543
1997	0.015	0.300	0.000	0.097	0.037	0.094	0.000	0.000	0.543
1998	0.011	0.300	0.170	0.097	0.037	0.094	0.000	0.000	0.709
1999	0.011	0.300	0.170	0.074	0.020	0.166	0.000	0.000	0.741
2000	0.018	0.300	0.170	0.074	0.020	0.166	0.000	0.000	0.748
2001	0.016	0.300	0.170	0.074	0.020	0.166	0.000	0.000	0.746
2002	0.016	0.300	0.170	0.074	0.020	0.166	0.000	0.000	0.746
2003	0.027	0.300	0.628	0.280	0.028	0.021	0.003	0.096	1.383
2004	0.019	0.300	0.677	0.404	0.034	0.029	0.001	0.056	1.520
2005	0.036	0.300	0.598	0.429	0.046	0.036	0.001	0.091	1.537
2006	0.036	0.300	0.598	0.429	0.046	0.036	0.001	0.091	1.537
2007	0.036	0.300	0.580	0.380	0.050	0.027	0.003	0.107	1.483
2008	0.036	0.405	0.580	0.380	0.050	0.027	0.003	0.107	1.588

Commercial wastage (legal-sized)

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
1996	0.001	0.029	0.044	0.177	0.022	0.024	0.029	0.022	0.348
1997	0.006	0.037	0.040	0.074	0.054	0.026	0.030	0.022	0.289
1998	0.001	0.053	0.041	0.154	0.056	0.020	0.017	0.016	0.358
1999	0.007	0.040	0.067	0.117	0.071	0.034	0.028	0.031	0.395
2000	0.007	0.028	0.038	0.059	0.058	0.026	0.023	0.021	0.260
2001	0.003	0.046	0.037	0.065	0.032	0.033	0.029	0.026	0.271
2002	0.005	0.036	0.026	0.139	0.034	0.020	0.016	0.014	0.290
2003	0.002	0.035	0.025	0.068	0.035	0.020	0.016	0.014	0.215
2004	0.000	0.036	0.031	0.076	0.015	0.015	0.012	0.012	0.197
2005	0.005	0.037	0.032	0.156	0.026	0.012	0.007	0.012	0.287
2006	0.002	0.036	0.021	0.051	0.011	0.007	0.004	0.007	0.139
2007	0.003	0.029	0.029	0.053	0.018	0.008	0.004	0.012	0.156
2008	0.001	0.023	0.012	0.063	0.004	0.012	0.012	0.014	0.141

Bycatch (sublegal-sized)

	2A	2B	2C	3A	3B	4A	4B	4CDE	total
1996	0.140	0.133	0.111	1.297	0.972	1.582	0.160	2.708	7.103
1997	0.140	0.106	0.157	1.415	0.714	1.543	0.098	2.230	6.403
1998	0.248	0.096	0.123	1.192	0.657	1.297	0.157	2.030	5.800
1999	0.226	0.085	0.127	1.602	0.992	1.586	0.073	2.141	6.832
2000	0.188	0.102	0.141	1.606	0.863	1.335	0.106	2.330	6.671
2001	0.192	0.028	0.158	1.392	1.045	0.934	0.145	2.177	6.071
2002	0.171	0.092	0.174	1.121	1.205	1.697	0.081	2.038	6.579
2003	0.199	0.115	0.197	1.613	1.064	1.571	0.039	2.349	7.147
2004	0.181	0.121	0.205	2.084	0.837	1.574	0.053	2.136	7.191
2005	0.103	0.165	0.197	1.810	0.765	1.392	0.050	2.461	6.943
2006	0.197	0.143	0.127	1.912	0.892	1.063	0.193	3.217	7.744
2007	0.197	0.146	0.127	1.781	0.792	1.075	0.270	2.855	7.243
2008	0.157	0.064	0.128	1.905	0.852	0.814	0.176	2.337	6.433

Commercial wastage (sublegal-sized)

	2A	2B	2C	3A	3B	4A	4B	4CDE	total
1996	0.002	0.184	0.115	0.323	0.059	0.016	0.017	0.009	0.725
1997	0.002	0.248	0.136	0.426	0.161	0.029	0.029	0.016	1.047
1998	0.002	0.275	0.147	0.473	0.218	0.039	0.025	0.019	1.198
1999	0.003	0.276	0.154	0.491	0.296	0.055	0.031	0.029	1.335
2000	0.003	0.240	0.135	0.393	0.370	0.072	0.041	0.033	1.287
2001	0.005	0.236	0.143	0.459	0.443	0.080	0.038	0.040	1.444
2002	0.009	0.286	0.155	0.516	0.528	0.092	0.032	0.040	1.658
2003	0.009	0.302	0.165	0.530	0.593	0.104	0.029	0.038	1.770
2004	0.011	0.343	0.225	0.612	0.597	0.085	0.018	0.043	1.934
2005	0.013	0.388	0.260	0.659	0.558	0.093	0.012	0.047	2.030
2006	0.014	0.410	0.283	0.667	0.511	0.101	0.009	0.051	2.046
2007	0.016	0.438	0.267	0.918	0.423	0.132	0.018	0.074	2.286
2008	0.015	0.262	0.212	0.924	0.681	0.133	0.019	0.091	2.337

Appendix III. CASE STUDY: GOA Rockfish Program.

Excerpt from GOA Rockfish Program June 2010 Public Review Draft

Halibut

Pacific halibut (*Hippoglossus stenolepsis*) range from the Eastern Bering Sea to Oregon, with the center of abundance in the GOA. Spawning takes place in the winter months from December to February, mostly off the edge of the continental shelf at depths of 400 to 600 meters. Male halibut become sexually mature at 7 or 8 years of age; females become sexually mature at 8 to 12 years. In the 1970s, 10-year old males averaged 9.1 kilograms, and females averaged 16.8 kilograms. Males can grow to approximately 35 kilograms and live up to approximately 30 years; females can grow to over 225 kilograms and live up to approximately 40 years. Females can produce up to 3 million eggs annually. Fertilized eggs float free for about 15 days before hatching. Larvae drift free for up to 6 months and can be carried great distances to shallow waters by prevailing currents. Most young halibut spend 5 to 7 years in shallow waters. At about 35 centimeters, these fish begin life as bottom dwellers. Up to age 10, halibut in the Gulf are highly migratory, generally migrating clockwise throughout the Gulf. Older halibut are much less migratory. Halibut prey on variety of fish, crab, and shrimp, at times leaving the bottom to feed on fish, such as herring and sand lance.

The catch of halibut in directed fisheries is managed under a treaty between the U.S. and Canada, through the International Pacific Halibut Commission. Pacific halibut are considered a single interrelated stock, but are regulated by quotas at the subarea level. Both commercial and recreational fisheries date back to the 1800s.

Currently, regulations limit catch of halibut as PSC. NOAA Fisheries annual sets PSC limits under 50 CFR 679.21 through the annual TAC-setting process. Halibut PSC limits are apportioned by gear group, fishery categories, and season to create more refined PSC limits.

Table 1 and Table 2 show the halibut PSC limits by gear, seasons, and fisheries. The purpose of the seasonal apportionment is to maximize the ability of the fleet to harvest the available groundfish TAC and to minimize halibut PSC. NOAA fisheries will base any seasonal apportionment of the halibut PSC on 1) seasonal distribution of halibut, 2) seasonal distribution of target groundfish species, 3) PSC bycatch needs on a seasonal basis, 4) expected variations in bycatch rates throughout the fishing year, 5) expected changes in directed groundfish fishing season, 6) expected start of fishing effort, and 7) economic effects of establishing seasonal halibut allocations on segments of the target groundfish industry.

For the GOA trawl fisheries, the halibut PSC limit is 2,000 metric tons. The 2,000 metric tons are then apportioned among seasons (currently five[17]) and fishery complexes (shallow water and deep water species) through the annual specification process. The shallow water fishery complex includes pollock, Pacific cod, flathead sole, Atka mackerel, and "other species." The deep water complex includes all rockfish species, rex sole, deep water flatfish, sablefish, and arrowtooth flounder. There is no apportionment between shallow-water and deep-water fishery complexes during the 5th season.

Unused seasonal apportionment of halibut PSC will be added to the respective seasonal apportionment for the next season during the current fishing year. If a seasonal apportionment of halibut PSC is exceeded, that amount of halibut limit will be deducted from the next season's apportionment during the current fishing year. Unused halibut PSC that has been allocated to a rockfish cooperative is added to the last seasonal apportionment for trawl gear after November 15 or after the effective date of a declaration to terminate fishing by the rockfish cooperative during that fishing year.

If, during the fishing year, NOAA Fisheries determines the trawl vessels will catch the halibut PSC limit for that fishery category, NOAA Fisheries will close the entire GOA or regulatory area to directed fishing with trawl gear for that species complex.[18] NOAA Fisheries currently apportions 800 metric tons of

[17] Season 1: January 20 – April 1; Season 2: April 1 – July 1; Season 3: July 1- September 1; Season 4: September 1 – October 1; Season 5: October 1 – December 31.

[18] Trawl vessels fishing for pollock with pelagic gear may continue despite closure of shallow-water fisheries.

halibut PSC to the deep-water complex. This apportionment is split among the five seasons, with the third season (starting in July, when the rockfish fisheries open) being apportioned 400 metric tons.

Prior to implementation of the rockfish program, if the halibut mortality limit was reached prior to catch of the rockfish TAC, the rockfish fisheries were closed for the season and reopened when the next apportionment came available in September. Since implementation of the pilot program, cooperatives receive exclusive allocations of halibut PSC from the third quarter deep water apportionment that constrain their fishing activity. Participants in the limited access fishery (who elected not to join a cooperative) are subject to the same limitation as participants in the rockfish fisheries prior to the pilot program. In other words, if the third season halibut PSC apportionment is fully used prior to harvest of the applicable limited access rockfish TAC, that fishery will be closed until the next season's apportionment comes available in September.

Table 1 Final 2009 and 2010 Pacific halibut PSC limits, allowances, and apportionments (all values are in metric tons)

Trawl gear		Hook-and-line gear [1]			
		Other than DSR		DSR	
Season	Amount	Season	Amount	Season	Amount
January 20–April 1	550 (27.5%)	January 1–June 10	250 (86%)	January 1–December 31	10 (100%)
April 1–July 1	400 (20%)	June 10–September 1	5 (2%)		
July 1–September 1	600 (30%)	September 1–December 31.	35 (12%)		
September 1–October 1	150 (7.5%)	n/a	n/a		
October 1–December 31	300 (15%)	n/a	n/a		
Total	2,000 (100%)	n/a	290 (100%)		10 (100%)

[1] The Pacific halibut PSC limit for hook-and-line gear is allocated to the demersal shelf rockfish (DSR) fishery and fisheries other than DSR. The hook-and-line sablefish fishery is exempt from halibut PSC limits.

Table 2. Final 2009 and 2010 apportionment of Pacific halibut PSC trawl limits between the trawl gear deep-water species complex and the shallow-water species complex (values are in metric tons)

Season	Shallow-water species complex	Deep-water species complex [1]	Total
January 20–April 1	450	100	550
April 1–July 1	100	300	400
July 1–September 1	200	400	600
September 1–October 1	150	Any remainder	150
Subtotal January 20–October 1	900	800	1,700
October 1–December 31 [2]	n/a	n/a	300
Total	n/a	n/a	2,000

[1] Vessels participating in cooperatives in the Central Gulf of Alaska Rockfish Pilot Program will receive a portion of the third season (July 1–September 1) deep-water category halibut PSC apportionment. At this time, this amount is unknown but will be posted later on the Alaska Region Web site at *http://www.alaskafisheries.noaa.gov* when it becomes available.
[2] There is no apportionment between shallow-water and deep-water fishery complexes during the 5th season (October 1–December 31).

Estimated annual halibut catch and mortality for catcher processors and catcher vessels in the CGOA rockfish fisheries from 1996 to 2006 are provided in Table 3.

Table 3. Halibut mortality of trawl vessels in the Central Gulf directed rockfish fishery (1996-2006)

Year	Catcher processors			Catcher vessels		
	Halibut PSC mortality (pounds)	Catch of primary rockfish (tons)	Pounds of halibut PSC mortality per ton of primary rockfish retained catch	Halibut PSC mortality (pounds)	Catch of primary rockfish (tons)	Pounds of halibut PSC mortality per ton of primary rockfish retained catch
1996	117,064.3	4,456.4	26.3	204,983.7	3,445.9	59.5
1997	328,198.8	5,899.6	55.6	109,215.9	3,297.9	33.1
1998	322,643.2	6,680.7	48.3	191,447.5	5,156.5	37.1
1999	372,511.3	8,532.4	43.7	274,097.9	5,877.8	46.6
2000	105,732.6	4,591.2	23.0	300,861.8	8,577.5	35.1
2001	243,916.9	6,301.8	38.7	454,742.8	6,656.4	68.3
2002	244,909.0	4,782.1	51.2	209,657.5	8,051.9	26.0
2003	144,423.1	4,148.7	34.8	340,930.7	9,728.1	35.0
2004	107,653.0	4,977.7	21.6	474,015.4	8,548.7	55.4
2005	150,053.8	5,506.0	27.3	306,010.6	7,445.8	41.1
2006	127,343.3	5,558.0	22.9	165,482.1	6,839.4	24.2

Source: CP data from Catch Accounting/Blend and CV data from ADF&G Fish Tickets

In 2007, the CGOA Rockfish Pilot Program was implemented. The intention of the program is to enhance resource conservation and improve economic efficiency for harvesters and processors who participate in the program. Under the pilot program, allocations of the primary rockfish (Pacific ocean perch, Northern Rockfish, and Pelagic rockfish) and important incidental catch species (i.e., sablefish, Pacific cod, shortraker and rougheye rockfish, and thornyhead rockfish) are divided between the catcher vessel sector and the catcher processor sector. In addition, each sector is also allocated halibut PSC based on historic catch of halibut in the target rockfish fisheries. Under the program, participants in each sector can either fish as part of a cooperative or in a competitive, limited access fishery. As seen from Table 4, annual halibut catch and mortality in the CGOA rockfish fishery has declined since the implementation of the pilot program in 2007 and 2008.

In the years leading up to the pilot program, vessels in the rockfish fishery averaged in excess of 20 pounds of halibut mortality for each metric ton of primary rockfish species. In the first two years of the program, vessels fishing in cooperatives and the limited access fishery under the program cut halibut mortality rates substantially. Vessels in the catcher processor limited access fishery reduced their catch to approximately 13 pounds of halibut per ton of primary rockfish catch in 2007, while in 2008 the halibut mortality rate was 16.5 pounds per ton of primary rockfish catch. [19] For catcher processor cooperative, the single vessel fishing in 2007 reduced its halibut mortality to less than 9 pounds of halibut per metric ton of primary rockfish catch, while the two participating vessels in 2008 had a halibut mortality of 10.5 percent. The catcher vessel sector reduced its halibut mortality to slightly more than 4 pounds of halibut per ton of primary rockfish species catch in 2007, while the halibut mortality in 2008 for this sector was roughly 8 pounds per metric ton of primary rockfish.[20]

[19] In assessing the change in catch rate in the catcher processor limited fishery access, it should be borne in mind that (although not fishing as a cooperative) the vessels fishing in that fishery did not compete for the allocations of pelagic shelf rockfish, reducing the pressure to race for fish.

[20] These calculations include all halibut mortality of vessels fishing allocations under the program, including mortality in trips targeting Pacific cod and sablefish.

Table 4. Halibut mortality of vessels in the Central Gulf rockfish pilot program (2007 and 2008)

Year	Fishery	Vessels	Halibut PSC mortality (pounds)**	Catch of primary rockfish (tons)	Pounds of halibut PSC mortality per ton of primary rockfish catch	Allocation including transfer of halibut PSC mortality (pounds)	Unused allocation (pounds)
2007	Catcher processor limited access	3	26,312.8	2,063.3	12.8	NA	NA
	Catcher processor cooperative*	1	16,623.3	1,933.1	8.6	77,760.7	61,137.3
	Catcher vessel cooperative	25	32,710.1	7,746.0	4.2	309,816.8	277,106.7
	Total	29	75,646.3	11,742.4	6.4	387,577***	338,244+
2008	Catcher processor limited access	4	47,624.4	2,892.1	16.5	NA	NA
	Catcher processor cooperative*	2	19,332.0	1,836.4	10.5	44,092.0	24,760.0
	Catcher vessel cooperative	23	60,622.0	7,446.7	8.1	331,906.9	271,284.9
	Total	29	127,578.4	12,175.2	10.5	375,998.9***	296,044.9+

Source: NMFS Catch Accounting Data

*Data are not confidential because of disclosure in cooperative reports.

** Includes all halibut mortality under the primary program (i.e., excludes entry level fishery).

*** Includes allocation to catcher processor cooperative that did not fish. No allocation is made to the limited access fishery.

+ Includes all allocations and only catches by vessels subject to those allocations.

The drastic reduction in halibut mortality (particularly in the catcher vessel sector) likely arises from several factors. First, vessels have exclusive allocations, allowing them to move from areas of high halibut catch without risking loss of catch of the primary rockfish. Second, exclusive allocations also increase the incentive for participants to communicate with each other concerning catch rates, improving information concerning areas of high halibut incidental catch in the fleet, and preventing repeated high halibut mortality among vessels exploring fishing grounds. Third, several vessels have begun employing new pelagic gear that limits bottom contact and halibut incidental catch. These gear changes are apparent when comparing the percentage of catch using pelagic trawl gear and non-pelagic gear in the first two years of the program with catch by those gear types in the preceding years (see Table 5). In the second year of the program over 40 percent of primary rockfish catch was with pelagic trawl, in comparison to less than 25 percent in 2006 and 6 percent or less in the preceding years. In the second year of the program, nearly 85 percent of the catcher vessel fleet used pelagic gear for some of its catch, in comparison to slightly more than half of that fleet in 2006 and less than 20 percent in the proceeding years. In the catcher processor sector, two of the four active vessels used pelagic gear in the first year of the program, in comparison to no pelagic trawl gear prior to implementation of the program. Catch data by gear type cannot be revealed for the catch processor sector because of confidentiality protections. Participants in the program report that a primary motivation for these changes in gear types is constraining halibut allocations, which could jeopardize cooperative catches in the event that halibut bycatch exceeds allocations.

Table 5. Catch by gear by sector in the Central Gulf of Alaska rockfish fishery (2003-2008)

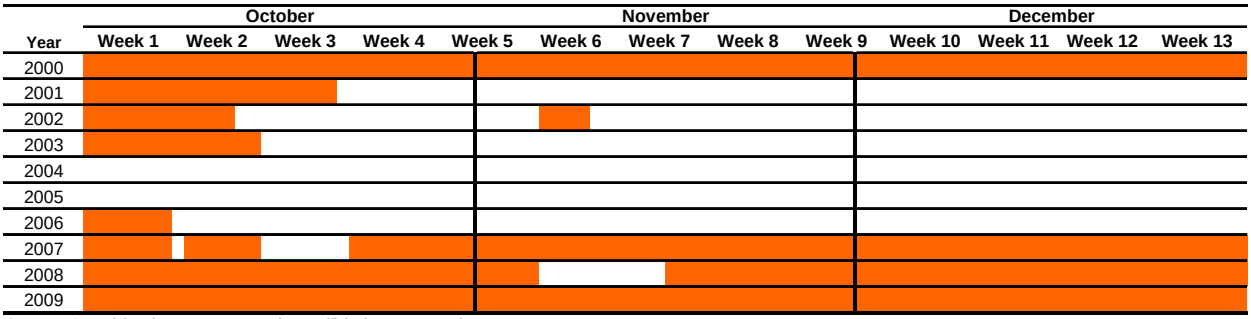
Year	Catcher processors		Catcher vessels					
	Non-pelagic trawl	Pelagic trawl	Non-pelagic trawl			Pelagic trawl		
	Number of vessels	Number of vessels	Number of vessels	Catch of primary rockfish species (in metric tons)	Percentage of catch of primary rockfish species	Number of vessels	Catch of primary rockfish species (in metric tons)	Percentage of catch of primary rockfish species
2003	5	0	31	9,396.6	99.0	1	95.6	1.0
2004	6	0	28	7,875.0	100.0	0	0.0	0.0
2005	6	0	24	6,702.4	94.0	4	429.2	6.0
2006	4	0	23	5,153.2	76.4	13	1,590.0	23.6
2007	4	2	24	4,813.0	62.1	19	2,933.0	37.9
2008	6	1	26	4,230.2	56.8	22	3,216.5	43.2

Source: NMFS Catch Accounting.

The incentive for halibut mortality reductions is increased by the rollover of saved halibut mortality to other fisheries late in the year, allowing the trawl sector as a whole (including vessels that did not qualify for the pilot program) to benefit from these halibut mortality reductions. As seen in the three years of the pilot program, any unused halibut PSC that has been allocated to the cooperatives that has not been used by a cooperative before November 15 or after a declaration to terminate fishing by the cooperative, will be added to the last seasonal apportionment for trawl gear during the current fishing year. On November 13, 2007, 128 metric tons of unused rockfish cooperative halibut PSC was reallocated to the trawl gear, on November 13, 2008, 135 metric tons was reallocated, and on November 15, 2009, 139 metric tons was reallocated. In all three years, the reallocation of halibut PSC from the rockfish pilot program to the GOA trawl fisheries allowed the trawl GOA groundfish fisheries to remain open until December 31. As demonstrated in Table 6, in the five years previous to implementation of the rockfish pilot program, the

trawl GOA groundfish fisheries were closed to directed fishing prior to the end of the season so as not to exceed the halibut PSC limit. In two of those years, 2004 and 2005, the trawl GOA groundfish fishery was closed to direct fishing on October 1.

Table 6. Season duration of the trawl Central Gulf of Alaska groundfish fisheries from October 1 to December 31, 2000 to 2009



Source: NOAA Fishereis status reports and groundfish closure summaries

* Gaps are approximate closure periods

Catch of groundfish late in the year has fluctuated both before and after implementation of the rockfish pilot program. Table 7 below shows vessel count, total catch, and halibut PSC by target for trawl vessels during the October 1 to December 31 period from 2000 to 2009. As seen in the table, in the two years preceding the program, no harvest of groundfish occurred, as all fisheries were closed because no halibut PSC was available. In earlier years, halibut PSC was primarily caught in the shallow-water flatfish, Pacific cod, and arrowtooth flounder fisheries. Smaller amounts of halibut PSC were caught in the rex sole and flathead sole fisheries. In years since the rockfish pilot program, halibut PSC was primarily caught in the shallow-water flatfish fishery, while a smaller amount of halibut PSC was caught in the Pacific cod and arrowtooth flounder fisheries. The rollover, 128 metric tons in 2007, 135 metric tons in 2008, and 139 metric tons in 2009 has clearly supported additional fishing activity, but the degree of the change is uncertain and appears to depend on target preferences, which have varied year-to-year.

Table 7. Vessel count, total catch, and halibut PSC by target for trawl vessels in central and western GOA during the 5th season (Oct 1 – Dec 31) from 2000 - 2009

Species Complex	Target		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Shallow-water	Shallow-water flatfish	Vessel Count	16	9	26	2	0	0	7	7	7	24
		Target catch	1,711	183	3,518	*	0	0	1,776	3,204	5,773	5,970
		Halibut PSC	82	9	213	*	0	0	210	208	238	138
	Pacific cod	Vessel Count	1	53	9	3	0	0	3	6	9	6
		Target catch	*	10,166	170	*	0	0	*	710	2,170	392
		Halibut PSC	*	437	6	*	0	0	*	15	56	7
	Flathead sole	Vessel Count	2	4	2	2	0	0	1	0	2	5
		Target catch	*	194	*	*	0	0	0	0	*	1,320
		Halibut PSC	*	4	*	*	0	0	0	0	*	13
Deep-water	Rex sole	Vessel Count	4	1	2	1	0	0	1	1	0	3
		Target catch	1,353	*	*	*	0	0	*	*	0	*
		Halibut PSC	38	*	*	*	0	0	*	*	0	*
	Arrowtooth	Vessel Count	2	1	8	13	0	0	7	6	8	8
		Target catch	*	*	2,702	6,700	0	0	2,095	1,808	2,025	1,098
		Halibut PSC	*	*	70	186	0	0	122	38	45	12
	Deep-water flatfish	Vessel Count	2	0	0	0	0	0	0	0	0	0
		Target catch	*	0	0	0	0	0	0	0	0	0
		Halibut PSC	*	0	0	0	0	0	0	0	0	0
	Rockfish	Vessel Count	0	0	0	1	0	0	3	7	5	4
		Target catch	0	0	0	*	0	0	*	973	1,392	458
		Halibut PSC	0	0	0	*	0	0	*	9	23	1
Days open during 5th season**			**92**	**20**	**16**	**14**	**0**	**0**	**7**	**82**	**82**	92

Source: Target catch was from Blend data/Catch Accounting, while halibut PSC was from NMFS PSC data

* Withheld for confidentiality

** All closures during the 5th season were to prevent exceeding halibut PSC limit

Information Bulletin 07-115
Sustainable Fisheries Division **November 19, 2007**
907-586-7228 3:15 p.m.

NMFS Reallocates Pacific Halibut from Rockfish Cooperatives in the Central Gulf of Alaska Rockfish Pilot Program to Vessels Using Trawl Gear in the Gulf of Alaska

The National Marine Fisheries Service (NMFS) is reallocating 128 metric tons (mt) of unused halibut prohibited species catch (PSC) from the rockfish cooperatives in the Central Gulf of Alaska (GOA) Rockfish Pilot Program to vessels using trawl gear in the open-access fishery in the GOA, according to James W. Balsiger, Administrator, Alaska Region, NMFS.

The following table summarizes the reallocation in metric tons:

	CURRENT SHARE	THIS ACTION	REVISED SHARE
Halibut rockfish cooperatives	176	- 128	48
Trawl gear	1,824	+ 128	1,952

This action is necessary to provide the opportunity to vessels using trawl gear to harvest available GOA groundfish total allowable catch (TAC) under existing PSC limits, and is issued pursuant to 50 CFR 679.21(d)(5)(iii)(B). This action does not imply any change in the status of the fisheries.

Information Bulletin 08-130
Sustainable Fisheries Division **November 13, 2008**
907-586-7228 4:00 P.M.

