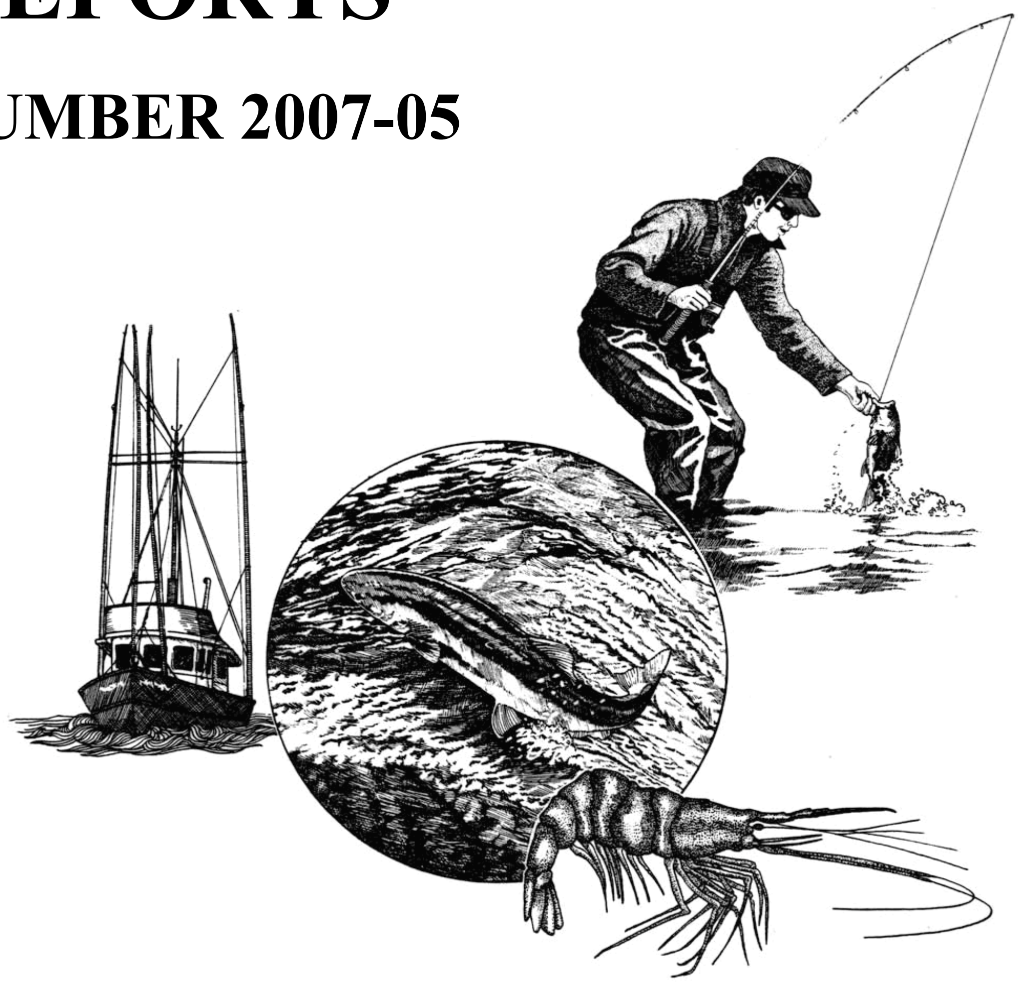
INFORMATION REPORTS

NUMBER 2007-05



FISH DIVISION

Oregon Department of Fish and Wildlife

Effectiveness of Selective Flatfish Trawls in the 2005 U.S. West Coast Groundfish Trawl Fishery

Effectiveness of Selective Flatfish Trawls in the 2005 U.S. West Coast Groundfish Trawl Fishery

Robert W. Hannah[1]
Nancy Gove[2]
Steven J. Parker[3]

[1]Oregon Department of Fish and Wildlife
Marine Resources Program
2040 S.E. Marine Science Drive,
Newport, Oregon 97365, USA

[2]National Marine Fisheries Service
Northwest Fisheries Science Center
2725 Montlake Blvd. E.
Seattle, WA 98112, USA

[3]National Institute of Water and Atmospheric Research
Private Bag 14901, Wellington 6241
New Zealand

September 2007

INTRODUCTION

Beginning in 2005, the Pacific Fishery Management Council (PFMC) required the use of selective flatfish trawls for all groundfish trawling on the U.S. west coast north of 40° 10' N latitude shoreward of the rockfish conservation area (RCA) (PFMC 2006). This requirement was enacted in an effort to maintain nearshore flatfish trawl fisheries while reducing the bycatch of depleted stocks of canary rockfish (*Sebastes pinniger*). Previous management actions to protect canary rockfish had greatly expanded the closed RCA, moving the eastern boundary shoreward. This change, while decreasing canary rockfish catch rates, also severely limited access to productive flatfish stocks (PFMC 2006). Research trials and fishery-scale tests of selective flatfish trawls showed a consistent 70-80% reduction in canary rockfish catch rates, providing a tool to allow flatfish trawling in traditional areas while reducing canary rockfish bycatch from levels projected for a fishery based on conventional trawls (King et al. 2004, Parker et al. 2004).

Selective flatfish trawls are very low-rise nets with a cutback headrope design that allows them to effectively catch bottom-tending fishes while avoiding species that are either distributed off-bottom or tend to rise when disturbed (King et al. 2004, Hannah et al. 2005). The bycatch reduction obtained with selective flatfish trawls for a particular species is dependent on a variety of factors, including how far the headrope follows behind the footrope, the maximum headrope height obtained, the height of the wing portions of the trawl, available light, and species-specific behaviors (King et al. 2004, Hannah et al. 2005). The numerous design factors influencing selective flatfish trawl performance create the potential for a large difference between the bycatch reduction obtained in research trials and that obtained by a fishery required to adopt the new technology. Commonly, fisheries adopting new gear technology for bycatch reduction fall short of bycatch reduction goals based on research trials (e.g. Richards and Hendrickson 2006, Foster 2004) but in some cases have met bycatch reduction goals (Hannah and Jones 2007). The primary objective of this study was to evaluate the evidence for, and magnitude of, any "performance gap" with regard to canary rockfish bycatch reduction in the U.S. west coast nearshore groundfish fishery now required to use selective flatfish trawls.

