HIGHLY MIGRATORY SPECIES MANAGEMENT TEAM REPORT ON DRIFT GILLNET HARDCAPS

Introduction

At their November 2021 meeting, the Council adopted a revised purpose and need and range of alternatives (ROA), as outlined in the analytical document prepared by Council staff (Agenda Item G.4, Attachment 1, June 2022) for reconsidering hard caps for the large-mesh (14" minimum mesh size) drift gillnet fishery for shark and swordfish (DGN). The Highly Migratory Species Management Team (HMSMT) discussed this ROA at the March 2022 Council meeting and proceeded to develop a methodology for the hard caps analysis, including methods to analyze the ROA, model inputs, and reporting of analysis results. The HMSMT refined their approach during their meeting on April 22, 2022 and agreed to key modeling approaches and parameters, which were later finalized during a meeting on April 29th. This report covers the methods that have been developed so far, those still under development, key model components, assumptions made for the analysis, scenarios for future fishery participation, and preliminary results.

Technical Description of Analysis

To analyze the ROA for the hard caps action, the HMSMT discussed the potential applicability of the bootstrap analysis that was used to analyze the Council's 2015 ROA for hard caps (NMFS 2017),a a description of the methodology (Agenda Item G.2.a, Supplemental NMFS Report 5) which was reviewed by the SSC during the March 2015 meeting (Agenda Item H.4.b, Supplemental SSC Report).

Bootstrap simulation offers a means to use data representative of past fishing experience to compare the economic and biological impacts over a proposed range of alternatives. Results of bootstrap simulation may be harnessed to obtain reliable standard errors, confidence intervals, and other measures of uncertainty[1]. To apply bootstrap analysis to the ROA for hard caps, a long time series of observer, landings, and cost data representative of DGN fishery operation was used to construct the empirical distribution (ED) of observed DGN fishing experience at the set level. Logbook records of vessel-level sets per season were used to construct the ED of fishing effort.

Bootstrap simulation proceeds by replicating a large number of simulated seasons representative of the historically observed DGN fishing operations (10,000 simulated seasons for our application), comparing fishery operation across management alternatives for each one. A simulated season is constructed for each vessel by first randomly resampling the ED of effort with replacement to simulate a number of sets, then similarly resampling the ED of observed sets to simulate a DGN season for an individual vessel. This process is carried out for each vessel in a

[1] Davison, A.C. and Hinkley, D.V., 1997. Bootstrap methods and their application (No. 1). Cambridge university press.

fleet size scenario, and combining simulated sets across all vessels produces a simulated season for the fleet.

A simulated season is representative of fishery operation before hard caps were introduced, and is summarized to represent Alternative 1. Applying options and suboptions under Alternatives 2 and 3 to determine which vessels could fish which days with caps in force is used to produce simulated seasons under each of the caps alternatives. These are summarized for each replicated season, and recorded for each replicate. After the simulation process is complete, results representative of 10,000 fishing seasons are available to summarize and compare the alternatives.

Given that Alternatives 1 and 2 in the 2022 ROA are the same as two of the alternatives in the 2015 ROA, the HMSMT decided that using a similar method to analyze the 2022 ROA would be the most logical approach. However, the new options and sub-options in Alternative 3 for the 2022 ROA require refinement of the methodology to properly analyze all alternatives consistently. To ensure that differences in the results of analyzing the alternatives are due to the differing policies of the alternatives, and not due differing methods of analysis, the HMSMT decided to use the refined methodology to analyze all of the alternatives in the 2022 ROA.

Refinements needed to analyze Alternative 3 under the new ROA include:

- Simulating in-season progress by individual observed vessels towards reaching a cap
- Determining whether a cap is reached before or after November 1, to model date-dependent closure lengths
- Parametrizing assumed numbers of observed and unobservable vessels (i.e., deemed unable to carry an observer)
- Identifying unobservable vessels in the model to capture economic and biological impacts of individual vessel closure sub-options
- Applying individual closures to unobservable vessels in addition to the observable vessel that triggers a hard cap individual vessel closure
- Tallying progress towards individual and fleetwide caps for each species subject to caps while factoring the consequences of individual and unobservable vessels becoming subject to removal from the tallying process for the duration of closures
- Simulating an entire season and then simulating a sampling process for only the observable vessels with an adjusted sampling rate to reach 25% observed effort from all effort
- Distinguishing the specific time durations of closures under different options and/or sub-options (Alternative 3 options/sub-options are described in Agenda Item G.4, Attachment 1, June 2022)

Model Inputs and Key Assumptions:

For the purpose of analyzing the alternatives, the HMSMT made decisions about temporal range of the data to inform the analysis, level of observer coverage, and key assumptions about vessel behavior. Additionally, the HMSMT considered three fleet size scenarios of future fishery participation. Specifications regarding observable versus unobservable vessels were also necessary to carry out the analysis. These aspects of the analysis are described below.

