

Logbook Auditing for EM: Bottom Trawl and Pot Fisheries

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Background

This report analyzes several key decisions related to logbook auditing for vessel discard accounting in the electronic monitoring (EM) bottom trawl and fixed gear fisheries¹. The analysis is based on EM and logbook data collected during 2016-2018 at 100% review rate under the current EM EFP. This data is used to summarize EM vs logbook discard data and to simulate a range of possible auditing scenarios.

Current structure (100% review)

Current practice in the EM EFP is to review discards on 100% of video collected on participating vessels. In addition, captains report their discards on a logbook. Discards reported on the logbook are compared to discards recorded by EM reviewers; accounts are debited based on a set of business rules comparing these values.² In general, EM and logbook estimates have been fairly close on average across the fleet, although the logbook estimate may be higher or lower for any individual haul.

Auditing approach options

In order to reduce EM review costs, a logbook auditing approach has been proposed. The general concept is to review a subset of the video data, then use that data to assess the accuracy of the logbook. If the logbook is sufficiently accurate, the logbook data would be used to track vessel discards. Key decisions to set-up an auditing program include:

- **Criteria to evaluate logbooks**
What is the acceptable margin of difference between EM and logbooks (either total pounds or percent difference)? Is the criteria the same for all species? How are unknowns, missing data, or other data issues handled? The criteria used essentially determines the *acceptable error rate*.
- **Review rate**
What percent of hauls are reviewed? Is the review rate the same in all cases? The review rate essentially determines the *acceptable risk of missing random events*.
- **Program framework**
Does the assessment occur always on a trip-by-trip basis, or is there a longer-term assessment of vessel performance? What other rules or guidelines are required (e.g. related to ESA species, following VMPs, etc)?

This analysis focuses on **the criteria to evaluate logbooks** and the **review rate**; these decisions will be relevant regardless of the program framework. For simplicity, the program framework used for this analysis is a simple trip-by-trip approach in which a percentage of hauls from each trip would be reviewed and used to assess the logbook; if the logbook met the criteria, the logbook data would be used and if the logbook did not meet the criteria then the remaining hauls would be reviewed in EM and compared to logbook data based on current business rules for vessel accounting.

¹ Whiting fisheries were not included in this analysis. Whiting hauls are reviewed very fast, so we believe the time saved at a reduced review rate would be negligible especially when weighing the added time to administer such a system.

² Current rules: for priority species the larger of EM or logbook is used. For non-priority species, if EM is greater than logbook by 10%, or if EM is >0 and logbook = 0, the EM estimate is used; otherwise the logbook estimate is used.

Simulation Scenarios

Simulations were run with the data collected from EM and logbooks from 2016-2018 bottom trawl and fixed gear EM EFP participants.

Table 1. Number of vessels, trips, and hauls included in the logbook auditing simulation.

Fishery	Year	Vessels	Trips	Hauls
Bottom Trawl	2016	9	108	634
	2017	11	167	948
	2018	10	175	1069
Pot	2016	6	70	1019
	2017	9	82	1224
	2018	7	66	991

Nine simulation scenarios were run using **3 sets of criteria x 3 rates of review**. These scenarios were chosen to represent a range of possibilities and should not be viewed as a fixed list of options. Each scenario was run across all trips 100 times.

- **Criteria**
 - High: *within 10% or 2 pounds for all species*
 - Mid: *within 10% or 2 pounds for species of management concern (see detail below); within 25% or 5 pounds for all others*
 - Low: *within 25% or 5 pounds for species of management concern; within 50% or 10 pounds for all others*
- **Review rate**
 - 25%
 - 33%
 - 50%

The criteria included both a weight and percent difference because of the impacts to small versus large discards (e.g., 1 versus 2 pounds is large percent difference but small in total number). It was assumed that criteria for species with higher management priority might be held to different standards (as with current business rules for comparing EM to logbook for vessel accounting). For this simulation, species that are considered “priority species” by NMFS as well as species that are caught close to the catch limit (sablefish north of 36° & petrale sole) were all treated as species of management concern:

- Sablefish North of 36° N
- Bocaccio Rockfish South of 40°10'
- Canary rockfish
- Cowcod rockfish south of 40°10'N
- Darkblotched rockfish
- Pacific Ocean perch north of 40°10'N
- Petrale Sole
- Yelloweye Rockfish

This list could be modified based on management concerns.

For all scenarios, the following policies were applied:

- Hauls were selected randomly for review.
- Only complete hauls were included (the review rate was multiplied by the number of hauls and then rounded up).
- Each IFQ species was independently compared based on the given criteria.
- The criteria for comparing EM to logbook were applied after summing discards across all reviewed hauls for each species (rather than comparing each haul separately).
- If a logbook estimate was higher for a given species, the criteria was considered met, regardless of the actual difference.
- A trip passed if all species met their respective criteria.
- If a trip passed, the logbook was used for all trip discard estimates; otherwise EM versus logbook comparison rules were applied for 100% of the trip.
- Thornyheads were grouped together for comparison since EM reviewers cannot routinely identify to species.
- If EM reviewers could not identify a discard to species it was ignored if there were less than 10 pounds; if there were more than 10 pounds the haul did not pass the criteria (i.e., the video quality was deemed insufficient to evaluate the accuracy of the logbook; see Appendix A for a detailed discussion of aggregated or unidentified species).