The federal regulation that defined a selective flatfish trawl was drafted after consideration of several factors including effectiveness, clarity, simplicity, and ease of enforcement (Appendix A). These rules included a specific ratio between headrope and footrope length to ensure that selective flatfish trawls had no overhanging "hood" or top panel to restrict the escape of fish that swim upwards when disturbed. The definition also relied on several measures to restrict overall trawl height or "rise" and height of the trawl wings. These included a restriction on the location of headrope floats, an upper limit on footrope length (to limit the scale of the trawl) and a 3 foot maximum length for the breastlines of the net. As the current definition of a selective flatfish trawl was developed, managers recognized that the criteria designed to restrict headrope rise might not be as effective as more detailed technical criteria. However, a more complex definition was considered more difficult to enforce. The language adopted was a compromise between ease of enforcement and the complexity needed to ensure that all selective flatfish trawls would incorporate essential design features. As a result, some vessels fishing in 2005 may have used trawls that met the legal definition of selective flatfish trawls but that still produced too much rise to meet bycatch reduction targets. Also, some nets may not have met the design criteria and been detected by enforcement. A second objective of this analysis was to determine if variation in the design of selective flatfish trawls fished in 2005 reduced the level of bycatch reduction achieved by the fishery, and whether changes to the legal definition of selective flatfish trawls are warranted.

METHODS

Fishery Performance

We evaluated the success of the 2005 selective flatfish trawl fishery in reducing canary rockfish bycatch by comparing bycatch rates from observed trips in 2005 to similar data collected in 2003 as part of a large-scale Exempted Fishing Permit (EFP) test-fishery of selective flatfish trawls (Parker et al. 2004). Observer data for vessels using selective flatfish trawls in 2005 were obtained from the NOAA National Marine Fisheries Service West Coast Groundfish Observer Program (WCGOP). In the WCGOP, trawl vessels were selected randomly for observer coverage, after stratification by primary port of landing, and sampled for a complete two-month catch limit period. The shipboard sampling and data analysis methods used by the WCGOP have been described by the NMFS Northwest Fisheries Science Center (2003).

In the 2003 EFP fishery, selected vessels were allowed higher flatfish landing limits and fishing access to a portion of the closed RCA (PFMC 2002) in exchange for building and using trawls that had been inspected and certified as meeting the design criteria for selective flatfish trawls (King et al. 2004). Vessels also agreed to 100% observer coverage. To allow the best possible comparison between EFP data and 2005 fishery observer data, we considered only data from the months of May-October and limited the EFP data to hauls made shallower than 100 fathoms, the shoreward limit of the RCA for most of 2005 (Table 1). Only 2 of 78 total observed EFP trips were conducted north of Cape Alava on the Washington coast, so we restricted our comparisons to data collected off Oregon and off Washington south of Cape Alava. We also included 2003 canary rockfish bycatch rates from non-EFP vessels from the WCGOP for comparison with 2005 bycatch rates for selective flatfish trawls.

We calculated bycatch rates for canary rockfish and other species using the ratio estimator (Cochran 1977), with the catch of "northern target" species in the denominator (Table 2). Mean bycatch rates were calculated separately for vessels landing into Oregon and Washington.

Indicators of Trawl Height

Canary rockfish catch rates in selective flatfish trawls can be influenced by a variety of factors including fishing location, season, and substrate, as well as net design criteria including headrope height, wing height, and headrope length in relation to footrope length (King et al. 2004). We conducted three analyses to try and separate trawl performance issues, specifically trawl height, from factors related primarily to fishing location.

First, we compared Pacific hake (*Merluccius productus*) catch rates (lb/h) from the 2005 selective flatfish trawl fishery, the 2001-2002 selective flatfish trawl research trials (King et al. 2004), the 2003 EFP fishery (Parker et al. 2004) and the 2003 non-EFP fishery that used conventional trawls. Canary rockfish are very patchily distributed, mostly found over or near hard-bottom substrates. Pacific hake are a very common fish off the Pacific coast in the summer months and are widely distributed (Dark et al. 1980). Both research data and comments from fishermen participating in the 2003 EFP indicate that properly designed selective flatfish trawls have very low catch rates for Pacific hake (97% reduction in shelf research trials, 86% reduction in slope trials). If trawls fished in the 2005 fishery generated Pacific hake catch rates that were comparable to those observed in research trials, then 2005 canary rockfish bycatch rates are likely to have been driven primarily by the choice of fishing location rather than by variation in trawl configuration. Conversely, if Pacific hake catch rates in the 2005 fishery were much higher than expected based on the research and EFP data, then problems with net configuration and excessive trawl height in particular could have influenced the observed canary rockfish bycatch rates. For this particular comparison, we used catch rates (lb/h) rather than bycatch rates to facilitate comparison with 2001-02 research haul data. Bycatch rates are difficult to calculate for research haul data because all catch is enumerated and it's uncertain how much of the catch would have been retained under fishing conditions. As with canary rockfish bycatch rates, the Pacific hake catch data used were restricted to observed trips fishing south of Cape Alava, Washington in depths of 0-100 fathoms. Data from research trials did not match these spatial and depth criteria, as they were collected only in waters off Oregon and at somewhat deeper maximum depths than the 2005 trawl fishery (85% of the research hauls were conducted in water depths less than 131 fathoms, King et al. 2004).

Next, we examined 2005 canary rockfish and Pacific hake bycatch rates by individual vessel to determine how specific vessels were influencing bycatch rates in the selective flatfish trawl fishery. Some vessels in the Oregon fleet were known to be using properly configured selective flatfish trawl nets in 2005. Eight Oregon vessels developed certified, inspected nets as part of the 2003 EFP fishery (Parker et al. 2004). If the 2005 observed Oregon fleet was fishing a mixture of properly-configured and poorly-configured selective flatfish trawls, this should have resulted in canary rockfish and Pacific hake bycatch being highly concentrated in a small group of vessels.