The HMSMT decided upon an initial fishing season of 2001-2002 and a terminal fishing season of 2020-2021 for the dataset used in the bootstrap analysis. This timeframe coincides with the implementation of the Pacific Leatherback and Loggerhead Conservation Areas, while the terminal season reflects the latest available data at the time of report preparation. To produce the preliminary results in this report, the HMSMT used the same data as for the original 2015 analysis to analyze Alternatives 1 and 2 for the new ROA.

While incentivising fishing behavior to reduce unmarketable species bycatch, including protected species interactions, is a desired outcome of the revised hard caps policy, there are no data to support parametrizing a model of behavioral response to different hard cap alternatives. While the HMSMT recognizes the possibility for a hard caps policy to incentivize more conservative fishing behavior, it also seems possible that the policy could incentivize riskier behaviors by any or all of the following: 1) causing a race to catch fish before a potential closure, 2) incentivizing vessels to be unobservable because then they are not contributing to attaining hard caps, or 3) making it more likely that unobservable vessels will fish in a risky manner because they wouldn't be subject to hard caps closures caused by their own actions. The HMSMT also considered whether, under current management, there may be different fishing behaviors or incentives between observable and unobservable vessels, but noted that the analysis in Suter et al. and presented to the Council during its June 2021 meeting[2] provides evidence that there are not significant differences in fishing behavior among observable versus unobservable vessels (see, Agenda Item F.1.a, NMFS Report 2).

The HMSMT set observer coverage for the fleet for this analysis at 25 percent after discussions with National Marine Fisheries Service (NMFS) West Coast Region (WCR) observer program staff. This coverage level is an approximation of the coverage NMFS has been able to provide for the DGN fleet in recent years. The model executes this by applying a higher level of observer coverage for observable vessels to account for the lack of observer coverage on trips made by unobservable vessels. There has been attrition in fleet participation in recent years, so it is not likely that overall observer coverage levels will increase, since unobservable vessels could make up a larger proportion of the fleet.

In order to ensure the analysis appropriately covered the broad range of potential fleet sizes in the future, the HMSMT discussed several factors which may affect participation in the fleet under hard caps scenarios and agreed on three for further Council consideration. These scenarios consider that the state of California implemented a buyback program for which participating permit holders have until fall of 2022 to complete a "transition" out of the fishery. Permit holders participating in the program are required to surrender their state DGN permits and legally agree not to fish under a federal DGN permit. The HMSMT used the list of federal DGN LE permit holders in 2021 overlaid with information from CDFW regarding which permit holders were eligible to participate in the state program, and who has completed the state program as of April 1, 2022. Additionally, the WCR observer program provided information on the number of vessels likely to be unobservable in each scenario, based on past experience in assigning observers to participating vessels in the fleet.

[2] Suter, J. M., R. T. Ames, B. Holycross, and J. Watson. 2022. Observing unobserved fishing characteristics in the drift gillnet fishery for swordfish. Fisheries Research In review.

Based on these considerations the HMSMT used three fleet size scenarios in the analysis, intended to represent low, medium, and high numbers of potential future DGN vessels fishing. In practice, some vessels have been deemed unable to carry an observer in the past due to safety concerns or insufficient accommodations for observers, and then, were able to become observable after making necessary repairs or by reducing crew size. However, when developing the three scenarios, the HMSMT assumed that the vessels that were unobservable in the past are likely to remain so in the future. The three scenarios the HMSMT agreed to analyze are as follows:

- Scenario 1: 2 active vessels /1 observable / 1 unobservable
- Scenario 2: 11 active vessels / 7 observable / 4 unobservable
- Scenario 3: 30 active vessels / 24 observable / 6 unobservable