NMFS Reallocates Pacific Halibut from Rockfish Cooperatives in the Central Gulf of Alaska Rockfish Pilot Program

The National Marine Fisheries Service (NMFS) is reallocating 135 metric tons (mt) of unused halibut prohibited species catch (PSC) from the rockfish cooperatives in the Central Gulf of Alaska (GOA) Rockfish Pilot Program to vessels using trawl gear in the GOA, according to Robert D. Mecum, Acting Administrator, Alaska Region, NMFS.

The following table summarizes the reallocation in metric tons:

PACIFIC HALIBUT	CURRENT SHARE	THIS ACTION	REVISED SHARE
Rockfish Cooperatives	171	- 135	36
Trawl Gear	1,829	+ 135	1,964

This action is necessary to provide the opportunity to vessels using trawl gear to harvest available GOA groundfish total allowable catch (TAC) under existing PSC limits, and is issued pursuant to 50 CFR 679.21(d)(5)(iii)(B). This action does not imply any change in the status of the fisheries.

Appendix IV. CASE STUDY: Observer Program Restructuring.

Excerpts from Observer Program Restructuring June 2010 Public Review Draft

Halibut Fisheries (p.10-12)

In addition to the lack of observer coverage in the less than 60' fleet, there is no observer coverage in the halibut fisheries. Halibut fisheries are only observed incidentally to groundfish operations. In 2008, 3,141 permit holders fished halibut and sablefish IFQ using 1,157 vessels.[21] There are a number of potential bycatch issues pertaining to the halibut fleet of concern to managers that could be addressed with some level of observer coverage. Most of the information gathered for management of halibut vessels (and vessels <60') currently takes place at shoreside processors, which may provide adequate catch accounting for target species and retained incidental catch species. However, discards are self-reported for all vessels in these sectors. NMFS does not currently have a verifiable measure to account for these discards, nor does it have a method for assessing the accuracy of its management decisions. Additionally, current self-reporting requirements do not include information about vessel fishing behavior.

In addition, in 1998, the U.S. Fish and Wildlife Service (USFWS) prepared a Biological Opinion (BiOp) on the commercial Pacific halibut hook-and-line fishery in the GOA and BSAI, and its effects on the short-tailed albatross *(Phoebastria albatrus)* (USFWS 1998). The USFWS concluded:

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of short-tailed albatrosses which will result from this action.

> *1) The research plan required by the reasonable and prudent measures of the June 12, 1996 biological opinion on the BSAI/GOA groundfish fishery will apply also to this fishery, and will be implemented.*
>
> *2) Initial indications are that a given halibut vessel is far more likely to encounter a short-tailed albatross during a given unit of fishing effort than is a BSAI/GOA groundfish fishing vessel. Data supporting or refuting this supposition do not exist.* ***The NMFS shall prepare and implement a plan to investigate all options for monitoring the Pacific halibut fishery in waters off Alaska. It will then institute changes to the fishery appropriate to the results of this investigation.***
>
> *3) The NMFS has done an admirable job in making commercial fishers aware of the plight of endangered birds and marine mammals. They shall continue to educate commercial fishers about seabird avoidance measures, short-tailed albatross identification, the importance of not taking short-tailed albatrosses, and ways to avoid taking them when they are sighted near bait.*
>
> *In order to be exempt from the prohibitions of section 9 of the Act, the NMFS must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.*
>
> *Terms and conditions must include reporting and monitoring requirements that assure adequate action agency oversight of any incidental take [50 CFR §402.14(I)((1)(iii) and (I)(3)]. The monitoring must be sufficient to determine if the amount or extent of take is approached or exceeded, and the reporting must assure that the USFWS will know when that happens. The NMFS must provide for monitoring the actual number of short-tailed albatrosses taken, and assure that the reasonable and prudent measures are reducing the effect of the fishery to the extent anticipated. If the anticipated level of incidental take is exceeded, the action agency must immediately stop the action causing the take and reinitiate formal consultation.*
>
> *Under these terms and conditions, the NMFS must:*
>
> *1) Apply the groundfish fishery seabird avoidance evaluation research plan (required by the reasonable and prudent measures of the June 12, 1996 biological opinion on the BSAI/GOA*

[21] In the CDQ halibut fisheries, 278 vessels fished 6 CDQ permits.

groundfish fishery) to this fishery, with changes appropriate to reflect differences in the timing and methodologies between the two fisheries.

2) Implement the above seabird avoidance evaluation research plan. Implementation of this plan shall begin no later than 1999. The seabird avoidance evaluation shall be comprised of experiments to test the effectiveness of seabird deterrent devices and methods, and shall use observers to monitor the effectiveness of deterrent devices and methods used by the vessels participating in the evaluation. The NMFS will report to the USFWS on the parts of the plan that have been implemented concurrent with their implementation. A final report of this seabird avoidance device and methods evaluation will be made to the USFWS by December 31, 2000.

3) The NMFS will institute changes to the Pacific halibut fishery in waters off Alaska deemed appropriate based upon the evaluation of the seabird deterrent devices and methods. ***Changes may range from requiring minimal observation of the fishery due to the effectiveness of the deterrent devices to requiring extensive observer coverage and expanded or modified use of seabird deterrent devices and methods*** *(emphasis added).*

Section 3.3.2 Background (p. 110-112)

Effective fisheries management requires that the quantity of catch be known. This information can be garnered from industry in the form of landings (fish tickets) or at-sea production reports. Quantity of retained catch represents the most basic form of catch information. Because fisheries are not 100% efficient, industry reported data may not include information on at-sea discards or interactions with species of special concern such as marine mammals or seabirds. Deduction of non-marketable catch or prohibited species catch from individual catch quotas introduces economic incentive to misreport such information. When reported values systematically differ from true values, bias may result.

The domestic observer program was established in 1990 to address the need for unbiased data on catch and biological interactions from the North Pacific groundfish fishery. The program was set up as an industry-funded "pay-as-you-go" system. Consequently, rules specifying the coverage requirements (i.e., proportion of days required to be observed) were initially set according to vessel length overall according to what was considered "fair" by industry and government representatives at the time. Based on these initial rules, vessels less than 60' LOA were not required to be observed when fishing, vessels 60' – 125' LOA were required to have observers onboard for 30% of their fishing days and one-full trip per fishery (defined by target species), and vessels >125' LOA were required to have observers onboard for 100% of their fishing days.[22] Likewise, shore-based facilities processing 500 mt - 1,000 mt per month are required to have an observer present at the facility at least 30% of the days they receive or process groundfish during that month, and facilities processing over 1,000 mt are required to be observed for 100% of their days.

The way the system is designed, for vessels and processors required to have 30% observer coverage, industry decides which fishing or processing days are to be observed to meet mandated coverage requirements in regulation. Since there is a cost associated with each day observed, vessels with low profit margins may be tempted to reduce coverage costs through non-representative fishing. Two of the most common sources of bias that can be introduced into catch estimates are fishing in non-representative areas, and fishing at non-representative times.[23] Both of these types of bias appear driven by economic incentives, as non-representative trips are commonly taken close to shore (reducing time and fuel costs) and gear is hauled immediately before and after midnight (achieving two days coverage for less than 24 hours effort).[24] In addition, the current length-based system for categorizing vessels for coverage rates

[22]Throughout this implementation plan, staff commonly refers to fleets that are required to have these at-sea coverage levels as the 'less than 60 fleet,' 'the 30% fleet,' and 'the 100% fleet.'

[23]NPFMC, 2008. Public review draft: Regulatory impact review/initial regulatory flexibility analysis for a regulatory amendment to revise administrative and procedural aspects of the North Pacific Groundfish Observer Program. Accessed 07/13/2009 and available at http://alaskafisheries.noaa.gov/npfmc/current_issues/observer/Observer408.pdf

[24] The definition of observer day is scheduled to change (likely 2010) to prohibit this latter practice.

imposes an economic incentive to alter original vessel size, especially if near 60' or 125' LOA, since observer coverage rates (and incurred vessel cost) will change by 70% from 125' to 124' and by 100% from 60' to 59'. Since the inception of the observer program, management needs have amended the original rules regarding observer coverage, resulting in a complicated set of conditions for compliance (Appendix 1). Nonetheless, the core structure of a 0%, 30%, and 100% fleet, and industry control of observer deployment in the 30% fleet, has remained in place.

Over nearly two decades, the observer program has grown into one of the largest in the world; in 2008, aggregate observer days billed to industry exceeded 39,000.[25] The Fisheries Monitoring and Analysis Division (FMA) of the Alaska Fishery Science Center is responsible for oversight of the observer program and conducts the training and debriefing of observers and the maintenance of an observer database called NORPAC. The primary objective of FMA is to provide accurate and precise data on total catch (retained catch and bycatch), and biological information for conservation and management of groundfish resources and the protection of marine mammals, seabirds, and protected species. Specifically, observer data is prioritized to meet data requirements for in-season management, stock assessment, bycatch monitoring, and regulatory compliance (MRAG 2000). The importance of verifiable independent estimates of total catch is highlighted by amendments made to the MSA in 2007 that require fishery management plans to establish mechanisms for specifying annual catch limits (ACL) at such levels that overfishing does not occur.

Catch estimation and monitoring of quotas is the responsibility of the NMFS Alaska Region Office. North Pacific fisheries have been cited as among the best managed in the world (Worm et al. 2009), and a complex suite of rules to control fishing have been enacted by the Council and NMFS that include: limited entry, trip limits, quota sharing systems (including community development, cooperative, and individual quotas), and catch limits. NMFS' catch accounting system (CAS) estimates total removals within each fishery (defined by target species, area, gear, management program, and time) whereby retained catch is added to discarded catch.

Catch sampling and estimation of total catch by the CAS has recently been documented by Cahalan et al. (2010). Briefly, the CAS uses observer-derived data in conjunction with industry-derived data. For catcher processors and motherships, the data source used to estimate retained catch is dependent on reporting requirements and observer coverage rates specified by Federal regulations that vary greatly by vessel type (50 CFR 679.50). Landing reports (fish tickets or production reports) are required from all processors that are required to have a Federal Processing Permit and which receive groundfish from catcher vessels that are issued a Federal Fisheries Permit. Processors may be at-sea (motherships), floating, or shoreside types. The collection period for a landing report is a trip (defined as the period from when fishing begins to the time of delivery) for CVs delivering to floating and shoreside processors, and a day for each catcher vessel that delivers to a mothership. In contrast to landings reports derived from CVs, catcher processors and motherships must submit at-sea production reports if issued a Federal Fisheries Permit. Production reports are required daily for both shoreside processors and the at-sea fleet.

Information about non-retained species that were caught or otherwise impacted by fishing operations from industry landings and production reports are unverifiable or absent altogether. In general, the CAS estimates retained catch from observer data collected on CPs and motherships with ≥100% observer coverage (in cases where the observer has access to flow scales) and uses landing and production reports of retained catch on CVs delivering shoreside or CPs and motherships with less than 100% observer coverage. For the same reason, the CAS uses at-sea discard rates estimated from observer data obtained from observed vessels that are fishing with similar gear, areas and/or times, and applies this rate to industry landing reports to estimate at-sea discards. At-sea discards from vessels with 100% or greater observer coverage are estimated from observer data. Total catch used for quota management is then the sum of retained and discarded catch (Cahalan et al. 2010).

[25] As determined from embark-disembark dates in NORPAC database.

The regulatory nature governing observer deployment (i.e., coverage requirements) facilitates the introduction of bias into observer data through non-representative fishing. Given the use of observer data in the CAS, and the subsequent use of CAS data in stock assessments, this issue can undermine the validity of data used to manage North Pacific groundfish fisheries. What follows serves to provide the rationale and means to reduce the bias introduced by industry control over observer coverage for fishing operations with less than 100% observer coverage requirements, should the Council recommend restructuring the observer program such that NMFS controls the deployment of observers in the North Pacific groundfish and halibut fisheries.

Section 3.3.6 Recent review of deployment and observer effects (p. 115)

While past reviews have highlighted the potential for bias to be introduced into observer data through non-representative fishing, it has remained difficult to document whether or not such potential bias is actually present. Differences in the dynamics of observed and unobserved trips can be manifested in two ways. In the first, *the selection of fishing operations to be observed* is such that those trips are not representative of unobserved trips (i.e., the "deployment effect"). In the second, a change in the fishing behavior of vessels *when they are observed* results in trips with characteristics of fishing operations (e.g., location, timing, duration) that are not representative of unobserved fishing operations (i.e., the "observer effect"). Analyses of the 30% catcher vessel fleet landings in 2008 are presented in **Appendix 8**. These analyses indicate that the current regulatory nature of observer deployment results in a skewed, non-random deployment of observers (evidence of a deployment effect), and that in some fisheries an observer effect is also present.

Section 4.3.1 Benefits from improved observer data under Alternatives 2 – 5 (p 142)

Additional benefits, compared to the status quo, are expected to varying degrees under Alternatives 2 – 5, in which the deployment and funding mechanism of the observer program is restructured. Under the proposed restructuring alternatives, the greatest increase in improvement in the collection of observer data would be expected in the sectors that currently have either 30% observer coverage requirements or no observer coverage requirements.

Reducing sources of bias

Under the existing observer program, vessels required to carry observers 30% of their fishing days choose when and where to carry observers provided that they meet the minimum coverage requirement of 30% of fishing days per quarter and at least one observed fishing trip for each target fishery. Many vessel owners prefer to carry their required coverage later rather than earlier during each quarter for several reasons. First, when vessels carry observers later in the quarter or fishing season they may have a better idea of how many coverage days will actually be needed to meet the regulatory requirement than vessels carrying observers during the start of a fishing season. Therefore, vessels carrying observers later in each quarter or season are better able to avoid exceeding their coverage requirement and paying for additional observer days that are not required. Second, some vessel owners may prefer to carry observers later in each quarter so that they can first earn revenues required to pay for observer coverage and other expenses.

The preference for coverage later in the quarter is tempered to some extent by observer providers who have observers under contract and must keep their observers deployed in order to minimize unpaid downtime. Consequently, there is a constant give and take between observer providers and vessel owners in the existing 30% coverage fleet over when and where to carry observer coverage. However, these types of coverage decisions are generally driven by the observer provider's desire for efficiency and the vessel owner's desire for predictability, with little or no regard given to scientific or management objectives. This is because NMFS does not decide when and where observers are deployed in the 30% coverage fleet. Because catch and bycatch rates fluctuate by season and area, biased decisions about when and where to deploy observers in the 30% coverage fleet has the potential to greatly affect the quality and reliability of observer data. Refer to Sections 0 and 0 of the sample design, and Appendix 8 for a more detailed treatment of this issue.

Under Alternatives 2 - 5, the existing 30% coverage requirements in regulation would be eliminated, and NMFS would determine when and where to deploy observers and how much coverage is necessary for

each fishery in those sectors required to have <100% coverage. (The only exception is under Alternative 2, which proposes to restructure the observer program for the GOA groundfish and halibut fisheries and the <60' groundfish sector and halibut sector in the BSAI. Under this alternative, vessels ≥60' in the BSAI would continue under the status quo, and thus, the 30% coverage regulation would still exist for vessels operating in the BSAI that are currently subject to the 30% requirement.) Under Alternatives 2 – 5, NMFS would also have the ability to better 'match' observers' skills and experience to the deployment of observers in all fisheries, whether they are <100% covered or ≥100% covered. Fishery managers would be able to address these and other known sources of bias, to the benefit of the resulting data.

Recent examinations of the North Pacific Groundfish Observer Program have focused on operational aspects of the program and have dealt with such issues as sampling protocols, reducing bias, estimate expansion, and the statistical properties of estimates (e.g. Jensen et al. 2000, Dorn et al. 1997, Volstad et al. 1997, Pennington 1996, and Pennington and Volstad 1994). These and other studies suggest that sources of bias can be reduced and the statistical reliability of observer data improved through improvements in the manner in which observers are deployed. In particular, bias can be reduced by changing the current system, in which 30% coverage vessels can chose when and where to take observers, to a new system in which NMFS is responsible for the sample design that governs the deployment of observers among vessels in a more statistically sound manner.

Finally, in a March 2004 report, the U.S. Department of Commerce, Office of Inspector General (OIG) recommended that NMFS work with the Council to establish requirements for an observer program that includes a vessel selection process that is scientifically valid and unbiased. NOAA concurred that improved vessel selection procedures are needed for scientific data collection, and indicated that they were working with the Council to address these biases. A follow-up memorandum from the OIG to NMFS' Assistant Administrator in September 2008, documented that the OIG recommendation for this issue remains open, as fishery managers still cannot control when and where observers are placed in the North Pacific groundfish fisheries. All other recommendations in the 2004 OIG report for improving data quality, performance monitoring, and outreach efforts in NMFS observer programs have been addressed.

Lack of data in 30% sectors and sectors without coverage requirements

The current groundfish observer program throughout Alaska is one in which groundfish vessels less than 60' are not required to carry observers and vessels 60' – 125' LOA are required to carry and pay for their own observers 30% of their fishing days, regardless of gear type or target fishery.[26] These two size categories make up the majority of vessels fishing in the GOA and out of ports other than Dutch Harbor and Akutan in the BSAI. Observers on vessels greater than 60' estimate total catch for a portion of the hauls or sets, and sample these hauls or sets for species composition. These data are extrapolated to make estimates of total catch by species for the entire fishery, including unobserved vessels. Observer data from observed vessels are assumed to be representative of the activity of all vessels, and are used to estimate total catch of prohibited species for the entire fishery.[27] On average, vessels less than 60' harvested 27% of the total GOA groundfish catch from 2003 – 2007, and all of this catch was unobserved.

In addition to the lack of observer coverage in the less than 60' fleet, there is no observer coverage in the halibut fisheries. Halibut fisheries are only observed incidentally to groundfish operations. In 2008, 3,141 permit holders fished halibut and sablefish IFQ using 1,157 vessels.[28] There are a number of potential bycatch issues pertaining to the halibut fleet.[29] Most of the information gathered for management of

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[26] Unless participating in a limited access quota program as described previously, which may require additional coverage.

[27] This has resulted in additional data problems owing to fishing behavior by some boat operators, when an observer is aboard, that is clearly not representative of fishing practices when unobserved. Referred to as "fishing for observer coverage", these resulting data, when extrapolated to other vessels that are unobserved, compound the potential catch and bycatch estimation errors, but to an unknown degree.

[28] Includes CDQ halibut fisheries.

[29] Note that NMFS and the IPHC are currently working through an NPRB grant to evaluate the potential for EM systems on these vessels.

halibut vessels (and vessels <60') currently takes place at shoreside processors, which may provide adequate catch accounting for target species and retained incidental catch species. However, discards are self-reported for all vessels in these sectors. NMFS does not currently have a verifiable measure to account for these discards, nor does it have a method for assessing the accuracy of its management decisions. Additionally, current self-reporting requirements do not include information about vessel fishing behavior.

Under Alternatives 2 - 5, the existing 30% coverage requirements in regulation would be eliminated, and NMFS would determine when and where to deploy observers and how much coverage is necessary for each fishery. (The only exception is under Alternative 2, which proposes to restructure the observer program for the GOA groundfish and halibut fisheries and the <60' groundfish sector and halibut sector in the BSAI. Under this alternative, the 30% coverage regulation would still exist for vessels operating in the BSAI that are currently subject to the 30% requirement.) In addition, the <60' groundfish sector and halibut sector, for both the GOA and BSAI, are included under every alternative to restructure the observer program (Alternatives 2 – 5).

Targeting coverage to address data needs

An additional benefit to a restructured program for fisheries with <100% coverage needs is the ability of NMFS to target coverage to address specific data needs. Under Alternatives 2 - 5, fishery managers would have the flexibility to adjust coverage as necessary to fill data gaps and address specific conservation or management issues for the fisheries included in the preferred alternative. For example, if questions arise about catch or bycatch by vessels operating in a specific area or time of year, NMFS would have the ability to develop the sampling design such that observers are deployed on vessels during specific times or into specific areas to address those questions. In addition, because NMFS would have greater control over the deployment of specific observers, observers could be directed and trained to engage in more specialized data collection or research than is possible today. These types of specialized projects could include more intensive data collection on specific species or species groups, data collection on gear performance and gear interactions, and more intensive data collection on interactions with marine mammals and other protected species.

Alaska Region Office, NMFS
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Discussion Paper on Process for Modifying Halibut Prohibited Species Limits in the Alaska Groundfish Fisheries

At its December 2009 meeting, the North Pacific Fishery Management Council (Council) requested staff to prepare a discussion paper examining how Pacific halibut prohibited species catch (PSC) limits are established each year in the annual harvest specifications process and the process for modifying them.

Background

The annual halibut PSC limits for the federally managed groundfish fisheries in the Bering Sea and Aleutian Islands management area (BSAI) and Gulf of Alaska (GOA) are established by different procedures described below.

BSAI: The Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Area (BSAI FMP) authorizes the establishment of the BSAI halibut PSC limits in regulations and sector allocations thereof. Accordingly, total BSAI limits and sector allocations (trawl, Amendment 80 sector, BSAI trawl limited access sector, and non-trawl sectors) are set in regulation and the limits allocated to each sector as part of the annual harvest specifications reflect those regulations. **Modifications to PSC limits would require either an FMP amendment or regulatory amendment, depending on the modification.** Current regulatory allocations of the BSAI halibut PSC limits are as follows:

BSAI Sector	Halibut PSC limit	Regulatory authority
Total Trawl Sector	**3,675**	§ 679.21(e)(1)(iv)
Amendment 80	2,425 (in 2010)	§ 679.21(e)(3); Table 35 to part 679
BSAI Limited Access	875	§ 679.21(e)(3); Table 35 to part 679
Trawl CDQ	326	§ 679.21(e)(3)(i)(A)(2)
Total Non-Trawl	**900**	§ 679.21(e)(2)
Nontrawl CDQ	67	§ 679.21(e)(4)(i)(A)
Other Nontrawl	833	

NOTE: The trawl PSC limits do not add up to the regulatory limit of 3,675 mt because the PSC limit reductions for the Amendment 80 sector are not reflected in a commensurate downward adjustment of the PSC limit established in regulations. In reality, the trawl PSC limit in 2010 is managed to 3,626. By 2012, the Amendment 80 sector allocation will be 2,325. This allocation plus the 875 mt for the BSAI trawl limited access sector and 326 mt for trawl CDQ will equate to a managed PSC limit of 3,526 mt.

Pursuant to § 679.21(e)(1)(iv) and § 679.91(d) through (f), trawl halibut PSC assigned to the Amendment 80 sector is sub-allocated to Amendment 80 cooperatives as PSC cooperative quota (CQ) and to the Amendment 80 limited access fishery. PSC CQ assigned to Amendment 80 cooperatives is not allocated to specific fishery categories. The PSC allocations between Amendment 80 cooperatives and the Amendment 80 limited access sector are not known until eligible participants apply for participation in the program by November 1 each year. Section 679.21(e)(3)(i)(B) requires the apportionment of each trawl PSC limit not assigned to Amendment 80 cooperatives into PSC bycatch allowances for seven specified fishery categories. Section 679.21(e)(4)(i) authorizes the apportionment of the non-trawl halibut

PSC limit into PSC allowances among six fishery categories. Halibut bycatch PSC allowances may be seasonally apportioned as part of the annual harvest specification process after considering information listed in regulations at § 679.21(e)(5).

GOA: Under the current Fishery Management Plan for Groundfish of the Gulf of Alaska (GOA FMP), the halibut mortality PSC limits are specified annually as a component of the proposed and final groundfish harvest specifications under the regulatory process described at § 679.21(d). **However, the actual amount of the trawl and non-trawl halibut PSC limits are discretionary consistent with the considerations set forth in the FMP and implementing regulations.** The GOA FMP at section **3.6.2.1.1 Apportionment and Seasonal Allocation of Pacific Halibut** (Appendix 1) sets forth criteria for the annual PSC limits that must be considered. These include:

- estimated change in biomass and stock condition of halibut;
- potential impacts on halibut stocks;
- potential impacts on the halibut fisheries;
- estimated bycatch in years prior to that for which the halibut PSC mortality limit is being established;
- expected change in target groundfish catch;
- estimated change in target groundfish biomass;
- methods available to reduce halibut bycatch;
- the cost of reducing halibut bycatch; and
- other biological and socioeconomic factors that affect the appropriateness of specific bycatch measures in terms of objectives.

Additionally, separate but related criteria are set forth in the GOA FMP for the seasonal distribution of the halibut PSC limits (Appendix 1), as well as in regulations at §679.21(d)(5). The final harvest specifications summarize the Council and NMFS's findings with respect to each of these FMP considerations.

Section 679.21(d) authorizes the apportionment of annual halibut PSC limits to GOA trawl and hook-and-line gear and allows the establishment of apportionments for pot gear. Since 1986, the Council has recommended that NMFS maintain the halibut PSC limit of 2,000 mt for the trawl fisheries and since 1995 has recommended a 300 mt PSC limit for the hook-and-line gear fisheries. Prior to 1995, the Council recommended a fixed gear halibut PSC limit of 750 mt. Pot gear was exempted from closures under the fixed gear limit, so all of the 750 mt was allocated to hook-and-line gear. Since 1995, the Council reduced the PSC limit for hook-and-line gear to 300 mt by exempting the IFQ sablefish fishery from halibut PSC restrictions. Halibut PSC limits for GOA trawl and non-trawl fisheries and associated catch mortality since 1995 are listed in Table 1.

At its September 1993 meeting, the Council adopted a regulatory amendment to authorize separate apportionments of the trawl halibut bycatch mortality limit between trawl fisheries for the deep-water species complex (deep-water flatfish, rockfish, sablefish, and arrowtooth flounder) and for the shallow-water species complex (pollock, Pacific cod, shallow-water flatfish, flathead sole, Atka mackerel, and "other species"). This action was subsequently implemented through emergency and then normal rulemaking process.

Section 679.21(d)(5) provides NMFS the authority to seasonally apportion the GOA halibut PSC limits after consultation with the Council. The GOA FMP and regulations require the Council and NMFS to consider the following information in seasonally apportioning halibut PSC limits: (1) seasonal distribution of halibut; (2) seasonal distribution of target groundfish species relative to halibut distribution; (3) expected halibut bycatch needs on a seasonal basis relative to changes in halibut biomass

and expected catch of target groundfish species; (4) expected bycatch rates on a seasonal basis; (5) expected changes in directed groundfish fishing seasons; (6) expected actual start of fishing effort; and (7) economic effects of establishing seasonal halibut allocations on segments of the target groundfish industry. Sections 679.21(d)(5)(iii) and (iv) specify that any underages or overages of a seasonal apportionment of a PSC limit will be deducted from or added to the next respective seasonal apportionment within the fishing year.