Finally, we examined the effect that "technical help" from net shops and agency staff may have had on the performance of vessels participating in the 2005 selective flatfish trawl fishery. Vessels participating in the 2003 EFP fishery produced canary rockfish bycatch rates that were comparable to those produced by selective flatfish trawls in research trials (Parker et al. 2004). However, these EFP fishermen either had significant help in modifying their existing trawl nets to meet the design criteria for selective flatfish trawls, or opted to buy a new trawl from the Newport, Oregon net shop (Foulweather Trawl Inc.) that designed and produced the initial west coast selective flatfish trawl used in research trials. Although a series of Oregon Seagrant workshops was conducted to introduce the rest of the fleet to the new trawl design, it's likely that some vessel operators entering the fishery in 2005 modified their trawl nets to meet the legal guidelines for selective flatfish trawls without help from knowledgeable net shops or agency staff. Therefore, these vessels could have utilized technically legal nets in 2005 that still produced excessive headrope height, which would tend to increase both Pacific hake and canary rockfish bycatch rates. This assertion is supported by the fact that many vessel operators participating in the 2003 EFP fishery initially submitted net designs that would have produced too much height and had to be convinced by agency staff and net shops that lower rise nets would still effectively catch flatfish (pers. observ, R.W. Hannah). With the help of Foulweather Trawl Inc., we assembled information on which vessels had "technical help" in configuring their nets. We then compared canary rockfish and Pacific hake bycatch rates between these two groups:

1) Vessels that had technical help in meeting the trawl design criteria (purchased their selective net from Foulweather Trawl Inc. prior to fishing in 2005 or participated in the 2003 EFP). All were Oregon-based.
2) Oregon and Washington vessels with no known technical help.

As in other graphical comparisons, we examined mean values of the canary rockfish bycatch rate and Pacific hake catch rate, by state, for hauls south of Cape Alava, Washington. However, for statistical tests, we further restricted the data used for these two groups to hauls south of 47.0° N latitude. This further restriction was chosen to minimize any spatial differences between the two groups. For the statistical test, bycatch rates were normalized via log transformation and randomization tests were used to test for significant differences. Randomization tests avoid the problems that standard methods, such as t-tests, have with highly skewed data with many zero values. The hypothesis tested was that the catch rates from the vessels with known assistance were the same as the rates from the other vessels. The specific statistic tested was the ratio of the bycatch rate of the vessels “with help” to the rate of the "unknown help" vessels:

$$R_{Comp} = \frac{\dfrac{\sum_i b_{help\ i}}{\sum_i t_{help\ i}}}{\dfrac{\sum_j b_{unknown\ j}}{\sum_j t_{unknown\ j}}}$$

where

$b_{help\ i}$ = bycatch from vessels with help on haul i
$t_{help\ i}$ = Retained northern target from vessels with help on haul i
$b_{unknown\ j}$ = bycatch from the "unknown help" vessels on haul j
$t_{unknown\ j}$ = Retained northern target from the "unknown help" vessels on haul j
R_{Comp} = Ratio of rates

The test statistics were compared to a reference distribution created by randomly assigning hauls to the "help" or "unknown help" categories 1000 times. The sample size and the number of vessels per category remained the same. The significance of the statistic was determined using the quantiles from the test distribution. If the null hypothesis is true, then the test statistic should be equal to one.

A randomization test was also used to compare the *variance* of canary rockfish bycatch rates between groups, and the test statistic evaluated was:

$$R_{Var} = \frac{Var(r_{unknown})}{Var(r_{help})}$$

where

$r_{unknown}$ = bycatch rate from the "unknown help" vessels
r_{help} = bycatch rate from the vessels with help
R_{Var} = ratio of the variances

The variances were calculated using the formula from Cochran (1977).

RESULTS

Fishery Performance

The expected incidental catch rates for both Pacific hake and canary rockfish should change with changes in their stock abundance in relation to the abundance of the target species. Between 2003 and 2005, the spawning biomass of hake declined 17.7%, while the spawning biomass of canary rockfish increased 16.2% (Methot and Stewart 2005, Helser et al. 2006). Therefore, even if selective flatfish trawls were performing well in 2005, we would expect canary rockfish bycatch rates to be somewhat higher than those observed in 2003, while hake catch rates would be somewhat reduced.

The 2005 observer data show that the Oregon and Washington trawl vessels fishing selective flatfish trawls in 2005 greatly exceeded the expected canary rockfish bycatch rates that were projected from the 2003 selective flatfish trawl EFP fishery (Figure 1). Oregon and Washington vessels produced canary rockfish bycatch rates 4.1 and 5.5 times higher than expected, respectively. This is a much larger difference than would be expected based on changes in stock abundance. However, despite less restrictive RCA boundaries (deeper shoreward boundary) in May-August 2005 (Table 1) and increased canary rockfish abundance, the selective flatfish trawl fishery produced canary rockfish bycatch rates comparable to Oregon vessels fishing conventional trawls in 2003 and much lower than Washington vessels in 2003, (Figure 1). These summary data suggest that the introduction of the selective flatfish trawl in 2005 achieved some reduction in canary rockfish bycatch rates for Washington vessels and probably for vessels from both states combined, but much less than expected based on 2001-02 research trials (King et al. 2004) and the 2003 EFP test-fishery.

Indicators of Trawl Height – Pacific hake catches

Pacific hake catch rates for vessels fishing selective flatfish trawls in 2005 were 3.9 and 3.5 times higher for Oregon and Washington vessels, respectively, than in the 2001-02 selective flatfish trawl research trials (Figure 2). However, they were comparable to catch rates obtained by EFP vessels in 2003 and much lower than any of the data generated by conventional trawls (Figure 2). Given the estimated 17.7% decline in Pacific hake abundance between 2003 and 2005, the 2005 catch rates with selective trawls suggest that the trawls fished in 2005 were less effective at reducing Pacific hake catch rates than expected, supporting the hypothesis that some selective flatfish trawls had excessive rise in 2005.