Simulations were evaluated based on 1) comparison of whether trips would pass or fail a set of criteria at 100% review versus a reduced rate of review; 2) comparison of discards estimated under 100% review versus audited review; and 3) comparison of review times under 100% review versus audited review. Additionally we looked at vessel-specific performance at passing or failing a set of criteria.

Results

Passing/failing trips and misclassification rates

We determined if each trip “passed” or “failed” the comparison of EM and logbook data at 100% rate of review using the 3 sets of criteria outlined above (25-48% of trips passed these criteria). We then determined whether each simulation “passed” or “failed” when comparing the randomly selected hauls (33-68% of trips passed in the reduced review rate simulation). We could then say whether each simulation correctly matched the expected outcome (pass or fail) when compared to 100% review.

Misclassified trips are those that would pass (or fail) when audited at the given review rate and criteria, but not if the whole trip was reviewed. For example, if the logbook reported discards accurately on all hauls except for one, that haul might not be selected in the random sample so that discrepancy might be missed. For both fisheries, these “false passes” occurred most often at the lower rates of review but were not influenced much by the criteria used (Figure 1). False passes were somewhat more common on bottom trawl trips. The opposite result, a “false fail”, occurs when the trip-level discards might pass the criteria, but the individual haul does not. These false fails were unusual, occurring less than 7% of the time regardless of the review rate or the criteria used. False fails were somewhat more common on pot trips than bottom trawl.

