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Intended and Unintended Consequences: Fisher responses to bycatch reduction requirements in the Alaska Groundfish Fisheries.

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Abstract
Bycatch of certain species, including Pacific halibut and several Pacific salmon species, is limited in the Alaska groundfish fisheries. Catch and bycatch in these fisheries is monitored at sea by observers. Fisheries for targeted demersal species often close prematurely when halibut bycatch limits are reached and vessels harvesting pollock may be required to relocate when salmon bycatch limits are reached in specific areas. Premature closures and mandatory relocation may be costly and provide incentives for implementation of innovative bycatch reduction measures. They also provide incentives for interference with observer sampling which results in under reporting of bycatch rates. We discuss both types of behavior and illustrate our perspective with two examples. The first involves industry-agency collaboration providing near real time information on salmon bycatch rates to guide fleet avoidance of high bycatch areas; vessels targeting pollock are members of fishery cooperatives and response to salmon bycatch is governed by intercooperative contracts which ensure participation of all fleet members. The second considers evidence of observer sampling interference leading to underestimation of halibut bycatch rates, and the consequences of improved enforcement of regulations that prohibit interference with observer sampling. These include measures to discourage and detect sampling interference, and emulation of the successful salmon bycatch reduction measures employed in the pollock fishery.

Introduction

The statutory basis for bycatch reduction in federal waters of the United States can be found in National Standard 9 of the Sustainable Fisheries Act (SFA) of 1996 (16 U.S.C. § 1802 (2)) which states that ''Conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch." Through this language, Congress directs NOAA and the regional Fishery Management Councils to emphasize reduction of bycatch (or bycatch mortality) when promulgating Fishery Management Plans (FMPs). The extent of the commitment by NOAA to document and mitigate bycatch issues throughout the United States is documented in the recent report "Evaluating Bycatch: A National Approach to Standardized Bycatch Monitoring Programs" (NMFS 2004).

Bycatch is of serious concern in many of the groundfish fisheries off Alaska (see Pennoyer 1997). These fisheries target a broad range of commercially-important species and employ several gear types including demersal and pelagic trawls, loglines, and pots. The fisheries are managed under the provisions of two FMPs which have been developed (and periodically amended) through a the process laid out in SFA which is based on deliberations by the North Pacific Fishery Management Council (NPFMC) and the NOAA Fisheries Service. The FMPs govern management of groundfish fisheries in federal waters of the Gulf of Alaska (GOA) and Bering Sea/Aleutian Islands (BSAI).

Certain bycatch species are designated as "Prohibited Species Catch" or PSC in these FMPs because they are not considered to be groundfish and are harvested by fleets managed under different regulations. These include all salmonid species (generally harvested in State of Alaska waters) and Pacific halibut (*Hippoglossus stenolepis*) which is managed by the International Pacific Halibut Commission under the authority of an international treaty (U.S. - Canada). Retention of PSC by vessels fishing under GOA and BSAI groundfish FMP provisions is prohibited and regulations require fisheries to be curtailed or relocated when bycatch of these species exceeds specified levels. PSC bycatch rates are determined from catch composition data submitted by fisheries observers deployed at sea.

In the following we consider the effectiveness of regulations developed to encourage PSC reduction in two different types of fisheries, the directed fishery for walleye pollock (*Theragra chalcogramma)* in the BSAI, where salmonid PSC is of major concern, and the multispecies demersal catcher-processor trawl fishery (largely prosecuted in the BSAI), where PSC concerns include Pacific halibut and some species of crab. These fisheries are distinctly different from each other in terms of their target species and gear types, the regulations under which they are managed, the PSC species they encounter, and the operational and organizational characteristics of the fleets.