Process for modifying the GOA Halibut PSC limits under the Current FMP.

As described above, the GOA FMP and implementing regulations authorize the Council to recommend, and NMFS to approve, annual halibut mortality PSC limits as a component of the proposed and final groundfish harvest specifications. The current 2,000 mt PSC limit for the GOA trawl fisheries has remained unchanged since 1989 and prior to that (1986 – 1988) approximated this amount in the domestic and joint venture groundfish fisheries as well. As mentioned above, the 300 mt PSC limit for the non-trawl fisheries has remained unchanged since 1995 when the IFQ sablefish fishery was exempted from the PSC limit.

Prior to 2007, the environmental and socioeconomic effects of the annual harvest specifications, including the PSC limits, were considered in annual environmental assessments prepared each year for the harvest specifications process. Preparation of annual environmental assessments ceased in 2007 with the development of an environmental impact statement (EIS) prepared for the groundfish harvest strategy supporting the annual harvest specifications. The EIS did not address the process for setting annual PSC limits and likely will be updated with a supplemental EIS in 2011. At that time, the Council may wish to expand the supplemental EIS to include a range of alternatives for halibut PSC limits. Alternatively, the Council could update the environmental assessment (EA) and final regulatory flexibility analysis (FRFA) prepared for the 2006-2007 harvest specifications. This document was finalized in January 2006 and would need to be updated to assess alternatives for changing the current GOA PSC limits. The scope of alternatives could be designed to provide some flexibility in future years to modify PSC limits, similar to how adjustments to annual groundfish specifications are determined within the scope of the EIS supporting the harvest specifications.

The schedule for such an analysis would need to be dovetailed with the annual harvest specifications process so that harvest specifications are not delayed. A description of a recommended schedule is provided below and summarized in Figure 1.

Scheduling considerations for an analysis on alternatives to modify GOA halibut PSC limits

The Council proposes harvest specifications, including halibut PSC limits and apportionments thereof, in October each year for the next two year period. The proposed harvest specifications are published in the *Federal Register* for a 30-day comment period that typically spans the December Council meeting. Final Council recommendations on harvest specifications for the next two-year period occur in December and pending NMFS approval, these recommendations typically are implemented by final rule between mid-February and March 1 of the following year. During the time period between January 1 and when the new harvest specifications are published (about March 1), harvest specifications that were recommended for that year by the Council two years prior are effective. These early year specifications sometimes are revised by inseason adjustment authority (50 CFR 679.25) if they are determined to be misspecified and not based on the best available science. For example, pollock and Pacific cod TACs often are adjusted prior to January 1 to reflect new ABC/TACs stemming from the most recent Council recommendations

and to ensure that seasonal harvest limits are based on the best available science and not exceeded for consistency with Steller Sea Lion protection measures. Further consultation with NOAA General Counsel is required to determine whether the existing inseason adjustment authority extends to the adjustment of a halibut PSC limit thereby allowing such changes to be effective within the next fishing year. This is important because PSC limits for a year must be effective at the beginning of a fishing year so that seasonal or fishery apportionments are not exceeded. Thus, downward adjustments of a GOA halibut PSC limit recommended by the Council in December under the current harvest specification process *may* not be effective until the second year of the upcoming two-year specifications.

To avoid a delay in the harvest specifications process, the analysis of alternatives for adjustments to halibut PSC limits should be initiated early in the year. Ideally alternatives would be identified by April, an analysis prepared for initial Council review in June, with a preliminary preferred alternative chosen by the Council in October that would be incorporated in the proposed harvest specifications for public review and comment. The final recommendation of a modified PSC limit would occur in December and included in the final harvest specifications. As stated above, a modification to the PSC limits may not be effective until the second year of the two-year specification process if the March 1 effective date of the harvest specifications during year 1 would undermine or preempt the Council's objective for the modified PSC limit. An exception to this delay could occur if cause for waiver of prior notice and comment under the Administrative Procedure Act exists and action were taken by the Council in October to change the existing halibut PSC limit established for the upcoming year by direct final rule. Given the systemic changes to harvest specifications that would be necessary and associated analyses, review and approval processes, NMFS would be concerned about staff resources being diverted to this abbreviated rulemaking process instead of completing staff work necessary to support the normal harvest specifications process.

Other Options for Modifying the GOA Halibut PSC limits

An alternative to developing an EA/initial RFA supporting modification of halibut PSC limits as a provision of the annual harvest specifications could be the development of an analysis for a new GOA FMP amendment that establishes the PSC limits in regulations, similar to the BSAI FMP and implementing regulations. The level of analysis, staff resources, and schedule considerations necessary to accomplish a modification to PSC limits would be similar under either approach. If the Council wished instead to develop an FMP amendment to establish PSC limits in regulations, regulations implementing the new PSC limits would need to be effective by December for the upcoming harvest specification process. Further consultation with NOAA General Counsel is required to assess whether a new PSC limit could be effective the next fishing year by inseason adjustment authority or whether the effective date of a new PSC limit would be delayed until the following year, similar to the schedule set forth in Figure 1.

Conclusion

Halibut PSC limits in the GOA are set on an annual basis as a provision of the harvest specifications process, while in the BSAI they are set by regulation. Changes to the GOA PSC limits would require that an analysis (EA/initial RFA) be prepared within a timeframe that allows for final Council action in December and implementation through the harvest specification process. Alternatively, an FMP amendment could be considered that authorizes the establishment of modified PSC limits in regulations, similar to the BSAI.

Table 1. 1995 - 2009 trawl and hook-and-line halibut PSC mortality in the GOA; Trawl PSC limit is 2000 mt and Hook-and-Line PSC limit is 300 mt.

Year	Trawl bycatch mortality	Hook and Line bycatch mortality	Total bycatch mortality
1995	2,152	377	2,529
1996	2,050	172	2,221
1997	1,946	125	2,071
1998	2,113	296	2,409
1999	2,028	348	2,376
2000	2,137	276	2,414
2001	1,888	285	2,173
2002	2,197	244	2,441
2003	1,995	290	2,286
2004	2,444	302	2,745
2005	2,108	208	2,316
2006	1,984	335	2,319
2007	1,948	294	2,242
2008	1,955	502	2,458
2009	1,818	277	2,095

Figure 1. Schedule for analytical and harvest specification process necessary to support change to the GOA halibut PSC limits using the 2011/2012 harvest specification process as an example.

Action	**Apr**	May	June	Jul	Aug	Sept	Oct	Nov	Dec	**Jan**	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	**Jan**
	2010									**2011**												**2012**
Choose alternatives and task analysis (April 2010)																						
Analysis developed for Council initial review & approval for public review (June 2010)																						
Council selects preliminary preferred alternative (Oct 2010)																						
NMFS prepares & publishes proposed harvest specs for 30-day comment period (12/1/10)																						
Council final action on 2011/2012 harvest specifications; adoption of modified PSC limit for 2012																						
Publish 2011/2012 final harvest specifications (March 1, 2011)																						
Modified PSC limits effective January 1, 2012																						

Appendix 1. GOA FMP policy regarding halibut PSC limits (Section 3.6.2.1.1 Apportionment and Seasonal Allocation of Pacific Halibut)

Apportionments of PSC limits, and seasonal allocations thereof, will be determined annually by the Secretary of Commerce in consultation with the Council. Separate PSC limits may be established for specific gear. PSC limits, apportionments, and seasonal allocations will be determined using the following procedure:

1.Prior to the October Council meeting. The GOA Groundfish Plan Team will provide the Council the best available information on estimated halibut bycatch and mortality rates in the target groundfish fisheries.

2. October Council meeting. While developing proposed groundfish harvest levels under Section 3.2.3, the Council will also review the need to control the bycatch of halibut and, if necessary, recommend proposed halibut PSC mortality limits and apportionments thereof. The Council will also review the need for seasonal allocations of the halibut PSC. The Council will make proposed recommendations to the Secretary about some or all of the following:

a. the regulatory areas and districts for which PSC mortality limits might be established;
b. PSC for particular target fisheries and gear types;
c. seasonal allocations by target fisheries, gear types, and/or regulatory areas and district;
d. PSC allocations to individual operations; and
e. types of gear or modes of fishing operations that might be prohibited once a PSC is reached.

The Council will consider the best available information in doing so. Types of information that the Council will consider relevant to recommending proposed PSCs include:

a. estimated change in biomass and stock condition of halibut;
b. potential impact on halibut stocks;
c. potential impacts on the halibut fisheries;
d. estimated bycatch in years prior to that for which the halibut PSC mortality limit is being established;
e. expected change in target groundfish catch;
f. estimated change in target groundfish biomass;
g. methods available to reduce halibut bycatch;
h. the cost of reducing halibut bycatch; and
i. other biological and socioeconomic factors that affect the appropriateness of specific bycatch measures in terms of objectives.

Types of information that the Council will consider in recommending seasonal allocations of halibut include:

a. seasonal distribution of halibut;
b. seasonal distribution of target groundfish species relative to halibut distribution;
c. expected halibut bycatch needs on a seasonal basis relevant to changes in halibut biomass and expected catches of target groundfish species;
d. expected bycatch rates on a seasonal basis;
e. expected changes in directed groundfish fishing seasons;
f. expected start of fishing effort; and
g. economic effects of establishing seasonal halibut allocations on segments of the target groundfish industry.

3. As soon as practicable after the Council's October meeting, the Secretary will publish the Council's recommendations as a notice in the Federal Register. Information on which the recommendations are based will also be published in the Federal Register or otherwise made available by the Council. Public comments will be invited by means specified in regulations implementing the FMP for a minimum of 15 days.

4. Prior to the December Council meeting. The Plan Team will prepare for the Council a final Stock Assessment and Fishery Evaluation (SAFE) report under Section 3.2.3 which provides the best available information on estimated halibut bycatch rates in the target groundfish fisheries and recommendations for halibut PSCs. If the Council requests, the Plan Team also may provide PSC apportionments and allocations thereof among target fisheries and gear types, and an economic analysis of the effects of the apportionments.

5. December Council meeting. While recommending final groundfish harvest levels, the Council reviews public comments, takes public testimony, and makes final decisions on annual halibut PSC limits and seasonal apportionments, using the factors set forth under (2) above relevant to proposed PSC limits, and concerning seasonal allocations of PSC limits. The Council will provide recommendations, including no change for the new fishing year, to the Secretary of Commerce for review and implementation.

6. As soon as practicable after the Council's December meeting, the Secretary will publish the Council's final recommendations as a notice of final harvest specifications in the Federal Register. Information on which the final harvest specifications are based will also be published in the Federal Register or otherwise made available by the Council.

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GCAK: 1-21-10
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g:\fmgroup\bycatch\goa halibut psc discussion paper jan 2010.doc

Gulf of Alaska Halibut Mortality Data Tables and Charts

Draft

Prepared for

North Pacific Fishery Management Council

November 2010

Prepared by

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Abbreviations

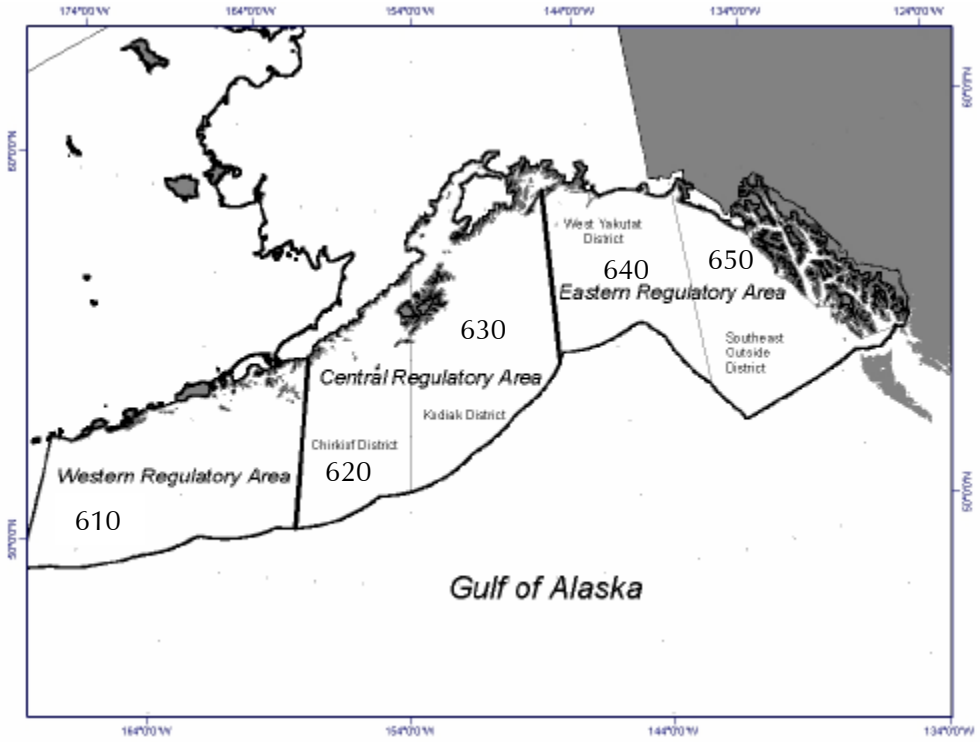
AKFIN	Alaska Fisheries Information Network
GOA	Gulf of Alaska
H&L	hook and line
MT	Metric ton
NPFMC	North Pacific Fishery Management Council
PacFIN	Pacific Fisheries Information Network

1 Halibut Bycatch Mortality in the Trawl and Fixed Gear Fisheries of the Gulf of Alaska.

This summary presents a series of tables that show successively greater amounts of detail regarding the sources of halibut bycatch in the Gulf of Alaska (GOA) for the year 2000 - 2009. The summary is divided into 6 sections, one section summarizing the entire GOA, and a section for each of the five 3-digit management zones as listed below and as shown in Figure 1:

- Area 610 - Western Gulf Regulatory Area
- Area 620 – Chirikof District of the Central Gulf Regulatory Area
- Area 630 – Kodiak District of the Central Gulf Regulatory Area
- Area 640 – West Yakutat District of the Eastern Gulf Regulatory Area
- Area 650 – Southeast Outside District Eastern Gulf Regulatory Area

Figure 1. Regulatory Areas, 3-Digit Zones and Management Districts in the Gulf of Alaska



Source: Adapted by Northern Economics from NPFMC (2009).

In each section there are three tables:

- The first table is a high level table that shows total halibut mortality by all gears and targets combined as well as halibut mortality in deep water and shallow water fisheries by general gear type—trawl and fixed gear.
- The second table in each section focuses on target fisheries in the Deep Water Complex of target species. These target fisheries include: arrowtooth flounder, deep water flatfish, rex

sole, rockfish, sablefish. It should be noted that halibut taken in a sablefish hook and line (H&L) fishery are not counted toward halibut mortality caps and thus we do not include halibut mortality in sablefish H&L fisheries.

- The third table in each section focuses on target fisheries in the Shallow Water Complex of target species. These target fisheries include: Atka mackerel, flathead sole, "Other Species", Pacific cod, pollock (bottom and mid-water), and shallow water flatfish.

The data in the tables come from NMFS Catch Accounting System (CAS) and were provided by AKFIN to Northern Economics (Fey, 2010). Each of the tables consists of a series of data for various target fisheries and gears. For each target fishery and gear combination we present three rows of data showing: Mortality, Target Catch, and Mortality Rate. The definitions of these row labels are listed in Table 1.

Table 1. Table Key—Definition of Row Labels

Row Labels	Description	Unit
Mortality (MT)	The total halibut mortality for the target fishery for the year.	Metric tons
Target Catch (MT)	The total catch of the groundfish species in the target fishery for the year	Metric tons
Mortality Rate (%)	The total halibut bycatch mortality divided by the total groundfish harvest in the target fishery for the year	Metric tons per metric ton

In addition to the three sets of table for the GOA and for each 3-digit management zone, we have included two sets of charts that graphically illustrate the data found in the first of the three tables. The first set of three charts in each section shows compares target catch, halibut mortality and mortality rates for the area in deep water and shallow water target fisheries. The second set of three charts focuses on the shallow water target fisheries and compares catch and bycatch across trawl and fixed gears.

We note that there are many different ways to examine halibut bycatch. In this series we have chosen to look at annual mortality and mortality rates by target fishery. It is also reasonable to look at halibut mortality by month or season, or to examine mortality revenue to value earned in the fishery. These and other alternative examinations can be included in future iterations.

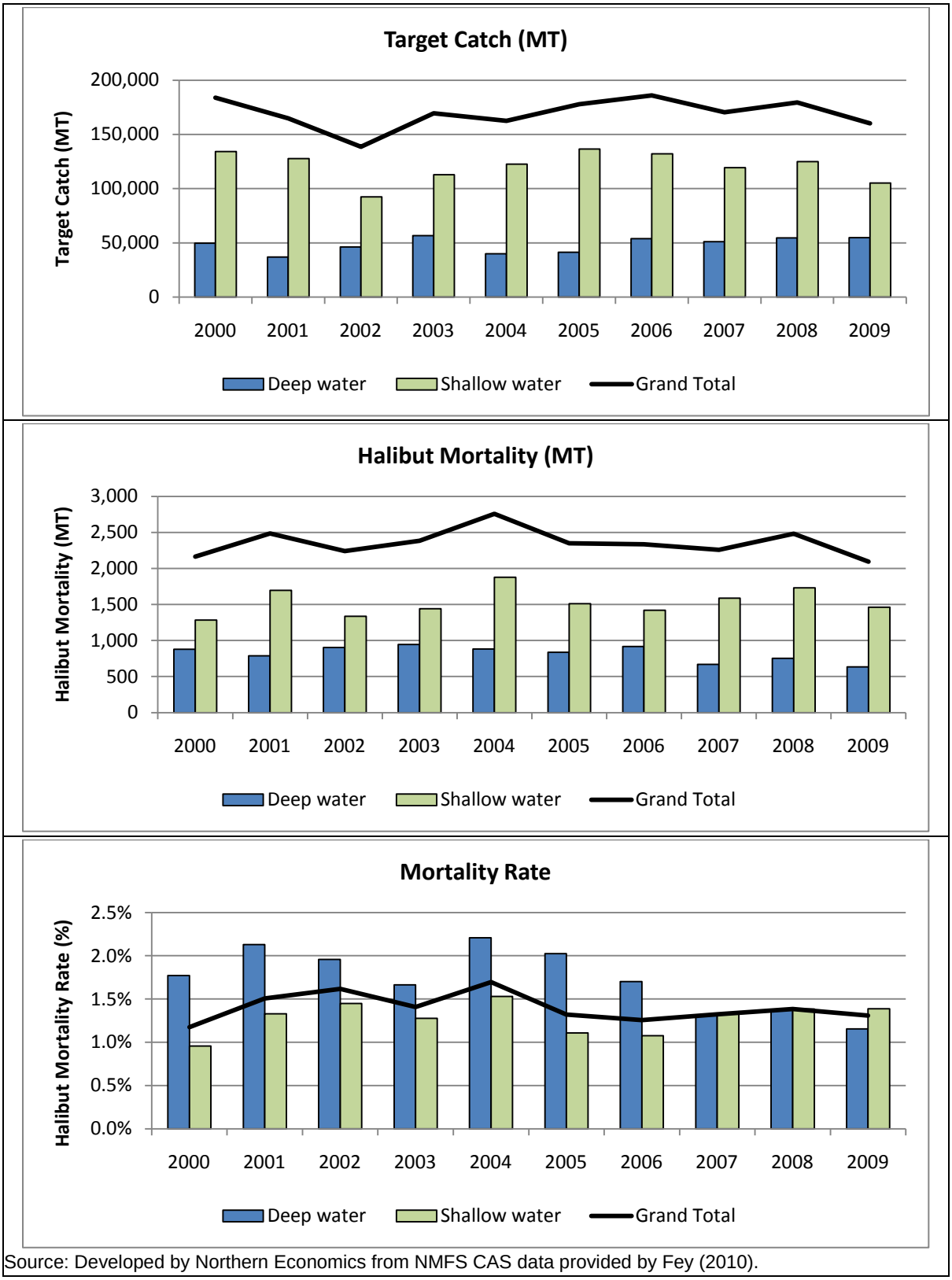
1.1 Summary of Halibut Bycatch Mortality in the Gulf of Alaska

Table 2. Summary of Halibut Mortality by Complex and Gear for All GOA Reporting Areas, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
All Targets And Species Combined										
Mortality (MT)	2,162.8	2,484.6	2,241.3	2,384.5	2,758.8	2,348.1	2,336.6	2,257.0	2,482.3	2,095.6
Target Catch (MT)	183,992.2	164,773.2	138,593.8	169,582.2	162,641.3	177,867.4	185,911.6	170,486.0	179,466.6	160,189.4
Mortality Rate (%)	1.18%	1.51%	1.62%	1.41%	1.70%	1.32%	1.26%	1.32%	1.38%	1.31%
All Trawl Targets										
Mortality (MT)	1,887.5	2,196.6	1,995.2	2,085.4	2,443.8	2,107.6	1,984.1	1,947.8	1,955.3	1,817.8
Target Catch (MT)	151,789.2	145,628.6	115,779.9	137,071.8	125,276.1	146,867.7	150,177.7	132,960.8	144,272.4	123,491.2
Mortality Rate (%)	1.24%	1.51%	1.72%	1.52%	1.95%	1.44%	1.32%	1.46%	1.36%	1.47%
Deep Water Trawl Targets										
Mortality (MT)	868.4	779.2	900.5	942.8	874.8	833.4	912.6	670.9	752.0	634.5
Target Catch (MT)	49,143.2	36,356.5	45,913.5	56,796.5	39,679.6	41,218.1	53,852.0	51,102.9	54,541.8	54,898.9
Mortality Rate (%)	1.77%	2.14%	1.96%	1.66%	2.20%	2.02%	1.69%	1.31%	1.38%	1.16%
Shallow Water Trawl Targets										
Mortality (MT)	1,019.1	1,417.4	1,094.7	1,142.7	1,568.9	1,274.2	1,071.4	1,277.0	1,203.4	1,183.3
Target Catch (MT)	102,646.1	109,272.1	69,864.6	80,275.3	85,596.6	105,649.6	96,325.7	81,857.8	89,730.6	68,592.3
Mortality Rate (%)	0.99%	1.30%	1.57%	1.42%	1.83%	1.21%	1.11%	1.56%	1.34%	1.73%
Shallow Water Fixed Gear Targets										
Mortality (MT)	263.3	279.9	242.6	297.2	308.8	235.9	347.9	309.1	527.0	277.7
Target Catch (MT)	31,611.2	18,503.9	22,514.3	32,507.6	37,136.3	30,836.4	35,703.4	37,525.2	35,194.2	36,684.7
Mortality Rate (%)	0.83%	1.51%	1.08%	0.91%	0.83%	0.76%	0.97%	0.82%	1.50%	0.76%

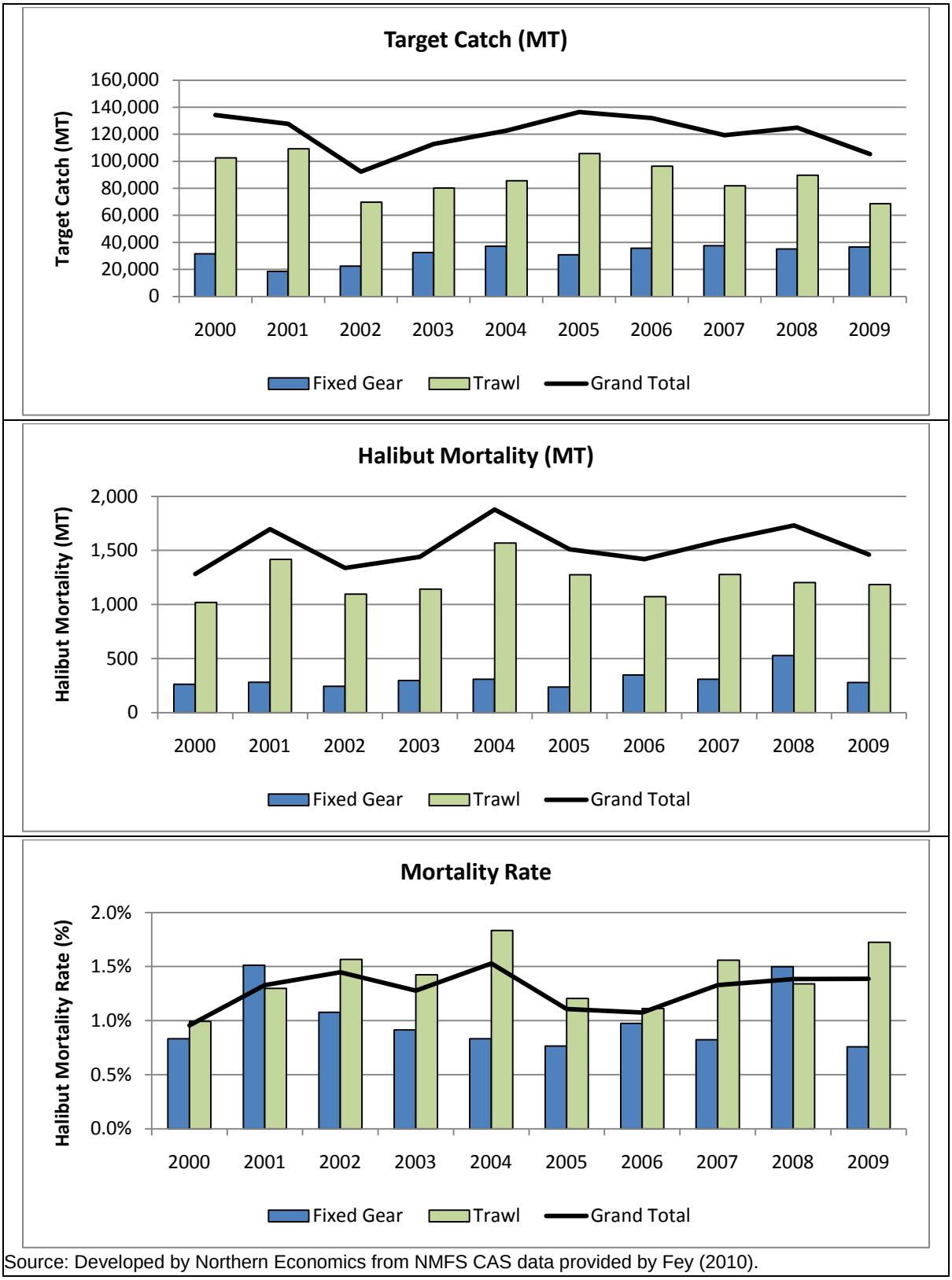
Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Figure 2. Deep v. Shallow Target Comparisons of Catch, Halibut Mortality, and Mortality Rates, Gulf Wide



Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Figure 3. Comparison of Catch, Halibut Mortality and Rates by Gear in Shallow Targets, Gulf Wide



Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Table 3. Halibut Mortality in the Deep Water Complex Fisheries by Target and Gear for the GOA, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Arrowtooth Trawl										
Mortality (MT)	369.5	157.0	323.1	429.3	313.2	500.5	613.0	442.3	532.0	285.6
Target Catch (MT)	16,210.7	5,579.9	13,429.5	20,134.4	8,541.3	15,031.8	21,331.0	20,822.7	24,931.3	15,812.3
Mortality Rate (%)	2.28%	2.81%	2.41%	2.13%	3.67%	3.33%	2.87%	2.12%	2.13%	1.81%
Deep Water Flatfish Trawl										
Mortality (MT)	42.6	43.4	24.1	20.5	72.0	--	--	0.3	--	--
Target Catch (MT)	1,007.0	1,176.8	551.2	814.4	1,196.0	--	--	22.1	--	--
Mortality Rate (%)	4.23%	3.69%	4.37%	2.52%	6.02%	--	--	1.42%	--	--
Rex Sole Trawl										
Mortality (MT)	255.4	249.4	310.4	236.6	189.6	85.6	129.2	132.2	108.3	274.1
Target Catch (MT)	8,898.7	7,741.2	7,943.1	10,310.6	3,521.1	3,244.0	7,166.3	5,926.7	4,740.4	13,207.9
Mortality Rate (%)	2.87%	3.22%	3.91%	2.29%	5.38%	2.64%	1.80%	2.23%	2.28%	2.08%
Rockfish Trawl										
Mortality (MT)	200.9	329.4	242.9	256.4	300.1	247.3	170.5	96.0	111.7	74.9
Target Catch (MT)	23,026.7	21,858.6	23,989.7	25,537.1	26,421.1	22,942.3	25,354.7	24,331.4	24,870.1	25,878.7
Mortality Rate (%)	0.87%	1.51%	1.01%	1.00%	1.14%	1.08%	0.67%	0.39%	0.45%	0.29%
Deep Water H&L (Misc)										
Mortality (MT)	0.5	0.1	0.2	--	0.4	1.6	0.5	--	--	--
Target Catch (MT)	5.6	1.2	2.6	--	13.4	36.4	16.6	--	--	--
Mortality Rate (%)	8.98%	6.72%	6.20%	--	2.75%	4.38%	2.71%	--	--	--
Deep Water ComplexTotal										
Mortality (MT)	170.1	146.7	245.0	236.0	65.0	214.4	336.9	135.0	145.3	196.7
Target Catch (MT)	6,648.9	5,161.0	7,485.3	15,252.6	5,440.1	11,178.9	17,070.0	10,644.7	8,957.0	11,864.2
Mortality Rate (%)	2.56%	2.84%	3.27%	1.55%	1.19%	1.92%	1.97%	1.27%	1.62%	1.66%

Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).
Note: Deep water H&L comprised target fisheries for rockfish (92 percent), arrowtooth flounder (7 percent), and deep water flatfish (>0.5 percent).

