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Monitoring bycatch: a fishing industry generated solution.

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Abstract

The groundfish industry in the province of British Columbia and the Department of Fisheries and Oceans Canada implemented the B.C. Groundfish Integrated Pilot Project in March of 2006. The project was initiated, in general, because of the difficulty of managing many species of groundfish across multiple license/gear sectors and, in particular, because of the difficulty in quota-managing stocks without discard information. Motivated, in part, by a combination of "carrot" (introduction of ITQs) and "big stick" (fix it or lose it) incentives, the fishing industry took the lead role in designing, funding, and implementing a cost-effective 100% at-sea catch monitoring program in a small-boat fleet of over 250 vessels. In its first three years, the Project has surpassed the expectations of many of the industry and government participants. This monitoring now provides accurate and statistically defensible estimates of total catch for all quota species, thereby removing the need for more complex, and possibly biased, discard estimation procedures. The accurate monitoring of total catch by species (discarded and retained) by each vessel in near real time provides managers with relatively simple options for controlling and even minimizing discards through individual species caps. With this individual accountability framework, fishers are motivated to develop their individualized strategies to reduce non-desirable catches, as opposed to the more problematic approach of top-down design and enforcement of temporal or spatial closures, or gear restrictions. The presentation focuses on the importance of a bottom-up industry-driven solution to the problem, the key elements of the monitoring, and the results of a test case to assess the accuracy of the monitoring.

Keywords: discards, bycatch, electronic monitoring, ITQ, groundfish

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Introduction

The commercial groundfish industry in the province of British Columbia, Canada and the Department of Fisheries and Oceans Canada (DFO) implemented the Commercial Groundfish Integrated Pilot Project (CGIPP) in March of 2006. The Project was initiated because of the difficulty of managing many species of groundfish across multiple license/gear sectors and, in particular, because of the difficulty in quota-managing stocks without discard information.

In spite of a difficult birth, in its first three years (April 2006-March 2009) the Project has progressed beyond the expectations of many industry and government participants. Among other achievements, and motivated, in part, by a combination of "carrot" (ITQs) and "big stick" (fix it or lose it) incentives, the fishing industry took the lead role in designing, funding, and implementing cost-effective 100% monitoring program in a small-boat fleet of over 200 vessels. The monitoring appears to provide sufficiently accurate and statistically defensible estimates of total catch for all quota species, removing the need for more complex, and possibly biased, discard estimation procedures.

We provide a brief description of the fishery and a summary of the events leading to implementation of the CGIPP in 2006. This is followed by a brief description of the CGIPP monitoring design and then an analysis of the accuracy of the catch data using one species, yelloweye rockfish (*Sebastes ruberrimus*), as a test case. We conclude the document with a summary of strengths and weakness of the monitoring design. Much of this paper is derived from Koolman et al. (2007) and Stanley et al. (2009).

B.C. groundfish hook-and-line and trap fisheries

Prior to 2006, the B.C. groundfish commercial hook-and-line and trap fisheries were operating with numerous licences/sectors in overlapping areas and under different sets of management regulations. This complexity led to significant inefficiencies and wastage. Foremost among these was the result that as each of the sectors was retaining their targeted or directed species, they were discarding, often dead, the target species of other sectors. While landings were validated, there was no reliable means for estimating the discards thereby rendering stock assessment and quota management problematic. Complete coverage (100%) observer programs were deemed too costly to implement by the harvesters, many of whom ran 1- or 2-man operations.

By the mid to late 1990s, the fishing industry also recognised that the increasing pressures from policy development related to, for example, "Precautionary Approach, "Responsible Fishing", and the Canadian Species at Risk Act (SARA), required a new way of conducting business. In addition to the operational problems that needed fixing, industry felt that these operational changes could be packaged with the introduction of individual transferable quotas (ITQs) which would provide significant economic benefit and more efficient management.