BSAI Pollock Fisheries

Walleye pollock is the most important species in the Alaska groundfish complex in terms of catch value and quantity and is the target species for one of the world's largest fisheries. During 2003, pollock made up 71.4% of the groundfish catch off Alaska. The pollock catch for 2003 was 1.54 million t, up approximately 0.5% from 2002 (Hiatt et al. 2004). All directed pollock fishing employs large midwater trawls. While this minimizes the impact of fishing on habitat and limits bycatch of demersal species, it does not mitigate the potential for incidental capture of salmonids, which are generally distributed in the pelagic zone

Pollock are harvested by catcher vessels (CVs) that deliver catches to floating or shoreside plants, and catcher processors (CPs) that process their catches at sea. Before 1999, directed pollock fishing in the BSAI was managed under an "Olympic" style fishery under which all qualified fishing vessels competed for specified seasonal and area quotas (the race for fish). Regulations required curtailment of fishing operations in specific (salmon savings) areas if bycatch of certain salmonid species exceeded threshold levels. Pollock catch rates are generally high in the salmon savings areas so curtailment of fishing in these areas may result in decreased fishing efficiency (Witherell et al. 2002).

The American Fisheries Act (AFA) of 1998 mandated significant changes in management of this fishery and configuration of the CV and CP fleets. Of particular importance in the context of this paper is the "rationalization" of the fleet that occurred under AFA. After setting aside a portion of the pollock total allowable catch (TAC) for the Community Development Quota (CDQ) program[1] and for bycatch needs in the non-pollock groundfish fisheries, federal regulations implemented under AFA divided the remaining pollock quota permanently among three sectors: inshore (CVs delivering to shoreside plants), catcher/processor, and mothership (CVs delivering to floating processors) sectors. Within each sector one or more fishery cooperatives was established as required by AFA. Each cooperative has considerable authority for managing

[1] The Community Development Program requires that a proportion of the total allowable catch for each groundfish species be allocated to specified Alaska Native Communities under federal regulations.

fishing operations among its member vessels, provided that these operations are in overall compliance with cooperative-specific catch and bycatch limits and applicable regulations. Provisions for intercooperative agreements were also established.

As a direct result of AFA implementation, fleet consolidation occurred and latent capacity was reduced. Furthermore, elimination of the race for fish encouraged the fleet to work collectively on strategies for reducing PSC and other bycatch levels, especially in situations were high bycatch levels might restrict fishing opportunities or otherwise increase costs associated with harvesting of pollock. Cooperative and intercooperative agreements have allowed the fleet to respond collectively and effectively to several challenges. These include implementation of strategies to comply with mitigation measures related to the listing of the Steller sea lion (*Eumetopias jubatus*) as endangered under the Endangered Species Act which required temporal and spatial dispersion of harvests and reduced removals from critical habitat, and a program that curtails fishing in other (non salmon savings) areas when salmon bycatch rates become excessive.

The Multispecies Demersal Catcher-Processor Trawl Fishery

This fleet consists of approximately 26 vessels that harvest a range of species including several flatfish species (“rock sole” consisting of northern rock sole (*Lepidopsetta polyxystra)* and southern rock sole (*L. bilineata*), yellowfin sole (*Limanda aspera*), flathead sole (*Hippoglossoides elassodon*), and arrowtooth flounder (*Atheresthes stomias)*), Atka mackerel (*Pleurogrammus monopterygius)*, Pacific cod (*Gadus macrocephalus*), and rockfish (*Sebastes* spp. and *Sebastolobus* spp.), principally Pacific ocean perch (*Sebastes alutus*), in the BSAI and GOA. In 2003, this sector harvested approximately 149,000 t of flatfish, 56,000 t of Atka mackerel, 37,000 t of Pacific cod, and 31,000 t of rockfish. These vessels range from 30 m to 76 m length overall and because of their size, processing on most of them is restricted to heading and eviscerating of fish, thus they are commonly referred to as the "head and gut” fleet.