Table 4. Halibut Mortality in the Shallow Water Complex Fisheries by Target for the GOA, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pollock - Bottom Trawl										
Mortality (MT)	1.4	33.0	2.0	6.0	1.4	0.1	8.0	11.4	9.9	19.0
Target Catch (MT)	333.7	8,448.5	3,376.3	1,278.0	3.7	7,704,386.4	17,090.8	4,637.8	3,858.7	4,120.4
Mortality Rate (%)	0.41%	0.39%	0.06%	0.47%	0.04%	0.00%	0.05%	0.25%	0.26%	0.46%
Pollock - Midwater Trawl										
Mortality (MT)	1.2	0.6	0.2	0.2	0.3	0.1	0.1	0.0	0.3	0.2
Target Catch (MT)	11,627.5	10,489.0	17,140.6	18,893.4	19,390.0	21,418.4	11,512.2	14,171.0	15,595.5	10,201.8
Mortality Rate (%)	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Shallow Water Flatfish Trawl										
Mortality (MT)	96.2	13.4	402.3	156.9	62.5	115.1	57.3	72.1	74.9	153.5
Target Catch (MT)	1,066.3	280.2	6,449.8	2,006.0	1,073.7	1,617.7	1,534.2	1,866.4	1,955.3	2,996.2
Mortality Rate (%)	9.03%	4.79%	6.24%	7.82%	5.82%	7.11%	3.73%	3.86%	3.83%	5.12%
Flathead Sole Trawl										
Mortality (MT)	1.3	--	0.5	8.3	4.1	1.6	--	--	5.7	10.3
Target Catch (MT)	33.0	--	38.7	441.0	579.4	375.7	--	--	60.6	437.6
Mortality Rate (%)	3.88%	--	1.19%	1.88%	0.71%	0.43%	--	--	9.35%	2.35%
Other Species/Atka Mackerel Trawl										
Mortality (MT)	1.0	0.2	0.0	9.8	15.0	--	--	0.0	--	0.2
Target Catch (MT)	14.5	2.8	0.1	948.2	340.7	--	--	88.3	--	7.4
Mortality Rate (%)	7.17%	6.41%	8.33%	1.04%	4.40%	--	--	0.00%	--	3.07%
Pacific Cod Trawl										
Mortality (MT)	76.4	202.3	13.5	25.8	69.5	22.0	21.4	34.4	93.8	18.0
Target Catch (MT)	2,246.3	4,349.1	1,346.3	933.7	2,189.0	486.6	192.7	844.4	3,636.2	487.3
Mortality Rate (%)	3.40%	4.65%	1.00%	2.77%	3.18%	4.51%	11.09%	4.07%	2.58%	3.70%
Pacific Cod Pot										
Mortality (MT)	1.6	0.7	0.3	1.9	2.3	4.3	1.6	5.2	4.7	0.9
Target Catch (MT)	3,744.9	1,840.7	1,274.2	3,677.2	4,049.5	3,325.2	3,113.5	5,710.4	3,716.3	4,359.1
Mortality Rate (%)	0.04%	0.04%	0.02%	0.05%	0.06%	0.13%	0.05%	0.09%	0.13%	0.02%
Pacific Cod H&L										
Mortality (MT)	4.4	4.9	64.1	11.2	25.8	14.8	78.3	71.5	86.0	20.9
Target Catch (MT)	131.6	178.0	1,916.2	1,711.4	1,871.7	691.6	3,104.5	3,472.9	3,524.1	2,767.0
Mortality Rate (%)	3.32%	2.75%	3.35%	0.65%	1.38%	2.14%	2.52%	2.06%	2.44%	0.76%
Shallow Water H&L (Misc)										
Mortality (MT)	0.1	1.9	1.1	7.7	--	0.1	0.0	--	--	--
Target Catch (MT)	1.1	19.0	10.5	112.6	--	1.8	0.8	--	--	--
Mortality Rate (%)	11.71%	10.05%	10.15%	6.83%	--	7.84%	4.96%	--	--	--
Shallow Water Complex Total										
Mortality (MT)	183.6	257.0	483.9	227.8	180.9	158.2	166.7	194.6	275.1	223.1
Target Catch (MT)	19,198.9	25,607.3	31,552.6	30,001.4	32,880.8	35,621.4	36,548.7	30,791.3	32,346.7	25,376.9
Mortality Rate (%)	0.96%	1.00%	1.53%	0.76%	0.55%	0.44%	0.46%	0.63%	0.85%	0.88%

Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Note: Shallow water H&L comprised target fisheries for "other species" (99 percent), flathead sole (1 percent), and bottom pollock (>0.5 percent).

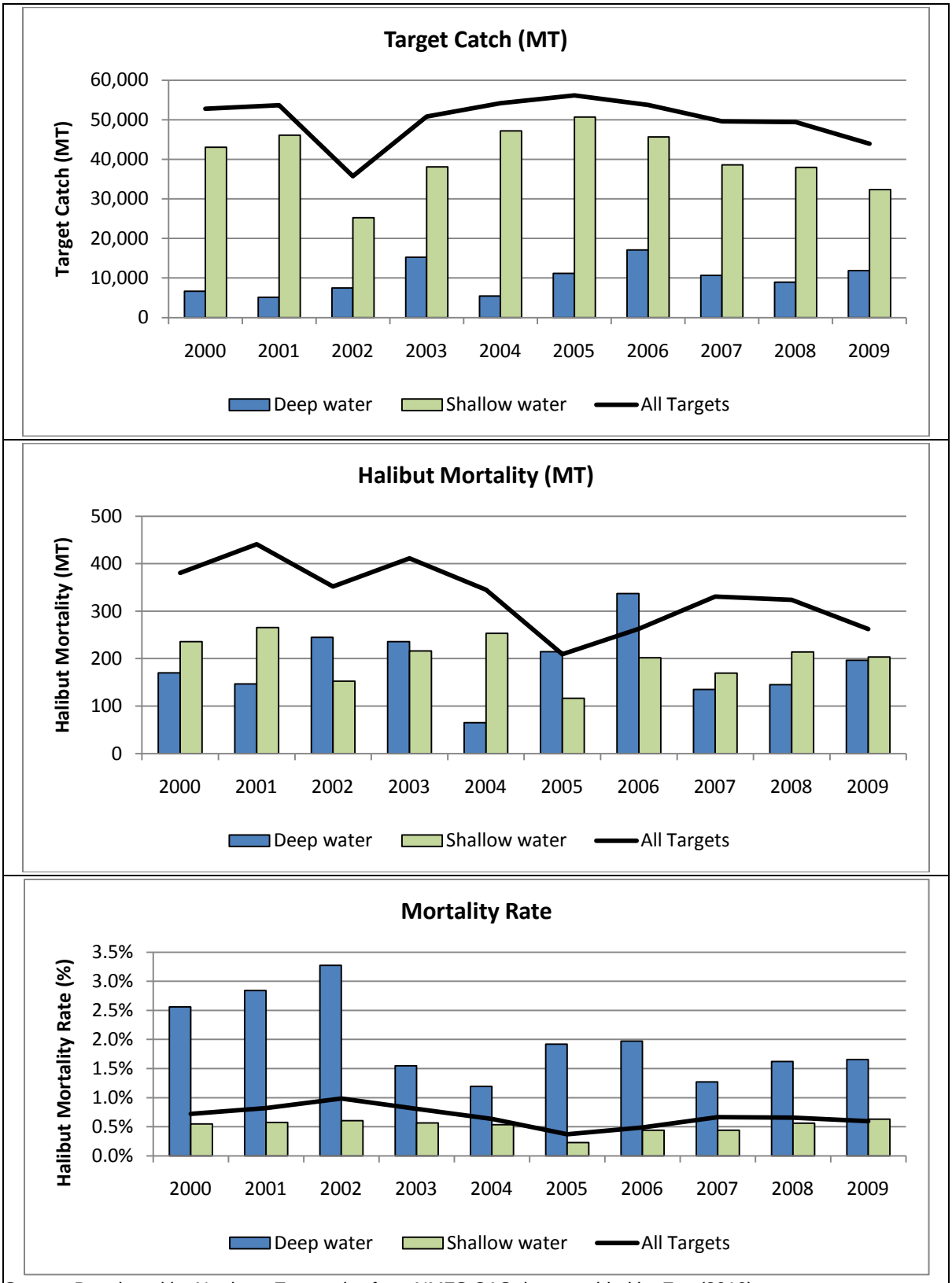
1.2 Reporting Area 610

Table 5. Summary of Halibut Mortality by Gear, Target and Complex for Area 610, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
All Targets And Species Combined										
Mortality (MT)	380.4	440.7	351.9	411.2	345.0	209.2	262.8	330.8	323.7	262.4
Target Catch (MT)	52,806.1	53,656.6	35,764.1	50,820.0	54,171.9	56,131.4	53,742.6	49,607.5	49,387.7	43,921.8
Mortality Rate (%)	0.72%	0.82%	0.98%	0.81%	0.64%	0.37%	0.49%	0.67%	0.66%	0.60%
All Trawl Targets										
Mortality (MT)	294.2	316.8	250.4	304.0	237.2	161.5	152.1	231.2	229.5	125.3
Target Catch (MT)	42,840.7	46,237.4	24,421.0	32,222.7	34,998.7	43,226.9	38,957.6	35,110.2	35,461.4	26,119.4
Mortality Rate (%)	0.69%	0.69%	1.03%	0.94%	0.68%	0.37%	0.39%	0.66%	0.65%	0.48%
Deep Water Trawl Targets										
Mortality (MT)	144.4	175.1	199.3	193.1	91.5	92.2	61.2	161.1	109.9	58.6
Target Catch (MT)	9,748.8	7,542.6	10,536.3	12,697.7	6,974.8	5,420.9	8,059.9	11,025.2	11,418.0	11,538.2
Mortality Rate (%)	1.48%	2.32%	1.89%	1.52%	1.31%	1.70%	0.76%	1.46%	0.96%	0.51%
Shallow Water Trawl Targets										
Mortality (MT)	149.8	141.8	51.2	110.8	145.7	69.3	90.9	70.2	119.6	66.7
Target Catch (MT)	33,092.0	38,694.8	13,884.8	19,525.0	28,023.9	37,806.0	30,897.7	24,085.0	24,043.3	14,581.2
Mortality Rate (%)	0.45%	0.37%	0.37%	0.57%	0.52%	0.18%	0.29%	0.29%	0.50%	0.46%
Shallow Water Fixed Gear Targets										
Mortality (MT)	86.2	123.6	101.1	105.4	107.7	47.4	110.8	99.6	94.2	137.0
Target Catch (MT)	9,965.4	7,408.5	11,337.3	18,594.5	19,171.8	12,887.9	14,784.4	14,497.3	13,926.3	17,789.1
Mortality Rate (%)	0.86%	1.67%	0.89%	0.57%	0.56%	0.37%	0.75%	0.69%	0.68%	0.77%

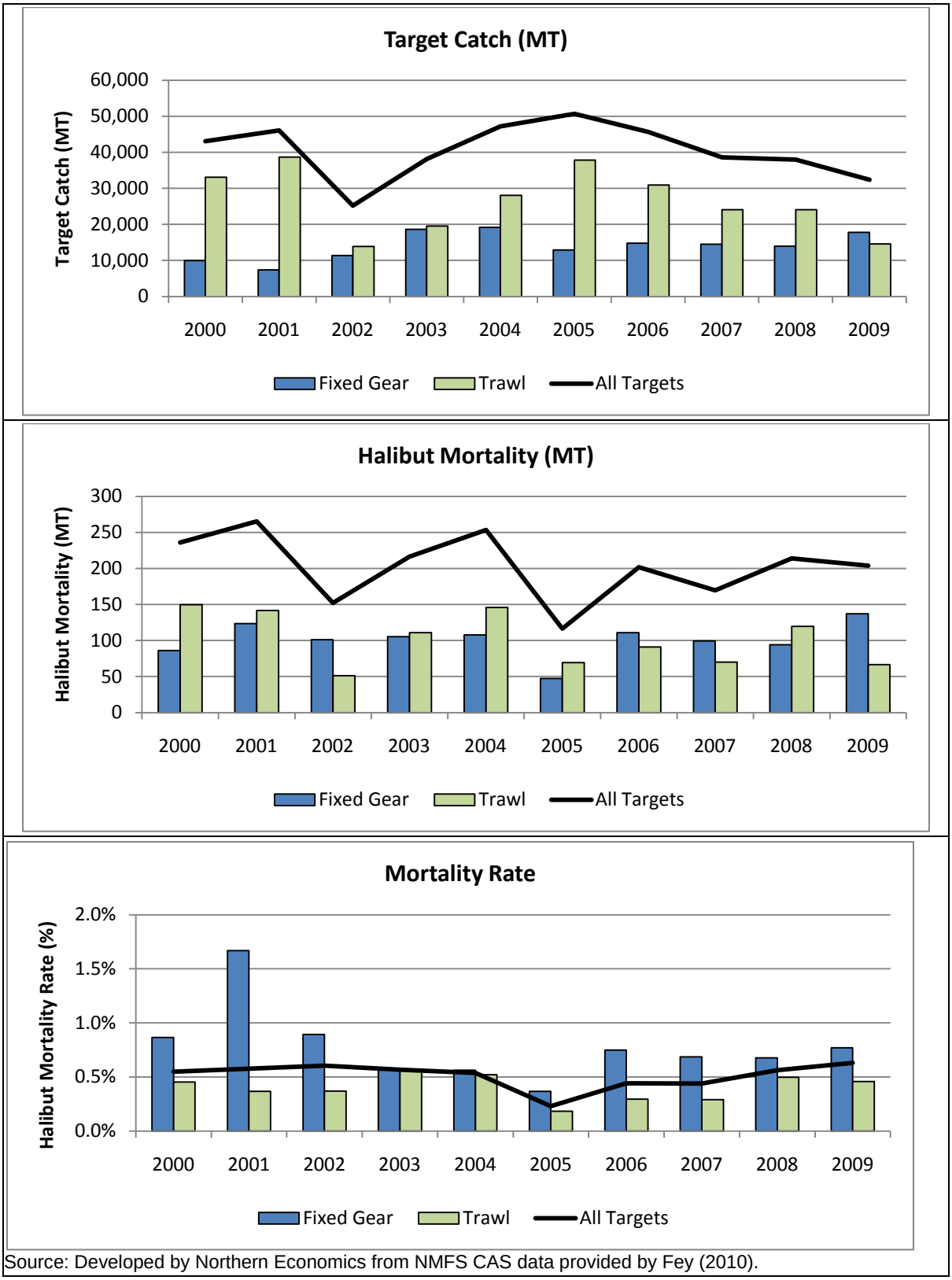
Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Figure 4. Deep v. Shallow Target Comparisons of Catch, Halibut Mortality, and Mortality Rates, Area 610



Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Figure 5. Comparison of Catch, Halibut Mortality and Rates by Gear in Shallow Targets, Area 610



Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Table 6. Halibut Mortality in the Deep Water Complex Fisheries by Target for Area 610, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
					Arrowtooth Trawl					
Mortality (MT)	86.3	138.9	153.6	142.5	25.5	44.7	18.7	108.7	45.0	15.7
Target Catch (MT)	4,923.2	4,967.8	6,169.2	8,121.4	927.9	1,231.3	1,033.2	2,318.0	2,236.8	577.5
Mortality Rate (%)	1.75%	2.80%	2.49%	1.75%	2.75%	3.63%	1.81%	4.69%	2.01%	2.72%
					Deep Water Flatfish Trawl					
Mortality (MT)	--	--	--	--	--	--	--	--	--	--
Target Catch (MT)	--	--	--	--	--	--	--	--	--	--
Mortality Rate (%)	--	--	--	--	--	--	--	--	--	--
					Rex Sole Trawl					
Mortality (MT)	44.4	28.4	13.9	21.3	35.9	8.8	7.1	12.5	1.8	5.9
Target Catch (MT)	2,482.3	1,117.1	589.6	1,454.9	754.6	395.2	283.1	342.3	85.1	799.7
Mortality Rate (%)	1.79%	2.54%	2.36%	1.46%	4.75%	2.23%	2.52%	3.65%	2.13%	0.73%
					Rockfish Trawl					
Mortality (MT)	13.8	7.8	31.8	29.4	30.2	38.7	35.4	39.9	63.1	37.1
Target Catch (MT)	2,343.3	1,457.7	3,777.5	3,121.4	5,292.3	3,794.4	6,743.6	8,364.9	9,096.1	10,161.0
Mortality Rate (%)	0.59%	0.53%	0.84%	0.94%	0.57%	1.02%	0.52%	0.48%	0.69%	0.36%
					Deep Water H&L (Misc)					
Mortality (MT)	0.0	0.3	0.4	1.9	0.0	0.4	0.0	--	--	0.1
Target Catch (MT)	0.0	10.7	5.7	2.8	1.4	16.6	0.6	--	--	13.3
Mortality Rate (%)	0.00%	2.91%	6.29%	67.38%	2.75%	2.31%	0.00%	--	--	0.38%
					Deep water Complex					
Mortality (MT)	144.4	175.4	199.6	195.0	91.6	92.6	61.2	161.1	109.9	58.7
Target Catch (MT)	9,748.8	7,553.3	10,542.0	12,700.4	6,976.2	5,437.5	8,060.6	11,025.2	11,418.0	11,551.5
Mortality Rate (%)	1.48%	2.32%	1.89%	1.54%	1.31%	1.70%	0.76%	1.46%	0.96%	0.51%

Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).
Note: Deep water H&L comprised target fisheries for rockfish (50 percent), arrowtooth flounder (38 percent), and deep water flatfish (12 percent).

Table 7. Halibut Mortality in the Shallow Water Complex Fisheries by Target for Area 610, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pollock - Bottom Trawl										
Mortality (MT)	0.4	0.4	0.2	0.1	0.1	0.1	0.5	0.3	2.9	0.1
Target Catch (MT)	2,902.1	3,057.1	1,186.8	570.0	416.4	1,762.6	3,692.7	2,939.4	4,775.9	4,688.7
Mortality Rate (%)	0.01%	0.01%	0.01%	0.01%	0.02%	0.00%	0.01%	0.01%	0.06%	0.00%
Pollock - Midwater Trawl										
Mortality (MT)	0.8	5.6	0.2	0.1	0.6	0.2	0.2	0.3	1.2	0.3
Target Catch (MT)	16,415.6	27,282.3	6,156.4	15,729.5	22,975.3	29,519.3	20,181.6	14,893.7	10,721.4	7,278.6
Mortality Rate (%)	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%
Shallow Water Flatfish Trawl										
Mortality (MT)	2.0	--	0.5	8.7	2.3	11.7	17.3	2.3	--	2.4
Target Catch (MT)	78.8	--	30.5	145.6	39.6	297.4	177.2	54.9	--	13.8
Mortality Rate (%)	2.50%	--	1.64%	5.97%	5.89%	3.93%	9.78%	4.24%	--	17.34%
Flathead Sole Trawl										
Mortality (MT)	0.4	24.9	12.0	35.4	55.4	32.2	12.1	15.7	15.3	11.0
Target Catch (MT)	36.4	796.9	575.5	988.8	2,272.8	1,825.1	606.7	1,040.3	302.6	412.9
Mortality Rate (%)	1.02%	3.12%	2.08%	3.58%	2.44%	1.77%	1.99%	1.51%	5.06%	2.66%
Other Species/Atka Mackerel Trawl										
Mortality (MT)	--	--	--	1.1	--	--	--	--	--	--
Target Catch (MT)	--	--	--	56.5	--	--	--	--	--	--
Mortality Rate (%)	--	--	--	1.89%	--	--	--	--	--	--
Pacific Cod Trawl										
Mortality (MT)	146.3	110.9	38.4	65.5	87.2	25.0	60.7	51.6	100.1	52.9
Target Catch (MT)	13,659.1	7,558.5	5,935.5	2,034.7	2,319.8	4,401.6	6,239.4	5,156.8	8,243.4	2,187.1
Mortality Rate (%)	1.07%	1.47%	0.65%	3.22%	3.76%	0.57%	0.97%	1.00%	1.21%	2.42%
Pacific Cod Pot										
Mortality (MT)	1.2	1.3	1.2	5.8	8.4	7.5	4.6	5.4	13.3	3.1
Target Catch (MT)	4,992.9	3,068.4	4,286.9	13,847.0	15,845.9	11,822.0	11,549.9	10,759.1	10,003.0	10,997.4
Mortality Rate (%)	0.02%	0.04%	0.03%	0.04%	0.05%	0.06%	0.04%	0.05%	0.13%	0.03%
Pacific Cod H&L										
Mortality (MT)	85.0	122.3	100.0	99.3	99.3	39.9	106.0	94.2	80.9	133.8
Target Catch (MT)	4,972.5	4,340.1	7,050.4	4,742.6	3,326.0	1,065.9	3,233.2	3,736.1	3,923.2	6,791.7
Mortality Rate (%)	1.71%	2.82%	1.42%	2.09%	2.98%	3.74%	3.28%	2.52%	2.06%	1.97%
Shallow Water H&L (Misc)										
Mortality (MT)	--	--	--	0.3	--	--	0.1	0.0	--	--
Target Catch (MT)	--	--	--	4.9	--	--	1.3	2.0	--	--
Mortality Rate (%)	--	--	--	6.83%	--	--	10.56%	1.18%	--	--
Shallow Water Complex Total										
Mortality (MT)	236.0	265.3	152.3	216.2	253.4	116.6	201.6	169.7	213.8	203.7
Target Catch (MT)	43,057.4	46,103.3	25,222.1	38,119.5	47,195.7	50,693.9	45,682.0	38,582.3	37,969.6	32,370.3
Mortality Rate (%)	0.55%	0.58%	0.60%	0.57%	0.54%	0.23%	0.44%	0.44%	0.56%	0.63%

Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Note: Shallow water H&L comprised target fisheries for "other species" (76 percent), and bottom pollock (24 percent).