The seminal moment occurred in May 2001 with the presentation of a discussion paper by the commercial sectors, which recommended a move toward integrating groundfish fisheries by combining fishing privileges in order to "reduce bycatch …rationalize fishing capacity, and allow for more efficient, effective and rational fishing practices". This report was followed by three DFO-convened meetings in 2003 which included representatives from the fishing industry, ENGOs, First Nations, and the B.C. Provincial Government. These groups, with funding from the Provincial Government, then commissioned two additional discussion papers which continued to refine the statement of the problem while expanding the list of objectives to include:

- conservation with improved research and assessments
- improved catch utilization
- sector and individual catch accountability
- increased industry responsibility and cost recovery
- security of access and a "year-round" fishery
- economic viability and efficiency
- improved social benefits
- comprehensive management with administrative and operational simplicity.

The documents evolved from a simple plea to "fix" things, to an attempt to develop a lasting structure that could respond and therefore persist. The documents also proposed an advisory and coordinating structure and membership.

In November 2003, the Provincial Government and DFO formed the Commercial Groundfish Integrated Advisory Committee (CGIAC). Its membership originally included the governments, commercial fisheries, coastal communities, Marine Conservation Caucus (representing ENGOs), Sports Fish Advisory Board, and B.C. Aboriginal Fisheries Commission. CGIAC's task was to develop a strategic approach to management that integrates all commercial groundfish fisheries and satisfies five initial criteria:

- the fishery must account for all rockfish catches
- rockfish catches will be managed according to rockfish management areas
- fishermen will be individually accountable for their catch
- monitoring standards will be established to meet the above three objectives
- species of concern will be closely examined, and actions such as reduction of TACs and other catch limitations will be considered and implemented to be consistent with the precautionary approach for management.

The Commercial Industry Caucus (CIC) was formed as an industry-only subcommittee of the CGIAC to coordinate planning within the groundfish commercial license categories (Table 1). The CIC was specifically tasked to explore and recommend action on reducing rockfish by-catch, more progressive fisheries management, security of access, and at-sea monitoring.

The CIC deliberations were difficult and time-consuming but after two years resulted in April 2005 with a first draft of the "Commercial Industry Caucus Pilot Integration

Proposal (Diamond Management Consulting[1]). This report was then endorsed in principle by DFO, with the caution that the proposal represented a "major fishery reform" requiring extensive consultation. DFO noted that the proposal not only had implications with respect to allocation among commercial sectors but also with the sport fishing sector and First Nations. At this time, DFO requested that the principal fishery monitoring components be in place by April 2005, however difficulties in designing and implementing the monitoring delayed implementation until March 2006.

The driving operational elements of the Project were the introduction of ITQs in conjunction with cost-effective and sufficiently accurate catch monitoring. The details of the initial allocation of ITQs and the trading program are too complex to describe in this document. In brief, each year each sector license category (Table 1) is allocated portions of the quota for each quota species[2]. There are over 27 groundfish species managed by quota, with about 20 being important in the hook-and-line and trap fisheries. ITQ holders may then lease, sell and trade ITQ privileges, however, there are vessel and sector caps which limit the flow of quota share among sectors and individual licenses.

The catch monitoring

The Project catch monitoring system was designed by the Electronic Monitoring (EM) Subcommittee of the CIC over a two year period from early 2004 to March 2006. The permanent membership of the EM subcommittee is composed of fishers and DFO managers. Most meetings include invited participants from DFO-Science Branch and contract data providers including a company which specializes in electronic fisheries monitoring (Archipelago Marine Research). The design phase included test trips to compare accuracy in catch recording between video review and observers, and prototyping the EM functionality on a subset of the fleet. Much of the meeting time and background analysis during the design phase was spent in designing the scoring system that would be used when comparing the fisher's log with results of video review and dockside validation. This phase also included testing whether video footage could be used to estimate fish length of discarded fish, and examined the sample sizes required to provide sufficiently precise (i.e. ± 10%) estimates of the mean length of retained specimens.

The monitoring was fully implemented in the fleet in March 2006. It covers hook-and-line and trap fishing conducted by commercial groundfish vessels in B.C. waters with a focus on approximately 20 quota species. Implementation included installation of EM equipment on all vessels[3]and operationalizing the random review of randomly selected video footage. It also required development of a sophisticated data and information management system (IMS) that accepts data from outgoing and incoming vessel hails, fisher logs, observer logs, dockside monitoring data, the results of video review, and GIS-base vessel tracking. From these data input streams, the IMS provides real time updates on the status of each fisher's total catch relative to their ITQ for each quota species by

[1] http://www.diamondmc.com
[2] http://www-ops2.pac.dfo-mpo.gc.ca/xnet/content/MPLANS/plans09/2009Groundfish_aug17.pdf
[3] as of the 2008/2009 fishing year, 210 vessels had the EM equipment.

management area, results of test audits of the fisher logs, and an automated check on whether the vessel fished in a closed area.