This fleet differs from the AFA fleet in many ways. Even though it is relatively small, it targets a broad range of species and supplies a number of niche markets with specific products. Vessel configurations and fishing strategies vary considerably and, although the majority of the companies owning vessels in this fleet are represented by a trade organization some companies with significant harvest capacity are not represented by this organization. Furthermore, this fleet is not rationalized and fishing operations are characterized by a "race for fish" which encourages fierce competition among fishing companies and provides little incentive for collaborative approaches to bycatch reduction.

The diversity of species composition in the catch, procedures for handling, sorting and processing catches, and layout of holding and processing facilities also differ markedly from CPs in the AFA sector.

Prohibited Species Bycatch Management

NOAA tracks all PSC catch levels through reports submitted by fishery observers. For a large portion of the fleet, observers submit catch quantity and composition reports daily through an electronic link with the NOAA Alaska Fishery Science Center's laboratory in Seattle. This data is screened for errors and made available to managers on a daily basis. As target and bycatch limits are approached in specific fisheries, fishery participants are alerted of projected closure dates. Sampling challenges faced by observers vary considerably and are linked closely to the characteristics of catches in specific fisheries and the catch handling procedures employed aboard the vessels on which they are deployed. In the directed fisheries for pollock, catches are generally quite large and overall bycatch rates are very low. Access to catches for sampling is often difficult, especially on CVs that deliver unsorted catches to processing plants. But opportunities for crew to presort (remove certain species before observer sampling) are few and observers generally have access to aggregate catches at the point of delivery to a shore plant where sampling for prohibited species may be completed. On pollock CPs, access to catches for sampling may also be difficult, but AFA provisions require two observers on all CPs, and special arrangements to facilitate sampling. Nevertheless, salmon occur infrequently and unpredictably in the pollock fisheries, so sampling for salmon mortality estimation is problematic (Vølstad et al. 1996; Karp and McElderry 1999).

Catch composition and factory design complexity create particularly difficult observer sampling challenges on multispecies demersal trawl catcher processors. Catch species diversity is generally high and many flatfish and rockfish species are difficult to identify. Sorting and processing facilities are cramped on many of the vessels in this fleet and this often impedes observer access to the catch for sampling. Furthermore, because a great deal of sorting by crew is necessary, PSC species are easily identified, and catch handling often occurs in locations that are not accessible to observers, there are many opportunities to presort. Evidence of this practice is documented by Renko (1998) and in numerous anecdotal reports and affidavits submitted by observers. Two recent enforcement cases are also significant in this context.

In 2004, government attorneys successfully prosecuted a case involving illegal presorting aboard the F/V *Rebecca Irene*. Penalties included a substantial fine and permit sanctions. Official notification of this judgment (http://www.fakr.noaa.gov/newsreleases/2004/halibut061804.htm) includes the following:

"The vessel owner, Rebecca Irene Fisheries LLC, and vessel operator Mark Decker were found responsible for the crew's removal of halibut from the vessel's conveyor belt prior to the observer having an opportunity to include those halibut in the sampling. They also were found liable for failing to minimize the catch of halibut and for the crew's actions that impeded the observers' ability to perform their duties".

In 2005, a similar case was brought against another of the factory trawlers in this fleet, F/V *Unimak*. Large fines, permit sanctions, and probation for key company employees were associated with this judgment (http://www.fakr.noaa.gov/newsreleases/unimak_skrock1_anderson.pdf).

Before implementation of AFA, companies involved in the BSAI pollock fisheries, the multispecies demersal trawl fishery, and other Alaskan groundfish fisheries began to work collectively to mitigate PSC bycatch concerns. Sea State, Inc., a private company, began contracting with some fishing companies to provide near real time information on PSC bycatch rates in some fisheries (; Gauvin et al. 1995; Gilman et al. 2005). Their approach utilized reports submitted to NOAA by fisheries observers that provided haul specific location and catch composition information. Under federal confidentiality restrictions, NOAA can release this information only to the company aboard whose vessel the data were collected, or their designee. Several fishing companies contracted with Sea State and authorized them to access observer data. Sea State began developing maps summarizing catch and bycatch information, and providing guidance on operational changes which might reduce bycatch of limiting species. At this time, all the groundfish fisheries in the BSAI and GOA were managed under an open access model so each fishing company had to consider carefully the costs and benefits of sharing catch and bycatch information with competing companies.