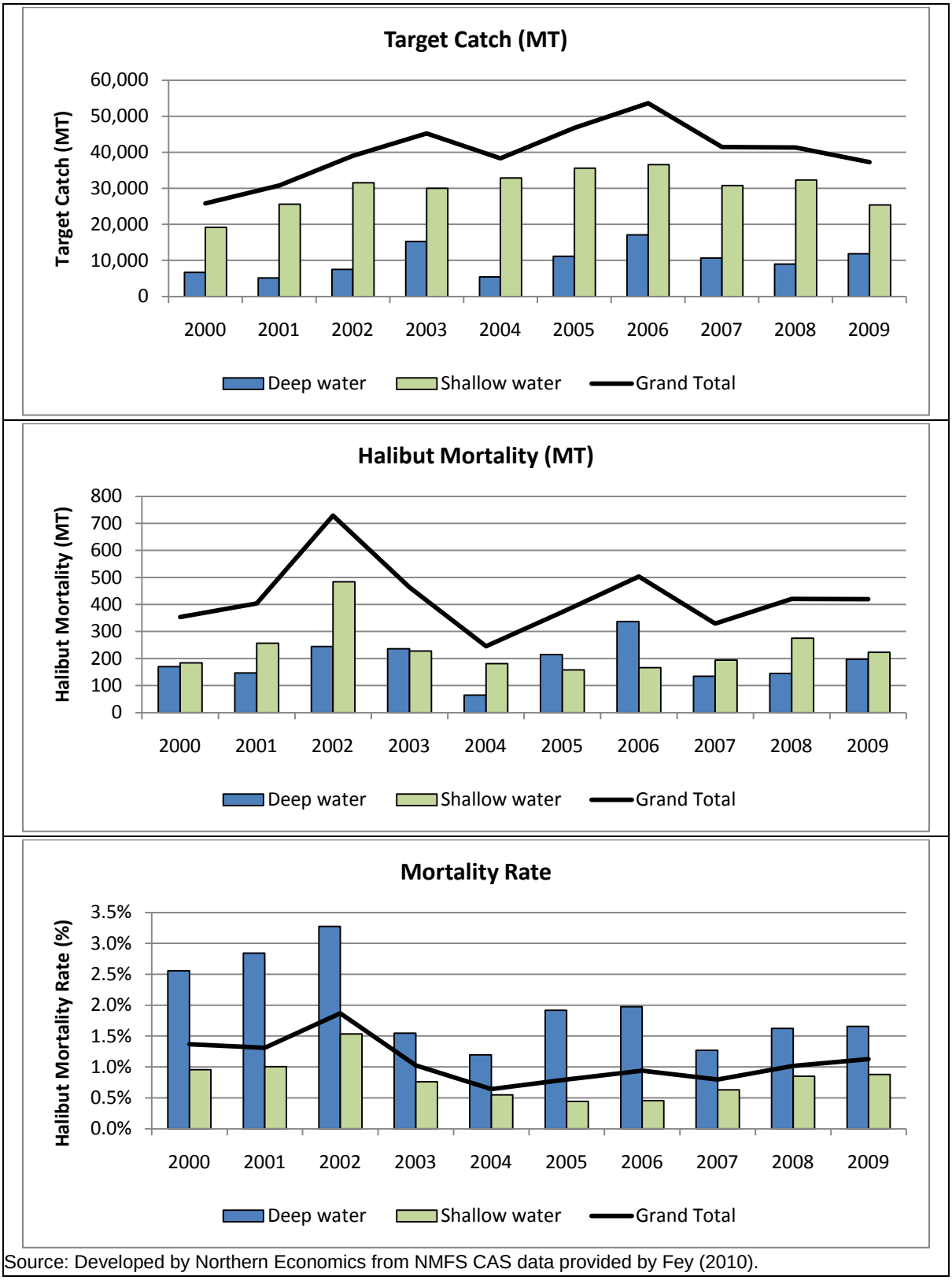
1.3 Reporting Area 620

Table 8. Summary of Halibut Mortality by Gear, Target and Complex for Area 620, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
All Targets And Species Combined										
Mortality (MT)	353.7	403.7	728.9	463.8	245.9	372.6	503.6	329.6	420.5	419.8
Target Catch (MT)	25,847.8	30,768.3	39,037.9	45,254.0	38,320.8	46,800.3	53,618.7	41,436.0	41,303.7	37,241.0
Mortality Rate (%)	1.37%	1.31%	1.87%	1.02%	0.64%	0.80%	0.94%	0.80%	1.02%	1.13%
All Trawl Targets										
Mortality (MT)	347.1	396.1	663.3	443.0	217.4	351.7	423.2	252.9	329.8	398.0
Target Catch (MT)	21,964.7	28,729.4	35,836.3	39,752.8	32,386.2	42,745.3	47,383.3	32,252.7	34,063.3	30,114.9
Mortality Rate (%)	1.58%	1.38%	1.85%	1.11%	0.67%	0.82%	0.89%	0.78%	0.97%	1.32%
Deep Water Trawl Targets										
Mortality (MT)	169.6	146.6	244.8	236.0	64.6	212.8	336.4	135.0	145.3	196.7
Target Catch (MT)	6,643.3	5,159.8	7,482.7	15,252.6	5,426.6	11,142.6	17,053.4	10,644.7	8,957.0	11,864.2
Mortality Rate (%)	2.55%	2.84%	3.27%	1.55%	1.19%	1.91%	1.97%	1.27%	1.62%	1.66%
Shallow Water Trawl Targets										
Mortality (MT)	177.5	249.5	418.5	207.0	152.8	138.9	86.7	117.9	184.5	201.3
Target Catch (MT)	15,321.3	23,569.6	28,351.7	24,500.2	26,959.5	31,602.7	30,329.9	21,608.0	25,106.3	18,250.7
Mortality Rate (%)	1.16%	1.06%	1.48%	0.85%	0.57%	0.44%	0.29%	0.55%	0.73%	1.10%
Shallow Water Fixed Gear Targets										
Mortality (MT)	6.1	7.5	65.5	20.8	28.2	19.3	80.0	76.7	90.7	21.8
Target Catch (MT)	3,877.6	2,037.7	3,200.9	5,501.2	5,921.2	4,018.6	6,218.8	9,183.3	7,240.4	7,126.1
Mortality Rate (%)	0.16%	0.37%	2.05%	0.38%	0.48%	0.48%	1.29%	0.84%	1.25%	0.31%

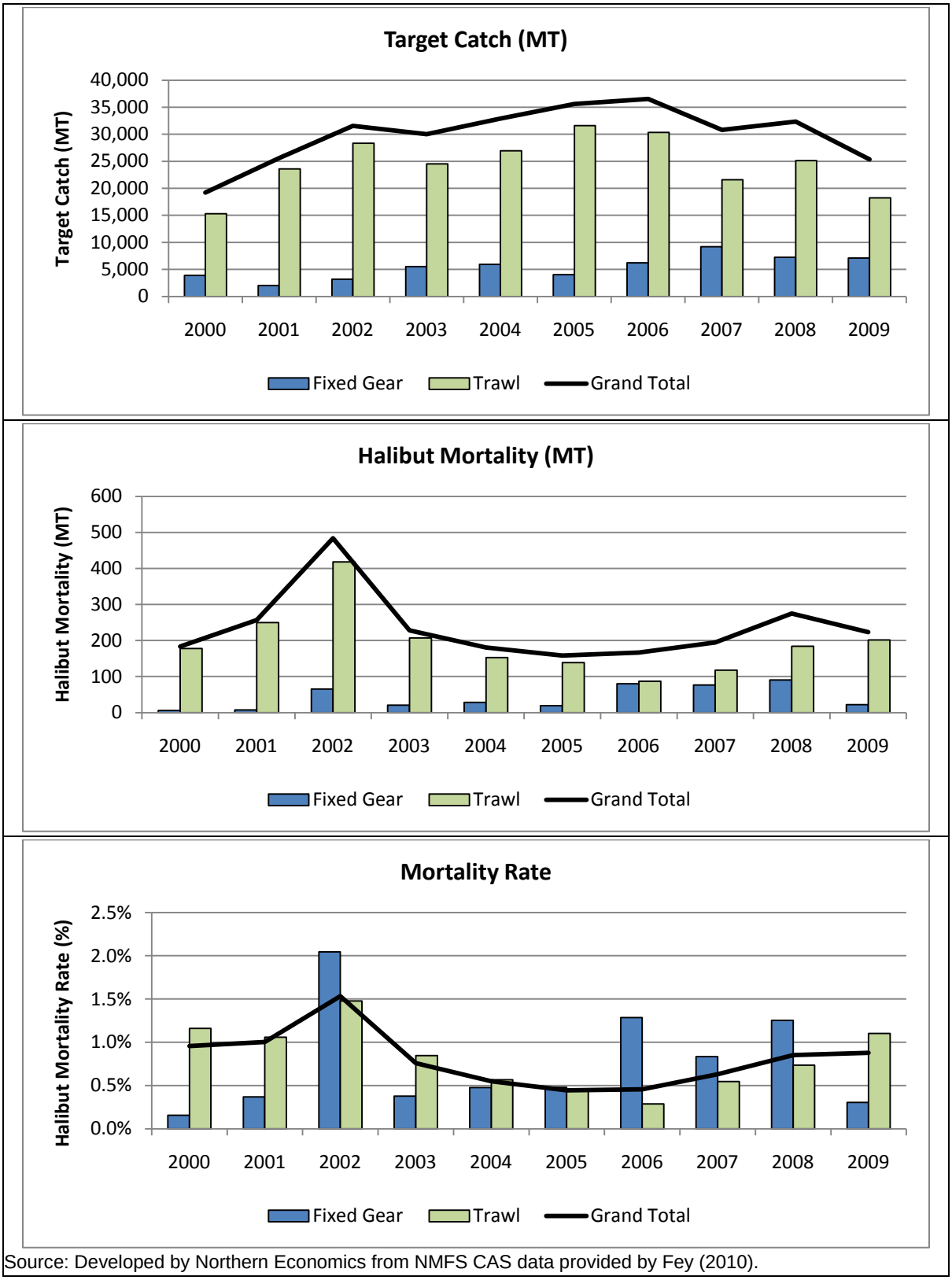
Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Figure 6. Deep v. Shallow Target Comparisons of Catch, Halibut Mortality, and Mortality Rates, Area 620



Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Figure 7. Comparison of Catch, Halibut Mortality and Rates by Gear in Shallow Targets, Area 620



Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Table 9. Halibut Mortality in the Deep Water Complex Fisheries by Target for Area 620, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
					Arrowtooth Trawl					
Mortality (MT)	62.4	--	12.6	143.4	4.0	155.4	224.7	92.5	88.5	41.4
Target Catch (MT)	3,016.2	--	979.1	5,782.9	134.1	4,617.9	7,466.8	5,004.6	2,544.0	1,847.4
Mortality Rate (%)	2.07%	--	1.29%	2.48%	3.02%	3.36%	3.01%	1.85%	3.48%	2.24%
					Deep Water Flatfish Trawl					
Mortality (MT)	0.6	--	--	--	--	--	--	--	--	--
Target Catch (MT)	27.5	--	--	--	--	--	--	--	--	--
Mortality Rate (%)	2.07%	--	--	--	--	--	--	--	--	--
					Rex Sole Trawl					
Mortality (MT)	104.3	133.5	227.5	72.6	50.2	27.9	70.1	25.8	30.9	142.5
Target Catch (MT)	3,426.3	3,908.3	4,841.4	5,233.7	897.6	1,429.8	3,610.4	1,525.7	1,486.9	6,483.0
Mortality Rate (%)	3.04%	3.41%	4.70%	1.39%	5.60%	1.95%	1.94%	1.69%	2.08%	2.20%
					Rockfish Trawl					
Mortality (MT)	2.3	13.2	4.7	19.9	10.3	29.5	41.6	16.8	25.8	12.9
Target Catch (MT)	173.4	1,251.6	1,662.2	4,236.0	4,395.0	5,094.9	5,976.2	4,114.4	4,926.1	3,533.9
Mortality Rate (%)	1.31%	1.05%	0.28%	0.47%	0.24%	0.58%	0.70%	0.41%	0.52%	0.36%
					Deep Water H&L (Misc)					
Mortality (MT)	0.5	0.1	0.2	--	0.4	1.6	0.5	--	--	--
Target Catch (MT)	5.6	1.2	2.6	--	13.4	36.4	16.6	--	--	--
Mortality Rate (%)	8.98%	6.72%	6.20%	--	2.75%	4.38%	2.71%	--	--	--
					Deep water Complex					
Mortality (MT)	170.1	146.7	245.0	236.0	65.0	214.4	336.9	135.0	145.3	196.7
Target Catch (MT)	6,648.9	5,161.0	7,485.3	15,252.6	5,440.1	11,178.9	17,070.0	10,644.7	8,957.0	11,864.2
Mortality Rate (%)	2.56%	2.84%	3.27%	1.55%	1.19%	1.92%	1.97%	1.27%	1.62%	1.66%

Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).
Note: Deep water H&L comprised target fisheries for rockfish (30 percent) and arrowtooth flounder (70percent).

Table 10. Halibut Mortality in the Shallow Water Complex Fisheries by Target for Area 620, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pollock - Bottom Trawl										
Mortality (MT)	1.4	33.0	2.0	6.0	1.4	0.1	8.0	11.4	9.9	19.0
Target Catch (MT)	333.7	8,448.5	3,376.3	1,278.0	3,386.7	7,704.4	17,090.8	4,637.8	3,858.7	4,120.4
Mortality Rate (%)	0.41%	0.39%	0.06%	0.47%	0.04%	0.00%	0.05%	0.25%	0.26%	0.46%
Pollock - Midwater Trawl										
Mortality (MT)	1.2	0.6	0.2	0.2	0.3	0.1	0.1	0.0	0.3	0.2
Target Catch (MT)	11,627.5	10,489.0	17,140.6	18,893.4	19,390.0	21,418.4	11,512.2	14,171.0	15,595.5	10,201.8
Mortality Rate (%)	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Shallow Water Flatfish Trawl										
Mortality (MT)	96.2	13.4	402.3	156.9	62.5	115.1	57.3	72.1	74.9	153.5
Target Catch (MT)	1,066.3	280.2	6,449.8	2,006.0	1,073.7	1,617.7	1,534.2	1,866.4	1,955.3	2,996.2
Mortality Rate (%)	9.03%	4.79%	6.24%	7.82%	5.82%	7.11%	3.73%	3.86%	3.83%	5.12%
Flathead Sole Trawl										
Mortality (MT)	1.3	--	0.5	8.3	4.1	1.6	--	--	5.7	10.3
Target Catch (MT)	33.0	--	38.7	441.0	579.4	375.7	--	--	60.6	437.6
Mortality Rate (%)	3.88%	--	1.19%	1.88%	0.71%	0.43%	--	--	9.35%	2.35%
Other Species/Atka Mackerel Trawl										
Mortality (MT)	1.0	0.2	0.0	9.8	15.0	--	--	0.0	--	0.2
Target Catch (MT)	14.5	2.8	0.1	948.2	340.7	--	--	88.3	--	7.4
Mortality Rate (%)	7.17%	6.41%	8.33%	1.04%	4.40%	--	--	0.00%	--	3.07%
Pacific Cod Trawl										
Mortality (MT)	76.4	202.3	13.5	25.8	69.5	22.0	21.4	34.4	93.8	18.0
Target Catch (MT)	2,246.3	4,349.1	1,346.3	933.7	2,189.0	486.6	192.7	844.4	3,636.2	487.3
Mortality Rate (%)	3.40%	4.65%	1.00%	2.77%	3.18%	4.51%	11.09%	4.07%	2.58%	3.70%
Pacific Cod Pot										
Mortality (MT)	1.6	0.7	0.3	1.9	2.3	4.3	1.6	5.2	4.7	0.9
Target Catch (MT)	3,744.9	1,840.7	1,274.2	3,677.2	4,049.5	3,325.2	3,113.5	5,710.4	3,716.3	4,359.1
Mortality Rate (%)	0.04%	0.04%	0.02%	0.05%	0.06%	0.13%	0.05%	0.09%	0.13%	0.02%
Pacific Cod H&L										
Mortality (MT)	4.4	4.9	64.1	11.2	25.8	14.8	78.3	71.5	86.0	20.9
Target Catch (MT)	131.6	178.0	1,916.2	1,711.4	1,871.7	691.6	3,104.5	3,472.9	3,524.1	2,767.0
Mortality Rate (%)	3.32%	2.75%	3.35%	0.65%	1.38%	2.14%	2.52%	2.06%	2.44%	0.76%
Shallow Water H&L (Misc)										
Mortality (MT)	0.1	1.9	1.1	7.7	--	0.1	0.0	--	--	--
Target Catch (MT)	1.1	19.0	10.5	112.6	--	1.8	0.8	--	--	--
Mortality Rate (%)	11.71%	10.05%	10.15%	6.83%	--	7.84%	4.96%	--	--	--
Shallow Water Complex Total										
Mortality (MT)	183.6	257.0	483.9	227.8	180.9	158.2	166.7	194.6	275.1	223.1
Target Catch (MT)	19,198.9	25,607.3	31,552.6	30,001.4	32,880.8	35,621.4	36,548.7	30,791.3	32,346.7	25,376.9
Mortality Rate (%)	0.96%	1.00%	1.53%	0.76%	0.55%	0.44%	0.46%	0.63%	0.85%	0.88%

Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).
Note: "Other Species" target fisheries were the only component of the Shallow Water H&L aggregate.

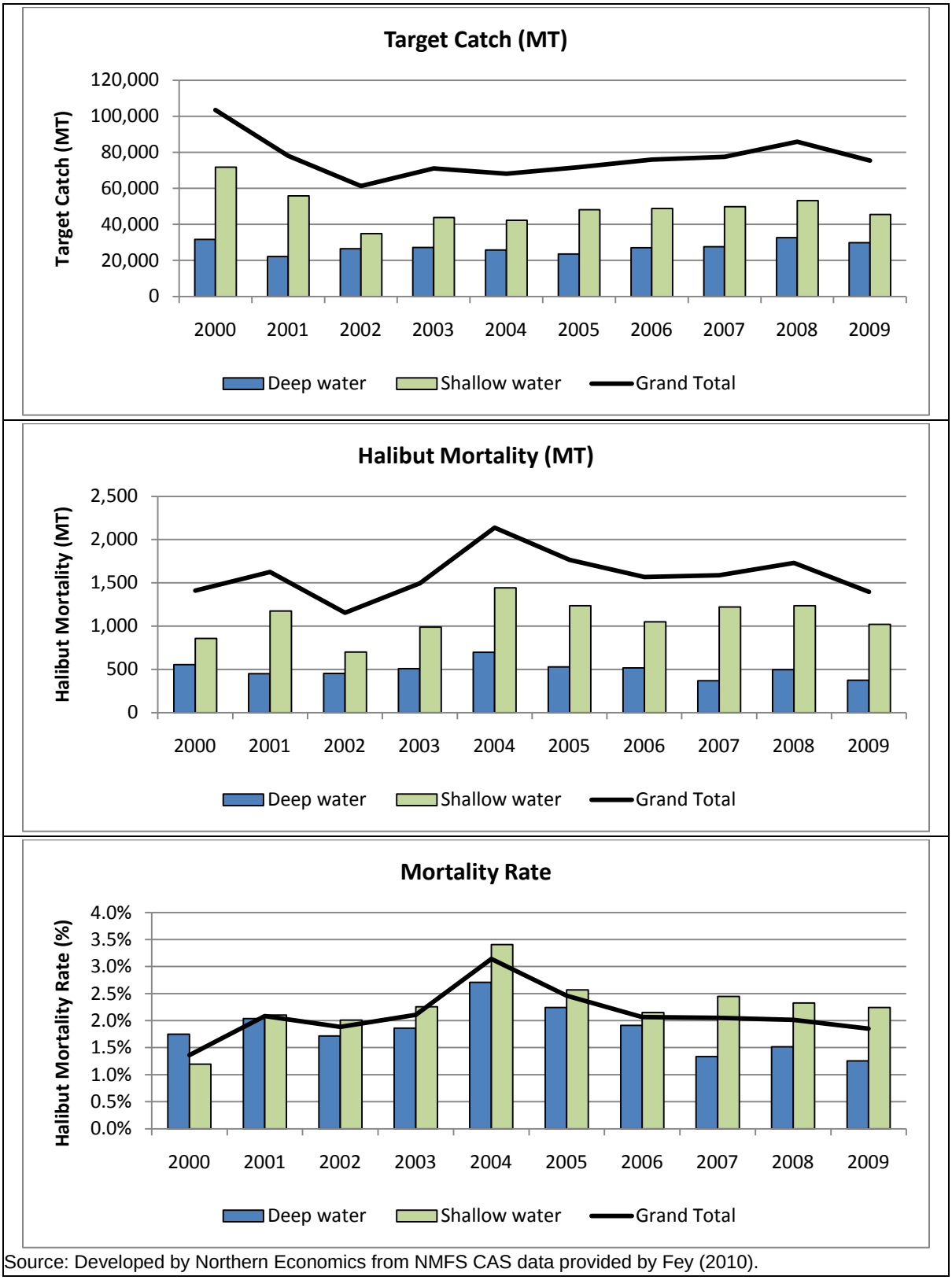
1.4 Reporting Area 630

Table 11. Summary of Halibut Mortality by Gear, Target and Complex for Area 630, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
All Targets And Species Combined										
Mortality (MT)	1,411.3	1,624.6	1,154.4	1,495.5	2,138.7	1,764.6	1,567.2	1,589.3	1,731.2	1,395.8
Target Catch (MT)	103,432.3	77,984.0	61,313.4	70,998.4	68,069.2	71,730.0	75,891.1	77,510.0	85,857.1	75,343.2
Mortality Rate (%)	1.36%	2.08%	1.88%	2.11%	3.14%	2.46%	2.07%	2.05%	2.02%	1.85%
All Trawl Targets										
Mortality (MT)	1,235.9	1,471.8	1,076.5	1,331.6	1,967.5	1,592.6	1,406.6	1,457.4	1,393.4	1,289.2
Target Catch (MT)	85,680.9	68,857.2	53,368.9	62,713.0	56,108.0	57,690.1	61,200.1	63,708.5	72,119.5	64,329.6
Mortality Rate (%)	1.44%	2.14%	2.02%	2.12%	3.51%	2.76%	2.30%	2.29%	1.93%	2.00%
Deep Water Trawl Targets										
Mortality (MT)	547.6	446.4	451.5	506.8	697.2	526.6	512.8	368.4	495.3	373.9
Target Catch (MT)	31,544.4	22,040.3	26,432.7	27,218.0	25,756.0	23,505.9	27,048.5	27,631.9	32,691.4	29,790.6
Mortality Rate (%)	1.74%	2.03%	1.71%	1.86%	2.71%	2.24%	1.90%	1.33%	1.52%	1.26%
Shallow Water Trawl Targets										
Mortality (MT)	688.3	1,025.5	625.0	824.8	1,270.4	1,066.0	893.8	1,089.0	898.0	915.3
Target Catch (MT)	54,136.5	46,816.9	26,936.2	35,495.0	30,352.1	34,184.1	34,151.5	36,076.6	39,428.2	34,538.9
Mortality Rate (%)	1.27%	2.19%	2.32%	2.32%	4.19%	3.12%	2.62%	3.02%	2.28%	2.65%
Shallow Water Fixed Gear Targets										
Mortality (MT)	169.6	148.8	75.7	163.9	170.8	169.3	156.5	131.9	337.8	106.6
Target Catch (MT)	17,660.4	9,051.9	7,907.5	8,285.5	11,946.7	13,929.6	14,677.8	13,801.5	13,737.6	11,013.6
Mortality Rate (%)	0.96%	1.64%	0.96%	1.98%	1.43%	1.22%	1.07%	0.96%	2.46%	0.97%

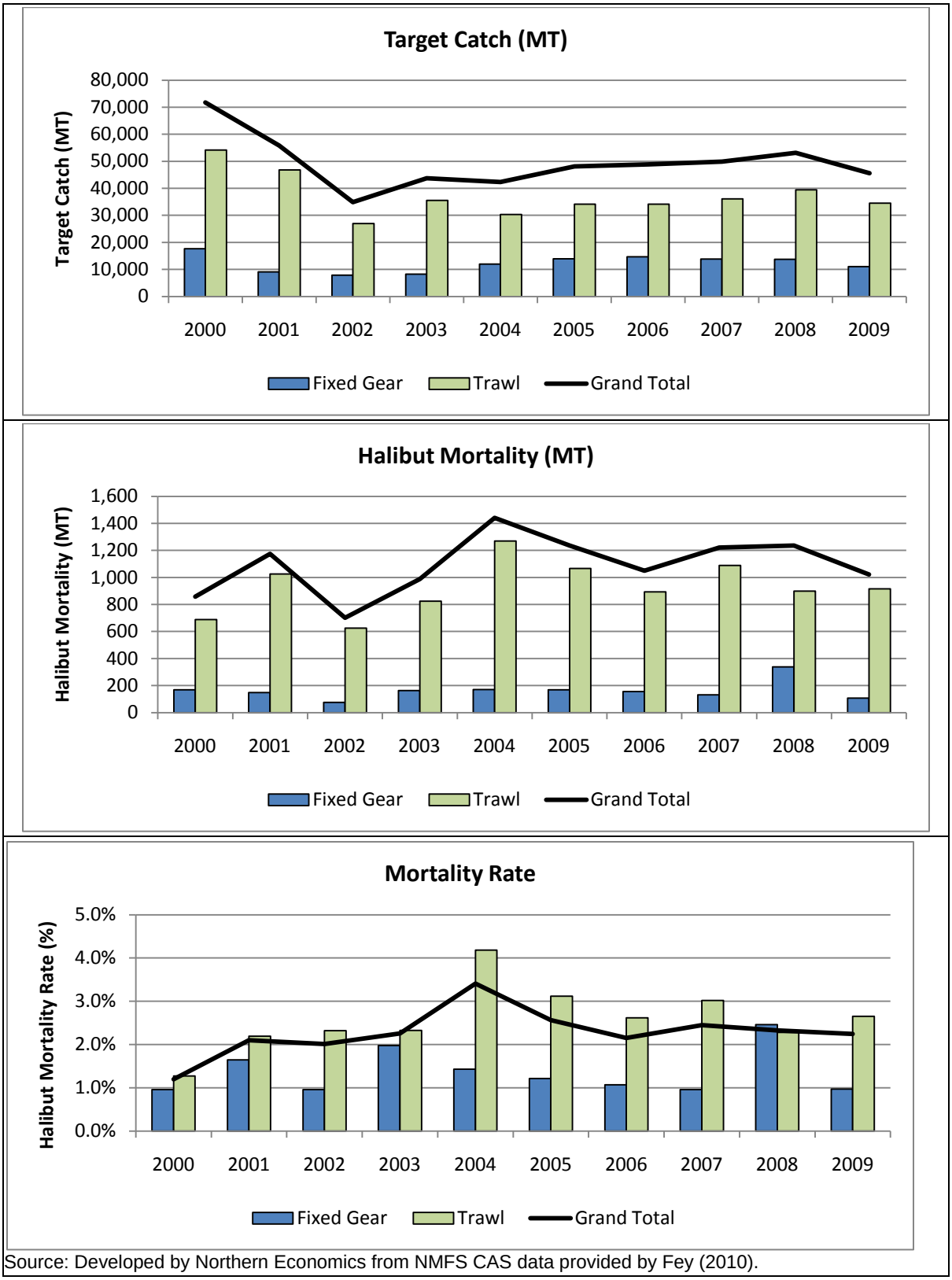
Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Figure 8. Deep v. Shallow Target Comparisons of Catch, Halibut Mortality, and Mortality Rates, Area 630



Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Figure 9. Comparison of Catch, Halibut Mortality and Rates by Gear in Shallow Targets, Area 630



Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Table 12. Halibut Mortality in the Deep Water Complex Fisheries by Target for Area 630, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
					Arrowtooth Trawl					
Mortality (MT)	219.9	18.1	156.9	143.3	283.7	300.4	369.6	241.1	398.5	228.5
Target Catch (MT)	8,253.7	612.1	6,281.1	6,230.1	7,479.4	9,182.6	12,831.1	13,500.1	20,150.4	13,387.4
Mortality Rate (%)	2.66%	2.95%	2.50%	2.30%	3.79%	3.27%	2.88%	1.79%	1.98%	1.71%
					Deep Water Flatfish Trawl					
Mortality (MT)	38.6	37.1	24.1	20.5	56.3	--	--	0.3	--	--
Target Catch (MT)	836.0	920.5	551.2	814.4	1,066.5	--	--	22.1	--	--
Mortality Rate (%)	4.62%	4.03%	4.37%	2.52%	5.28%	--	--	1.42%	--	--
					Rex Sole Trawl					
Mortality (MT)	106.8	87.5	69.1	142.7	103.5	48.8	52.0	94.0	75.5	125.7
Target Catch (MT)	2,990.2	2,715.8	2,512.1	3,622.0	1,868.9	1,419.1	3,272.8	4,058.7	3,168.5	5,925.3
Mortality Rate (%)	3.57%	3.22%	2.75%	3.94%	5.54%	3.44%	1.59%	2.32%	2.38%	2.12%
					Rockfish Trawl					
Mortality (MT)	182.2	303.8	201.5	200.3	253.7	177.4	91.2	33.0	21.3	19.6
Target Catch (MT)	19,464.5	17,791.9	17,088.3	16,551.5	15,341.2	12,904.2	10,944.7	10,051.0	9,372.5	10,478.0
Mortality Rate (%)	0.94%	1.71%	1.18%	1.21%	1.65%	1.37%	0.83%	0.33%	0.23%	0.19%
					Deep Water H&L (Misc)					
Mortality (MT)	5.8	4.0	2.3	--	0.4	2.7	4.1	--	--	0.0
Target Catch (MT)	90.9	74.9	37.0	--	14.5	110.4	13.2	--	--	0.0
Mortality Rate (%)	6.39%	5.38%	6.19%	--	2.75%	2.44%	31.11%	--	--	0.36%
					Deep water Complex					
Mortality (MT)	553.4	450.4	453.8	506.8	697.6	529.3	516.9	368.4	495.3	373.9
Target Catch (MT)	31,635.3	22,115.2	26,469.7	27,218.0	25,770.4	23,616.3	27,061.8	27,631.9	32,691.4	29,790.7
Mortality Rate (%)	1.75%	2.04%	1.71%	1.86%	2.71%	2.24%	1.91%	1.33%	1.52%	1.26%

Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).
Note: Deep water H&L comprised target fisheries for rockfish (79 percent), arrowtooth flounder (21 percent).