Bottom Trawl



Fixed Gear

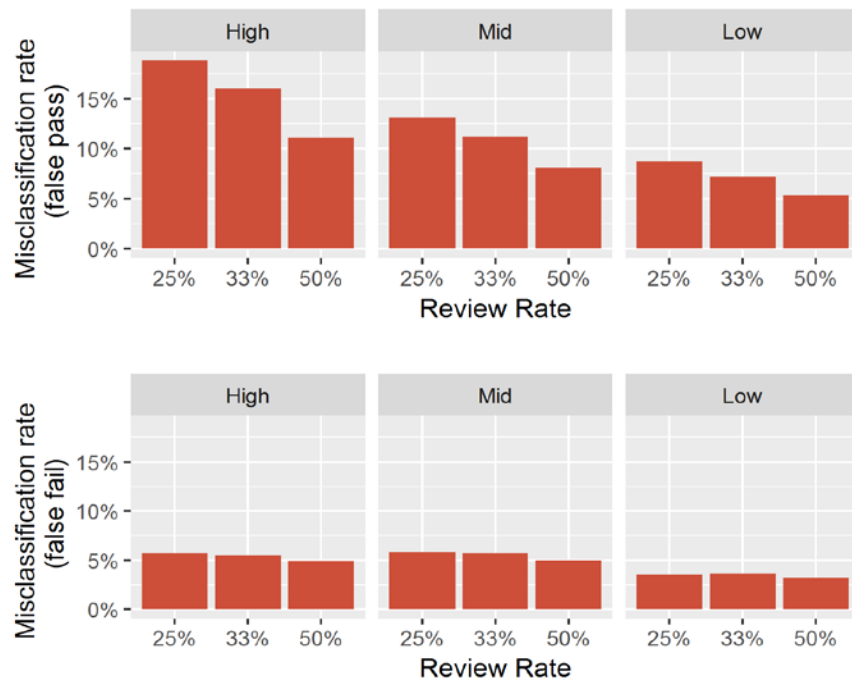


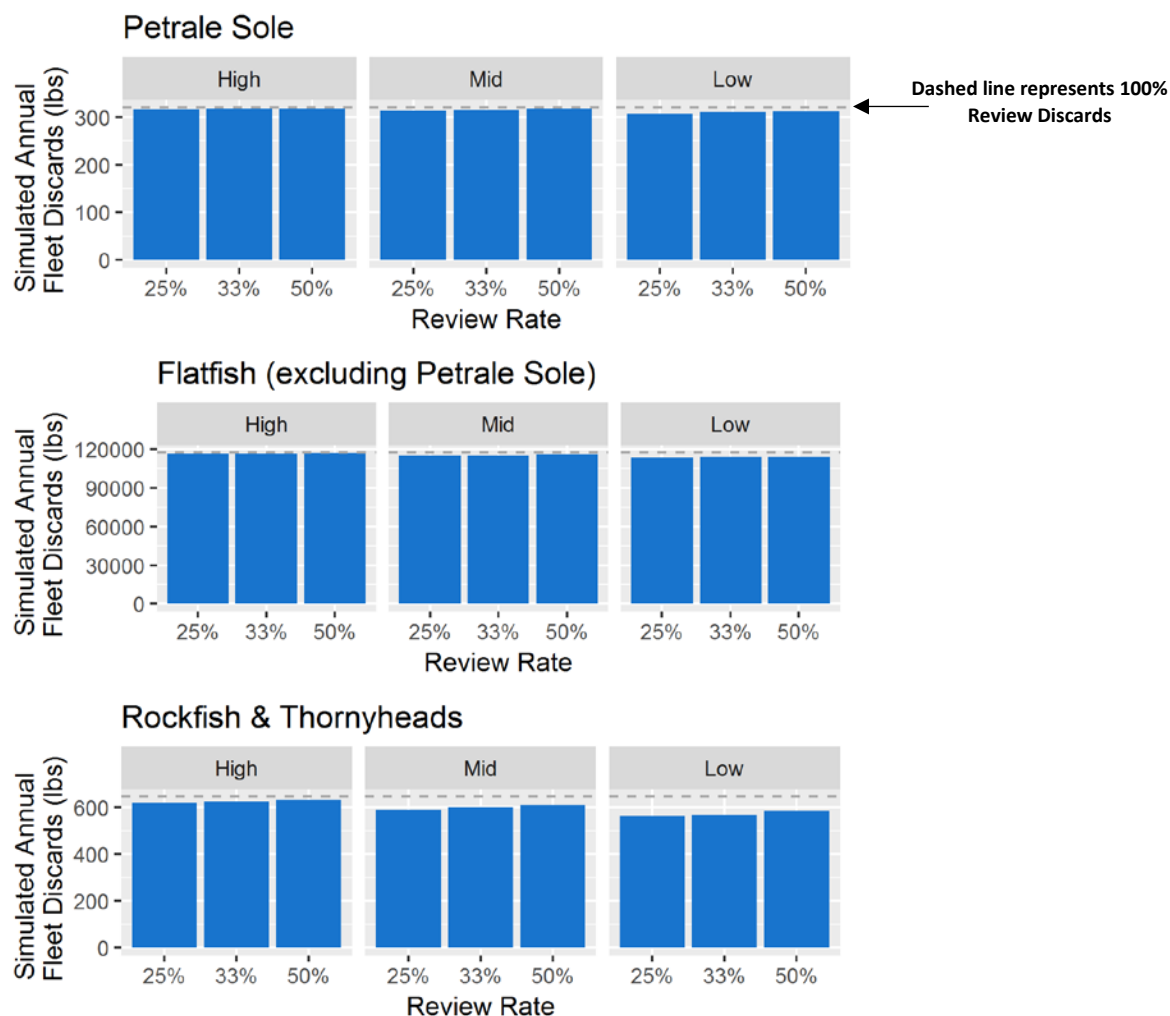
Figure 1. Percent of simulated trips that were misclassified as passing (when the trip would have failed) or failing (when the trip would have passed) for each criteria and review rate. False passes indicate that criteria were not met for all hauls, but this discrepancy was “missed” in the random haul selection. False fails indicate that criteria were met when all hauls were included, but the randomly selected hauls did not meet the criteria.

Total discard estimates

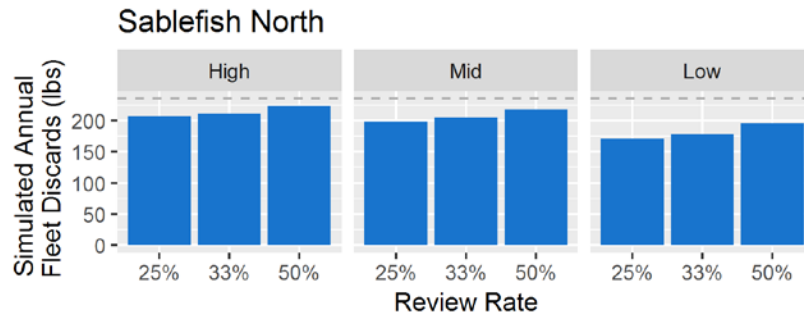
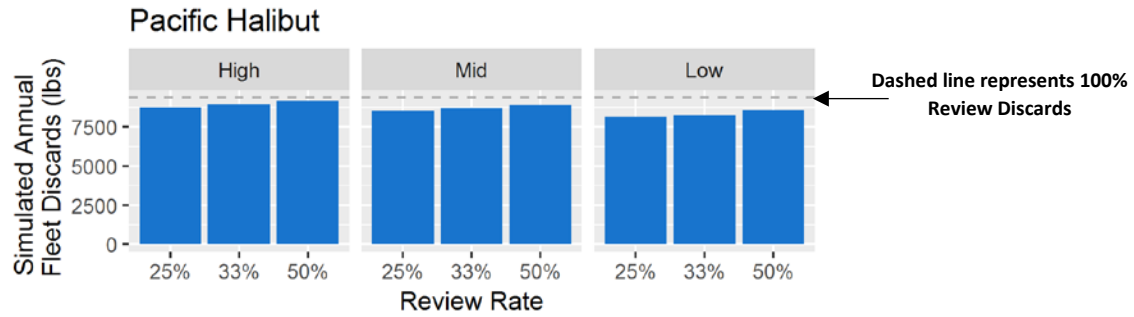
For each simulation, the fleet average annual discards per IFQ species were calculated (calculated separately for pot and bottom trawl fleets). The average of the 100 runs for each scenario was compared to the actual estimate for the trip at the 100% review level³. As would be expected, discard estimates were closer to current estimates with the higher criteria and with greater rates of review. However in all scenarios the discard estimates were not dramatically different from estimates at 100% review, and the total pounds difference was small relative to the total IFQ quota.

Comparisons are shown for a selection of species in the figures below, including some aggregations; a table of estimates with confidence intervals for each IFQ species is provided in Appendix B.