Gauvin et al. (1995) characterizes this quandary as follows:

"A critical determinant of success in any voluntary (bycatch reduction) program is to obtain a critical mass for participation. Further, there must be a legitimate reason why a company would want to participate because volunteerism normally wanes when there is no tangible reward. If the program successfully prevents premature closures of fisheries, then there is clearly a common benefit to the fishery. Our experience shows that sometimes the common benefit is adequate motivation for participation and sometimes the motivation for private gain can outstrip the incentive for common benefit.

"A discrepancy between self interest and common interest occurs when catch rates for the target fishery are higher in the same locations where bycatch rates are high. Under these conditions firms would have to sacrifice target catch to keep bycatch rates low if a location with high target catch rates and low bycatch rates cannot be found. Since the cap is a common pool, the economic benefits of high catch rates are individual while the economic consequences of high bycatch rates are shared. We believe this is a fundamental limitation to any voluntary bycatch reduction program based on common bycatch caps".

These authors discuss several examples of attempts to reduce PSC bycatch and postpone premature fishery closures in the multispecies demersal trawl catcher-processor fishery. In one example, the 1995 directed fishery for rock sole, all of the fishing companies involved agreed that it was in their collective interest to track PSC rates and take collective action to avoid high bycatch areas. They were successful in directing the fleet to avoid high rates of red king crab (*Paralithodes camtschaticus*) PSC and this was accomplished without reducing catch rates of the target species. However, halibut PSC rates were notably higher in the area to which they moved, raising new concerns regarding premature fishery closures. In the yellowfin sole fishery, however, it was apparent that any action taken to avoid high halibut PSC rates would reduce target species catch rates markedly. One fishing company, which owned five of the 20 vessels participating in the fishery, chose not to participate and continued to enjoy high target species catch rates while other companies relocated their vessels. This same company is thought to have been responsible for very high halibut PSC rates which ultimately triggered a premature closure of the fishery for all participants.

Bycatch reduction may be difficult to achieve for a number of reasons. Some of these are related to the biological characteristics of bycatch species and the extent to which these are predictable, and some, such as the complex situation described above where successful avoidance of red king crab only exacerbated halibut bycatch problems, are particularly challenging. However, it is apparent that provision of accurate and timely bycatch information of high temporal and spatial resolution (observer data) with a management system which provides fleets with a complete set of tools and incentives for reducing bycatch can be successful. With the implementation of AFA, the BSAI pollock fishery has demonstrated a high degree of effectiveness in managing salmon PSC through synthesis and distribution by Sea State of current PSC and target species catch information submitted by observers. Binding agreements signed by cooperative members, and binding intercooperative agreements, mandate collective fleetwide action when high salmonid bycatch rates are encountered, and the fleet has been proactive in relocating to avoid high salmon bycatch rate, even in areas outside the designated salmon savings areas. The regulatory process is slow to adapt to changes in underlying conditions, such as long- or short-term differences in the distribution (and consequent rate of encounter during pollock fishing) of salmonids. By combining the information services described above with the ability to establish contractual obligations under AFA, the fleet has demonstrate its ability to respond rapidly and effectively when bycatch concerns arise, without the need for regulatory process. In recognition of the potential for further overall reductions of salmonid bycatch in the BSAI pollock fisheries, the North Pacific Fishery Management Council and the NOAA Fisheries Service have recently initiated analysis of a the concept of a voluntary rolling hotspot alternative to regulatory salmon savings area closures (NPFMC 2005a) .