In scenario 1, any permit holder eligible to participate in California's buyback program does so, which leaves two remaining active vessels out of those that have been active in recent years, and for the purposes of modeling impacts we assume one is observable and one is unobservable. In scenario 2, any permit holder that has yet to complete California's buyback program does not do so, which leaves 11 remaining active vessels of those that have been active in recent years: seven observable and four unobservable. Finally, in scenario 3, it is assumed that any permit holder that has yet to complete California's buyback program does not do so and that all remaining permit holders have vessels that will become active. In this scenario, there would be thirty active vessels: twenty-four observable and six unobservable. This conjecture regarding the proportion of unobservable to observable vessels is based on input from the WCR observer program about the number of unobservable vessels during periods when more vessels were active in the fishery.

The HMSMT discussed the application of individual and fleetwide caps in the bootstrap simulation. For example, under the intermediate scenario with seven observable and four unobservable vessels, both individual and fleetwide caps would only apply to the seven vessels with (potential) observations. The HMSMT's interpretation is that the individual caps and fleet caps in Tables 1 and 2 of Agenda Item G.4, Attachment 1, June 2022 will apply in the bootstrap simulation to the cumulative totals for individual and the sum of individual vessel takes at each day in a simulated season.

Preliminary Model Results

Preliminary results for Alternative 1 (No Caps) and Alternative 2 (2015 FPA) under the three fishery participation level scenarios are presented below in a series of tables and figures. The tables represent metrics of simulated economic and conservation performance for Alternatives 1 and 2 across three fleet size scenarios: (1) Small, (2) Medium, (3) Large.

Violin plots are used in Figures 1, 3 and 5 to visually depict the simulated distributions of ex-vessel revenues across bootstrap replicates for Alternatives 1 and 2 under the three fleet size scenarios. A violin plot is a hybrid of a box plot inside a kernel density plot and its mirror image. Unlike a box plot that can only show summary statistics, violin plots depict both summary statistics and the density for bootstrap simulation results.

The rectangular figures embedded inside the kernel density plots are box plots. The top and bottom of the boxes are called hinges, and the thin lines above and below the box are called whiskers. The lower and upper hinges correspond to the first and third quartiles (i.e. the 25th and 75th percentiles). The upper whisker extends from the hinge to the largest value no further than 1.5 * IQR from the hinge, where IQR is the inter-quartile range, or distance between the first and third quartiles. The lower whisker extends from the hinge to the smallest value at most 1.5 * IQR of the hinge. Data beyond the end of the whiskers are called "outlying" points and are plotted individually.

Conservation performance is depicted by bar plots (Figures 2, 4 and 6), which represent simulated distributions of mortalities or injuries (M/I) across bootstrap replicates for Alternatives 1 and 2 under the three fleet size scenarios. The heights of the bars represent percentages of simulated sets with the numbers of takes shown on the horizontal scale.

Scenario 1 (total= 2 /observable= 1 /unobservable= 1) Results

With only two vessels fishing under Scenario 1, and only one of them observable, there is very little discernible difference between the preliminary bootstrap simulation results for Alternative 1 (No Caps) and Alternative 2 (2015 FPA). These similarities are numerically evident in comparing the upper (Alternative 1) and lower (Alternative 2) portions of Table 1; for example, the median[3] number of sets (Q50) fished under Alternative 1 was 94 versus 93 under Alternative 2. Similarly, median revenues declined from $166,412 under Alternative 1 to $165,313 under Alternative 2, a percentage decrease of less than 1%. Other corresponding economic metrics across the two tables are comparably similar. By contrast, the median number of protected species interactions was 0 for all species subject to caps, suggesting little if any discernible difference in conservation impacts between Alternatives 1 and 2.

[3] We use the median in comparing alternatives as a more robust measure of central tendency than the mean for skewed distributions such as our simulated revenues distributions.

Table 1. Bootstrap analysis summary results for Alternatives 1 and 2 for Scenario 1 showing values for 5% through 95% quantiles, mean, and standard deviations for economic metrics and hard cap species mortality/injury.