Indicators of Trawl Height – Individual vessel catches

Some of the Oregon vessels fishing selective flatfish trawls in 2005 did achieve low canary rockfish bycatch rates (Figure 3); 8 of 22 vessels produced canary rockfish bycatch rates at or below the expected value of 0.0011 based on the 2003 EFP fishery. Only 5 of 22 observed Oregon vessels had rates higher than the average rate of 0.0046. Just six vessels accounted for over 81% of the total observed canary rockfish bycatch poundage. These 6 vessels also had 4 of the 7 highest catch rates for Pacific hake. In Washington, only seven vessels with hauls south of Cape Alava were observed, making it difficult to separate vessel effects from other factors, however generally canary rockfish bycatch was spread more evenly across the Washington vessels with only 2 of 7 producing bycatch rates at or below the 0.0011 level (Figure 3). For Washington vessels, the association between Pacific hake catch and canary rockfish catch was very weak. Considering vessels from both states, the agreement between a vessel's canary rockfish and Pacific hake bycatch rates was less than would be expected if excessive trawl height was the dominant factor creating higher than expected canary rockfish bycatch rates.

Indicators of Trawl Height – Vessels with technical help vs. "unknown help" status

Vessels that were known to have had technical help in configuring their selective flatfish trawls produced mean canary rockfish bycatch rates that were 50% lower than vessels of "unknown help" status, a difference that was not statistically significant (Figure 4, $P > 0.13$, one haul for the "help"group was included in the randomization tests but deleted from Figure 4 because it had 26 lbs of canary rockfish but no catch of northern target species, causing the rate to be undefined). The variance of canary rockfish bycatch rates for vessels with "unknown help" status however, was much greater than for vessels that had help ($P < 0.01$, Figure 5); vessels of "unknown help" status produced much higher extreme values of the bycatch rate (note that the log transformation reduces the influence of extreme values on the mean; the mean transformed values for the two groups are almost the same in Figure 5, while the means of the untransformed data are quite different in Figure 4).

Vessels with "unknown help" status produced much higher Pacific hake catch rates in 2005 ($P < 0.01$, Figures 6 and 7, one haul for "unknown help" vessels was included in randomization tests but deleted from the Figure because it produced 8 lbs of Pacific hake and no catch of northern target, causing the rate to be undefined). Vessels that were known to have had help produced lower Pacific hake catch rates in 2005 than the EFP vessels did in 2003, consistent with a decline in Pacific hake abundance over time (Figure 6). The vessels with help produced canary rockfish bycatch rates higher than the 2003 EFP vessels, again consistent with the time trend in abundance (Figure 4). For both species though, the difference in catch or bycatch rates was much greater than would be expected based on the modest changes in stock abundance over time (Figures 4 and 6).

DISCUSSION

The results presented here do not provide a clear explanation as to why the selective flatfish trawl fishery performed so poorly in 2005 in meeting bycatch rate targets based on the 2003 EFP fishery (Parker et al. 2004). The high catch rates for Pacific hake and high variance in canary rockfish bycatch rates within the "unknown help" vessel group are indicative of excessive headrope height for some of the nets being fished by these vessels in 2005. However, the lack of a significant difference in canary rockfish bycatch rates between vessels with help and the "unknown help" vessels and the poor correspondence between individual vessel's canary rockfish and Pacific hake bycatch rates (Figure 3) weaken this argument. The confounding factors within these data sets that make more definitive conclusions difficult include changes in species abundance and distribution over time, different vessels being sampled in different years, and in the depth, spatial and habitat distributions of hauls in different years.

The evidence presented here for excessive height in some selective flatfish trawls in 2005 is inconclusive, however there are some reasonable arguments for modifying the definition of selective flatfish trawls to better prevent the use of trawls with excessive headrope height. First, anecdotal evidence suggests that some trawls with excessive headrope height have been used. Fishery observers in 2005 reported that some vessel operators were attaching additional floats to portions of the body of their nets to increase net rise. Selective flatfish trawls with extreme numbers of ribline floats have also been observed by agency staff. Recent comments by net shop operators also suggest that some vessels made only the very minimum adjustments to their flatfish trawls in 2005 to meet the legal definition prior to fishing, leaving a configuration that could still generate a high headrope height. Comments from one operator and one net shop owner suggest that two vessels actively tried to achieve higher headrope height to make their nets fish more effectively, without consideration of the impact on canary rockfish bycatch.

The anecdotal evidence suggests that the current rule defining selective flatfish trawls allows nets that may generate excessive rise to be built and fished, which makes interpretation of observer-generated canary rockfish bycatch data more difficult. If excessive rise in some trawls is contributing to the high canary rockfish bycatch rates observed in 2005, a more effective legal definition of selective flatfish trawls could reduce the need for other management actions, such as closing areas to fishing. If a change in the legal definition of selective flatfish trawls can result in consistently lower canary rockfish bycatch rates in this fishery, observed differences in bycatch rates can be more reliably attributed to other important factors such as RCA boundaries, catch limits, bycatch "hotspots" and latitudinal and habitat-based differences in the distribution of canary rockfish. A more rigorous legal definition for selective flatfish trawls has the potential to improve the PFMC's management performance as it relates to limiting canary rockfish bycatch in this fishery segment.

RECOMMENDATION

Considering all of the factors discussed above, management actions to improve the performance of the selective flatfish trawl fishery would be precautionary, and should include consideration of some changes to the definition of selective flatfish trawls that more effectively restrict headrope and wing height. Such an initiative may need to be coordinated with additional training for enforcement officers on how to evaluate selective flatfish trawls effectively under a more complex legal definition. It should be noted though, that while changes in the selective flatfish trawl definition may help control canary rockfish bycatch, it is not likely to be sufficient on its own. Factors other than trawl configuration clearly also contributed to the poor performance of the 2005 selective flatfish trawl fishery in meeting the projected canary rockfish bycatch rates. The vessels that had technical help with their nets only achieved a bycatch rate of 0.0025, still more than double the rate of 0.0011 projected from the 2003 EFP fishery. This performance gap could be due to an unusual distribution of canary rockfish in 2005 or to differences in the specific habitats, species and areas trawled in 2005 or due to differences in incentives between EFP vessels in 2003 and regular trawl vessels in 2005. When they become available, an analysis of 2006 observer data for vessels fishing selective flatfish trawls may help further define what will improve the performance of the selective flatfish trawl fishery.

