

OVERVIEW OF MANAGEMENT ACTIONS TAKEN BY THE PACIFIC FISHERY MANAGEMENT COUNCIL TO ACCOUNT FOR AND MINIMIZE BYCATCH OF GROUND FISH

Regulatory efforts to reduce bycatch fulfill multiple management goals -- from protecting overfished and depleted species, to preventing over-harvest of species of unknown abundance, to acknowledging that vessels using different gear types require different harvest strategies, to matching within-year harvest rates to within-year abundance and congregation habits of managed species. These goals must be balanced with the mandate to achieve the optimum yield (OY) from the fishery as a whole, over time. For a multi-species fishery, the catching of species other than the particularly targeted species is not necessarily a problem. Discard of non-targeted species, whether for economic or regulatory reasons, is a problem, and one the Council has worked to reduce through ongoing changes to the management system.

Since the groundfish fishery management plan (FMP) went into effect in 1982, the Pacific Fishery Management Council (Council) has taken a number of steps designed to improve the manner in which annual specifications account for discard mortality and to reduce discard mortality through changes in the fishery's management and regulatory environment. The following summarizes the major changes which have transpired in both of these areas since the FMP's inception.

Actions Intended to Reduce Discard Mortality

One of the original objectives of the FMP was to, "Provide a favorable climate for existing domestic commercial and recreational groundfish fisheries within the limitations of other objectives and guidelines. When change is necessary, institute the regulation which accomplishes the change while minimizing disruption of current domestic fishing practices, marketing procedures, and environment." (PFMC, 1982) This objective of "minimizing disruption of current domestic fishing practices" has remained a management objective through various iterations of the FMP, and has been combined with current objectives to "promote year-round availability of quality seafood to the consumer," and "promote year round marketing opportunities and establish management policies that extend those sectors (for which year round marketing is beneficial) fishing and marketing opportunities as long as practicable during the fishing year" (PFMC, 1982; PFMC, 1990) Taken together, these objectives have resulted in the Council's enduring policy of year-round trip limit management for most groundfish fisheries.

Active groundfish management began in 1983, when the Council introduced the first numerical OYs for several managed species, trip limits for widow rockfish, the *Sebastes* complex, and sablefish. The first landing limits the Council used were "per trip" limits, which were intended to slow landings somewhat, so the fleet would not achieve species' annual harvest guidelines early in the year. Almost all domestic discards in the early years of groundfish management were market-induced, where fishers discarded unmarketable species or unmarketable sizes of targeted species. Domestic fisheries management did not account for these discards; targets for landed catch were set equal to acceptable biological catch (ABC).

Over time, the Council introduced trip limits for a greater number of species taken in the domestic fisheries. Effort increased in the domestic fishery, and trip limits became more restrictive to control harvest rates. The Council realized that managing a variety of species under trip limits could lead to increased rates of discards for some species. Bycatch and discards can result from a regime of multiple trip limits, because a fisher might target an assemblage of species, and then find that in order to catch the full limit on one species, he has to exceed the limit on another species, discarding the excess. To address this issue, the Council shifted away from per trip limits, converting most to monthly cumulative limits by the 1994 season. Cumulative limits were preferable to per trip limits, because a fisher could accumulate species at different rates over different trips, without having to discard fish each trip because of exceeding per trip limits. In an effort to further reduce the likelihood fishermen would have to discard overages of particular species within a multi-species fishery, the Council began extending the cumulative limit period length to two months for most major species throughout most of the 1997 season.

In addition to these efforts to modify the trip limit regime to reduce discards, the Council used several regulatory measures to reduce incidental catch of juvenile fish that would be discarded as unmarketable. In the early 1990s, the Council experimented with different combinations of gear regulations, first requiring larger trawl mesh sizes in net codends, and then moving to requirements for larger mesh sizes throughout trawl nets. By 1995, bottom trawl nets were required to have a minimum of 4.5 inch mesh, double-walled (lined) codends were prohibited, and the use of chafing gear was restricted (60 FR 13377, March 13, 1995, codified at 50 CFR 660.322.) All of these measures were intended to give smaller-size fish the opportunity to escape from the trawl net, reducing the likelihood those fish would be caught and then discarded.