Alternative 1	***Q5***	***Q25***	***Q50***	***Q75***	***Q95***	***Mean***	***SD***
Sets	16	50	94	153	291	114	86
Total Revenue	$19,664	$81,463	$166,412	$292,608	$566,648	$212,132	$176,791
Total Profits	-$5,988	$22,189	$68,263	$139,923	$305,216	$97,598	$104,838
Avg. Profits	-$2,994	$11,095	$34,131	$69,962	$152,608	$48,799	$52,419
Landings (mt)	2.90	11.63	23.39	40.88	78.76	29.71	24.54
Leatherback M/I	0	0	0	0	0	0.05	0.22
Loggerhead M/I	0	0	0	0	1	0.07	0.27
Olive Ridley M/I	0	0	0	0	0	0.00	0.00
Green Turtle M/I	0	0	0	0	0	0.02	0.13
Fin Whale M/I	0	0	0	0	0	0.02	0.13
Humpback M/I	0	0	0	0	0	0.00	0.00
Sperm Whale M/I	0	0	0	0	1	0.08	0.34
SF Pilot Whale M/I	0	0	0	0	1	0.09	0.30
Bottlenose M/I	0	0	0	0	0	0.02	0.14

Alternative 2	***Q5***	***Q25***	***Q50***	***Q75***	***Q95***	***Mean***	***SD***
Sets	15	49	93	152	290	113	86
Total Revenue	$18,437	$80,496	$165,313	$291,312	$565,034	$210,983	$176,575
Total Profits	-$5,977	$21,756	$67,749	$139,176	$304,737	$97,091	$104,665
Avg. Profits	-$2,989	$10,878	$33,875	$69,588	$152,368	$48,545	$52,332
Landings (mt)	2.73	11.50	23.27	40.67	78.50	29.55	24.50
Leatherback M/I	0	0	0	0	0	0.05	0.22
Loggerhead M/I	0	0	0	0	1	0.07	0.27
Olive Ridley M/I	0	0	0	0	0	0.00	0.00
Green Turtle M/I	0	0	0	0	0	0.02	0.13
Fin Whale M/I	0	0	0	0	0	0.02	0.13
Humpback M/I	0	0	0	0	0	0.00	0.00
Sperm Whale M/I	0	0	0	0	1	0.08	0.34
SF Pilot Whale M/I	0	0	0	0	1	0.09	0.30
Bottlenose M/I	0	0	0	0	0	0.02	0.14

Violin plots under Scenario 1 (Figure 1) show little discernible difference in the distributions of ex-vessel revenues between Alternatives 1 and 2. In both cases, the distributions are highly skewed, with the highest density near zero and a very long tail at the high end of the distributions.

Figure 1. Violin plot showing the distribution of ex-vessel revenue across bootstrap replicates for Alternatives 1 and 2 under Scenario 1.