The monitoring is composed of three key data sources: 1) the fisher logs; 2) the electronic monitoring (EMP); and 3) the dockside monitoring (DMP). The fisher logs provide the fishers' piece count records of catch by species for each fishing event. Catch is defined as the catch of all specimens (retained or discarded) that rise above water level at the vessel's side during fishing, including those that are shaken loose during retrieval.

The EMP provides video footage (VF) of the retention or discarding of all fish at the hauling site during all fishing events (Ames et al. 2007, McElderry et al. 2003). The cameras are recording at all times as the gear is being set and hauled. The EMP also includes a GPS-linked vessel monitoring system (VMS) connected to the winches which tracks vessel location during fishing to confirm the fishing location of each event in the fisher logs. Fishers may choose to take an observer in place of the EM; this option was used for 17 of the 1,274 trips in the April/08-March/09 fishing year (FY08/09).

The role of the DMP is to provide validation of the piece counts of non-directed quota species and total weights of all species during unloading for all trips. The piece counts and weights are collected by independently contracted validators. It is conducted even landings of live specimens. Owing to the difficulty for video review to distinguish among some rockfish species, combined with the fact that most rockfish die after capture, the Project mandated that all rockfish specimens must be retained during fishing and unloaded for dockside monitoring ("100% retention"). The DMP landed weights are used to track the official quota status of all quota species for each vessel.

A key element of the monitoring is the random audit of the fisher logs. Within two weeks of the unloading of each trip, the VF from 10% of the fishing events of each trip is reviewed to enumerate catch in pieces (retained and discarded) by species for the entire event. The 10% target translates in practice to one event for trips with 1-14 events, two events for trips with 15-24 events, three events for 25-34 events, and so forth (Table 2). The VF piece counts are then compared with the fisher log piece counts for the same events. If the counts match within a prescribed tolerance for the non-directed quota species, the fisher logs for that trip are deemed valid and the fisher logs become an official record of total pieces caught (retained and discarded) by species for all events in the trip. If the deviations exceed the prescribed tolerances, the VF for all events of the trip may have to be reviewed at vessel expense ("100% VF review") to provide the official record of total catch in pieces by species for that trip. The vessel may also have to take an observer on the next trip, at vessel expense. Although prohibited, if the fisher logs contain records of discarded rockfish, these can be converted to weight using a mean weight/piece in the fishery and added to the landed weights that are assigned to the vessel's cumulative catch.

The intent of the fisher log-VF audit is to validate the fisher logs and, in particular, confirm the veracity of fishers' logbook records of discards and retained pieces. In the case of rockfish, they are intended to provide confirmation that no rockfish were discarded and therefore the DMP landed weight and piece count is a true record of total catch by species. While a 100% review of the VF would be preferable, the costs of complete review were deemed unacceptable in that the fishery would have become uneconomical for many of the participants. Thus the VF review is designed to both monitor and discourage misreporting, but was not intended as the principal means for estimating total catch. In that sense, it is likened to the radar traps used by law enforcement agencies to discourage speeding on highways.

While the fisher log-VF audit confirms information on discarding during gear retrieval, unreported dumping (the disposal of fish after being recorded in the fisher logs but prior to unloading) remains a possibility. For the different rockfish species, this can be checked by comparing the total piece counts noted as retained in the fisher logs with the DMP piece count for that trip. If the DMP piece count is significantly lower than the fisher log retained piece count, then it can be assumed that the fisher disposed of rockfish before the DMP check by using the specimens for bait, unloading them illegally, or simply dumping them. For example, when targeting Pacific halibut (*Hippoglossus stenolepis*), fishers may not have sufficient yelloweye rockfish IVQ (in weight) attached to their vessel to cover the incidental capture of yelloweye rockfish that could accrue during targeted Pacific halibut fishing. Rather than purchasing additional IVQ of yelloweye rockfish, these fishers may attempt to misrepresent the yelloweye rockfish catch. Even though the fisher log could be correct, there is no way to detect the dumped fish through a comparison between the fisher log <u>piece count</u> and the DMP <u>weight</u> since the mean weight of yelloweye rockfish varies widely among trips. Therefore, a piece count in addition to the total weight is obtained during the DMP for non-directed species, albeit at significant cost and inconvenience to the fisher, especially in the live rockfish fishery.