Additional gear restrictions were also introduced during the 2000 fishery. Previously, fishers had been allowed to use footropes equipped with large rollers--often truck tires--to target shelf rockfish species (see 2000 management description, below) residing in high-relief habitat. Beginning in 2000, trawl landings of shelf rockfish were prohibited if large footrope trawls (gear with footropes or rollers greater than 8 inches in diameter) were onboard the vessel; small amounts of shelf rockfish bycatch were allowed to be landed if footropes less than 8 inches in diameter were onboard, and higher limits were provided for targeting healthy shelf rockfish stocks when only midwater nets were onboard. Although the effect of these gear requirements on bycatch of depleted rockfish species has yet to be validated through observation, a review of tow locations from 1999 and 2000 trawl logbooks does suggest many areas where canary rockfish were previously caught are no longer being trawled.

In addition to changes in trip limit duration and gear usage, management measures have incorporated a variety of other strategies to reduce bycatch in the groundfish fishery. For trawl vessels, cumulative landings limits for the "Dover sole/thornyhead/trawl-caught sablefish (DTS) complex" have been constrained by management-imposed ratios between the two or more species in the complex -- Dover sole, thornyheads (shortspine and longspine), and sablefish. These ratios reflect the species mix in the fishery catch data. In circumstances where an imbalance has been observed between species OY ratios and species catch ratios, basing trip limits on catch ratios reduces the likelihood of discard occurring for a species whose proportion of assemblage catch is greater than its proportion of the assemblage OY. In the DTS complex, these constraints have resulted in substantial amounts of OYs for more abundant species going unharvested, in order to reduce the chances of over-harvesting shortspine thornyhead. As examples, during 1999 and 2000, less than 46% of the available longspine thornyhead OY was harvested in either year, and only 84% and 77% of the trawl sablefish allocations were taken in the two years, respectively.

For the 2000 fishery, the Council also revised its historical practice of managing the "minor" *Sebastes* complex species through two broad northern and southern units. Since rockfish generally cannot be released alive, regardless of the method of catch, the Council's challenge has been to eliminate targeting of depleted species and to reduce the likelihood of their incidental catch, while still allowing small amounts of these species to be retained when they are incidentally caught in other target fisheries. In previous years, rockfish species without assessments and those with less rigorous assessments were managed under generic *Sebastes* complex landings limits for the northern and southern areas. In 2000, each of these geographic areas was divided into three sub-groups of rockfish -- nearshore, shelf, and slope--for the northern (U.S. Vancouver, Columbia and Eureka subareas combined) and Southern (Monterey and Conception subareas combined) areas. Rockfish occupy a wide variety of habitats along the West Coast, from shallow kelp forests and nearshore reefs to depths beyond the continental shelf that reach 600 fathoms or more. They also exhibit varying degrees of mobility with regard to geographic location and position in the water column. The assignment of species to one of these categories was based on the depth strata in which they are most commonly found--shallow nearshore areas, moderate depths along the continental shelf, or the greater depths descending to the deep-sea floor--and also upon the tendency of species to be caught with other species in a group. Most of the species currently designated as overfished are found primarily in rocky habitat along the continental shelf.

Cumulative limits for minor shelf rockfish were set at minimal levels for all gear groups in order to reduce incidental catch of canary and bocaccio rockfish and lingcod. During 2000, these restrictions resulted in less than 10% of the commercial OYs for minor shelf rockfish being landed in both the southern and northern areas. The fishery is projected to utilize a similar percentage in 2001 and an even lower percentage in 2002, in order to protect yelloweye rockfish. In 2001, similar limit reductions were

implemented for the northern slope sub-group, in order to protect darkblotched rockfish. Commercial landings of the northern slope species are expected to comprise less than one-third of their 2001 OY. Similarly, constraining ratios were used in 1999 in establishing cumulative limits for the healthy chilipepper rockfish stock in an effort to protect bocaccio. As a result, less than 800 mt of the 3,700 mt chilipepper commercial OY was landed. Beginning in 2000, the Council also reduced the chilipepper OY from 3,700 mt to 2,000 mt; however, the restrictive limits approved by the Council allowed landings of just 400 mt.