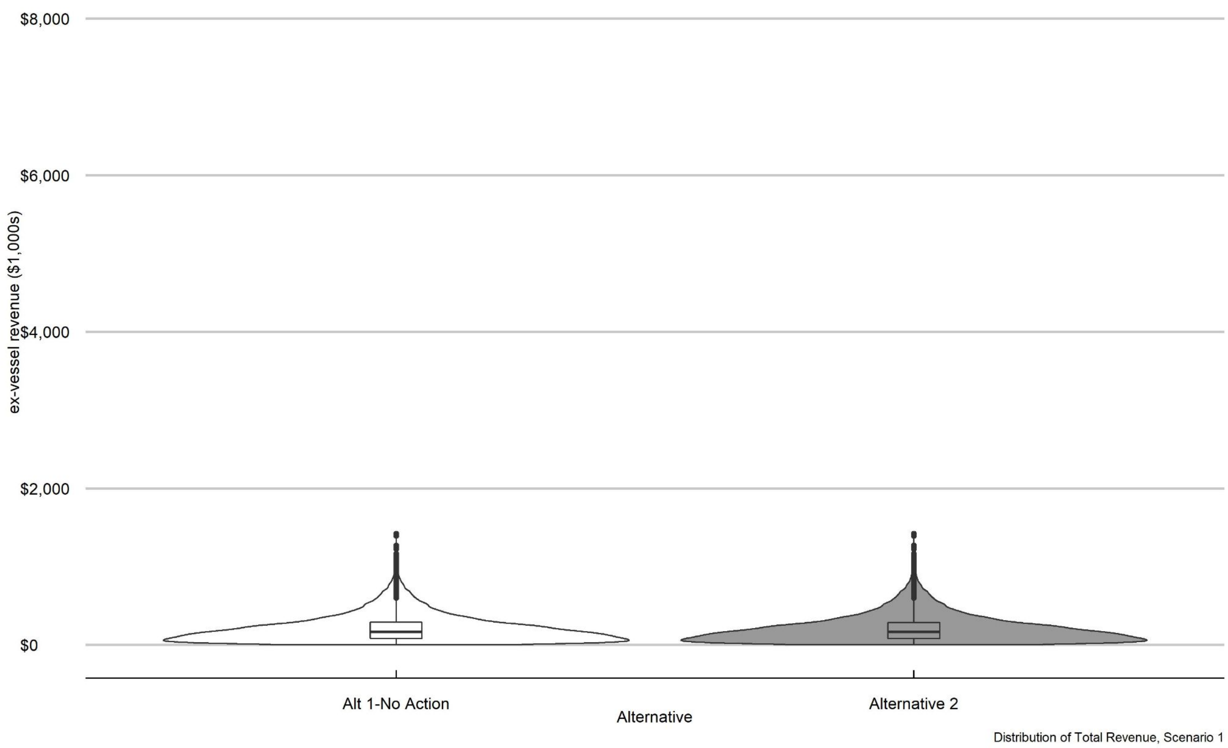
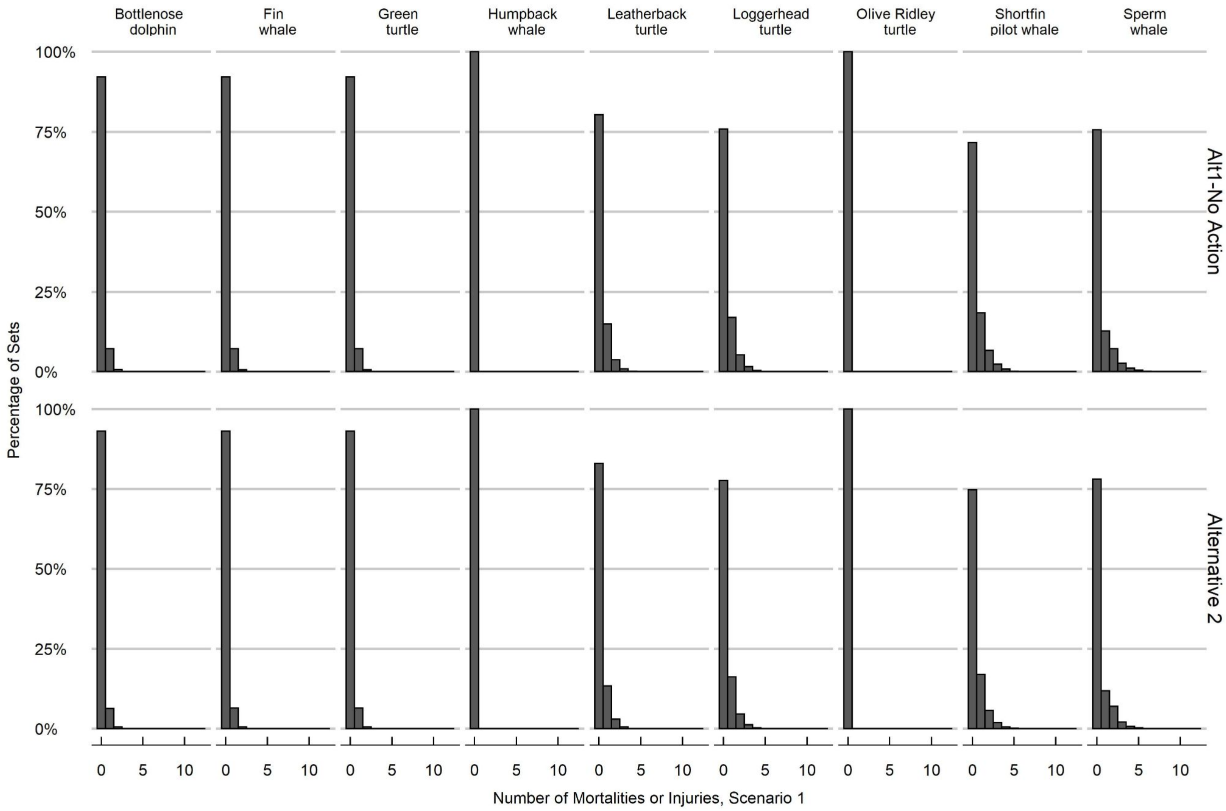