As with the fisher log-VF comparison, if the deviations in the fisher log-DMP test do not fall within prescribed tolerances, the trip may be subjected to 100% review and the vessel may have to take an observer on future trips at vessel expense. If the deviations are large, the piece counts from the fisher can be converted to total weight and used in place of DMP weight for tracking each vessel's catch.

If no quota species have been discarded or dumped, the fisher logs and DMP provide two different estimates of the total species catch in pieces for each trip, and the DMP also provides catch in weight. Since all trips are monitored, summing the catches over all trips provides two estimates of total catch in pieces (fisher logs or DMP) and one of total weight (DMP). The fisher logs, verified by the VMS, indicate where, when, and how the fishing was conducted which allows the catches to be allocated to the appropriate Region. In addition to providing confirmation on the location of the catches, VMS is used to ensure there is no fishing in closed areas or during closed periods.

In summary, the fishery is operationally managed within the year under the default assumption that the DMP is a correct record of retained catches by weight. The fisher logs confirm that there are no discards of quota specimens and used to assign catch to Region. However, a series of audit checks are applied to the fishing logs and DMP of each trip to verify that these operational assumptions are valid. If they are shown to have been violated for individual trips, the results of the 100% VF review are available to provide a corrected catch for suspect trips.

Status of the monitoring as of April 2006

The system has proved successful even from the outset although many operational problems required solving in over the first three years. For the first time in these fisheries, credible total catch estimates are available for all quota and most non-quota species. Table 3 shows the example results for yelloweye rockfish. Furthermore, the non-targeted but marketable species within each sector are now retained for sale rather than discarded.

The monitoring also appears to have the confidence of the majority of the fishers. While there have been complaints, mostly about the cost, there is no suggestion that the fishers think the IVQ system is failing owing to significant misreporting or cheating. Following an adjustment period in the first year, most fishers now receive passing scores in the fisher log and DMP validation steps. The three years of experience has also added an experiential basis for determining whether a fisher logbook is "sufficiently" accurate. Using yelloweye rockfish, as a test case, it is reassuring that the total fisher log and DMP piece counts for yelloweye rockfish match overall (Table 3) as do the total counts from the fisher logs and VF counts for the subset of reviewed events representing about 10% of the fishery (Table 4).

CGIPP Catch estimation accuracy – a test case

While the CGIPP monitoring system gives every appearance of meeting its objectives, it has been noted from early in the design phase that in spite of the quality assurance checks, it was still be possible to cheat the system. For example, fishers might under-report the piece count by 5% in their fisher logs, knowing that this level of bias will fall within the tolerances of the fisher log-VF audit. The same fisher may then dump an additional 5% of the yelloweye rockfish pieces prior to unloading knowing that this 5% mismatch would also lie within the tolerances of the fisher log-DMP audit. If all fishers were to push these tolerances, then actual catch could exceed reported catch by 10% or more. This concern had left managers wondering whether or not to assume there would an overage of the quota simply because it would be possible.

Such concerns are common in most if not all catch monitoring programs. Even 100% observer programs are often questioned for their precision and particularly the bias (Kelleher 2007; Lennert-Cody and Berk 2005). In most cases, fishery monitoring is designed and conducted as well as is reasonable, but in the end can only be assumed to be sufficiently adequate. Nevertheless, while rarely attainable, it will always be preferable to have an independent means for estimating the bias and precision of the catch estimates.