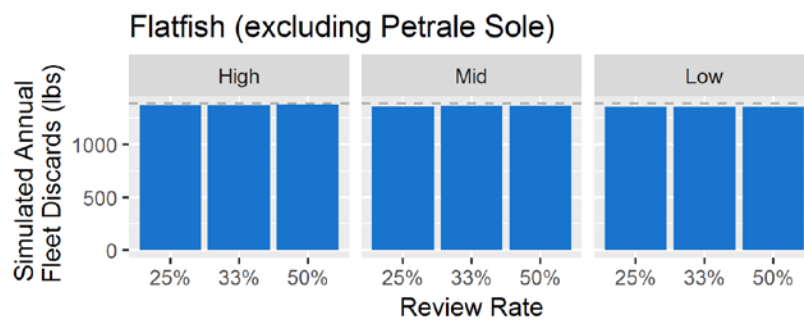
Bottom Trawl



³ The estimate for the 100% review level was calculated based on the rules described in footnote 2; these numbers may differ slightly from the actual amounts debited because in the vessel accounting process unidentified discards are split up based on logbook species ratios and therefore may add to the EM estimate slightly.



Fixed Gear



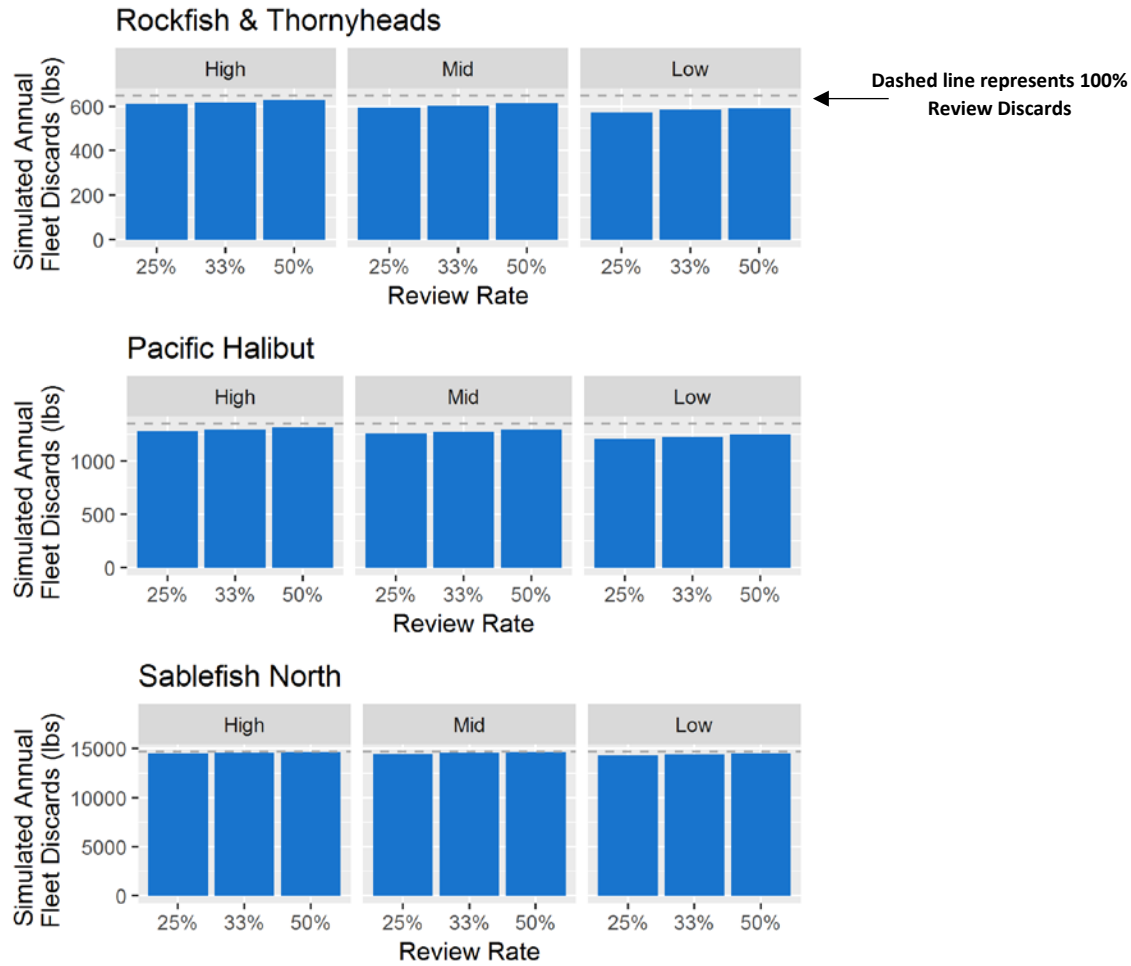


Figure 2. Simulated discards for IFQ species at each criteria and review rate. Detailed results for each IFQ species, including average simulated discards and confidence intervals, are provided in the detail table in Appendix C. The gray dotted lines indicate the discard estimate using 100% review data.