Discussion

Reduction of bycatch and discard are primary fishery management goals throughout the world. Many strategies are available to managers, including regulations that explicitly limit bycatch and discard, mandate specific, selective types of gear, or establish temporal and spatial restrictions on fishing operations. Notable successes have been associated with each of these approaches although they are not universally applicable (e.g. Alverson et al. 1994; Anonymous 1996; Hall et al. 2000; Warren 1994).

It is apparent that the likelihood of success in any bycatch mitigation attempt can be enhanced if certain considerations are taken into account. These include: understanding relevant aspects of the biology of target and bycatch species, meeting information needs for designing effective programs and monitoring their effectiveness, providing industry with the tools necessary for effective and efficient bycatch reduction, and providing incentives for compliance with strategies and regulations. Comprehensive consideration of all of these factors requires active participation by the industry itself as well as other interested parties.

We have described two distinctly different groundfish fisheries that operate in the BSAI region. Each is faced with unique bycatch reduction challenges and each has demonstrated some degree of success in addressing these challenges.

Relevant aspects of the biology of target and non target species include those aspects of life history and behavior that influence temporal and spatial distribution, and vulnerability to fishing gear. Analysis of historic fishery data, especially when detailed information on catch composition is available, can be particularly insightful. Witherell et al. (2002) provide a thorough review of the life history and distribution of salmonid species that occur as bycatch in the Alaska groundfish fisheries, and much information is available on the biology of walleye pollock in the BSAI (e.g. Bailey et al. 1999; Ianelli et al. 2003). Occurrence of salmonids in preferred pollock fishing areas is well documented, although it is apparent from the work of Sea State and other industry reports (see NPFMC 2005a) that high pollock catch rates can be obtained in areas were salmonid encounter rates are low. The current state of knowledge provides little guidance for systematic avoidance of salmonid bycatch and, therefore, use of near real time encounter information is particularly important if bycatch reduction measures are to be effective. Innovations in fishing gear design that take into account fish behavior during the capture process also hold promise for salmon bycatch reduction (C. Rose and J. Gauvin, personal communication).

Much is also known of the biology of the commercially important flatfish (including Pacific halibut) and other demersal species encountered by the head and gut fleet (e.g. Wilderbuer et al. 2005). Adlerstein and Trumble (1998) provide insights on temporal and spatial patterns of Pacific halibut distribution which may be useful in avoiding halibut bycatch in directed fisheries for Pacific cod and, possibly other species. Gauvin et al. (1995) also note that there are predictable temporal and spatial patterns in halibut distribution which may be useful for reducing bycatch in directed fisheries for some (but not all) flatfish species; they also note that successful avoidance of halibut may simply exacerbate bycatch problems with other species, drawing attention to the complex biological and ecological factors associated with the multispecies demersal trawl fisheries. Another aspect of the biology of Pacific halibut is of importance in bycatch reduction. Research has demonstrated that careful and rapid release of halibut following capture greatly increases their probability of survival (Kaimmer and Trumble 1998). Regulations have been implemented to encourage careful and timely release, and recognize the condition of released fish when estimating bycatch mortality. The work of Rose and Gauvin (2000) demonstrates the potential for trawl modifications to reduce halibut bycatch rates. Even though a great deal of information on the biology and ecology of important target and bycatch species in the GOA and BSAI is available but this is not the case in all regions. Furthermore, substantial and detailed historic fishery catch information is generally required to characterize the nature of fishery interactions with bycatch species, document patterns in bycatch rates, and recognize associated estimation uncertainty.

The regulatory process is generally time consuming and, once implemented, regulations may be difficult to modify. If fishing practices change, or shifts in distributional patterns of target or non target species occur, regulations that constrain temporal and spatial fishing operations to reduce bycatch may become ineffective. Management measures that focus on reduction of bycatch rates or quantities are particularly vulnerable to changes in the abundance of bycatch species. Increases in the abundance of bycatch species will generally be indicative of strong recruitment and improving stock condition; but target fisheries may be closed prematurely because of high bycatch levels. The reverse situation, resulting in continued target fishing under low bycatch rates when bycatch species abundance is low, may also occur.