The following section documents an analysis of the accuracy of the monitoring using yelloweye rockfish as a test case. It was concerns over the conservation status and lack of discard information for this species that helped precipitate the drive for changes in these fisheries. This accuracy test relies on a somewhat fortuitous outcome of the video monitoring. The observations collected during the VF review (VF-data), although collected for the random fisher log audits, provide the basis for deriving a virtually independent and unbiased estimate of total catch in pieces. The method is simple in concept. Since the reviewed events are supposed to be chosen at random, one can simply expand the mean catch rate in the reviewed sets by the total number of sets in the fishery. In our "proof-of-concept" example, the expansion was treated as stratified sampling wherein each sector defines a non-overlapping stratum of all possible fishing events for each year (see Stanley et al. 2009).

Oversimplifying somewhat, groundfish vessels using hook-and-line or trap gear conduct their fishing trips within one of five groundfish license or sector categories. These are distinguished in this document as the Rockfish (*Sebastes* spp.), Halibut, Sablefish (*Anoplopoma fimbria*), Lingcod (*Ophiodon elongatus),* and Dogfish (*Squalus acanthius*) sectors. Sablefish and halibut fishers sometimes conduct trips under a combination category. These are grouped in this document as the Halibut/Sablefish sector (Tables 2-7). There are also considered to be two distinct populations of yelloweye rockfish on the B.C. coast: the Inside and Outside regions. Therefore we have examined the catch accuracy by both sector and Region (Figure 1).

Mean estimates and confidence limits of the piece counts for each sector and Region are provided in Table 5. While the 95% confidence limits for the bootstrap estimates are about ± 30%, the mean estimates closely match the official estimates provided as the sum of the fisher logs or DMP at the rolled-up level of Region. They even provide reasonable matches for estimates by sector (Table 6). The match of the piece counts indicates that the total weights reported in the DMP (Table 3) reflect the actual total catch of yelloweye rockfish in the Regions for these sectors with sufficient accuracy to meet the needs of quota management.

The relative discrepancies for Halibut and Dogfish/Inside sectors, wherein the fisher logs and DMP estimates are about 13% and 19% higher, respectively, than the VF estimates requires further examination. However, since it is the official estimates that are higher, the possible bias does not represent a conservation risk. The only cases where the VF estimate is higher, the discrepancies are modest. All the official estimates fall well within the 95% confidence limits of the VF estimates.

Discussion

The possibly unique feature of the program is that the official total catch estimates from the fisher logs and DMP can be validated by an estimate generated from VF-data, a subset of all events. This was a somewhat unanticipated benefit of the EM program, since the random review of VF was only to provide an audit check on the quality of individual fisher logs. However, since the VF is obtained before fishers can falsify the logs and/or dump specimens, and if it can be assumed that the VF-data provide a random set of observations (see Stanley et al. 2009), they provide an opportunity to obtain an unbiased estimate of the true catch with estimates of uncertainty. Although the VF estimates are in piece counts, the DMP provides reliable estimates of mean weight/piece by sector or Region, therefore the piece counts can be converted to weight.

The agreement between the VF estimates and the fisher log and the DMP estimates indicates there is negligible unreported discarding and dumping, at least with respect to yelloweye rockfish. In fact, fishers on the Project design team predicted that there would be little evidence of this bias. They stated that it was difficult to record their catches with enough accuracy to pass the audit tolerances. Thus, they would be unlikely to bias their logbooks or the DMP by even a few fish for fear of increasing the likelihood of failing the audits and thereby incurring the cost of 100% review and/or an observer.

The VF estimate also provides the advantage of remaining unbiased even if some elements of the monitoring system are changed. The Project's achievements in catch monitoring in a small-boat fishery have come at considerable cost, about CDN $2.6 million/y, although this includes the DMP which was in place prior to CGIPP. The fishing industry and DFO, who share the cost about 75%/25% respectively, are looking to reduce these costs. They have asked, for example, how the accuracy would be affected if the VF audit rate were reduced from 10% to 5%. In particular, they suggest that the subset of fishers/vessels, which have a proven history of validated logbooks have earned the right to less review and less cost.