Table 13. Halibut Mortality in the Shallow Water Complex Fisheries by Target for Area 630, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pollock - Bottom Trawl										
Mortality (MT)	37.5	35.7	0.7	3.4	11.3	1.6	59.4	67.6	56.2	16.8
Target Catch (MT)	6,615.4	18,676.7	5,070.8	1,716.3	7,084.4	8,946.2	14,166.9	7,159.7	7,903.6	1,014.1
Mortality Rate (%)	0.57%	0.19%	0.01%	0.20%	0.16%	0.02%	0.42%	0.94%	0.71%	1.66%
Pollock - Midwater Trawl										
Mortality (MT)	9.6	4.6	0.1	0.1	0.1	0.2	0.0	0.3	0.4	0.6
Target Catch (MT)	29,361.3	1,778.3	4,268.5	10,528.0	7,463.3	10,367.7	4,640.4	7,846.7	5,984.6	8,693.2
Mortality Rate (%)	0.03%	0.26%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.01%
Shallow Water Flatfish Trawl										
Mortality (MT)	474.7	470.2	439.1	364.4	461.6	437.8	560.0	633.1	421.0	640.2
Target Catch (MT)	8,542.3	8,000.3	7,512.0	6,296.6	3,002.4	6,345.2	9,502.0	12,472.2	13,119.2	16,764.3
Mortality Rate (%)	5.56%	5.88%	5.84%	5.79%	15.37%	6.90%	5.89%	5.08%	3.21%	3.82%
Flathead Sole Trawl										
Mortality (MT)	2.8	37.6	43.6	76.4	5.5	9.3	10.6	0.8	37.1	38.3
Target Catch (MT)	70.7	738.5	2,110.3	2,593.8	223.3	857.8	854.4	550.8	1,416.5	1,935.0
Mortality Rate (%)	3.97%	5.09%	2.07%	2.95%	2.45%	1.08%	1.24%	0.15%	2.62%	1.98%
Other Species/Atka Mackerel Trawl										
Mortality (MT)	0.8	0.5	0.1	9.9	10.1	0.1	--	--	0.0	1.0
Target Catch (MT)	107.2	68.3	6.5	1,361.2	230.8	73.7	--	--	3.1	32.0
Mortality Rate (%)	0.74%	0.72%	0.77%	0.73%	4.40%	0.08%	--	--	0.67%	3.07%
Pacific Cod Trawl										
Mortality (MT)	162.9	477.0	141.4	370.6	781.7	617.1	263.9	387.1	383.4	218.3
Target Catch (MT)	9,439.7	17,554.9	7,968.2	12,999.0	12,347.9	7,593.6	4,987.8	8,047.2	11,001.2	6,100.3
Mortality Rate (%)	1.73%	2.72%	1.77%	2.85%	6.33%	8.13%	5.29%	4.81%	3.48%	3.58%
Pacific Cod Pot										
Mortality (MT)	4.1	2.5	1.0	1.5	5.3	21.2	12.4	8.3	13.2	2.8
Target Catch (MT)	8,872.7	2,459.2	1,527.3	3,630.8	6,191.8	9,559.5	9,163.4	8,199.8	7,079.1	6,746.3
Mortality Rate (%)	0.05%	0.10%	0.07%	0.04%	0.09%	0.22%	0.14%	0.10%	0.19%	0.04%
Pacific Cod H&L										
Mortality (MT)	165.1	139.3	73.9	74.2	165.5	148.1	139.1	123.5	324.7	103.8
Target Catch (MT)	8,783.2	6,529.4	6,372.5	3,362.9	5,754.9	4,370.1	5,464.7	5,601.8	6,658.4	4,267.2
Mortality Rate (%)	1.88%	2.13%	1.16%	2.21%	2.88%	3.39%	2.55%	2.21%	4.88%	2.43%
Shallow Water H&L (Misc)										
Mortality (MT)	0.5	7.0	0.7	88.2	--	--	5.0	--	--	--
Target Catch (MT)	4.5	63.2	7.7	1,291.8	--	--	49.7	--	--	--
Mortality Rate (%)	10.56%	11.01%	9.43%	6.83%	--	--	10.11%	--	--	--
Shallow Water Complex Total										
Mortality (MT)	858.0	1,174.2	700.6	988.7	1,441.2	1,235.2	1,050.4	1,220.8	1,235.9	1,021.9
Target Catch (MT)	71,796.9	55,868.7	34,843.7	43,780.4	42,298.7	48,113.7	48,829.3	49,878.1	53,165.7	45,552.5
Mortality Rate (%)	1.19%	2.10%	2.01%	2.26%	3.41%	2.57%	2.15%	2.45%	2.32%	2.24%

Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).
Note: Shallow water H&L comprised fisheries for "other species" (99 percent), and flathead sole (1 percent).

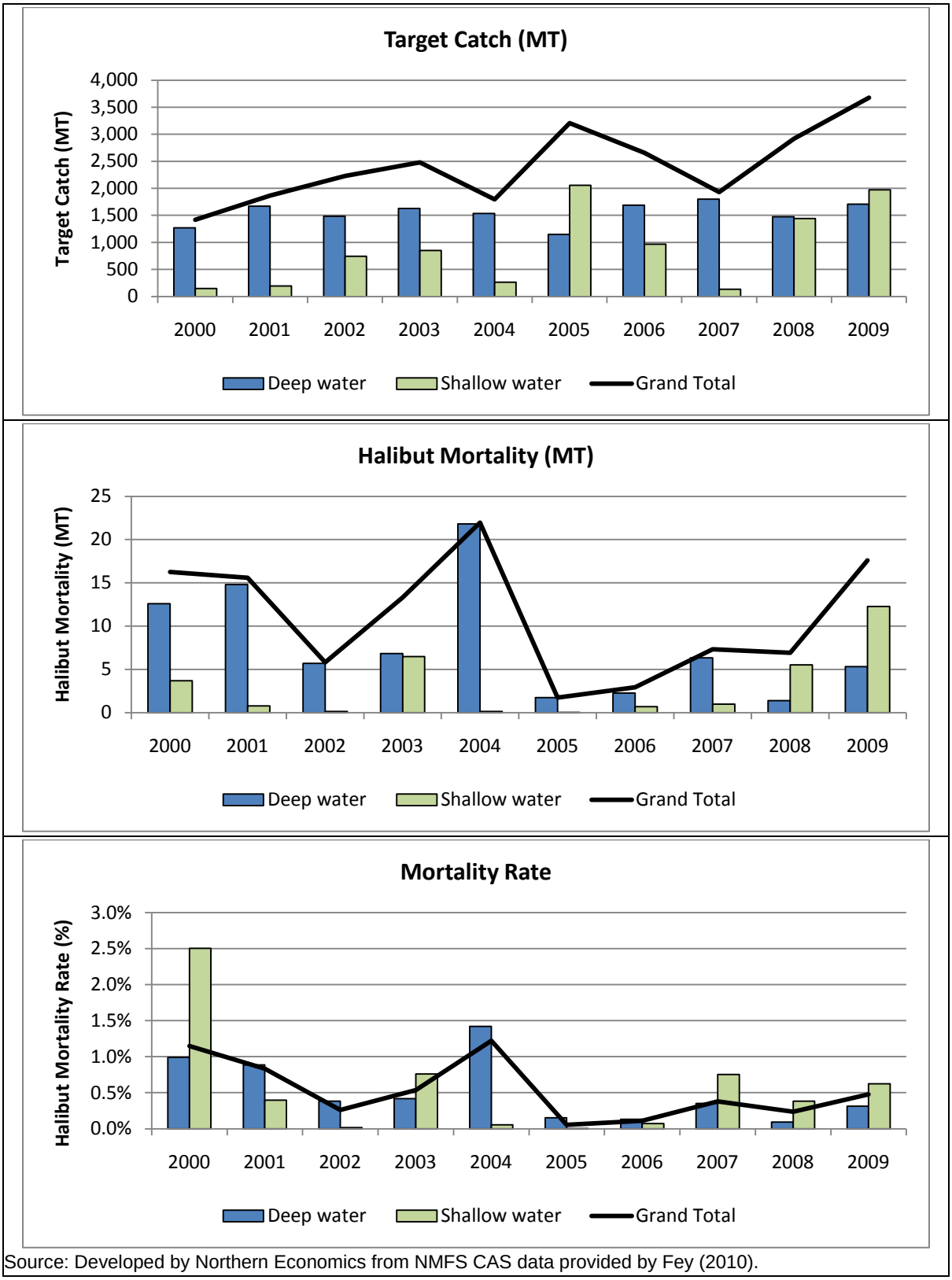
1.5 Reporting Area 640

Table 14. Summary of Halibut Mortality by Gear, Target and Complex for Area 640, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
All Targets And Species Combined										
Mortality (MT)	16.3	15.6	5.8	13.3	22.0	1.7	2.9	7.3	6.9	17.6
Target Catch (MT)	1,417.1	1,865.9	2,228.3	2,479.2	1,797.0	3,205.4	2,659.2	1,932.4	2,917.9	3,676.8
Mortality Rate (%)	1.15%	0.83%	0.26%	0.54%	1.22%	0.05%	0.11%	0.38%	0.24%	0.48%
All Trawl Targets										
Mortality (MT)	10.3	11.8	5.1	6.8	21.6	1.7	2.2	6.3	2.6	5.3
Target Catch (MT)	1,302.9	1,804.6	2,153.6	2,383.3	1,783.3	3,205.4	2,636.7	1,889.4	2,628.2	2,927.4
Mortality Rate (%)	0.79%	0.66%	0.23%	0.29%	1.21%	0.05%	0.09%	0.34%	0.10%	0.18%
Deep Water Trawl Targets										
Mortality (MT)	1,206.7	1,613.8	1,461.8	1,628.2	1,522.2	1,148.7	1,690.1	1,801.1	1,475.4	1,705.9
Target Catch (MT)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mortality Rate (%)	338.00%	75.00%	7.00%	1.54%	6.46%	0.80%	0.13%	0.04%	122.43%	3.06%
Shallow Water Trawl Targets										
Mortality (MT)	3.4	0.8	0.1	0.0	0.1	0.0	0.0	0.0	1.2	0.0
Target Catch (MT)	133.4	193.8	740.4	755.1	261.1	2,056.7	946.6	88.3	1,152.8	1,244.4
Mortality Rate (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shallow Water Fixed Gear Targets										
Mortality (MT)	0.3	0.0	0.1	6.5	0.1		0.7	1.0	4.3	12.2
Target Catch (MT)	50.8	4.1	52.2	95.9	1.9		22.4	43.0	289.8	749.4
Mortality Rate (%)	0.59%	0.49%	0.11%	6.74%	4.21%		3.04%	2.30%	1.49%	1.63%

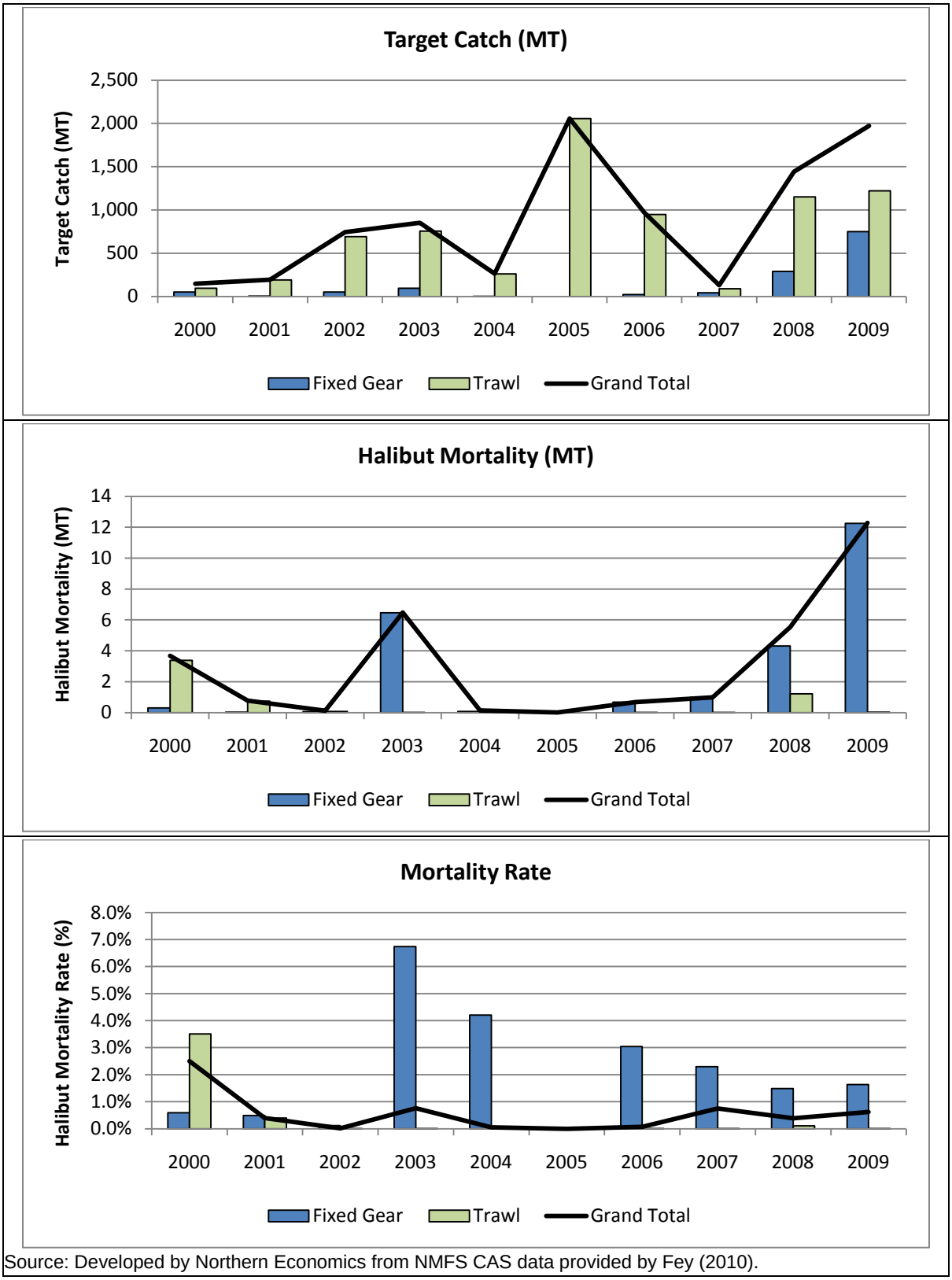
Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Figure 10. Deep v. Shallow Target Comparisons of Catch, Halibut Mortality, and Mortality Rates, Area 640



Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Figure 11. Comparison of Catch, Halibut Mortality and Rates by Gear in Shallow Targets, Area 640



Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Table 15. Halibut Mortality in the Deep Water Complex Fisheries by Target for Area 640, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
					Arrowtooth Trawl					
Mortality (MT)	0.9	--	--	--	--	--	--	--	--	--
Target Catch (MT)	17.7	--	--	--	--	--	--	--	--	--
Mortality Rate (%)	4.82%	--	--	--	--	--	--	--	--	--
					Deep Water Flatfish Trawl					
Mortality (MT)	3.4	6.3	--	--	15.6	--	--	--	--	--
Target Catch (MT)	143.5	256.4	--	--	129.5	--	--	--	--	--
Mortality Rate (%)	2.36%	2.47%	--	--	12.08%	--	--	--	--	--
					Rex Sole Trawl					
Mortality (MT)	--	--	--	--	--	--	--	--	--	--
Target Catch (MT)	--	--	--	--	--	--	--	--	--	--
Mortality Rate (%)	--	--	--	--	--	--	--	--	--	--
					Rockfish Trawl					
Mortality (MT)	2.7	4.7	5.0	6.8	5.9	1.7	2.2	6.3	1.4	5.3
Target Catch (MT)	1,045.5	1,357.5	1,461.8	1,628.2	1,392.7	1,148.7	1,690.1	1,801.1	1,475.4	1,705.9
Mortality Rate (%)	0.25%	0.35%	0.34%	0.42%	0.42%	0.15%	0.13%	0.35%	0.09%	0.31%
					Deep Water H&L (Misc)					
Mortality (MT)	5.7	3.7	0.7	--	0.3	--	--	--	--	--
Target Catch (MT)	63.4	57.2	22.4	--	11.8	--	--	--	--	--
Mortality Rate (%)	8.98%	6.52%	3.17%	--	2.48%	--	--	--	--	--
					Deep water Complex					
Mortality (MT)	12.6	14.8	5.7	6.8	21.8	1.7	2.2	6.3	1.4	5.3
Target Catch (MT)	1,270.0	1,671.1	1,484.2	1,628.2	1,534.0	1,148.7	1,690.1	1,801.1	1,475.4	1,705.9
Mortality Rate (%)	0.99%	0.89%	0.38%	0.42%	1.42%	0.15%	0.13%	0.35%	0.09%	0.31%

Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).
Note: Deep water H&L comprised target fisheries for rockfish (99 percent), arrowtooth flounder (1 percent).

Table 16. Halibut Mortality in the Shallow Water Complex Fisheries by Target for Area 640, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Pollock - Bottom Trawl										
Mortality (MT)	--	0.8	0.1	0.0	0.0	0.0	0.0	0.0	1.2	0.0
Target Catch (MT)	--	190.8	691.9	11.8	169.7	131.2	146.1	54.8	352.1	868.8
Mortality Rate (%)	--	0.39%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.35%	0.00%
Pollock - Midwater Trawl										
Mortality (MT)	--	0.8	0.1	0.0	0.0	0.0	0.0	0.0	1.2	0.0
Target Catch (MT)	--	190.8	691.9	11.8	169.7	131.2	146.1	54.8	352.1	868.8
Mortality Rate (%)	--	0.39%	0.01%	0.01%	0.00%	0.00%	0.00%	0.00%	0.35%	0.00%
Shallow Water Flatfish Trawl										
Mortality (MT)	3.4	--	--	--	--	--	--	--	--	--
Target Catch (MT)	96.3	--	--	--	--	--	--	--	--	--
Mortality Rate (%)	3.51%	--	--	--	--	--	--	--	--	--
Flathead Sole Trawl										
Mortality (MT)	--	--	--	--	--	--	--	--	--	--
Target Catch (MT)	--	--	--	--	--	--	--	--	--	--
Mortality Rate (%)	--	--	--	--	--	--	--	--	--	--
Other Species/Atka Mackerel Trawl										
Mortality (MT)	--	--	--	--	0.1	0.0	--	--	--	--
Target Catch (MT)	--	--	--	--	1.4	116.9	--	--	--	--
Mortality Rate (%)	--	--	--	--	4.40%	0.00%	--	--	--	--
Pacific Cod Trawl										
Mortality (MT)	--	--	--	--	--	--	--	--	--	--
Target Catch (MT)	--	--	--	--	--	--	--	--	--	--
Mortality Rate (%)	--	--	--	--	--	--	--	--	--	--
Pacific Cod Pot										
Mortality (MT)	0.0	0.0	0.0	--	--	--	--	--	--	0.0
Target Catch (MT)	37.2	3.0	48.6	--	--	--	--	--	--	22.9
Mortality Rate (%)	0.05%	0.00%	0.00%	--	--	--	--	--	--	0.03%
Pacific Cod H&L										
Mortality (MT)	0.3	0.0	0.1	0.1	0.1	--	0.7	1.0	4.3	12.2
Target Catch (MT)	13.1	0.5	3.7	2.2	1.9	--	22.4	43.0	289.8	726.5
Mortality Rate (%)	1.99%	1.92%	1.63%	2.92%	4.21%	--	3.03%	2.30%	1.49%	1.69%
Shallow Water H&L (Misc)										
Mortality (MT)	0.0	0.0	--	6.4	--	--	0.0	--	--	--
Target Catch (MT)	0.6	0.5	--	93.7	--	--	0.0	--	--	--
Mortality Rate (%)	3.17%	2.00%	--	6.83%	--	--	9.89%	--	--	--
Shallow Water Complex Total										
Mortality (MT)	3.7	0.8	0.1	6.5	0.1	0.0	0.7	1.0	5.5	12.3
Target Catch (MT)	147.1	194.9	744.1	851.0	262.9	2,056.7	969.0	131.3	1,442.5	1,970.9
Mortality Rate (%)	2.50%	0.40%	0.02%	0.76%	0.05%	0.00%	0.07%	0.75%	0.38%	0.62%

Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).
Note: "Other Species" target fisheries were the only component of the Shallow Water H&L aggregate.

1.6 Reporting Area 650

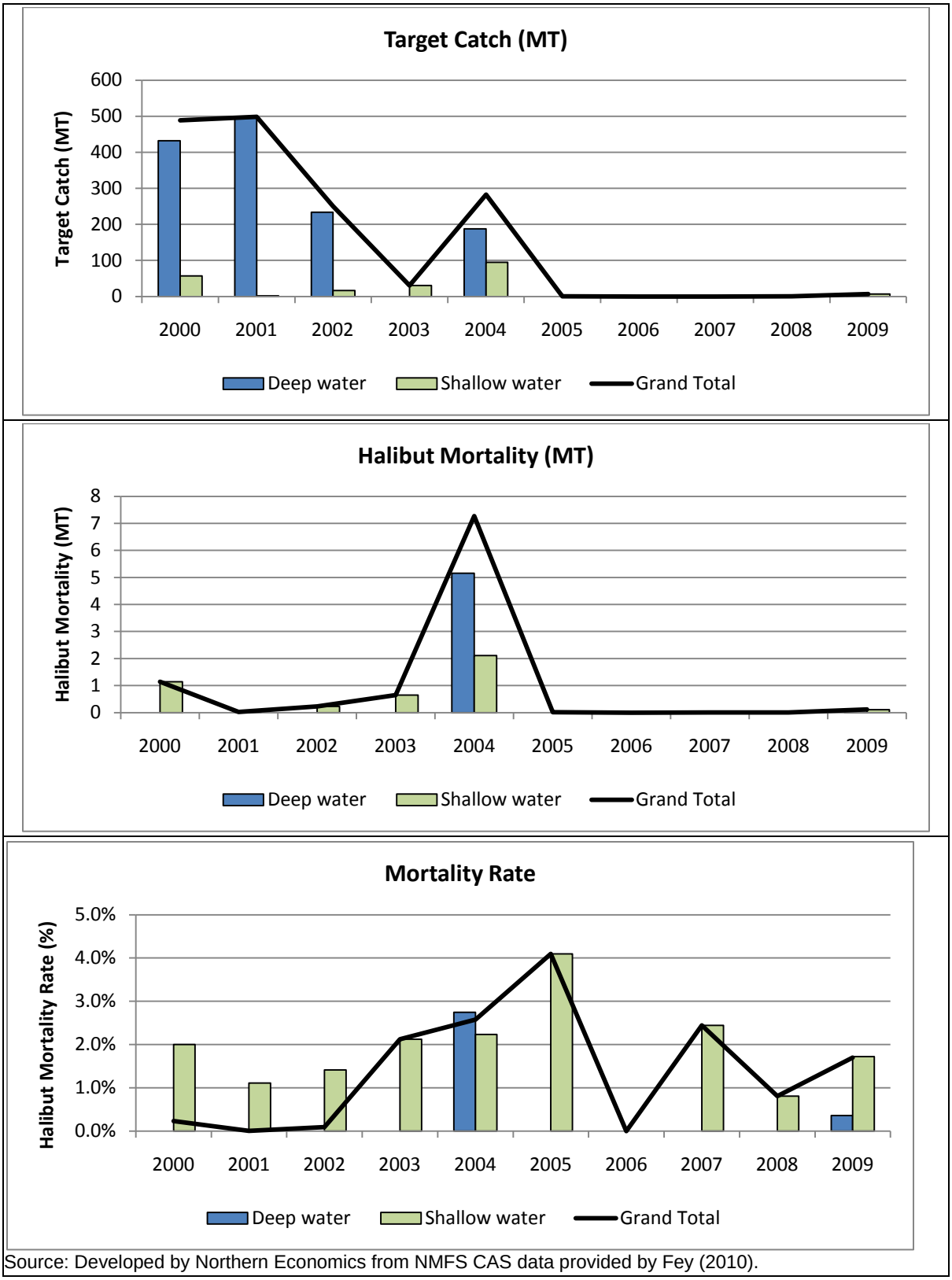
Trawling is closed by regulation in Area 650, and therefore the bycatch tables have a slightly different format with a focus on fixed gears. As seen in Table 17, in 2000 – 2002 and in 2004 the largest groundfish catch amounts were in the deep water species complex. Note that zero halibut bycatch were reported in the deep water fixed gear target fisheries from 2000 – 2002 and again in 2009. It is possible (although we are not certain) that these deep water fixed gear targets were incidentally classified as rockfish targets, when in fact harvesters were participating in a IFQ sablefish or halibut fishery and were able to land all of the halibut that was taken.