REFERENCES

Cochran, W. G. 1977. Sampling techniques. John Wiley and Sons, New York. 428 p.

Dark, T. A., M. O. Nelson, J. J. Traynor and E. P. Nunnallee. 1980. The distribution, abundance, and biological characteristics of Pacific whiting, *Merluccius productus*, in the California-British Columbia region during July-September 1977. Mar. Fish. Rev. 42:17-33.

Foster, D. G. 2004. 1999-2003 north-central and western Gulf of Mexico BRD performance. Report to the Gulf of Mexico Fishery Management Council. National Oceanic and Atmospheric Administration, Southeast Fisheries Science Center, Pascagoula, MS.

Hannah, R. W. and S. A. Jones. 2007. Effectiveness of bycatch reduction devices (BRDs) in the ocean shrimp (*Pandalus jordani*) trawl fishery. Fish. Res. 85:217-225.

Hannah, R. W., S. J. Parker and T. V. Buell. 2005. Evaluation of a selective flatfish trawl and diel variation in rockfish catchability as bycatch reduction tools in the deepwater complex fishery off the U.S. west coast. N. Amer. J. of Fish. Manag. 25:581-593.

Helser, T. E, I. J. Stewart, G. W. Fleischer and S. Martell. 2006. Stock assessment of Pacific hake (whiting) in U.S. and Canadian waters in 2006. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 200, Portland, Oregon 97220-1384.

King, S. E., R. W. Hannah, S. J. Parker, K. M. Matteson and S. A. Berkeley. 2004. Protecting rockfish through gear design: development of a selective flatfish trawl for the U.S. west coast bottom-trawl fishery. Can. J. Fish. Aquat.c Sci. 61(3):487-496.

Methot, R. D., and I. J. Stewart. 2005. Status of the U.S. canary rockfish resource in 2005. In: Status of the Pacific coast groundfish fishery through 2005 and recommended biological catches for 2006: stock assessment and fishery evaluation. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 200, Portland, Oregon 97220-1384.

Northwest Fisheries Science Center (National Marine Fisheries Service). 2003. West coast groundfish observer program initial data report and summary analyses, January 2003. Northwest Fisheries Science Center, NOAA. 26 p.

Parker, S. J., M. R. Saelens, S. A. Kupillas and R. W. Hannah. 2004. Using an exempted fishing permit for a large-scale test of a selective flatfish trawl in the continental shelf flatfish fishery. Oregon Dept. Fish Wildl., Inform. Rept. Ser., No. 2004-01. 22p.

PFMC (Pacific Fishery Management Council). 2002. Status of the Pacific coast groundfish fishery through 2001 and recommended biological catches for 2002: stock assessment and fishery evaluation. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 200, Portland, Oregon 97220-1384.

PFMC (Pacific Fishery Management Council) and NMFS (National Marine Fisheries Service). 2006. Proposed acceptable biological catch and optimum yield specifications and management measures for the 2007-2008 Pacific coast groundfish fishery, and Amendment 16-4: Rebuilding plans for seven depleted Pacific coast groundfish species; Final environmental impact statement including regulatory impact review and initial regulatory flexibility analysis. Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 200, Portland, Oregon 97220-13.

Richards, A., and L. Hendrickson. 2006. Effectiveness of the Nordmøre grate in the Gulf of Maine northern shrimp fishery. Fish. Res. 81:100-106.

Table 1. Depth boundaries (fathoms) of the Rockfish Conservation Area by fishing period and year, 2003-2005.

Year	January - February	March - April	May- June	July - August	September - October	November - December
2005	75-200[1]	100-200	100-200	100-200	100[2]-250	0-250
2004	75-200[1]	60-200	60-150	75-150	75[2]-200	0-250[1]
2003	100-250[1]	100-250	50-200	75-200	50-200	0-200[1]

[1] Modified to include winter petrale sole fishing areas.
[2] Changed to 0 fathoms mid-period.

Table 2. List of "northern target" species (or market categories) used for calculation of bycatch rates in the selective flatfish trawl fishery.

Arrowtooth flounder (*Atherestes stomias*)
Butter sole (*Isopsetta isolepis*)
Curlfin sole (*Pleuronichthys decurrens)*
Dover sole (*Microstomus pacificus*)
English sole (*Parophrys vetulus*)
Petrale sole (*Eopsetta jordani*)
Rex sole (*Glyptocephalus zachirus*)
Rock sole (*Lepidopsetta bilineata*)
Sand sole (*Psettichthys melanostictus*)
Sanddab (*Citharichthys* sp.)
Starry flounder (*Platichthys stellatus*)
Longspine thornyhead (*Sebastolobus altivelis*)
Sablefish (*Anoplopoma fimbria*)
Shelf rockfish (*Sebastes* sp.)
Shortspine thornyhead (*Sebastolobus alascanus*)
Slope rockfish (*Sebastes* sp.)
Yellowtail rockfish (*Sebastes flavidus*)