The fisher logs and DMP catch totals may become more biased as some fishers take advantage of the fact they will be less likely, or it will take longer, to be caught misreporting. While the reduction in reporting quality will be apparent in the increase in the audit failure rate, managers would not know how biased overall the fisher logs and DMP catch totals were becoming. Fortunately, while the variance in the VF estimates will increase as sample size declines, they should continue to provide an unbiased estimate to total catch. Therefore, fishery managers and industry can jointly experiment with such changes knowing they will not be incurring a long-term conservation risk.

This first use of the VF-data to estimate total catch indicates its potential to provide an independent estimate of total catch, however, the catch estimation from VF-data will be more problematic for the catches of the flatfishes, large skates, and birds which are not currently retained. There are specific pairings or aggregates of species that are difficult to distinguish in the VF, but because they are not currently subject to 100% retention, the DMP sorting does not provide a backup for partitioning these catches. A full review of the Project monitoring requires that the present work be expanded to address the catch accuracy for the remaining species in this fishery, quota and non-quota. It should be noted, however, that while it may not be possible to provide VF estimates of the individual species within these aggregates, it will be possible to estimate the total piece count of the group, such as all "birds". While less than ideal, prior to the Project there was no means to estimate the magnitude of the catch, so it is a major improvement to obtain a defensible estimate of the total piece count of the group. If greater accuracy by species is required for these groups, it may be possible to derive estimates of the species ratios within these groups from observations during fishery independent surveys or from strategic placement of observers. It also remains an option for managers to expand the 100% retention regulation to additional species groups.

This is an example of the expandability of the CGIPP monitoring design to address additional catch monitoring issues. Since managers now know total catch in pieces, including discards, by species or species groups, relatively modest regulation changes can be implemented and monitored to address new issues related to estimation of bycatch. For example, should managers wish to reduce the discarding of sub-legal sized fish, they could easily convert the known piece counts of discarded fish (from fishing logs) to weight (using a "negotiated" value for mean weight) and include these catches in each vessel's IVQ. This would provide a dis-incentive for fishers to catch undersized specimens.

The most problematic analytical issue with respect to the VF estimates and the monitoring overall lies in the assumption that viewers can select events at random from all trips. It was noted that the review process failed to review 10% of the events for 9% of all trips in FY08/09, while 6% of the trips received no review. Some of these failures could be traced to mechanical problems, while some failures, especially in earlier years, were caused because fishers neglected to turn the system on. For those trips in which reviewers had to select alternate "random" events, the VF reviewers' comments indicated that some events were non-reviewable because of "poor lighting" or "water/slime" on the camera lens, simply that the video capture failed for some events within a trip.

The integrity of the overall monitoring system and not just the VF estimates will be suspect if fishers are able, or even perceived to be able, to render entire trips or selected events non-reviewable. While a small amount of equipment malfunction can be expected, the Project will have to be diligent in managing this problem. With respect to complete system failures, the Project has worked hard to make the EM system more robust and satisfactory to the fishers with the result that the proportion of trips that did not meet the 10% target has fallen steadily from 15% to 12% and now to 9% over the first three years of the Project. However, subsequent analysis should routinely isolate the set of trips that could not be reviewed and look for suspicious patterns such as repeat offenders.

With respect to those trips in which only some events were non-reviewable, reviewers did not notice any suspicious patterns, but initially no attempt was made to electronically capture the details of why some events could not be reviewed. Thus, it was not possible in this study to examine this issue more systematically. However, as a result of the review of yelloweye rockfish data, VF reviewers are now codifying these details and including these metadata in the catch monitoring database to be available for future work.

Conclusions

From a technical standpoint, the CGIPP catch monitoring appears to provide sufficiently accurate catch monitoring of both retained and discarded species to meet the needs of management. The relative veracity of the data was assumed by managers and fishers from the outset owing to the complex and costly verification checks built into the system. However, the unforeseen capability of the VF-data to provide a virtually independent and unbiased estimate of total catch is proving to be a powerful and useful final validity check on the official estimates of total catch. This assumption is supported by the test case analysis for yelloweye rockfish,, however, similar analyses should be conducted for other quota and non-quota species. If the official catch system can be trusted, it obviates the need for complex catch estimation procedures based on partial observer coverage or more indirect estimation procedures. From a process viewpoint, one key lesson learned was that the system was built from the bottom-up. Industry was challenged to develop a monitoring system to work or lose their fishery, and they did.