Review time estimates

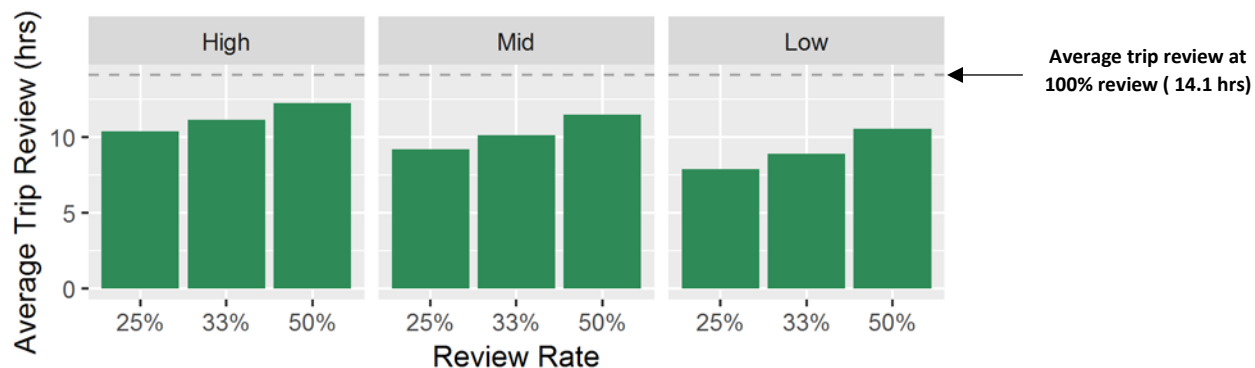
For each simulation scenario, the average review time was calculated. The calculated review time is based on the partial review time for trips that passed the set criteria plus the 100% review time for trips that did not pass the criteria for a given scenario.

The simulated auditing scenarios decreased review time by 13-44% for bottom trawl trips, and by 29-62% for pot trips. As expected, review time was most impacted by the review rate. Criteria also influenced review time to a lesser degree since higher criteria led to fewer trips passing the criteria and therefore more trips getting 100% review.

Costs other than review time would not be expected to decrease in this current model, so total savings would be somewhat less on a percent basis than the savings for review time.

There is high variability in review time among hauls (range 0.03-7 hours) due to differences in the volume of catch, catch composition, and image quality. As a result, the actual change in review time for an individual trip could be quite a bit higher or lower.

Bottom Trawl



Fixed Gear

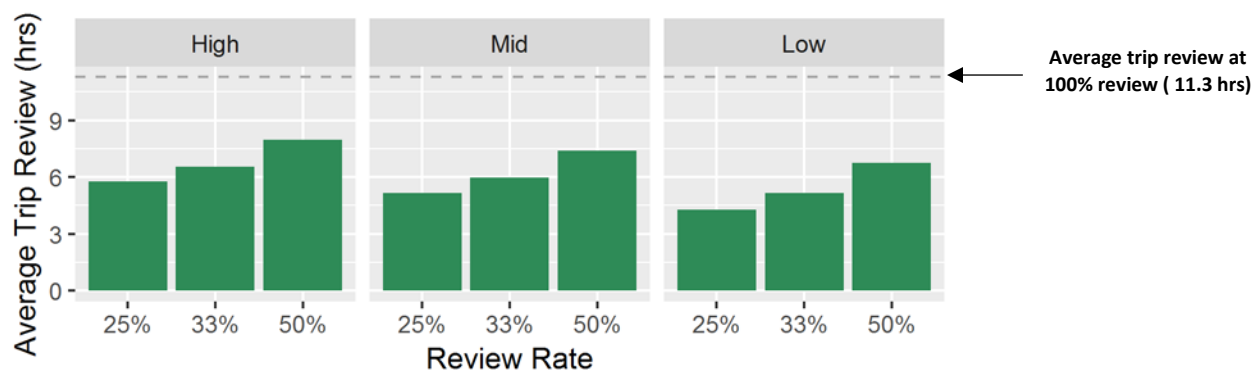


Figure 3. Average review hours per trip for each simulated criteria and review rate.

Vessel specific performance

For each vessel included in the analysis, we calculated the average rate of passing (meeting criteria) for each scenario. Some vessels passed more consistently than others in all scenarios. This is consistent with previous observation in EM analysis that some vessels' logbooks more consistently align with the EM review. The net result, if an auditing model is implemented, is that some vessels will save more on their review costs than others.

Individual vessel pass rates, depending on the scenario, ranged from 0-100%. In general, pot vessels had higher rates of passing than bottom trawl vessels. This is consistent with expectations of the EM team since pot boats have less diversity of bycatch and fish are handled individually.

Bottom Trawl



Fixed Gear

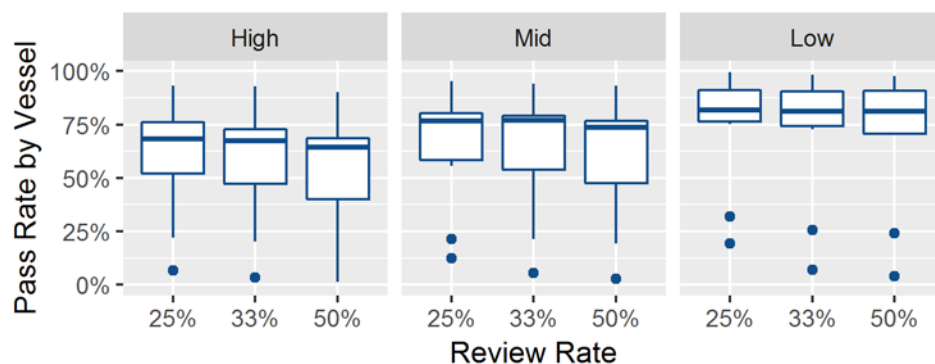


Figure 4. Average rate of trips passing the logbook audit (i.e., randomly selected hauls meet criteria) by vessel.