Logbook data have been used by the Council's Groundfish Management Team (GMT) in estimating coincident catch rates of depleted rockfish species that may occur during the prosecution of small-footrope fisheries for species such as flatfish. However, interpretation of these data is complicated by the absence of recorded discards as well as changes in gear usage, unreliable recording of the gear type used prior to 2000, and substantial changes in retention limits, and thus targeting opportunities for many species. Although considerable inference and filtering of these data, and input from fishers, is required to develop coincident catch rates that reflect the current fishery, these rates are grounded in the best available information regarding fishing practices. They have been used to develop trip limit recommendations for target species through assessment of the expected, associated catches of depleted species, and comparison of those amounts with limit opportunities for the depleted species. As a result, shelf flatfish fisheries which previously had no management limits, now have overall flatfish limits in conjunction with lower sub-limits on species which have exhibited higher historic coincident catch of depleted rockfish species. These types of analyses, as well as the knowledge of fishers, have also been used to craft seasonal variations in limit opportunities in an effort to harvest healthy stocks when they can be most cleanly targeted. An example of this would be the structure of Dover sole limits. Dover sole reside primarily in deeper slope areas throughout the winter and are distributed through the continental shelf during the summer. This migrational pattern factored into the scheduling of larger trip limits for Dover sole at the beginning of the year than during the summer in order to reduce impacts on depleted shelf rockfish.

Actions Taken to Better Account for Discard Mortality

Prior to the 2001 fishing season, the domestic commercial groundfish fishery off the West Coast has not been subject to routine at-sea monitoring by scientific observers. However, two studies, which included fishing vessels carrying observers on a voluntary basis, have provided information on catch rates and discards under the prevailing trip limits. The first study included observations during the 1985-1987 seasons (Pikitch, *et al.*, 1988). Observations for the second study (Enhanced Data Collection Project, EDCP) occurred about ten years later, beginning in late 1995 and continuing through 1998.

The Pikitch study observed five major fishing strategies which were, 1) bottom rockfish trawling (BRF), using roller gear; 2) midwater trawling (MID); 3) deepwater Dover sole trawling (DWD), using a mix of gears, generally outside of 100 fathoms; 4) nearshore-mixed trawling (NSM), using mud (small footrope) gear primarily to target flatfish; and 5) shrimp trawling (SHP), for pink shrimp. The survey sampled 1,470 tows during 139 trips over a range of tow locations from roughly Cape Blanco, in Oregon to the Canadian border.

In the text of the Pikitch report, widow rockfish is the only rockfish species for which discard rates are discussed. Ratios of estimated total catch-to-landings are reported for 1985, 1986, and 1987 as being 1.19, 1.13, and 1.15, respectively, representing an average of 1.157 across these three years. Since 1991, this 16% rate has been employed by the Council as an estimate for discarded widow rockfish, as well as an increasing number of other *Sebastes* (rockfish) species. Over time, as the number of rockfish species with assessments has increased, the Council has removed additional species from the generic *Sebastes* complex, and assigned individual OYs incorporating this discard rate. For example, the Council first specified an OY for canary rockfish individually in 1994, and management has incorporated an assumed discard rate at or near 16% since. For bocaccio, the 16% rate was used in 1993 and 1994, but discontinued from 1995-1999 based on GMT analysis that bocaccio trip limits were not being achieved. Beginning in 2000, the 16% discard assumption was re-instituted, in conjunction with imposition of lower trip limits needed to rebuild bocaccio.