Figure 2 compares the distributions of simulation results for the numbers of mortalities and injuries for each capped species under Scenario 1, with numbers of mortalities or injuries (M/I) for each species on the horizontal scale and frequencies given as percentages of the vertical scale. Alternative 1 simulation results are shown in the top part of the figure and Alternative 2 results in the bottom. As in the violin plots for Scenario 1, there is very little discernible difference between results for the two alternatives. The similarity of results between Alternatives 1 and 2 under Scenario 1 likely reflects a very low probability of hitting a fleet cap with only one observable vessel fishing.

Figure 2. Distributions of hard cap species mortality/injury under Alternatives 1 and 2 for Scenario 1.



<u>Scenario 2 (total=11 /observable= 7 /unobservable= 4) Results</u>

Scenario 2 features eleven total vessels fishing, with 7 of them observable and 4 unobservable. In scenario 2, there is a slightly more discernible difference in preliminary bootstrap simulation results between Alternative 1 and Alternative 2 than with scenario 1. The difference is numerically evident in comparing the upper (Alternative 1) and lower (Alternative 2) portions of Table 2; for example, the median number of sets (Q50) fished under Scenario 1 was 126 versus 123 under Scenario 2. Similarly, median revenues declined from $235,403 under Scenario 1 to $228,496 under Scenario 2, a decrease of less than 3 percent. Other corresponding economic metrics across the two tables are comparably similar. By contrast, the median number of protected species interactions was 0 for all species subject to caps, suggesting little if any discernible difference in conservation impacts between Alternatives 1 and 2.

Table 2. Bootstrap analysis summary results for Alternatives 1 and 2 for Scenario 2 showing values for 5% through 95% quantiles, mean, and standard deviations for economic metrics and hard cap species mortality/injury.

Alternative 1	***Q5***	***Q25***	***Q50***	***Q75***	***Q95***	***Mean***	***SD***
Sets	19	63	126	328	774	235	249
Total Revenue	$24,949	$106,353	$235,403	$616,708	$1,470,814	$439,349	$477,913
Total Profits	-$3,652	$34,861	$107,391	$287,482	$718,789	$202,227	$239,594
Avg. Profits	-$1,821	$16,401	$38,751	$66,567	$138,732	$48,743	$46,985
Landings (mt)	3.61	15.13	32.90	86.27	205.50	61.53	66.78
Leatherback M/I	0	0	0	0	1	0.10	0.34
Loggerhead M/I	0	0	0	0	1	0.14	0.40
Olive Ridley M/I	0	0	0	0	0	0.00	0.00
Green Turtle M/I	0	0	0	0	0	0.04	0.19
Fin Whale M/I	0	0	0	0	0	0.04	0.19
Humpback M/I	0	0	0	0	0	0.00	0.00
Sperm Whale M/I	0	0	0	0	1	0.18	0.53
SF Pilot Whale M/I	0	0	0	0	1	0.18	0.46
Bottlenose M/I	0	0	0	0	0	0.04	0.19

Alternative 2	***Q5***	***Q25***	***Q50***	***Q75***	***Q95***	***Mean***	***SD***
Sets	16	60	123	310	759	227	243
Total Revenue	$20,457	$101,510	$228,496	$582,381	$1,441,325	$424,228	$467,407
Total Profits	-$3,828	$32,454	$103,318	$274,332	$704,789	$195,300	$234,678
Avg. Profits	-$1,828	$15,261	$37,825	$65,889	$138,251	$47,956	$47,084
Landings (mt)	3.00	14.49	32.00	81.61	201.19	59.44	65.32
Leatherback M/I	0	0	0	0	1	0.10	0.33
Loggerhead M/I	0	0	0	0	1	0.14	0.40
Olive Ridley M/I	0	0	0	0	0	0.00	0.00
Green Turtle M/I	0	0	0	0	0	0.03	0.19
Fin Whale M/I	0	0	0	0	0	0.03	0.19
Humpback M/I	0	0	0	0	0	0.00	0.00
Sperm Whale M/I	0	0	0	0	1	0.17	0.51
SF Pilot Whale M/I	0	0	0	0	1	0.17	0.45
Bottlenose M/I	0	0	0	0	0	0.03	0.19

Violin plots under Scenario 2 (Figure 3) again show little discernible difference in the distributions of ex-vessel revenues between Alternatives 1 and 2. In both cases, the distributions are again highly skewed, with the highest density near zero and very long tails at the upper ends of the distributions. The outliers under Alternative 1 (left plot) reach a slightly higher maximum level than those under Alternative 2 (right plot), reflecting a disallowance of some effort in simulated seasons when a cap is reached.