Table 17. Summary of Halibut Mortality by Gear, Target and Complex for Area 650, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	All Fixed Gear Targets And Species Combined									
Mortality (MT)	1.1	0.0	0.2	0.6	7.3	0.0	--	0.0	0.0	0.1
Target Catch (MT)	488.9	498.5	250.2	30.6	282.5	0.3	--	0.1	0.2	6.7
Mortality Rate (%)	0.23%	0.00%	0.09%	2.12%	2.57%	4.09%	--	2.45%	0.80%	1.70%
	Deep water Fixed Gear Targets									
Mortality (MT)	0.0	0.0	0.0	--	5.2	--	--	--	--	0.0
Target Catch (MT)	431.9	496.7	233.9	--	187.8	--	--	--	--	0.1
Mortality Rate (%)	0.00%	0.00%	0.00%	--	2.75%	--	--	--	--	0.36%
	Shallow Water Fixed Gear Targets									
Mortality (MT)	1.1	0.0	0.2	0.6	2.1	0.0	--	0.0	0.0	0.1
Target Catch (MT)	57.0	1.8	16.3	30.6	94.7	0.3	--	0.1	0.2	6.5
Mortality Rate (%)	2.00%	1.11%	1.41%	2.12%	2.23%	4.09%	--	2.45%	0.80%	1.72%

Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Figure 12. Deep v. Shallow Target Comparisons of Catch, Halibut Mortality, and Mortality Rates, Area 650



Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Table 18. Halibut Mortality by Specific Target Fisheries in Area 650, 2000-2009

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
					Deep Water H&L (Misc)					
Mortality (MT)	0.0	0.0	0.0	--	5.2	--	--	--	--	0.0
Target Catch (MT)	431.9	496.7	233.9	--	187.8	--	--	--	--	0.1
Mortality Rate (%)	0.0	0.0	0.0	--	0.0	--	--	--	--	0.0
					Pacific Cod Pot					
Mortality (MT)	--	0.0	--	--	--	--	--	--	--	--
Target Catch (MT)	--	0.3	--	--	--	--	--	--	--	--
Mortality Rate (%)	--	0.00%	--	--	--	--	--	--	--	--
					Pacific Cod H&L					
Mortality (MT)	1.1	0.0	0.2	0.4	2.1	0.0	--	0.0	0.0	0.1
Target Catch (MT)	57.0	1.5	13.1	27.3	94.7	0.3	--	0.1	0.2	6.5
Mortality Rate (%)	2.00%	1.32%	1.67%	1.57%	2.23%	4.09%	--	2.45%	0.80%	1.72%
					Shallow Water H&L (Misc)					
Mortality (MT)	--	--	0.0	0.2	-	--	--	--	--	--
Target Catch (MT)	--	--	3.2	3.2	--	--	--	--	--	--
Mortality Rate (%)	--	--	0.0	0.1	--	--	--	--	--	--
					Shallow Water Complex Total					
Mortality (MT)	1.1	0.0	0.2	0.6	2.1	0.0	--	0.0	0.0	0.1
Target Catch (MT)	57.0	1.8	16.3	30.6	94.7	0.3	--	0.1	0.2	6.5
Mortality Rate (%)	2.00%	1.11%	1.41%	2.12%	2.23%	4.09%	--	2.45%	0.80%	1.72%

Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).
Note: Rockfish target fisheries were the only component of the Deep Water H&L aggregate. "Other Species" target fisheries were the only component of the Shallow Water H&L aggregate.

1.7 Halibut Bycatch Mortality in the GOA Pacific Cod Fishery by Month

This section drills down into halibut bycatch in the GOA Pacific cod fishery by month with the goal of answering the question of whether there are significant differences in bycatch volumes or bycatch rates during different parts of the year. The same data used in previous tables and charts were used to create the figures presented below.

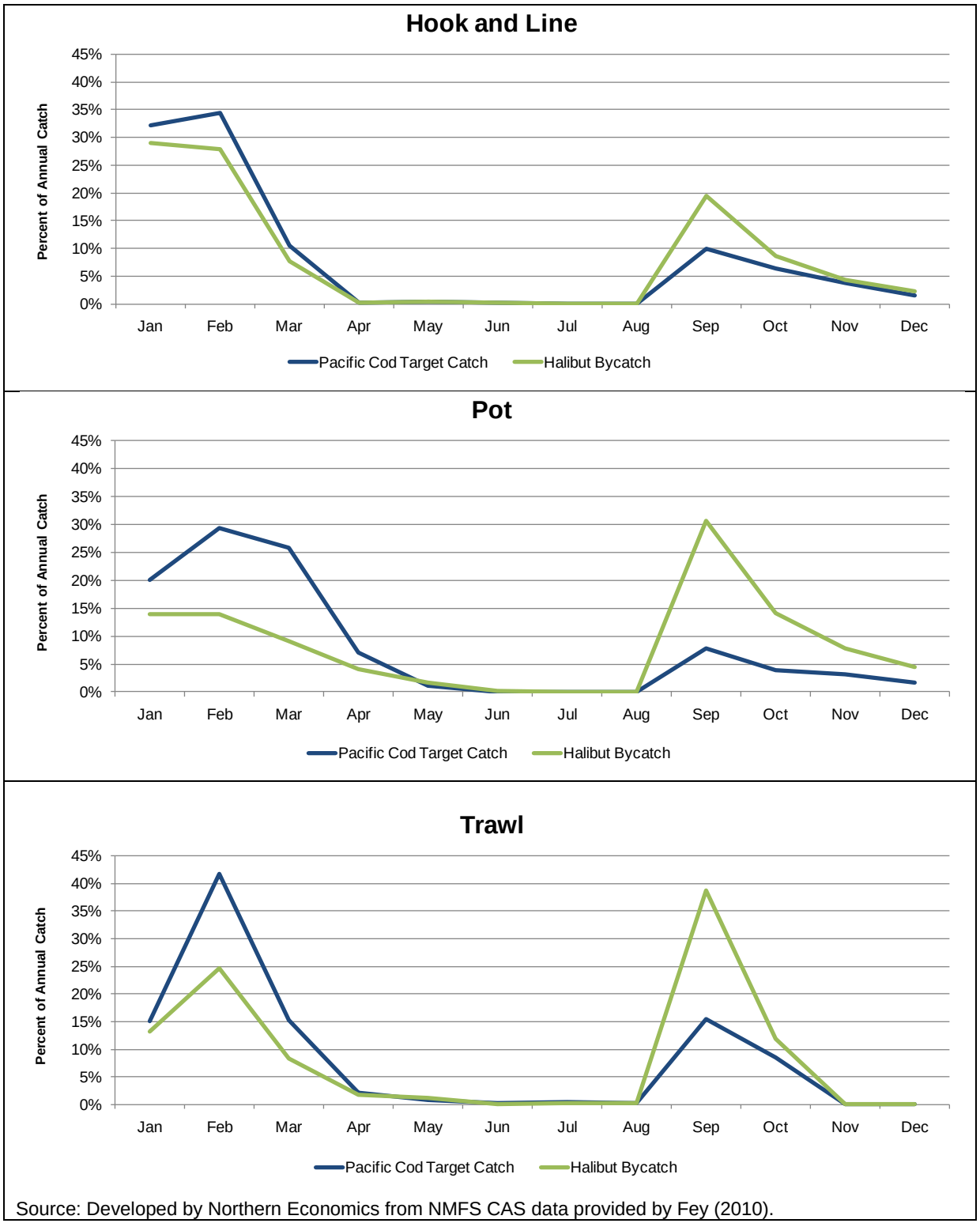
Figure 13 shows the average percentage of annual target and bycatch volumes caught by month, from 2000-2009. The data points are weighted averages; the catch for each month is summed over the ten year period and then divided by the total catch for the ten year period. Within the various fisheries there are yearly variations is season dates, season lengths, and management techniques. By showing the data as weighted averages over a period of time, the figure highlights the underlying relationship between target and bycatch volumes, by month. Note that to facilitate comparisons, the vertical axes for all three figures are identical.

Annual Pacific cod harvests in the Gulf of Alaska are highest from January to March, and in September and October. Little to no Pacific cod are caught by any gear type between April and August. Generally, the volumes of Pacific cod caught by the three different gear types (hook & line, pot and trawl) have peaked in February. Bycatch volumes of halibut in the Pacific cod fishery follow a different trend, traditionally peaking in September.

Figure 13 shows that the target catch peak periods are not in line with the halibut bycatch peak periods. In the fall months, the amount of bycatch (as a percentage of total annual bycatch volumes) is significantly higher than the percentage of target catch (relative to total annual target catch volumes). The relative difference is greatest in the pot fishery followed by the trawl fishery. Bycatch percentages for the hook and line fishery are highest in January and February.

It is important to note that the halibut bycatch percentages for each gear are calculated as the total amount bycatch mortality in the month over the 10-year period divided by the total amount of bycatch mortality. Total bycatch for each gear is shown in Table 4 back on page 7. Thus while bycatch in the pot fishery is highest in September, relative to other months, it is a higher percentage of a relatively small number. The 10-year total bycatch mortality in the pot fishery is 148 MT, compared to 2,823 in the hook and line fishery and 5,119 in the trawl fishery.

Figure 13. Pacific Cod Target and Halibut Bycatch Volumes as a Monthly Percentage of Annual Total, Weighted Average, 2000-2009



Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Figure 14 expands upon the data in Figure 13 by showing the monthly volumes of Pacific cod caught between 2000-2009, by each gear type. The design of Figure 14 makes visible the changes in all three variables. The vertical axis denotes the volume of target catch, the horizontal axis shows the month in which the fish were caught, and the depth axis (on the right) shows the change in the monthly harvest volumes by year, in reverse chronological order. Also note that to facilitate comparisons, the vertical axes for all three figures are identical.

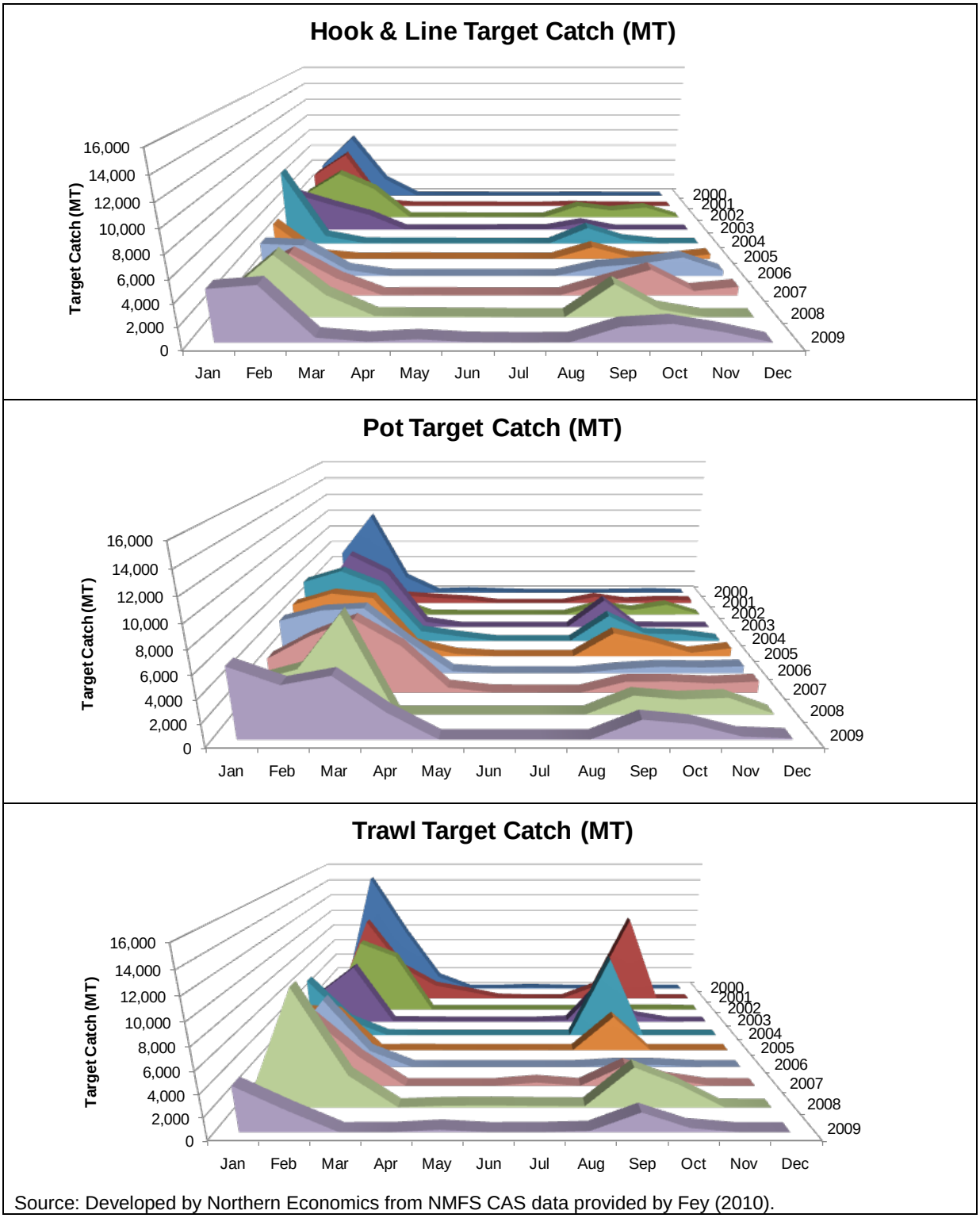
The figures reveal that while all three gear types yielded significant catch volumes over the ten year period, each may have had a different result in any given season. Both the hook and line and pot fisheries have significantly less harvest volume in the fall compared to the winter months, but in the hook and line fishery harvest amounts are trending upward during the fall months during the period. In the trawl fishery fall harvest of Pacific cod as a percent of annual harvest are trending downward.

Halibut bycatch rates (see Figure 15) are calculated by dividing the halibut bycatch volume by the target catch volume for a set period of time. On a multi-year or annual basis, this comparison yields valid results. On a monthly basis, however, it can skew results if harvest amount are relatively small. In months where target catch rates are low, even a small volume of bycatch can become a large percentage of the target catch, distorting conclusions by producing high bycatch rates. To paint a more accurate picture, months for which target catch volumes were less than six percent of annual target catch volumes were omitted from Figure 15.

Figure 15 summarizes the changes in halibut bycatch mortality rates by month, from 2000-2009. As with Figure 14, a 3-dimensional graph was chosen as a best fit for displaying the three variables. The angles of the figure were shifted from those of Figure 14 to accommodate the data pattern; the perspective chosen allows for maximum visibility. The figure also uses a reverse axis for months—earlier months appear closer to the front of the figure.

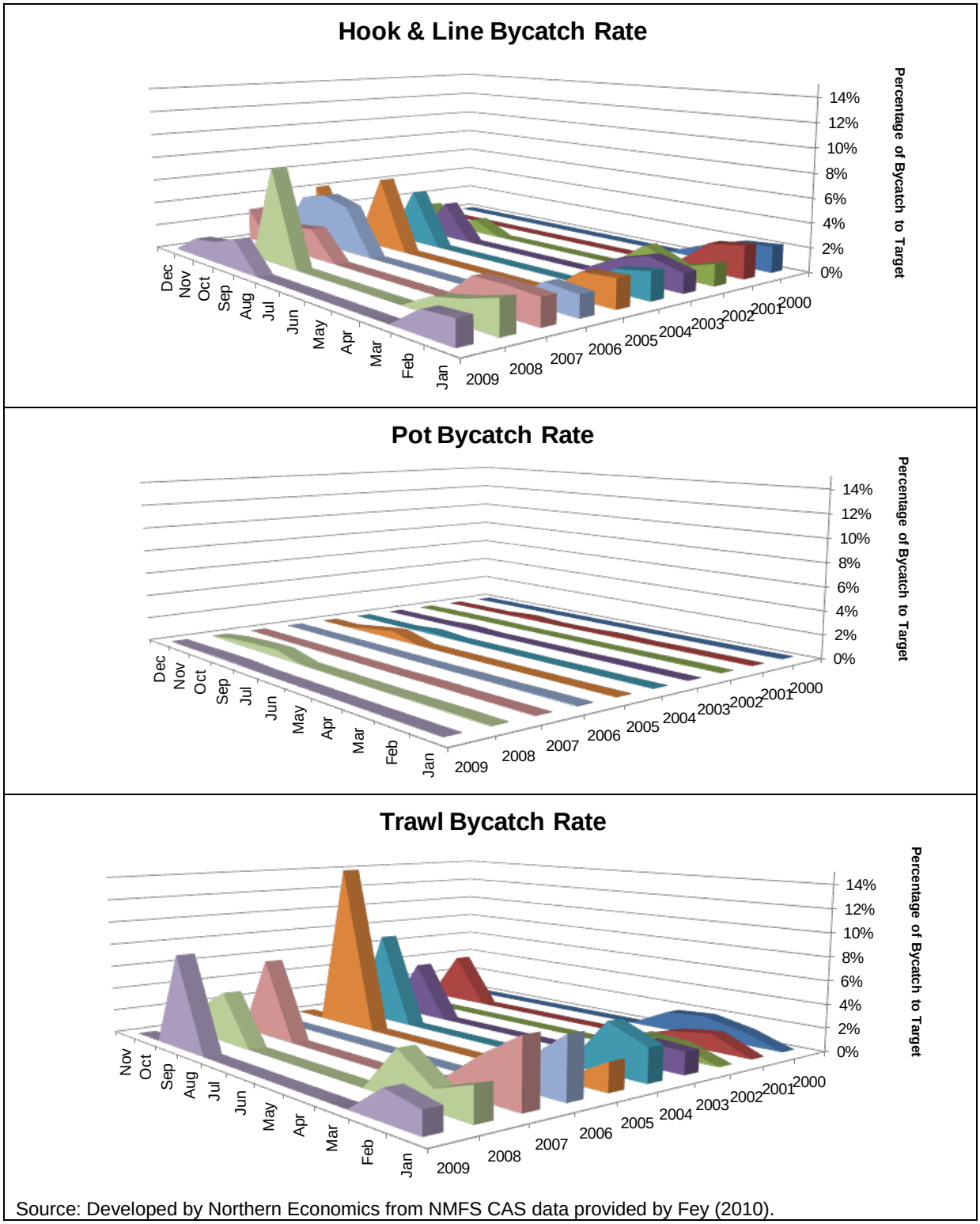
The figure shows that bycatch rates for pot gear are the lowest of the three gear types, averaging less than one percent each year. The remaining two gears show spikes in bycatch rates during September of most years. Hook and line bycatch rates spiked in September from 2004-2006 and jumped to a peak in September of 2008. Trawl bycatch rates in September are frequently high, and jumped to the highest rate of all gear types over all months (about 14 percent) in September of 2005.

Figure 14. Pacific Cod Volumes of Target Catch, by Gear Type



Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Figure 15. Halibut Bycatch as a Percentage of Target Catch in the Pacific Cod Fishery, by Gear Type



Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

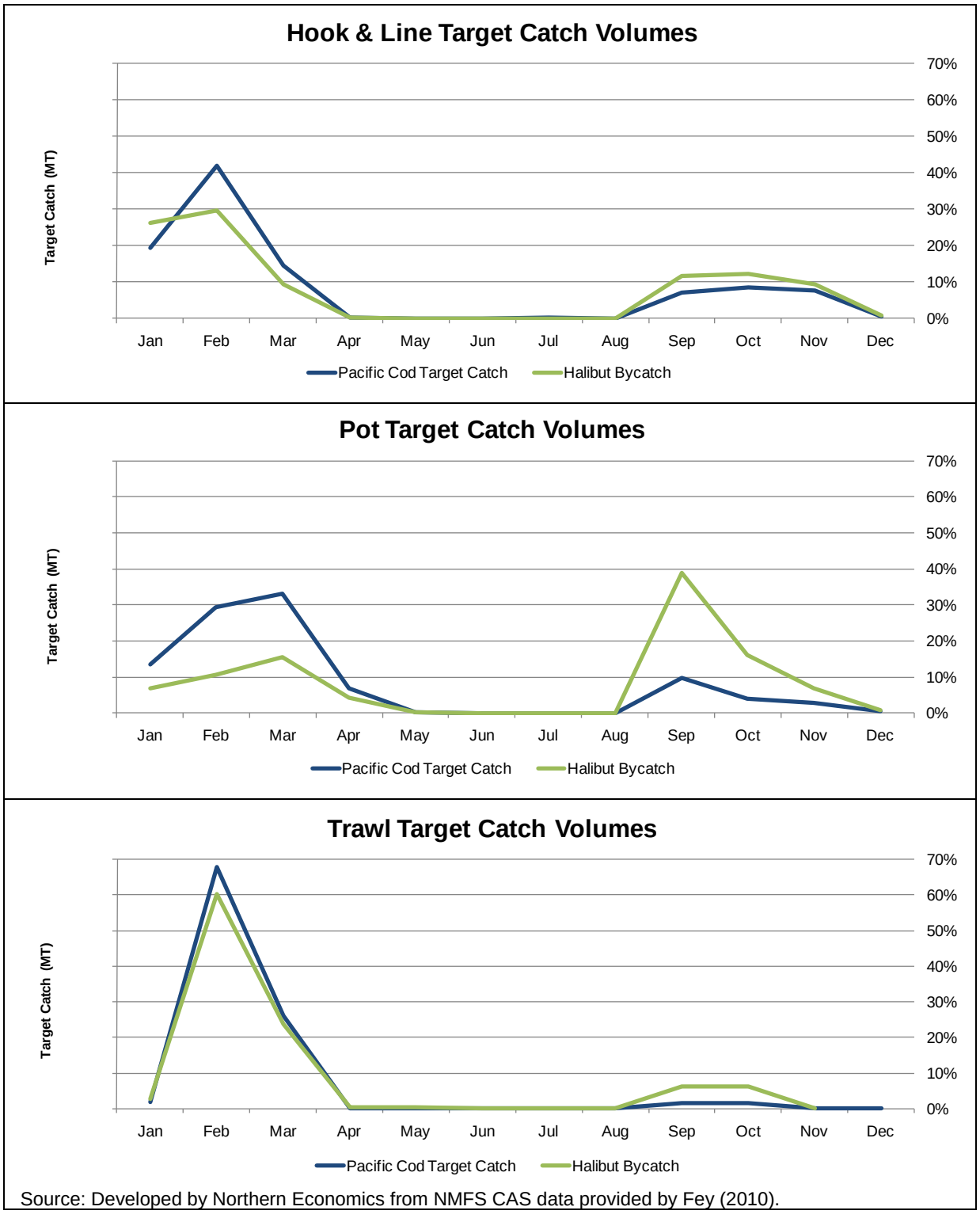
1.7.1 Monthly Bycatch in the Pacific Cod Fisheries by Management Zone

In this section we provide a brief comparison of halibut bycatch mortality by month across management zones in Western and Central Gulf.

The next three figures are similar to Figure 13 in that they show the weighted averages of annual target and bycatch volumes caught by month, from 2000-2009. The catch for each month is summed over the ten year period and then divided by the total catch for the ten year period.