In recent years, excess fleet capacity and declining trends for many groundfish stocks have forced the Council to lower cumulative limits substantially in order to preserve year-round supplies of groundfish to harvesters and processors while constraining catches to allowable levels. This pattern of trip limit reductions has led some to question the current appropriateness of the 16% discard estimate, which was derived from a period in which limits were far higher. One finding reported by Pikitch that the estimated discard rate for widow rockfish rose from 5.7% to 52.3% when limits were reduced from 30,000 pounds per week to 3,000 pounds per week, has been cited to support this concern.

In 2001, the GMT re-evaluated the appropriateness of the current 16% discard assumption for *Sebastes* species in general, and depleted species in particular, as it relates to observations described in the Pikitch study. Several key issues were considered including: gear usage on observed trips versus that in the current fishery, alternative shelf target opportunities available during low-limit periods, and changes in relative biomass of species over time.

The predominant gear for on-bottom targeting of widow and most other rockfish in 1985-1987 would have been some form of roller gear, which allows greater access to rocky habitat than the small footrope gear now required for landing any shelf rockfish. Within the Pikitch study, the nearshore-mixed strategy, targeting primarily flatfish with smaller footrope gear, represents the best analogy to the current shelf fishery. Data from the Pikitch study were obtained, and tows where "mud gear" was used in a "nearshore-mixed" strategy were examined separately with regard to coincident catch rates of shelf *Sebastes* species in general, and widow and canary rockfish in particular.

Table 1 shows a summary of catch for the 261 tows meeting this criterion and also for a "flatfish-target" subset (137) of these tows where at least 500 pounds of flatfish was caught, and flatfish comprised at least 70% of the total retained catch. In the larger group, 79% of tows had no canary rockfish catch with a higher percentage (89%) in the flatfish-target group. Of the 912 pounds of canary rockfish which was discarded in all 261 tows, 877 pounds was attributed to a single tow. Although the "reason for discard" was recorded for many tows in the study, no response is recorded for this tow. Regardless, since the total amount of *Sebastes* caught during the trip on which this tow occurred was less than 1,500 pounds, and the *Sebastes* limit at the time was 25,000 pounds once per week, it appears likely this discard resulted from size-related or other market factors and not limit attainment. It should be noted that greater processor acceptance of smaller rockfish and the mandated use of larger mesh trawl gear (described above) have likely lowered the incidence of size-related discards since the Pikitch study was conducted.

Excluding this tow, the canary rockfish discard rate was 4% for flatfish tows and 1% for the larger set of nearshore-mixed tows. The coincident catch rate of canary rockfish, relative to the weight of all retained flatfish, ranges from 0.9% to 0.3% depending on whether the large discard tow is included. This range is consistent with rates determined from examination of more recent logbook data and considered in the development of 2001 flatfish limits. Beyond canary rockfish, there were no catches of widow or yellowtail rockfish in any of the nearshore-mixed "mud-gear" tows. This also underscores the differences in rockfish encounters between this strategy and the other bottom trawl strategies which contributed to the overall 16% discard estimate for widow rockfish. These results suggest that, even during a period when trip limits would have allowed the retention of large amounts of rockfish, fishermen targeting flatfish with small footrope gear had minimal encounters with rockfish species, including canary rockfish.

The second issue is the magnitude of alternative rockfish fishing opportunities that were available during the portions of these years in which the 3,000 pounds per-trip limits were in place for widow rockfish. Limits for widow rockfish were lowered during September-December in 1985, and during October-December in 1986-87. During these periods, however, limits for other rockfish species remained, in general, very similar to their levels earlier in each year. Limits for the *Sebastes* complex were as high as 40,000 pounds per trip in the southern management area, and 30,000 pounds once per week in the northern area. Additionally, there were no landing limits on lingcod during these years. Therefore, it is likely significant fishing effort utilizing roller gear continued to be directed towards species in rocky habitat during these periods of reduced widow limits. With continuing opportunity to target all other rockfish species, it is not surprising discard rates for widow rockfish increased dramatically during these periods.