Figure 3. Violin plot showing the distribution of ex-vessel revenue across bootstrap replicates for Alternatives 1 and 2 under Scenario 2.

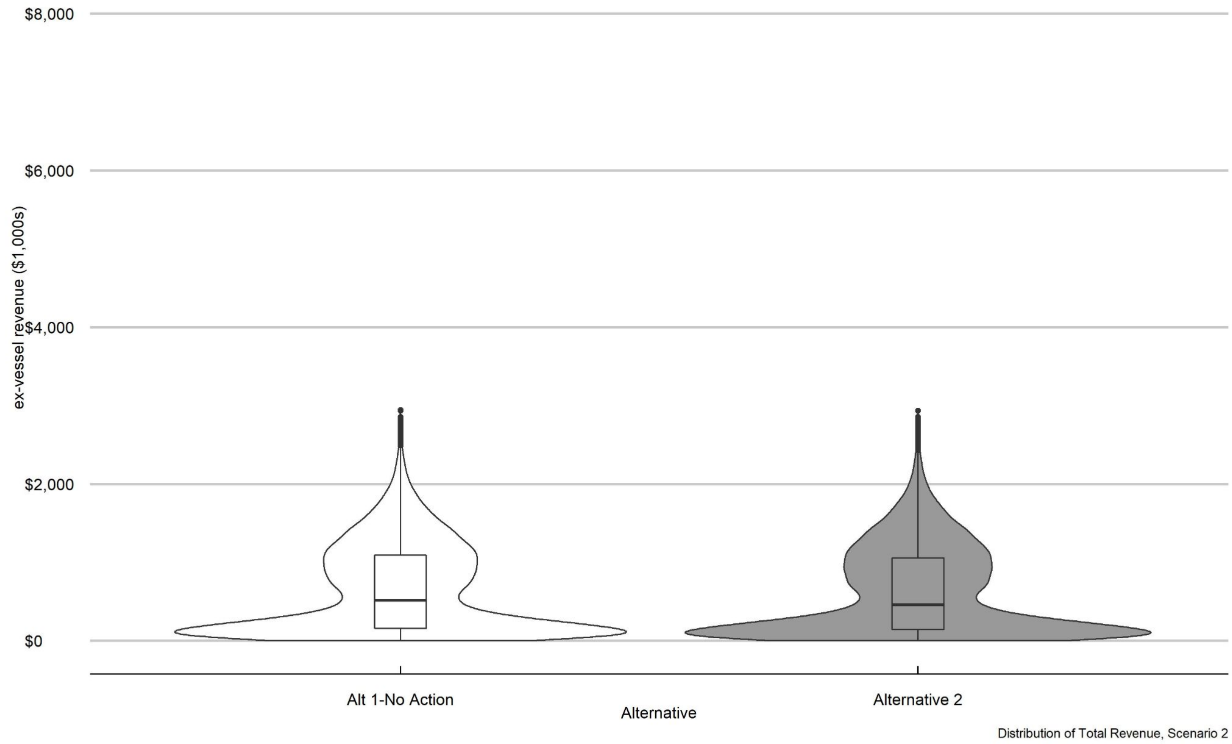
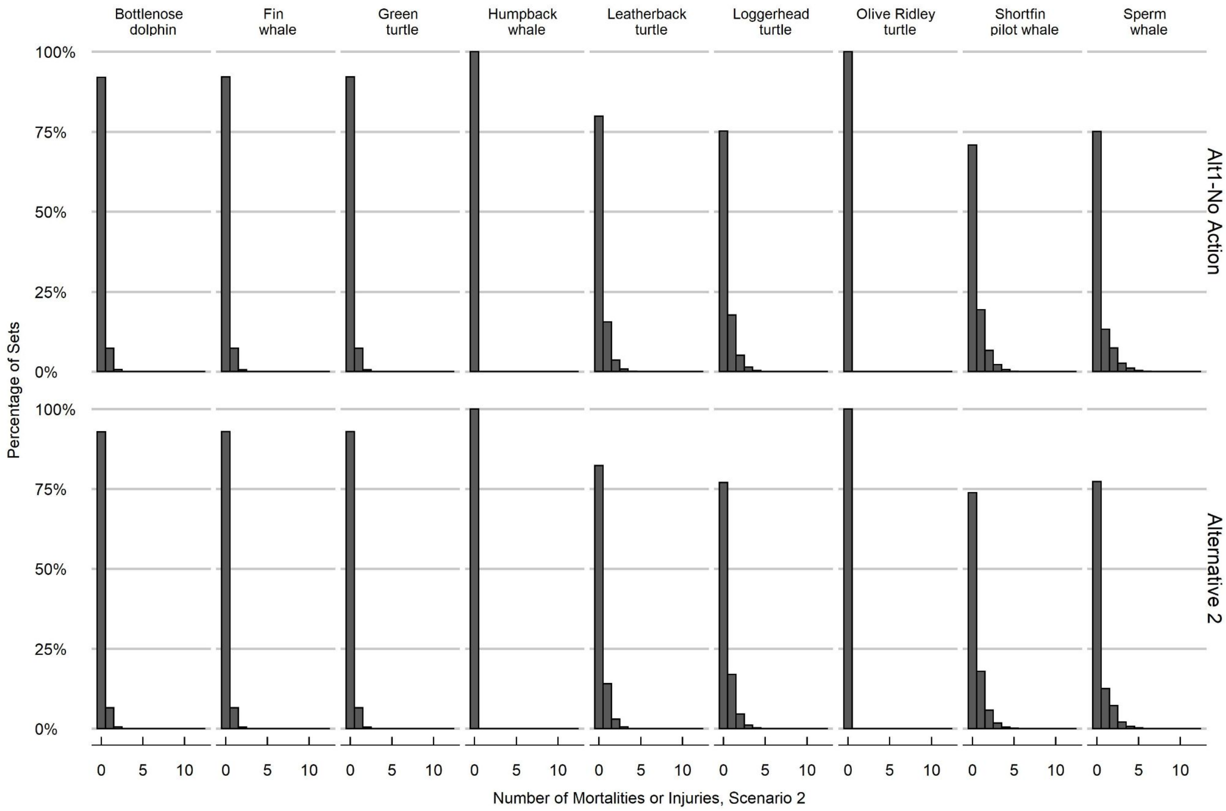