Conclusions

As would be expected, simulated scenarios at higher review rates and higher criteria led to discard estimates that were most similar to estimates at the 100% review rate. Nonetheless, the difference in estimates from 100% review were small relative to the total catch allowed for each species. Using lower criteria also did not result in a proportionate reduction in the discard estimate (that is, allowing a 50% error criteria did not decrease the discard estimate by 50%).

Review costs would be reduced by auditing logbooks. The actual savings in review time are not proportional to the decrease in review time since a trip will not always “pass” so it will be sent back for 100% review. For example, reviewing only 25% of hauls would reduce review time by ~30-55% rather than 75%. Other costs (e.g., program management, drive reports, etc.) would not be impacted by the reduced review rate so total savings would be even less. Since some vessels’ logbooks more consistently

match the EM review, individual vessels might see up to 75% savings on review time while others might see none.

These simulations are based on a framework of evaluating performance on a trip-by-trip basis. Alternative frameworks could include choosing an audit rate for a trip based on past performance. While criteria and review rate might be influenced by this framework (e.g, a vessel might be likely to meet more stringent criteria if looking at differences across multiple trips rather than just a subset of hauls from each trip), these simulations should help give a sense of the range of possible impacts to vessel catch accounting.

Appendix A. Unidentified Fish.

EM reviewers are able to identify most discarded fish to species, however some discards can only be identified to a group level (e.g., 'Red rockfish') or cannot be identified at all. This occurs most frequently when fish are damaged, although it can also occur when image quality is low or there are handling issues. Thornyheads cannot routinely be distinguished, therefore they were grouped for the comparison in these simulations. Other aggregated groups are more complicated because they contain greater numbers of possible species and because some of those are identified to species while a smaller number are identified to an aggregated group.

Table B1. Amount of discards that could not be identified to species level from trips included in this simulation. Unidentified thornyheads are not included in this table since they were grouped for the auditing simulation. Bottom trawl discards are presented with weights; pot discards are presented as counts since the weights are derived, or in some cases cannot be calculated.

Bottom Trawl

Aggregate Group	Bottom Trawl Discards (lbs)		
	2016	2017	2018
Flatfish	112	482	1,747
Rockfish	279	300	1,020
Roundfish	13	352	413
Unidentified fish	445	3,859	11,678
Total unidentified discards	849	4,993	14,858
Total all discards	27,643	169,203	268,338

Fixed Gear

Aggregate Group	Pot Discards (count)		
Flatfish	5	5	6
Rockfish	2	4	21
Roundfish	11	21	28
Unidentified fish	7	245	384
Total unidentified discards	25	275	439
Total all discards	4,207	5,445	4,909

Table B2. Number of hauls with unidentified discards (excluding thornyheads) at various weight thresholds. Bottom trawl discards are presented with weights; pot discards are presented as counts since the weights are derived, or in some cases cannot be calculated.

Bottom Trawl

Total Number of Hauls	1265	
# Hauls with unid discards	315	25%
# Hauls with > 1 lb unid discards	235	19%
# Hauls with > 5 lb unid discards	100	8%
# Hauls with > 10 lb unid discards	61	5%

Fixed Gear

Total Number of Hauls	3234	
# Hauls with unid discards	191	6%
# Hauls with > 5 unid fish	24	1%
# Hauls with > 10 unid fish	9	>1%

For this auditing simulation, a threshold acceptable amount of unidentified species was set at 10 pounds, which occurs on less than 5% of hauls. Alternative thresholds could reasonably be chosen. The idea of a threshold was to acknowledge that occasional unidentified discards should not disrupt the auditing process, but larger volumes of unidentified fish indicated that the video was of insufficient quality to judge the accuracy of the logbook.

Unidentified discards of less than 10 pounds were ignored in the EM-logbook comparison for the simulation. In practice, this makes the logbook more likely to meet the criteria. For example, if a logbook reported 5 pounds of minor slope rockfish discarded and the EM reviewer reported 10 pounds of unidentified rockfish, the unidentified fish would be dropped and the logbook would “pass” for the minor slope rockfish category.

If unidentified discards exceeded the threshold in the simulation, then the trip was treated as not passing the criteria and subject to 100% review.

Appendix B.

Table B1. Simulated discards (average and 95% confidence intervals from 100 runs) for each auditing simulation scenario. VAS stands for Vessel Accounting System and is an approximation of the discards that would be sent to the vessel account based on current business rules. No discard mortality rates have been applied to any of these estimates.