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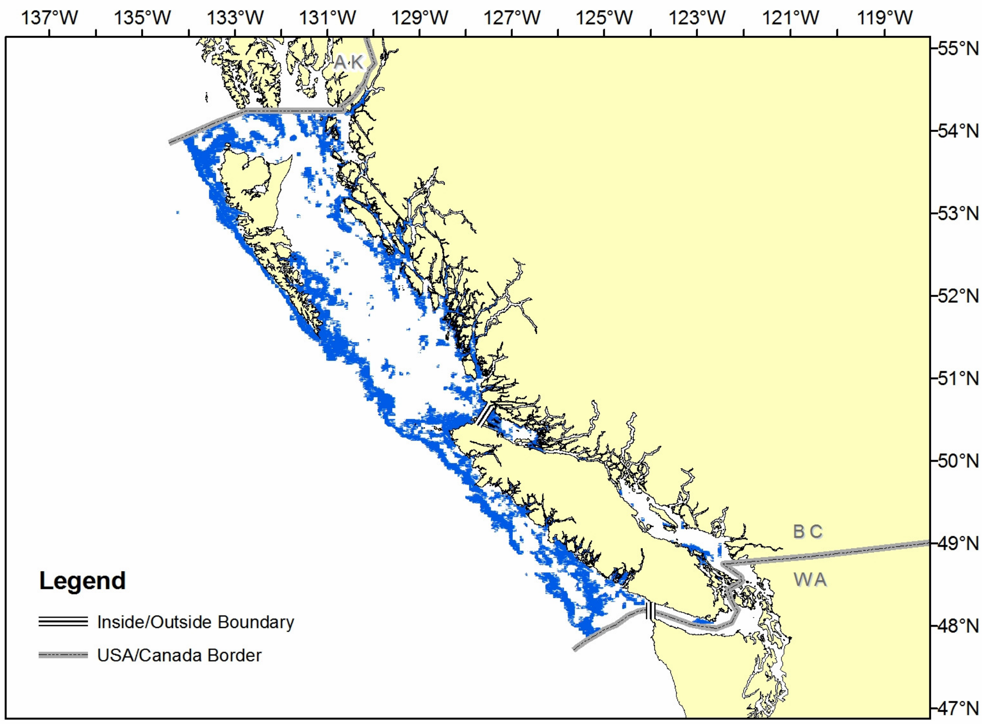

Figure 1 Chart of the coast of British Columbia showing the Outside and Inside management Regions for yelloweye rockfish and fishing locations from April 2006-March 2008. Note that for confidentiality, only locations (5-km x 5-km blocks) where at least 3 vessels have fished are shown.

Table 1. Existing groundfish likenesses in British Columbia (from Koolman et al. 2007)

licence/Sector	Gear[1]	Landed Value ($CDN)	Active licences	Target
L	LL, Jig, HL, Troll	$40 million	215	Halibut
Schedule II/C	Longline	$5 million	200-300	Lingcod and dogfish
Inside ZN	LL and HL	$1 million	55-60	Live rockfish, lingcod
Outside Zn-A	LL and HL	$4 million	85	Live rockfish, lingcod
Outside Zn-B	LL and HL			Yelloweye rockfish
Outside Zn-C	LL and HL			Slope rockfish
Outside Zn-D	LL and HL			Halibut and rockfish
K	Trap and LL	$20 million	27	Sablefish
T Option A	Trawl	$75 million	60	Most groundfish species
T Option B	Trawl		14	Most groundfish species

[1]LL = longline, HL = handline

Table 2. Number of trips and reviewed events by sector for FY08/09 (from Stanley et al. 2009)

Sector	Frequency of trips by number of events reviewed per trip					
	0	1	2	3 to 5	6 to 10	11 plus
Halibut (Outside)	28	183	215	73	1	2
Halibut/Sablefish (Outside)	7	14	33	19	10	2
Lingcod (Outside)	4	83	73	10	1	0
Rockfish (Inside)	4	43	13	14	4	0
Rockfish (Outside)	15	77	43	46	25	2
Sablefish (Outside)	5	4	7	14	9	20
Dogfish (Ins. and Out.)	17	76	59	12	7	0
All Sectors	80	480	443	188	57	26

Table 3. Total catch of yelloweye rockfish in pieces by sector as recorded in fisher logs and DMP for FY08/09 (from Stanley et al. 2009).