Meeting information needs for designing effective programs and monitoring their effectiveness is often difficult and sometimes impossible. Monitoring to assess compliance with bycatch reduction requirements and document improvements which may occur following implementation of bycatch reduction measures is complex and generally requires substantial resources. This issue merits careful attention because it is generally unwise to implement bycatch reduction measures without first specifying the information necessary to monitor for effectiveness, and assuring that this information will be provided. Even with high levels of observer coverage in the Alaska groundfish fisheries, sampling for rarely occurring species is often difficult and uncertainty associated with estimates of bycatch mortality are often high. This constrains meaningful evaluation of the success of bycatch reduction programs. Also, in some cases limitations in the design of bycatch reduction regulations may provide incentives for circumventing these regulations which undermine effective compliance monitoring and, in some instances, provide biased data which cannot be used to properly evaluate the program success or document accurate bycatch mortality rates.

Providing industry with the tools necessary for effective and efficient bycatch reduction, and providing incentives for compliance with strategies and regulations are closely linked. Some of the tools which are useful in bycatch reduction are described above. They include innovations in gear technology and fishing practice, and information systems which provide timely haul specific catch and bycatch data with the necessary temporal and spatial attributes (observer programs). Services of the type provided by Sea State are also critical to the success of bycatch reduction programs which rely and redirection of fishing effort in response to current fishing conditions. Gilman et al. (2005) provide additional examples of fisheries that have experienced some degree of success in reducing bycatch by disseminating catch information provided by observers or vessel operators to the fleet with the support of private companies. These tools are available to both the AFA and the head and gut fleets operating the BSAI. Both fleets have demonstrated bycatch avoidance success, but the head and gut fleet is faced with greater challenges under the status quo, and considerable effort may be necessary to encourage this sector to take advantage of the tools available. As we have discussed, there are substantial differences in the biological characteristics of the target and bycatch species in each of these fisheries. It is also important to recognize that the operations of the head and gut fleet are much more complex to the extent that they harvest an array of target species, each of which has its own catch and bycatch characteristics. However, differences in the quota management system under which these fisheries operate is of fundamental importance when considering s incentives for compliance with strategies and regulations designed to reduce PSC mortality and the manner in fishers participating in these fisheries have responded to PSC reduction measures..

These fundamental differences arise because the AFA fleet is rationalized and the head and gut fleet is not. Even though AFA rationalization did not result in establishment of individual fishery quotas (IFQs), it did result in assignment of quota to fishery cooperatives and allowed for intercooperative agreements. This provided many of the benefits of an IFQ system as well as some operational improvements which are, perhaps, easier to implement in a cooperative-based fishery than a traditional IFQ fishery. The single most consequential change has been the elimination of the race for fish and the associated strong incentive for fishery participants to collaborate in resolving problems which might curtail fishing operations or reduce overall efficiency. Each cooperative is allocated specific catch and bycatch quantities and, subject to broad seasonal and area restrictions, participants are able to fish at a pace which allows for innovation and relocation. Since each company's fishing opportunities are guaranteed by contract, there is a strong incentive to share innovative ideas and fishing information which might result in bycatch reductions. After all, if a fleetwide bycatch limit is reached, everyone must stop fishing or relocate, but if you alert your cooperative partners (or partner cooperatives) to areas of high bycatch, or fishing practices which reduce bycatch, fleetwide bycatch rates will be reduced and everyone will enjoy the resultant benefits. In the AFA fleet, inter- and intra-cooperative agreements require fishing companies to participate in the Sea State program and to respond as to bycatch avoidance relocation advice developed by Sea State. Furthermore, incentives to circumvent regulations by interfering with observer sampling can be greatly reduced through inter- and intra-cooperative agreements which might include penalties for non-compliance.