Bottom Trawl

IFQ Species	100 % Review			Low Criteria						Mid Criteria						High Criteria					
	EM	Logbook	VAS	25% Review		33% Review		50% Review		25% Review		33% Review		50% Review		25% Review		33% Review		50% Review	
				Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Arrowtooth flounder	59531	61303	67706	67150	(67069 - 67231)	67036	(66941 - 67130)	67205	(67121 - 67288)	66208	(66058 - 66359)	66229	(66076 - 66381)	66577	(66463 - 66691)	65095	(64876 - 65315)	65012	(64834 - 65189)	65210	(65043 - 65376)
Bocaccio rockfish S.	12.667	6.3333	13	13	(12 - 13)	13	(12 - 13)	13	(13 - 13)	11	(11 - 12)	12	(11 - 12)	13	(13 - 13)	10	(10 - 10)	10	(10 - 11)	11	(10 - 11)
Canary rockfish	0	1.6667	1.6667	2	(2 - 2)	2	(2 - 2)	2	(2 - 2)	2	(2 - 2)	2	(2 - 2)	2	(2 - 2)	2	(2 - 2)	2	(2 - 2)	2	(2 - 2)
Chilipepper rockfish S.	8.3333	1	8.3333	6	(6 - 6)	6	(6 - 7)	7	(6 - 7)	5	(5 - 5)	6	(6 - 6)	7	(6 - 7)	4	(4 - 4)	4	(4 - 5)	5	(5 - 5)
Darkblotched rockfish	0	0.3333	0.3333	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)
Dover sole	1842	2344.7	2835.7	2761	(2757 - 2766)	2777	(2774 - 2781)	2808	(2806 - 2810)	2714	(2709 - 2719)	2737	(2732 - 2742)	2771	(2768 - 2775)	2620	(2611 - 2628)	2653	(2646 - 2660)	2692	(2688 - 2697)
English Sole	22083	24495	25675	25570	(25560 - 25580)	25591	(25580 - 25601)	25639	(25634 - 25645)	25480	(25466 - 25495)	25518	(25507 - 25529)	25590	(25582 - 25598)	25287	(25272 - 25303)	25318	(25302 - 25335)	25394	(25382 - 25406)
Minor shelf rockfish N.	134	263.33	264	264	(264 - 264)	264	(264 - 264)	264	(264 - 264)	264	(264 - 264)	264	(264 - 264)	264	(264 - 264)	264	(264 - 264)	264	(264 - 264)	264	(264 - 264)
Minor shelf rockfish N.	114	90.333	123.67	123	(123 - 123)	124	(123 - 124)	124	(124 - 124)	116	(114 - 118)	118	(116 - 120)	117	(115 - 120)	108	(105 - 111)	109	(106 - 111)	114	(111 - 116)
Minor slope rockfish S.	2.6667	0	2.6667	3	(2 - 3)	3	(3 - 3)	3	(3 - 3)	2	(2 - 2)	2	(2 - 2)	2	(2 - 2)	1	(1 - 1)	1	(1 - 1)	2	(1 - 2)
Minor slope rockfish S.	0.6667	0	0.6667	1	(1 - 1)	1	(1 - 1)	1	(1 - 1)	0	(0 - 1)	1	(0 - 1)	1	(1 - 1)	0	(0 - 0)	0	(0 - 0)	0	(0 - 1)
Other flatfish	17807	19461	21093	20901	(20881 - 20920)	21011	(20996 - 21026)	21043	(21031 - 21056)	20634	(20602 - 20666)	20783	(20749 - 20817)	20838	(20808 - 20867)	20414	(20381 - 20447)	20631	(20599 - 20664)	20645	(20616 - 20675)
Pacific cod	0	23.333	23.333	23	(23 - 23)	23	(23 - 23)	23	(23 - 23)	23	(23 - 23)	23	(23 - 23)	23	(23 - 23)	23	(23 - 23)	23	(23 - 23)	23	(23 - 23)
P.halibut N. (IBQ)	8941.3	6891	9387.7	8756	(8719 - 8793)	8972	(8943 - 9000)	9165	(9148 - 9183)	8552	(8514 - 8589)	8730	(8695 - 8765)	8878	(8848 - 8908)	8136	(8090 - 8183)	8243	(8199 - 8286)	8569	(8531 - 8608)
Pacific whiting	31926	32582	36721	36250	(36219 - 36281)	36358	(36332 - 36384)	36514	(36492 - 36537)	35822	(35783 - 35861)	35980	(35945 - 36015)	36208	(36175 - 36240)	35042	(34986 - 35099)	35266	(35207 - 35326)	35570	(35535 - 35605)
Petrale sole	71.667	291.67	320	316	(316 - 316)	317	(317 - 317)	318	(318 - 319)	313	(313 - 313)	315	(315 - 315)	317	(317 - 317)	307	(306 - 307)	310	(309 - 310)	311	(311 - 312)
Sablefish N.	163.33	112.33	235.33	207	(206 - 208)	211	(210 - 212)	223	(222 - 224)	198	(196 - 200)	205	(204 - 207)	218	(217 - 219)	171	(168 - 173)	178	(177 - 180)	195	(193 - 196)
Sablefish S.	0.3333	0	0.3333	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)
Starry flounder	1.6667	0	1.6667	1	(1 - 2)	2	(2 - 2)	2	(2 - 2)	1	(1 - 1)	1	(1 - 2)	2	(1 - 2)	1	(1 - 1)	1	(1 - 1)	1	(1 - 1)
Widow rockfish	0	1.3333	1.3333	1	(1 - 1)	1	(1 - 1)	1	(1 - 1)	1	(1 - 1)	1	(1 - 1)	1	(1 - 1)	1	(1 - 1)	1	(1 - 1)	1	(1 - 1)
Lingcod N.	464.33	722.33	775.67	768	(766 - 769)	769	(769 - 770)	772	(771 - 773)	766	(764 - 768)	769	(768 - 771)	772	(771 - 773)	762	(759 - 765)	766	(764 - 768)	771	(770 - 772)
Lingcod S.	4913.3	3581	5337.7	5251	(5239 - 5262)	5277	(5269 - 5285)	5319	(5316 - 5322)	5148	(5133 - 5163)	5213	(5201 - 5225)	5290	(5284 - 5296)	4933	(4913 - 4953)	5015	(4997 - 5032)	5121	(5106 - 5135)
Mixed Thornyheads	142.33	130.33	230	206	(205 - 207)	210	(209 - 210)	217	(216 - 218)	189	(188 - 190)	194	(192 - 195)	201	(200 - 202)	172	(171 - 173)	176	(175 - 178)	186	(185 - 187)