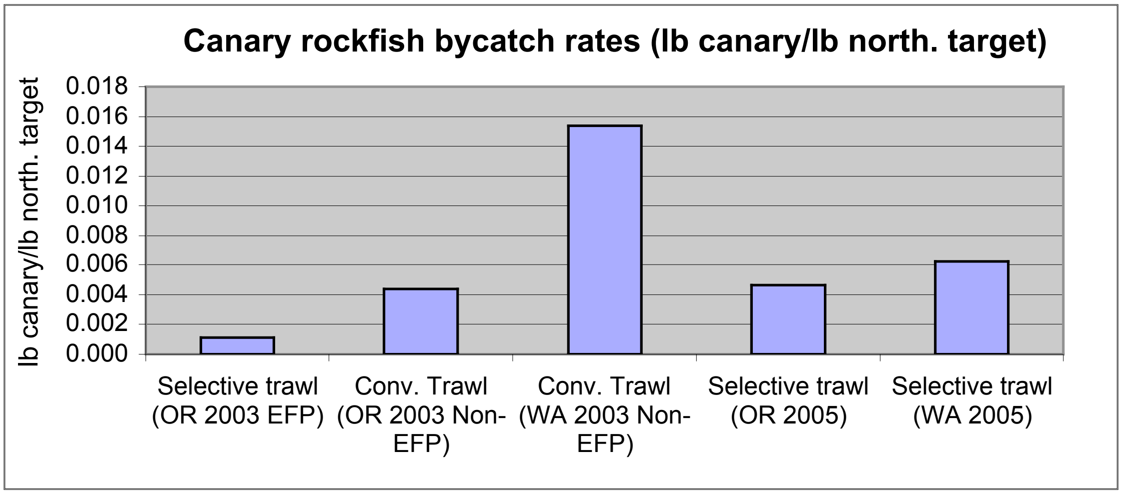


Figure 1. Mean canary rockfish bycatch rates (lbs/lb of northern target) for the 2003 selective flatfish trawl EFP fishery, the 2003 conventional trawl fisheries inside 100 fathoms landing into Oregon and Washington and observed vessels fishing selective flatfish trawls landing into Oregon and Washington in 2005. Hauls included are from the months of May-October and had haul locations south of Cape Alava, Washington (see text).

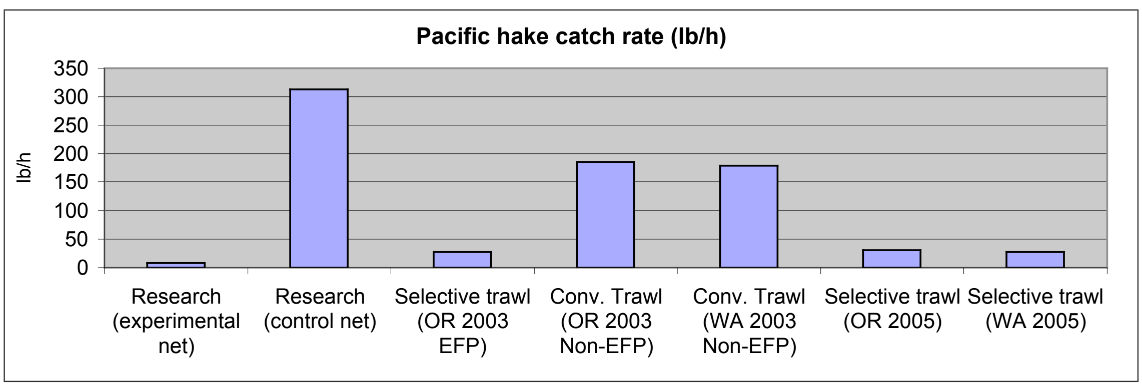
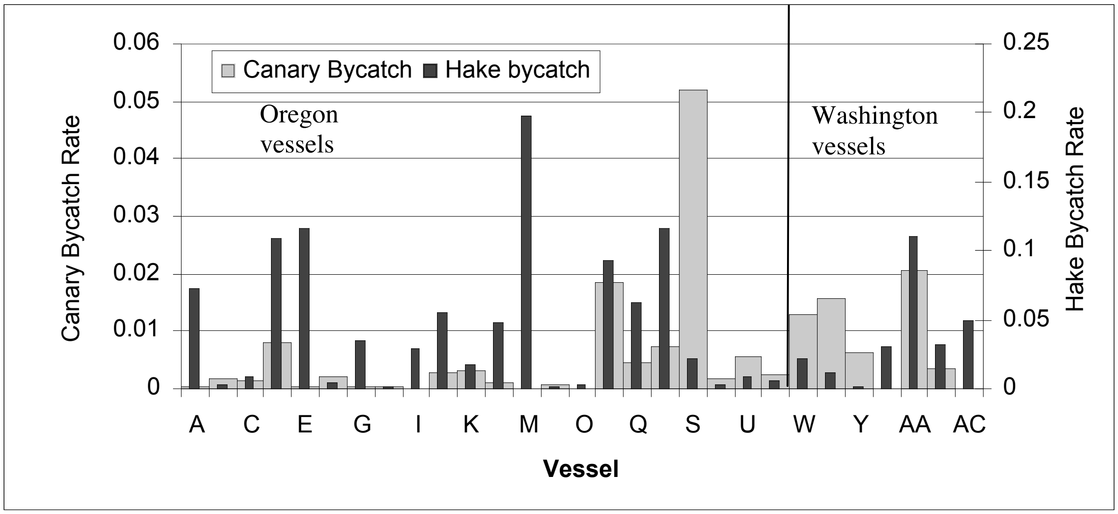


Figure 2. Mean Pacific hake catch rates (lbs/h) for 2001-02 selective flatfish trawl research hauls (experimental and control nets), the 2003 selective flatfish trawl EFP fishery, the 2003 conventional trawl fisheries inside 100 fathoms landing into Oregon and Washington and observed vessels fishing selective flatfish trawls landing into Oregon and Washington in 2005. Hauls included are from the months of May-October and had haul locations south of Cape Alava, Washington (see text).



F

Figure 3. Canary rockfish and Pacific hake bycatch rates (lbs/lb of northern target) by vessel and state of landing, for observed vessels fishing selective flatfish trawls in 2005. Hauls included are from the months of May-October and had haul locations (see text) south of Cape Alava, Washington.