Sector	Total catch in pieces		Total catch in wt (kg)
	Fisher logs	DMP	
Halibut (Outside)	39,880	39,988	
Halibut/Sablefish (Outside)	10,411	10,128	
Lingcod (Outside)	2,008	2,056	
Rockfish (Inside)	554	519	
Rockfish (Outside)	14,159	14,063	
Sablefish (Outside)	292	304	
Dogfish (Inside)	1,581	1,563	
Dogfish (Outside)	3,499	3,531	
Total (Outside)	70,249	70,070	215,588
Total (Inside)	2,135	2,082	4,289
Total (Coastwide)	72,384	72,152	219,877

Table 4 Comparison of the total piece count of yelloweye rockfish between fisher logs and video reviewed events by Region for FY 08/09 (from Stanley et al. 2009).

Region	Reviewed events	Total piece count	
		Fisher logs	VF-data
Outside	2,721	7,813	7,857
Inside	247	286	244
Coastwide	2,968	8,099	8,101

Table 5. Mean and 95% confidence intervals (CI) of the estimates of the mean number of yelloweye rockfish captured per sector for FY08/09 (from Stanley et al. 2009).

Sector	Pieces per event			Number of Events	Total piece counts		
	Mean	Lower CI	Upper CI		Mean	Lower CI	Upper CI
Halibut (Outside)	4.0	3.2	4.8	8,706	34,547	27,704	42,043
Halibut/Sablefish (Outside)	4.5	2.9	6.2	2,504	11,144	7,153	15,596
Lingcod (Outside)	0.9	0.7	1.1	2,669	2,310	1,810	2,858
Rockfish (Inside)	0.5	0.3	0.7	1,155	536	335	772
Rockfish (Outside)	5.0	3.5	6.7	3,420	16,991	12,120	22,894
Sablefish (Outside)	0.1	0.0	0.3	3,875	359	31	1,109
Dogfish (Inside)	1.8	1.3	2.4	721	1,282	908	1,695
Dogfish (Outside)	2.4	1.3	4.0	1,866	4,496	2,380	7,430
Outside	3.0	2.2	4.0	23,040	69,847	51,198	91,930
Inside	1.0	0.7	1.3	1,876	1,819	1,243	2,467
Coastwide	2.9	2.1	3.8	24,916	71,666	52,440	94,398

Table 6. Comparison of VF-estimate, fisher logs and DMP piece count for yelloweye rockfish by sector, Region and Coastwide FY08/09 (from Stanley et al. 2009).

Sector	Total piece counts		
	VF estimate	Fisher logs	DMP
Halibut (Outside)	34,547	39,880	39,988
Halibut/Sablefish (Outside)	11,144	10,411	10,128
Lingcod (Outside)	2,310	2,008	2,056
Rockfish (Inside)	536	554	519
Rockfish (Outside)	16,991	14,159	14,063
Sablefish (Outside)	359	292	304
Dogfish (Inside)	1,282	1,581	1,563
Dogfish (Outside)	4,496	3,499	3,531
Outside	69,847	70,249	70,070
Inside	1,819	2,135	2,082
Coastwide	71,666	72,384	72,152

Table 7. Number of trips and reviewed events by sector for FY08/09 (from Stanley et al. 2009).

Sector	Total number of trips	Total number of events	Mean number of events/trip	Total number of reviewed events	Overall percent of events reviewed	Percent of trips that met 10% review target
Halibut (Outside)	502	8,706	17	884	10%	92%
Halibut/Sablefish (Outside)	85	2,504	29	254	10%	89%
Lingcod (Outside)	171	2,669	16	272	10%	94%
Rockfish (Inside)	78	1,155	15	149	13%	95%
Rockfish (Outside)	208	3,420	16	509	15%	92%
Sablefish (Outside)	59	3,875	66	625	16%	90%
Dogfish (Ins. and Out.)	171	2,587	15	275	11%	82%
All sectors	1,274	24,916	20	2,968	12%	91%