The head and gut fleet is not rationalized, although a process to amend the BSAI groundfish FMP and develop regulations to rationalize this fishery is now underway (NPFMC 2005b). Even though this fleet has been able to take collective action to reduce PSC bycatch in some instances, incentives associated with the race for fish have constrained this potential. Individual fishing companies have been reluctant to employ innovative technologies to reduce bycatch if these result in even modest reductions in catch rates for target species. Similarly, incentives to relocate to areas where bycatch rates may be lower are limited if relocation-associated costs are sustained only by your company (Gauvin et al. 1995). The same argument applies to any possible mitigating action whose costs are not shared by all participants but whose benefits will be available to all. One aspect of industry response to bycatch reduction regulations in the head and gut fleet has been particularly troubling. Since the first regulations designed to reduce halibut PSC mortality in this fleet were introduced in 1991, anecdotal reports and affidavits from observers regarding compliance issues associated with these regulations have accumulated.

The incidence and nature of non-compliance between 1991 and 1996 is documented by Renko (1998). She identified eight strategies employed by the fleet: 1) physically removing halibut prior to the location where observer samples were collected, 2) introduction of structures that limit the passage of large animals (i.e. halibut) to the location where observer samples were collected, 3) putting pressure on observers to misreport halibut numbers, 4) dumping whole codends of fish so the observer could not sample, 5) processing hauls so rapidly that observers could not obtain minimum sample sizes (required by regulation), 6) increasing the number of hauls taken per day to constrain the observer's ability to sample the required 50% of hauls, 7) failing to notify the observer when a net was brought on board, and 8) theft of, or damage to the observer's sample scales.

Incentives to subvert sampling were exacerbated when these regulations were introduced because they sought to penalize owners of individual vessels whose halibut PSC rates exceeded published standards. Observer interference regulations have not always been well enforced due to limited enforcement resources and complex evidentiary standards. Observer sampling has been seriously compromised, allowing only very limited enforcement of PSC bycatch reduction regulations, and corrupting the data collected by observers. As a result, the value of observer data for documenting PSC mortality and evaluating the effectiveness of the bycatch reduction regulations is now in question. While circumstances have allowed two major observer sampling interference cases to be prosecuted successfully during the last two years, and some changes in fleetwide compliance with these regulations is now apparent, it can be argued that the most effective way to encourage compliance with the requirements and the intent of these regulations is to allow the fleet to establish fishing cooperatives and constrain noncompliance through inter- and intra-cooperative agreements.

In summary, while rationalization is not a panacea, and a range of factors may influence the ability of a fleet to respond quickly, collectively, and effectively to reduce bycatch of PSC and other species, many of the incentives for active fleetwide participation in bycatch reduction measures can be found in rationalized fisheries and have been demonstrated to be effective in the AFA fleet. Even though the head and gut fleet has demonstrated its ability to take effective bycatch avoidance action, individual companies will not always benefit from collective action in an open access fishery and, therefore, certain participants have sometimes been reluctant to comply with bycatch avoidance guidance. Furthermore, incentives to subvert these regulations have become apparent, and they have directly influenced NOAA's ability to collect unbiased catch composition data from these vessels and, thereby, to document PSC mortality rates or the effectiveness of regulatory programs designed to constrain these rates. Plans to rationalize the head and gut fleet hold promise for resolving many of these concerns and moving us closer to circumstances under which the likelihood of intended consequences to bycatch mitigation measures will increase markedly. As more fisheries become rationalized and the industry is allowed to play a greater role in developing and implementing strategies for bycatch reduction, further success can be expected. Under this scenario it may even become possible to place direct responsibility for compliance with fishery regulations and reduction of bycatch and discard in the hands of individual cooperatives and develop performance measures for tracking success. Portions of target species quotas could, perhaps, be withheld until performance goals are achieved.

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