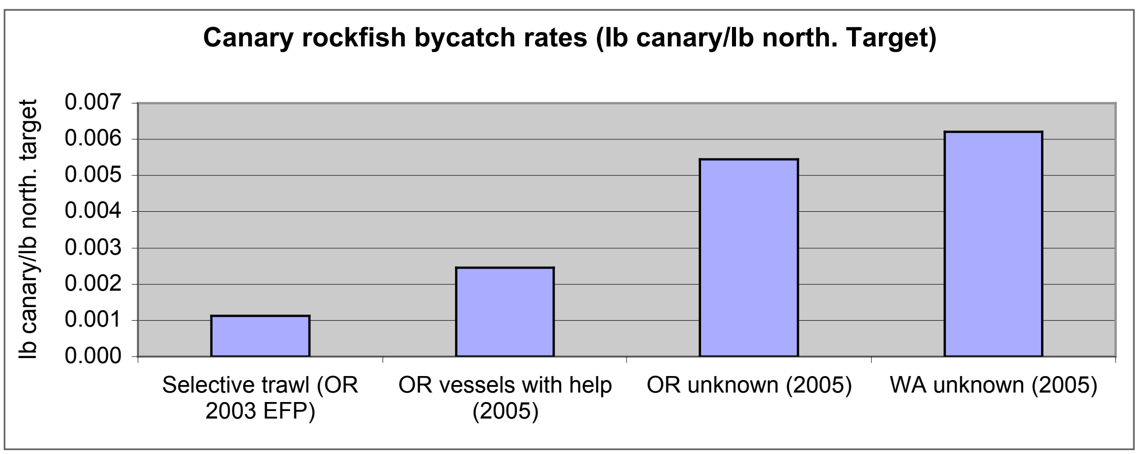


Figure 4. Mean canary rockfish bycatch rates (lbs/lb of northern target) for the 2003 selective flatfish trawl EFP fishery, and three classes of observed vessels fishing selective flatfish trawls in 2005: vessels landing into Oregon ports that were known to have had technical assistance in configuring their selective flatfish trawl nets (see text) and vessels landing into Oregon and Washington ports for which the level of technical help was unknown. Hauls included are from the months of May-October and had haul locations south of Cape Alava, Washington (see text).

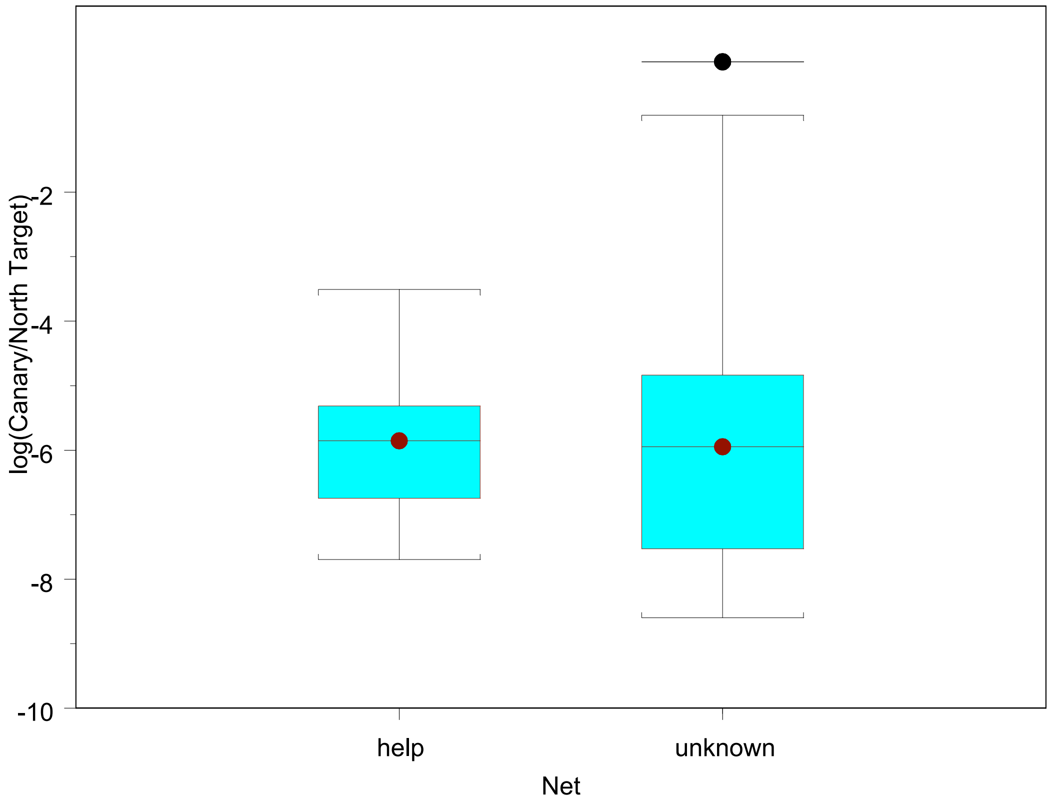


Figure 5. Box plot of the log of the canary bycatch rate (lb canary rockfish/lb northern target) for vessels with assistance (help) in configuring their selective flatfish trawls and vessels of "unknown help" status with regard to assistance in net configuration. Data are from the 2005 observer program for vessels fishing selective flatfish trawls in the months of May-October, including hauls off Oregon and Washington south of 47.0° N. latitude. One haul for the "help" group was deleted because it yielded 26 lbs of canary rockfish and no catch of northern target species. The line in the middle of the bar is the median. The whiskers extend to the range of the distribution up to 1.5 times the inter-quartile range. Any observations outside the whiskers are considered extreme values.

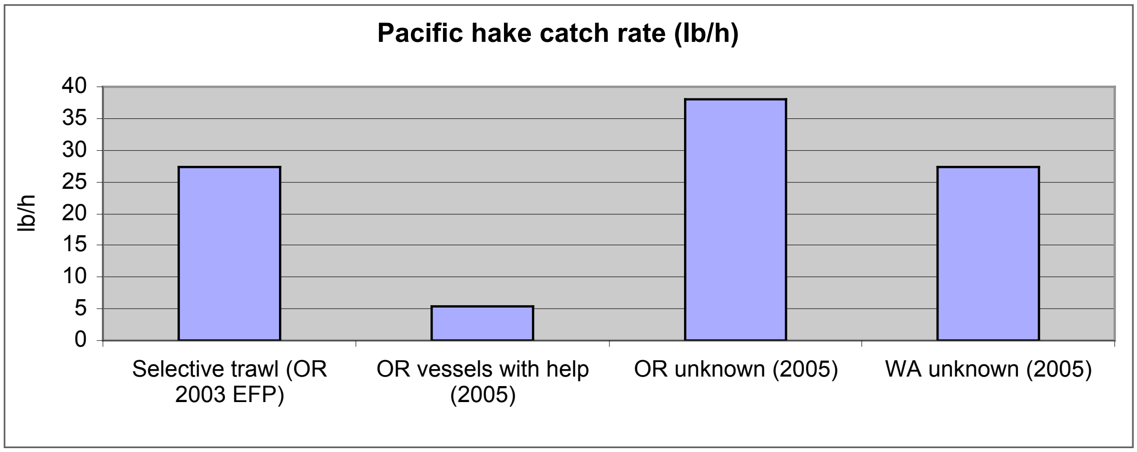


Figure 6. Mean Pacific hake catch rates (lbs/h) for the 2003 selective flatfish trawl EFP fishery, and three classes of observed vessels fishing selective flatfish trawls in 2005: vessels landing into Oregon ports that were known to have had technical assistance in configuring their selective flatfish trawl nets (see text) and vessels landing into Oregon and Washington ports for which the level of technical assistance was unknown. Hauls included are from the months of May-October and had haul locations south of Cape Alava, Washington (see text).