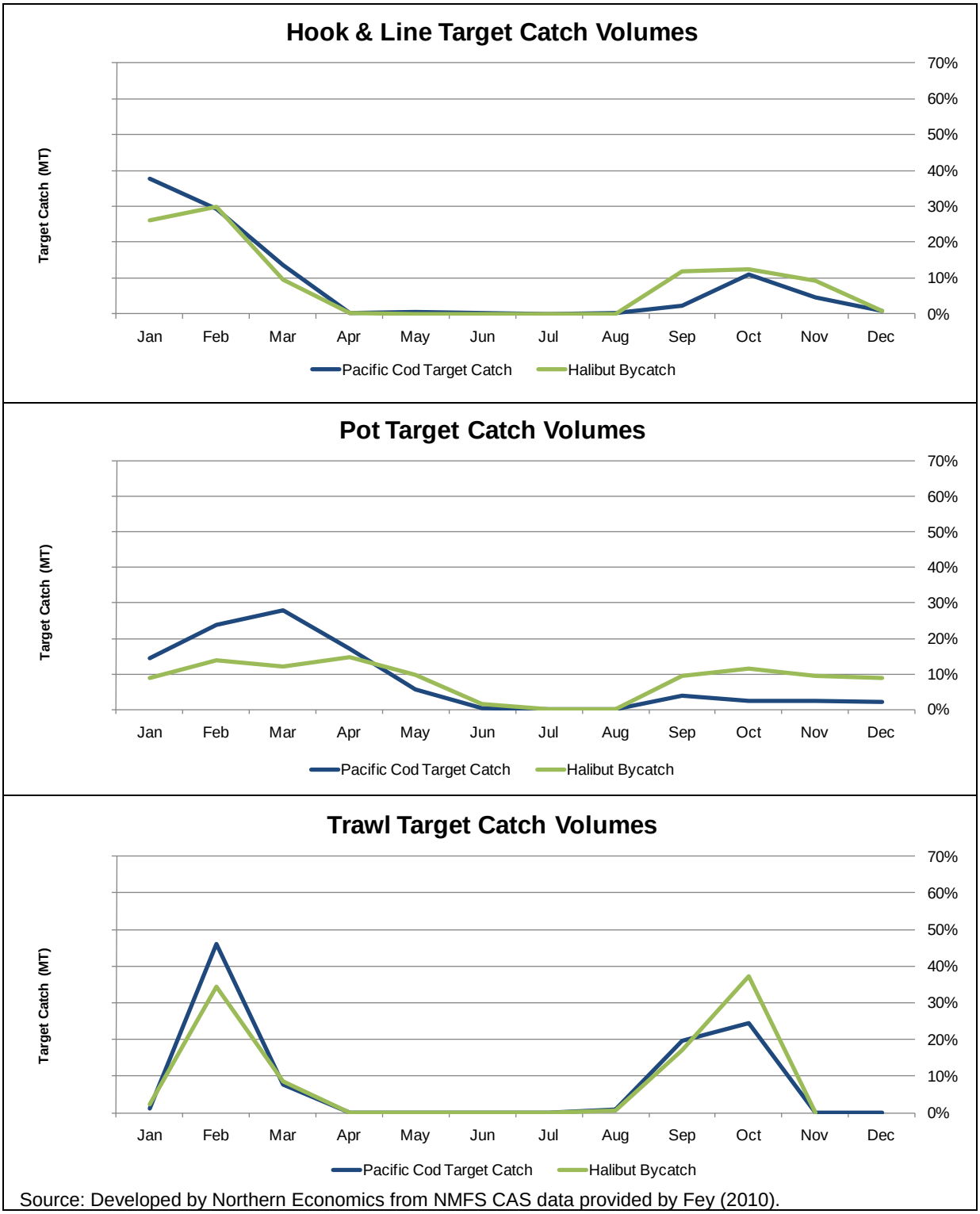
Figure 16, Figure 17, and Figure 18 focus on Areas 610, 620 and 630 of the Gulf of Alaska. In all three areas and for all three gear types, target and bycatch percentages show a similar relationship. In the winter and early spring, target catch percentages are higher than bycatch percentages. In the late summer and early fall the converse is true; bycatch percentages exceed target catch percentages. A comparison of the three areas shows that seasonal differences are much more noticeable in area 630 than in 610 and 620.

Figure 16. Area 610 Pacific Cod Target and Halibut Bycatch Volumes as a Monthly Percentage of Annual Total, Weighted Average, 2000-2009



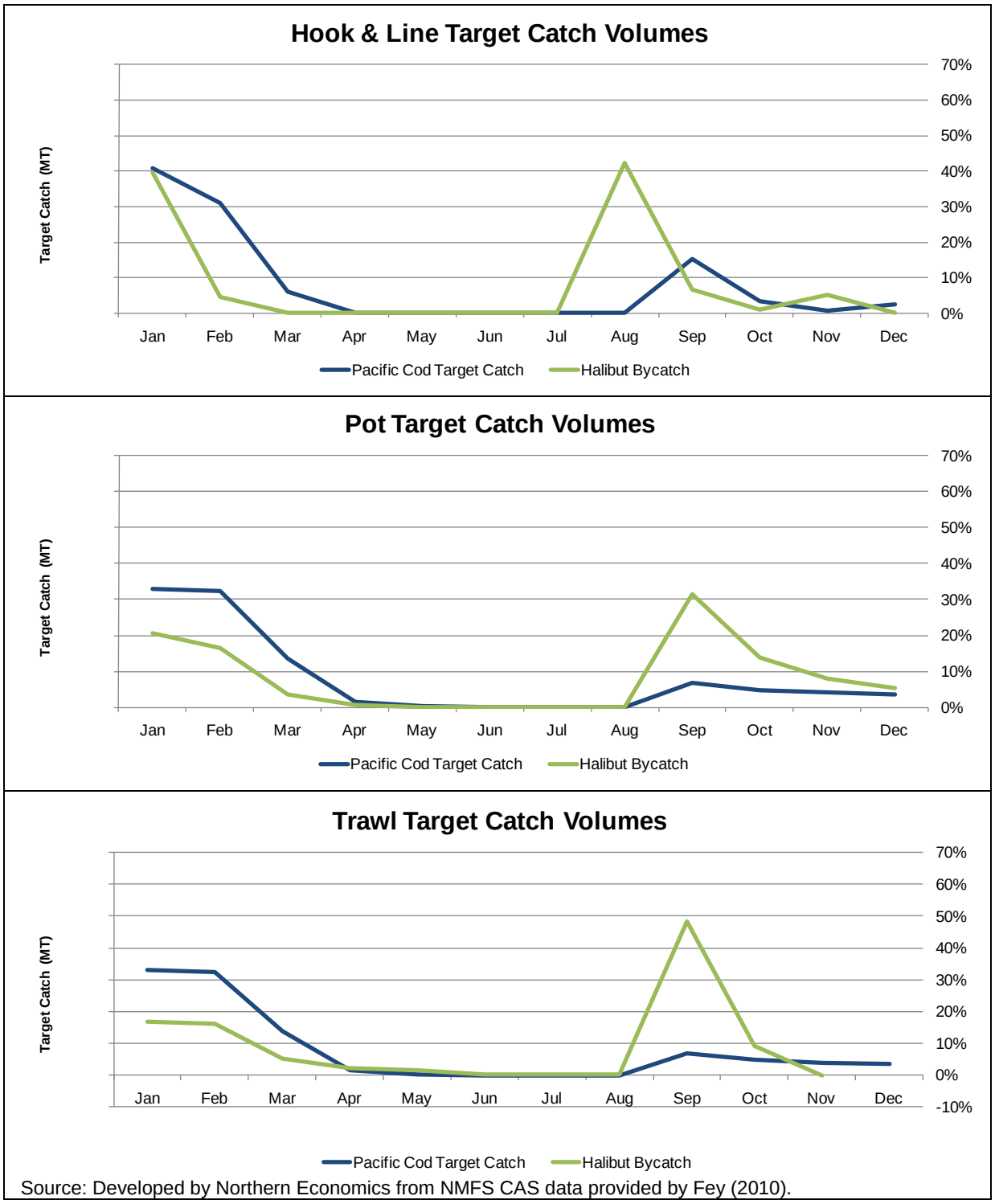
Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Figure 17. Area 620 Pacific Cod Target and Halibut Bycatch Volumes as a Monthly Percentage of Annual Total, Weighted Average, 2000-2009



Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

Figure 18. Area 630 Pacific Cod Target and Halibut Bycatch Volumes as a Monthly Percentage of Annual Total, Weighted Average, 2000-2009



Source: Developed by Northern Economics from NMFS CAS data provided by Fey (2010).

2 Ex-Vessel Revenue Generated per MT of Halibut Mortality

This section provides estimates of ex-vessel revenues earned in various GOA target fisheries per metric ton (MT) of halibut mortality. These estimates allow decision makers to assess the additional value of groundfish that could be generated if one additional MT of halibut were taken as bycatch by the fishery in question. This value represents a trade-off between 1) using halibut as bycatch to enable the harvests of groundfish and 2) using halibut in the directed longline IFQ fishery.

Table 19 summarizes these trade-off revenues for groundfish target fisheries over the entire GOA for the year 2003 - 2008. The table is organized into sections with each section summarizing a given gear group (trawl or fixed gears) for a particular complex of targets (deep or shallow-water complexes). At the bottom of the table is a summary of revenues per MT of halibut bycatch for all groundfish targets (excluding IFQ sablefish) over the entire GOA and a summary of estimated revenues generated in the directed IFQ fishery for halibut in terms of $/round weight MT. The latter includes estimates of ex-vessel revenues from incidentally caught groundfish landed in the IFQ fishery. Additional details on the interpretation and derivation of the estimates are provided on the following pages.

Table 19. Ex-Vessel Revenue Generated per MT of Halibut Mortality by Fishery, Gulf-wide from 2003 – 2008

Target & Gear	2003	2004	2005	2006	2007	2008	All Years (Weighted Avg.)
Deep Complex Groundfish Fisheries ($/mt of Round Weight Halibut Mortality)							
Arrowtooth Trawl	3,000	6,000	6,000	6,000	7,000	9,000	6,000
Deep Flatfish Trawl	4,000	2,000	0	0	27,000	0	3,000
Rex Sole Trawl	4,000	3,000	6,000	10,000	8,000	10,000	6,000
Rex Sole, Deep Flatfish, Arrowtooth	3,000	4,000	6,000	7,000	7,000	9,000	6,000
Rockfish Trawl	49,000	42,000	53,000	80,000	59,000	123,000	60,000
Sablefish Trawl	0	388,000	0	0	318,000	343,000	338,000
All Deep-water Trawl Targets	16,000	18,000	20,000	21,000	16,000	27,000	19,000
Shallow Complex Groundfish Fisheries ($/mt of Round Weight Halibut Mortality)							
Pollock (All Trawls)	1,132,000	838,000	6,897,000	243,000	142,000	226,000	338,000
Flathead Sole Trawl	3,000	5,000	9,000	8,000	14,000	8,000	6,000
Shallow Flatfish Trawl	2,000	2,000	7,000	7,000	8,000	13,000	7,000
Pacific Cod Trawl	18,000	9,000	11,000	22,000	23,000	33,000	18,000
Shallow Trawl Targets Except PLCK	9,000	6,000	9,000	12,000	14,000	23,000	12,000
All Shallow-water Trawl Targets	19,000	14,000	22,000	27,000	22,000	35,000	23,000
Fixed Gear Pacific Cod Fisheries ($/mt of Round Weight Halibut Mortality)							
Pacific Cod H&L	31,000	20,000	17,000	28,000	39,000	31,000	28,000
Pacific Cod Pot	1,406,000	922,000	473,000	1,070,000	1,286,000	803,000	887,000
All Groundfish Fisheries--Excludes Incidental Targets and Sablefish IFQ Fisheries ($/mt of Round Weight Halibut Mortality)							
All Targets/Gears (Weighted Av)	24,000	21,000	27,000	33,000	33,000	42,000	30,000
Directed Halibut Fishery ($/mt of Round Weight Halibut)							
Directed Halibut Fishery*	5,000	5,000	5,000	6,000	7,000	6,000	6,000

Source: Developed by Northern Economics using NMFS CAS data provided by Fey (2010), and secondary reports from Hiatt (2005, 2007, 2009) and PacFIN (2010a, 2010b).
Note: Includes the IFQ fishery, research, and the fishery in Metlakatla, and the value of incidental groundfish.

Interpretation of Estimates of Revenue /MT of Halibut Mortality

The estimates of ex-vessel revenue/MT of halibut mortality shown in Table 19 should be interpreted with care. In general the estimates provide an order of magnitude indication of the amount of ex-vessel revenue that was generated per MT of halibut mortality used in the groundfish fishery. Because the of potential rounding errors we show the estimated value to the nearest $1,000—even with rounding it may not be prudent to consider a difference of plus or minus $1,000 to be a significant difference. The primary reason for this caution is that data used in the calculation is likely to contain a fair amount of uncertainty. A few examples of the sources of this uncertainty include:

1) Low levels of observers in many of the fisheries in question.
2) The use of GOA-wide estimates from secondary sources for incidental harvests and retention of non-target groundfish species.
3) The use of single point estimates of ex-vessel price by year which do not recognize price differences by gear or area, and which do not include price differences that are likely to be seen when groundfish are landed as targets compared to when they are landed as incidental harvests.

If the Council believes these types of estimates are of value for decision-making, then we would propose to obtain and use primary data to generate more precise estimates. If for example individual fish-tickets were used rather than GOA-wide estimates of incidental groundfish harvest and retention, we would not only have better information for those variables, but we would also be more likely to see any differences in price by gear or port of landing, or in prices paid for incidental harvests.

In spite of the uncertainties and imprecision of the estimates in Table 19, there appear to some general conclusions that may be drawn from the information provided. These are summarized below and in Table 20.

1) The value of halibut as bycatch exceeds the value of halibut in the directed target fishery for groundfish fisheries targeting roundfish (pollock Pacific cod, rockfish, and sablefish).
2) The value of halibut as bycatch is close to, or may even be lower than, the value of halibut in the directed target fishery for groundfish targeting flatfish.

Table 20. General Conclusions Comparing Value of Halibut as Bycatch to Value in the Directed Fishsery

$/MT as Bycatch ≫ $/MT as Target	$/MT as Bycatch ≈/> $/MT as Target
Rockfish Trawl Sablefish Trawl Pollock Trawl Pacific Cod Trawl Pacific Cod H&L Pacific Cod Pot	Arrowtooth Trawl Rex Sole Trawl Flathead Sole Trawl Shallow Flatfish Trawl Deep Flatfish trawl
These are fisheries in which the $/MT of halibut as bycatch appears to be greater than the value per MT in the directed halibut fishery.	These are fisheries in which the $/MT of halibut as bycatch appears to be close to, or less than the value per MT in the directed halibut fishery.

Among roundfish fisheries, the trawl Pacific cod fishery appears to have the lowest differential from the halibut target fishery in terms of the amount of value generated per MT of halibut bycatch. As seen in Table 19, we estimated that an average of $18,000 in groundfish revenues were generated per MT of halibut bycatch, while the directed fishery for halibut generated an average revenue of $6,000 / MT of halibut including revenue generated from incidentally harvested groundfish. Other roundfish fisheries generated considerably more revenue on average from 2003 – 2009. For example the Pacific cod hook and line fishery generated an estimated $28,000 and the rockfish trawl fishery generated an estimated average of $60,000 per MT of halibut bycatch.

In the flatfish trawl fisheries an average $6,000 in revenue per MT of halibut bycatch was estimated over the five fisheries (arrowtooth, rex sole, flathead sole, deep-water flatfish, and shallow-water flatfish), with revenue/MT of bycatch in the deep-water flatfish the lowest of the group.

Derivation of Estimates of Revenue /MT of Halibut Mortality

The estimation of revenue / MT of halibut bycatch mortality was undertaken using aggregated catch and bycatch data combined with secondary reports on incidental harvests and retention in groundfish target fisheries as wells as secondary reports on groundfish and halibut prices.

Our baseline halibut bycatch data was the same dataset used to generate the tables and figures in Section 1 of this report. These data were weekly summaries of groundfish catch (MT of Groundfish) and halibut bycatch target (MT of halibut mortality) by target, gear and 3-digit management zone for 2003 – 2008.[1] These data were provided by request from AKFIN (Fey, 2010). We aggregated these data by target, gear, and year for the entire GOA.

We then obtained estimates of incidental harvests of groundfish by target and gear for the GOA from Table 3 of the document commonly referred to as the "Economic SAFE" for the years 2003 – 2008 (Hiatt 2005, 2007, 2009).[2] A few rows of the 2007 table (Hiatt 2009) are shown below.

Table 3. Gulf of Alaska groundfish catch by species, gear, and target fishery, 2007-08 (1,000 metric tons, round weight).

			Species											
			Pollock	Sable-fish	Pacific cod	Arrow-tooth	Flathd. sole	Rex sole	Flat deep	Flat shallow	Rock-fish	Atka mack.	Other	Total
2007 Gear/ Target	Hook & line	Sablefish	.0	10.2	.1	.4	.0	.0	.0	.0	.8	.0	.7	12.2
		Pacific cod	.2	.0	11.0	.1	.0	.0	.0	.0	.0	.0	1.5	12.9
		Halibut	.0	1.4	.4	.1	.0	-	.0	.0	.5	.0	.8	3.2
		Total	.2	11.6	11.5	.6	.0	.0	.0	.0	1.3	.0	3.0	28.3
	Pot	Pacific cod	.0	-	13.5	.0	.0	-	-	.0	.0	.0	.4	14.0
		Total	.0	-	13.5	.0	.0	-	-	.0	.0	.0	.4	14.0
	Trawl	Pollock, bottom	12.4	.0	.2	1.2	.3	.0	.0	.2	.0	.0	.6	14.9
		Pollock, pelagic	37.4	.0	.1	.5	.1	.0	.0	.0	.1	.2	.2	38.5
		[illegible]		.2					.0					

These were combined with estimates of retained groundfish by year from Table 7 of the "Economic SAFE" for the years 2003 – 2008 (Hiatt 2005, 2007, 2009). See the snippet on the following page. The combination of data from Table 3 and Table 7 of the "Economic SAFE" was used to generate estimates of retained groundfish by species groups for each ton of target fishery harvest for the GOA for the year 2003 – 2008.

[1] While these data were available back through 2003, algorithms that assigned targets to shoreside groundfish landing in the years prior to the use of NMFS' Catch Accounting System (prior to 2003) were judged to be too unreliable for this particular assessment.

[2] At the time these estimates were generated, the 2009 Economic SAFE had not yet been made available.

Table 7. Gulf of Alaska groundfish discards by species, gear, and target fishery, 2007-08 (1,000 metric tons, round weight).

			Species											
			Pollock	Sable-fish	Pacific cod	Arrow-tooth	Flathd. sole	Rex sole	Flat deep	Flat shallow	Rock-fish	Atka mack.	Other	Total
2007 Gear/ Target	Hook & line	Sablefish	.0	.2	.0	.3	.0	.0	.0	.0	.3	.0	.7	1.6
		Pacific cod	.0	.0	.1	.1	.0	.0	.0	.0	.0	.0	1.1	1.4
		Halibut	.0	.0	.1	.1	.0	-	.0	.0	.1	.0	.7	1.1
		Total	.0	.2	.2	.5	.0	.0	.0	.0	.4	.0	2.5	4.0
	Pot	Pacific cod	.0	-	.1	.0	.0	-	-	.0	.0	.0	.1	.3
		Total	.0	-	.1	.0	.0	-	-	.0	.0	.0	.1	.3
	Trawl	Pollock, bottom	.4	.0	.0	.3	.0	.0	.0	.0	.0	.0	.2	1.0
		Pollock, pelagic				.0			.0	.0	.0		.1	.8

We then combined the species level estimates with the aggregated data of total catch by target from AKFIN (Fey, 2010) to generate estimates of total retained harvest of each species group. These estimates were combined with estimates of prices for individual species generated from PacFIN data. (PacFIN 2003 – 2008).

The circuitous method used to estimate the value generated per MT of halibut bycatch undoubtedly introduced errors and uncertainty to the estimates, in part due to rounding, but also due to the fact that a single price for landings each species used regardless of the gear used, the condition of the fish, or the port of landing. If the NPFMC believes these types of estimates are useful, then we would recommend re-estimating the values using primary data contained within the Catch Accounting System, as well actual fish-ticket data from ADFG.

3 References

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Area 2B Halibut Management Presentation at IPHC Annual Meeting January 2010

Tamee Mawani, Regional Groundfish Manager
Fisheries and Oceans Canada

Canada

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Presentation Overview

- Historic Halibut Management
- Current Commercial Halibut Management Measures
  - Directed halibut fishery and bycatch fisheries

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Historic Halibut Management

- 1979 limited entry licensing
- 435 commercial (L) licenses created
- TAC implemented
- Competitive fishery management
  - Open fishery and close when TAC taken
  - Managers estimate harvesting capacity and ability to catch TAC
  - Monitor catches against TACs through port samplers, fishing logbooks, sale slips and plant information
  - 1989 Halibut fishery was reduced to 10 days (from 265)
- Introduced Individual Quotas (IQs) in 1991

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Need for change

- Even with limited entry and IQs, we still had some significant issues
  - Bycatch
  - Accounting for total mortality
- Scientific advice identified serious declines in rockfish stocks
- 10% at-sea observer coverage identified significant releases of rockfish and groundfish by all fisheries
- Uncertainty about total removals and mortality for many species of rockfish and groundfish

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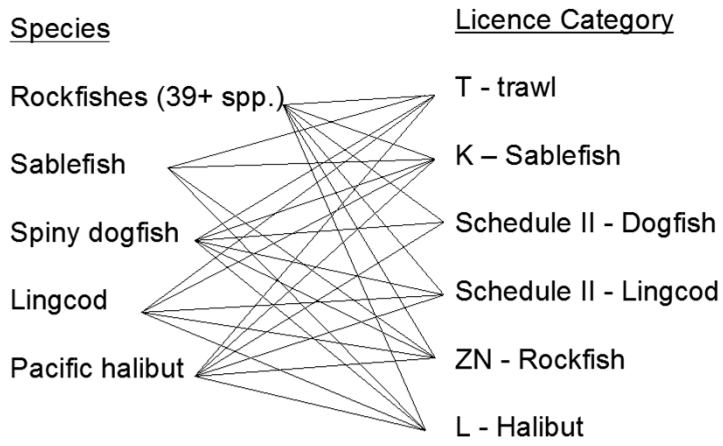
By-catch Issues



5

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The Problem

- There is mortality associated with discarded fish (rockfish mortality is 100%)
- Discarding is wasteful and results in unreported or misreported catch data that impairs the sustainable management of the groundfish resources
- The management procedure did not make individual harvesters accountable for their bycatch nor provide a mechanism for them to fish responsibly

6

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DFO Criteria

- DFO stated in 2003 that the following would be implemented in 2006:
  1. All rockfish must be accounted for;
  2. Rockfish catches will be managed to established rockfish management areas;
  3. Harvesters will be individually accountable for their catch;
  4. New monitoring standards (dockside and at sea) will be established and implemented to meet the above 3 objectives.

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Commercial Groundfish Integration Program

- In 2006 DFO implemented the Commercial Groundfish Integration Pilot Program:
  - 1 management plan, not 6
  - IQs in all fisheries (new for lingcod, dogfish, rockfish)
  - individual vessel accountable for all catch (mortality) – whether retained or released; targeted or non-targeted
  - IQ trading between vessels and fisheries
  - 100% at-sea monitoring (at-sea for trawl; video for H&L)

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Implications for Halibut Fishery

- Commercial catch of halibut reported annually by area 2B includes all halibut caught including by-catch groundfish fisheries
- 100% at-sea and dockside monitoring for halibut caught in both directed and by-catch fisheries
- All commercial harvesters intercepting halibut (targeted and by-catch) are individually accountable for their halibut catch and all other fish intercepted

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Trawl Management

- Retention of halibut caught by trawl gear is prohibited.
- In early 1990s Canada/US reached an agreement on a Halibut Bycatch Reduction plan to reduce halibut bycatch by half.
- The bycatch cap for the Canada was established at 1M lbs
- Canada's trawl bycatch plan was implemented in 1995 with 100% at sea observers required in 1996.
- IVQ program adopted to manage the Canadian trawl fishery in 1997 that included individual vessel accountability for halibut mortality.
- Halibut mortality is determined by the onboard at sea observer and is charged against the vessel's individual quota holdings.

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Trawl Management

- Halibut by-catch mortality IVQ can be reallocated only within the trawl sector
- Halibut catch in excess of a vessel's individual halibut by-catch holdings results in the vessel being restricted from bottom trawling coast-wide for the remainder of the fishing year, or until sufficient additional halibut by-catch quota is reallocated to cover the mortality

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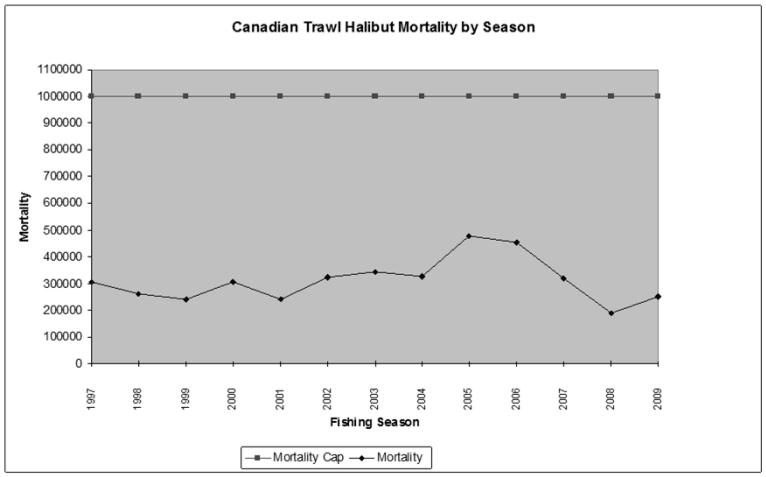
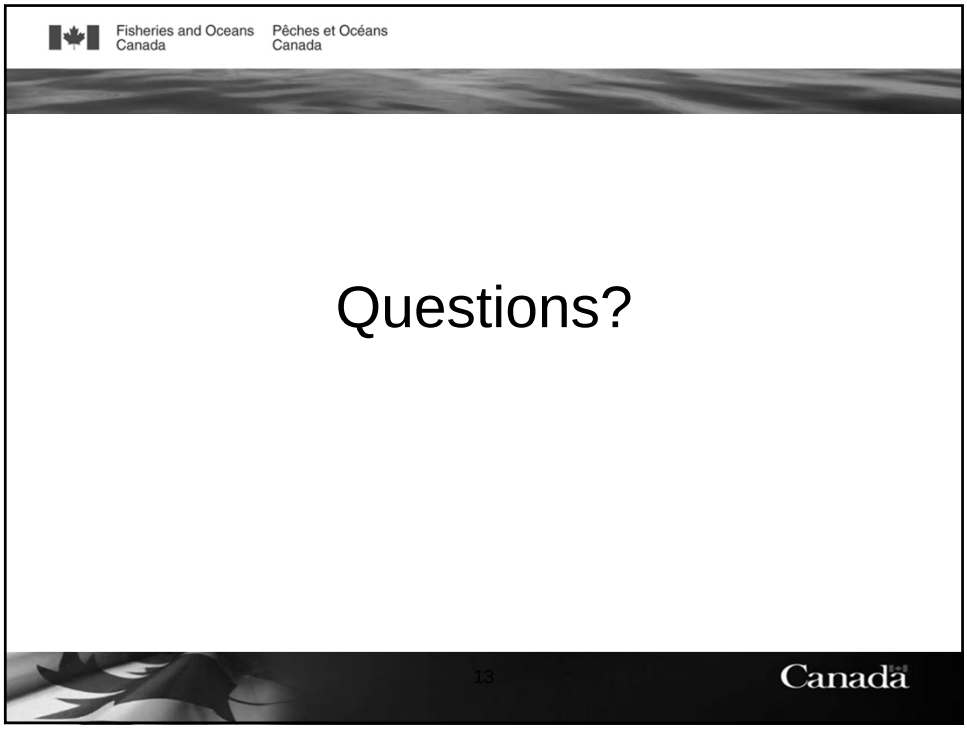
Trawl Mortality



Canada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