In contrast, during the 2000 fishery, the small footrope limits for minor shelf rockfish did not exceed 1,000

pounds per month throughout the year. Other shelf limits included widow rockfish (1,000 pounds per month), yellowtail rockfish in the north (1,500 pounds per month), Pacific ocean perch (POP) (500 pounds to 2,500 pounds per month), bocaccio (300 pounds to 500 pounds per month), canary rockfish (100 pounds to 300 pounds per month), chilipepper rockfish (3,750 pounds per month), and lingcod (0 to 400 pounds per month). Thus, not only was much of the gear used during the Pikitch study more suitable for on-bottom targeting of most rockfish than that with which shelf rockfish can be landed today, the opportunities that existed for targeting other rockfish species when widow rockfish limits were low are not comparable to the present trip limit regime. When the limit for a single component species of an assemblage is lowered relative to the remainder of the assemblage it is reasonable to conclude discard of the single species will tend to increase. However, when all limits within the assemblage are reduced in concert it is considerably more difficult to infer, for any of the species individually, the mere presence of a lower limit will result in a higher discard rate.

A third consideration involves changes in relative biomasses since the Pikitch study. Flatfish now represent the bulk of on-bottom trawling effort on the shelf. Flatfish abundance is currently believed to have been relatively stable and perhaps even increased since the mid-1980s. On the other hand, recent assessments suggest the current exploitable biomass of canary rockfish is less than one-third of what it was during the mid-1980s. Other rockfish species currently viewed as "overfished" have experienced similar, if not greater, declines over this period. In addition to changes in gear restrictions and targeting opportunities, such changes in relative abundance suggest rockfish encounter rates in other target small-footrope fisheries on the shelf should be lower now than during the Pikitch study period.

The later EDCP study was also focused on the fishery off Oregon, with some observations off northern California and Washington. Data from this study were analyzed during 1999 and 2000 and a preliminary report of findings presented to the Council in September of 2000. Because the major focus of vessels participating in the voluntary study was DTS species, the first analytical efforts focused on these four species. The analysis went beyond a simple calculation of discard rates on observed trips, to the development of models that projected discard amounts for all trawl trips in which DTS species were landed, based upon DTS volume and the amount of individual limits that remained at the time of each trip. The projected fleet discards were then combined with documented landings to estimate overall trawl discard rates for the four species. The Council promptly incorporated these new assumed discard rates in their recommendations for landed-catch OYs for the 2001 season.

Further examination of the EDCP data with regard to rockfish bycatch and discard in shelf flatfish fisheries is anticipated though has not yet been initiated. However, across all observed tows, discard rates were calculated for a number of species. Among these, the observed discard rate for widow rockfish was 1%, for canary rockfish 12%, for yellowtail rockfish 20%, for lingcod 10%, and for shortspine thornyhead 20%.

In addition to utilizing results from these major studies in setting landed-catch targets for the fishery, the Council has also incorporated findings from analyses conducted by the GMT and other scientists into this process. In 1997, independent projects examined potential discards in the fisheries for shortspine thornyheads and lingcod. The shortspine analysis was motivated by concerns over size-related discards and was based on comparison of length distributions in the survey and fishery landings. The lingcod analysis arose from concerns over management-induced discard that might be associated with drastic limit reductions anticipated for lingcod rebuilding. This analysis used logbook data to identify the extent to which lingcod had been targeted, and landings data to assess the degree to which previous cumulative limits had been attained. As a result of these efforts, the Council adjusted its discard assumptions for shortspine from 8% in 1997 to 30% in 1998, and from 0% to 25% for lingcod. The 2001 OYs for landed catch assume 20% discard rates for both species based on the EDCP results, in the case of shortspine, and subsequent analysis by the GMT in the case of lingcod.