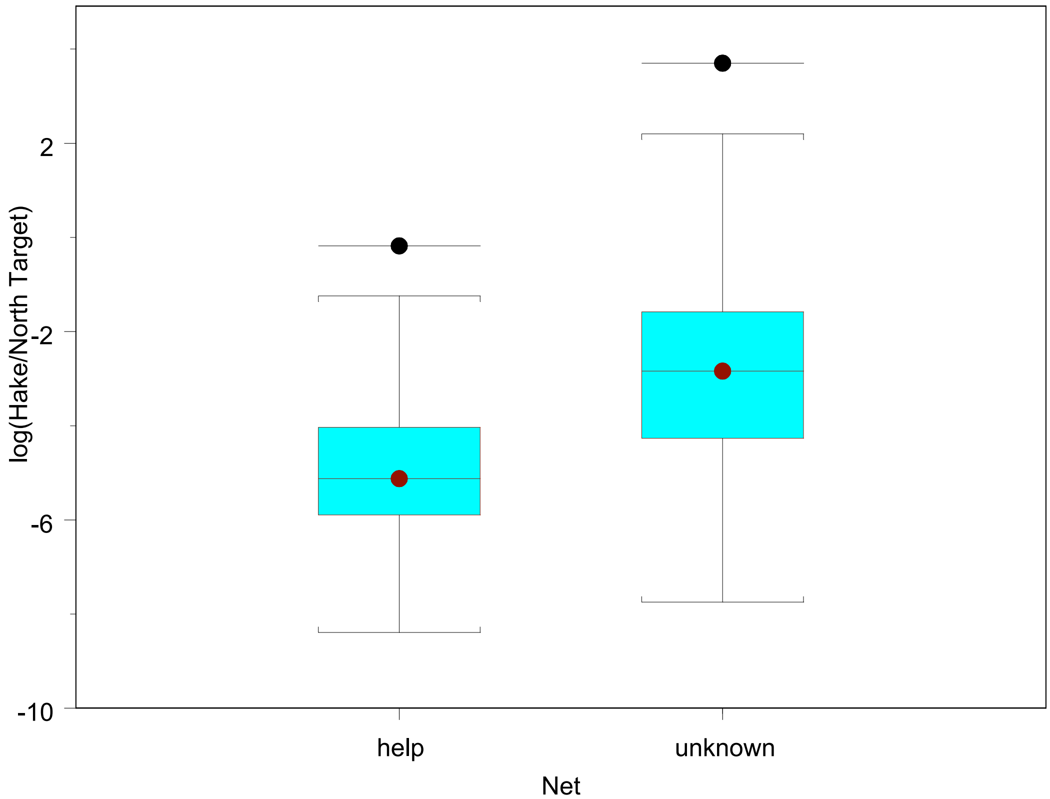


Figure 7. Box plot of log of the Pacific hake bycatch rate (lb Pacific hake/lb northern target) for vessels with assistance (help) in configuring their selective flatfish trawls and vessels of "unknown help" status with regard to assistance in net configuration. Data are from the 2005 observer program for vessels fishing selective flatfish trawls in the months of May-October, including hauls off Oregon and Washington south of 47.0° N. latitude. One haul for the "unknown help" group was deleted because it yielded 8 lbs of Pacific hake and no catch of northern target species. The line in the middle of the bar is the median. The whiskers extend to the range of the distribution up to 1.5 times the inter-quartile range. Any observations outside the whiskers are considered extreme values.

Appendix A. Current federal rule defining selective flatfish trawls.

(c) Selective flatfish trawl gear is a type of small footrope trawl gear. The selective flatfish trawl net must be a two-seamed net with no more than two riblines, excluding the codend. The breastline may not be longer than 3 ft (0.92 m) in length. There may be no floats along the center third of the selective flatfish trawl net's headrope or attached to the top panel except on the riblines. The footrope must be shorter than 105 ft (32.26 m) in length. The headrope must be at least 30 percent longer in length than the footrope. An explanatory diagram of the selective flatfish trawl net is provided as figure 1 of Part 660, Subpart G in Title 50 Code of *Federal Regulations*.

Appendix B. Proposed modified rule (changes highlighted) to better restrict rise in selective flatfish trawls.

(c) Selective flatfish trawl gear is a type of small footrope trawl gear. The selective flatfish trawl net must be a two-seamed net with no more than two riblines, excluding the codend. The breastline may not be longer than 3 ft (0.92 m) in length. **All floats on the trawl must be placed on the headrope between the breastline and the point where the ribline joins the headrope, or on the headrope within 4 feet of this point or on the codend.** There may be no floats along the center **40%** of the selective flatfish trawl net's headrope~~ or attached to the top panel except on the riblines~~. **The stretched distance between the footrope and the headrope, measured at the point where the ribline joins the headrope, cannot exceed 47 meshes and cannot exceed 7 ft (2.13m). Counted at the breastline, the trawl netting between the footrope and the headrope cannot exceed 20 meshes.** The footrope must be shorter than 105 ft (32.26 m) in length. The headrope must be at least 30 percent longer in length than the footrope. An explanatory diagram of the selective flatfish trawl net is provided as figure 1 of Part 660, Subpart G in Title 50 Code of *Federal Regulations*.

OREGON
Fish & Wildlife

3406 Cherry Ave. NE
Salem, Oregon 97303