Fixed Gear

	100 % Review			Low Criteria						Mid Criteria						High Criteria					
IFQ Species	EM	Logbook	VAS	25% Review		33% Review		50% Review		25% Review		33% Review		50% Review		25% Review		33% Review		50% Review	
				Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI	Mean	95% CI
Arrowtooth flounder	677.7	960.67	1047	1038	(1037 - 1038)	1039	(1038 - 1039)	1041	(1040 - 1041)	1035	(1035 - 1036)	1036	(1035 - 1036)	1036	(1035 - 1036)	1031	(1030 - 1031)	1031	(1030 - 1031)	1031	(1031 - 1032)
Canary rockfish	1.667	1	1.667	2	(2 - 2)	2	(2 - 2)	2	(2 - 2)	2	(2 - 2)	2	(2 - 2)	2	(2 - 2)	1	(1 - 2)	1	(1 - 2)	2	(1 - 2)
Darkblotched rockfish	0	1	1	1	(1 - 1)	1	(1 - 1)	1	(1 - 1)	1	(1 - 1)	1	(1 - 1)	1	(1 - 1)	1	(1 - 1)	1	(1 - 1)	1	(1 - 1)
Dover sole	287.7	178.67	337.7	329	(328 - 329)	330	(329 - 330)	331	(331 - 332)	324	(323 - 324)	325	(324 - 326)	327	(326 - 327)	320	(319 - 321)	320	(319 - 321)	323	(322 - 323)
Minor shelf rockfish N.	0.667	0	0.667	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)	0	(0 - 0)
Minor shelf rockfish N.	43.33	50	87	86	(86 - 86)	86	(86 - 87)	87	(86 - 87)	86	(86 - 86)	86	(86 - 86)	86	(86 - 86)	86	(86 - 86)	86	(86 - 86)	86	(86 - 86)
Minor slope rockfish S.	105.3	161.33	162	162	(162 - 162)	162	(162 - 162)	162	(162 - 162)	162	(161 - 162)	162	(162 - 162)	162	(162 - 162)	161	(161 - 161)	161	(161 - 161)	161	(161 - 161)
P.halibut N. (IBQ)	1239	713	1350	1277	(1272 - 1282)	1296	(1291 - 1300)	1312	(1308 - 1316)	1258	(1252 - 1263)	1273	(1268 - 1278)	1295	(1290 - 1299)	1209	(1203 - 1216)	1222	(1214 - 1229)	1248	(1242 - 1254)
Pacific whiting	11.33	5.3333	11.67	10	(9 - 10)	10	(10 - 10)	10	(10 - 10)	9	(9 - 9)	9	(9 - 9)	9	(9 - 10)	8	(8 - 8)	9	(8 - 9)	9	(9 - 9)
Petrale sole	5.667	1	6.667	7	(7 - 7)	7	(7 - 7)	7	(7 - 7)	7	(7 - 7)	7	(7 - 7)	7	(7 - 7)	7	(7 - 7)	7	(7 - 7)	7	(7 - 7)
Sablefish N.	13186	13294	14697	14553	(14538 - 14567)	14590	(14580 - 14601)	14638	(14633 - 14644)	14499	(14483 - 14516)	14559	(14546 - 14571)	14616	(14609 - 14623)	14332	(14304 - 14360)	14402	(14375 - 14429)	14503	(14480 - 14526)
Sablefish S.	2089	2507	2633	2594	(2589 - 2598)	2606	(2602 - 2610)	2618	(2616 - 2620)	2577	(2571 - 2582)	2586	(2581 - 2591)	2602	(2598 - 2605)	2545	(2540 - 2550)	2546	(2541 - 2550)	2548	(2543 - 2553)
Lingcod N.	230.7	352	457	446	(444 - 447)	448	(446 - 450)	451	(450 - 452)	443	(441 - 445)	447	(445 - 449)	450	(449 - 450)	436	(433 - 439)	440	(438 - 442)	443	(442 - 443)
Lingcod S.	40.67	92.667	93.67	93	(93 - 93)	93	(93 - 93)	93	(93 - 93)	93	(93 - 93)	93	(93 - 93)	93	(93 - 93)	93	(93 - 93)	93	(93 - 93)	93	(93 - 93)
Mixed Thornyheads	297.7	245.33	395.3	359	(357 - 361)	366	(364 - 368)	376	(374 - 377)	344	(342 - 346)	351	(349 - 353)	363	(361 - 364)	323	(320 - 326)	334	(331 - 336)	341	(339 - 342)