In an effort to allow continuance of a summer target fishery for arrowtooth flounder, the Council supported in June of 2001 a request by the State of Washington to conduct an experimental fishery during the months of August and September. Vessels participating in the program must carry observers on all trips during this period, and in return gain the opportunity to land higher amounts of arrowtooth flounder provided they can remain within their canary rockfish allowance. For 2002, the Council has also

supported a request by the State of California to conduct an experimental fishery to measure the rate of bocaccio bycatch in the small footrope trawl chilipepper fishery. Data from these experiments as well as the NMFS observer program which is also beginning in 2001 should provide an improved basis for evaluating the appropriateness of current management assumptions regarding discard and catch rates. If successful, these experimental programs may also lay a foundation for designing other such programs that would allow healthy species to be targeted while providing a full accounting of the discard of other species.

Literature Cited

- PFMC (Pacific Fishery Management Council). August 1990. Final Amendment 4 to the Pacific Coast Groundfish Plan, Including Supplemental Environmental Impact Statement, Regulatory Impact Review, and Initial Regulatory Flexibility Analysis. Pacific Fishery Management Council, Portland, OR.
- PFMC (Pacific Fishery Management Council). 1982. Pacific Coast Groundfish Plan, Fishery Management Plan and Environmental Impact Statement for the California, Oregon and Washington Groundfish Fishery. Pacific Fishery Management Council, Portland, OR.
- Pikitch, E.K, D.L. Erickson, and J.R. Wallace. 1988. An evaluation of the effectiveness of trip limits as a management tool. Northwest and Alaska Fisheries Center NMFS Processed Report 88-27, Seattle, WA.

TABLE 1. Coincident catch rates of flatfish and *Sebastes* species observed during the Pikitch discard study (1985-1987) for tows made with "mud gear" (no rollers) using a "nearshore-mixed" strategy and the subset of those where at least 500 pounds of flatfish were caught and flatfish comprised at least 70% of the retained catch.

	All Nearshore-mixed Strategy "Mud Gear" Tows	Flatfish Tows
Number of Tows	261	137
# Without Canary	207	122
% Without Canary	79.3%	89.1%
All Flatfish, <i>Sebastes</i>, Sablefish, and Lingcod		
Retained + Discard (pounds)	360,915	255,315
Retained (pounds)	265,326	182,924
% Retained	73.5%	71.6%
All Flatfish		
Retained + Discard (pounds)	292,613	202,748
Flatfish Retained (pounds)	213,076	143,151
% Retained	72.8%	70.6%
All <i>Sebastes</i> Species		
Retained + Discard (pounds)	18,700	2,544
% of Retained Flatfish	7.0%	1.8%
<i>Sebastes</i> Discard (pounds)	2,947	1,178
<i>Sebastes</i> Discard/Catch	16%	46%
-Excluding the Largest Single Canary Discard Tow		
Retained + Discard (pounds)	17,813	1,657
% of Retained Flatfish	6.7%	1.2%
<i>Sebastes</i> Discard (pounds)	2,060	291
<i>Sebastes</i> Discard/Catch	12%	18%
Canary Rockfish		
Retained + Discard (pounds)	5,676	1,352
% of Retained Flatfish	2.1%	0.9%
Canary Discard (pounds)	912	907
Canary Discard/Catch	16%	67%
-Excluding the Largest Single Canary Discard Tow		
Retained + Discard (pounds)	4,789	465
% of Retained Flatfish	1.8%	0.3%
Canary Discard (pounds)	25	20
Canary Discard/Catch	1%	4%
Widow Rockfish		
Retained + Discard (pounds)	181	14
% of Retained Flatfish	0.1%	0.01%
Widow Discard (pounds)	0	0
Widow Discard/Catch	0%	0%
Yellowtail Rockfish		
Retained + Discard (pounds)	2,405	447
% of Retained Flatfish	0.9%	0.3%
Yellowtail Discard (pounds)	0	0
Yellowtail Discard/Catch	0%	0%