Figure 4 compares the distributions of simulation results for the numbers of mortalities and injuries for each capped species under Scenario 2 (Medium fleet size), with numbers of mortalities or injuries (M/I) for each species on the horizontal scale and frequencies expressed as percentages shown on the vertical scale. Alternative 1 simulation results are shown in the top part of the figure and Alternative 2 results in the bottom. As in the violin plots for Scenario 1, there is very little discernible difference between results for the two alternatives. The similarity of results between Alternatives 1 and 2 under Scenario 2 likely reflects the probability of hitting a fleet cap remaining low with only four observable vessels fishing.

Figure 4. Distributions of hard cap species mortality/injury under Alternatives 1 and 2 for Scenario 2.



<u>Scenario 3 (total = 30 /observable= 24 /unobservable= 6) Results</u>

Scenario 3 features 30 total vessels fishing, and with 24 of them observable and six unobservable. In this scenario, the difference in preliminary bootstrap simulation results between Alternative 1 (No Caps) and Alternative 2 (2015 FPA) is more discernible than in the other scenarios. The difference is numerically evident in comparing the upper (Alternative 1) and lower (Alternative 2) portions of Table 1; for example, the median number of sets (Q50) fished under Scenario 1 was 180 versus 156 under Scenario 2. Median revenues declined from $346,332 under Scenario 1 to $297,074 under Scenario 2, a 15 percent decrease. Other corresponding economic summaries across the two tables are comparably similar. By contrast, the median number of protected species interactions was 0 for all species subject to caps, suggesting little if any discernible difference in conservation impacts between Alternatives 1 and 2.

Table 3. Bootstrap analysis summary results for Alternatives 1 and 2 for Scenario 3 showing values for 5% through 95% quantiles, mean, and standard deviations for economic metrics and hard cap species mortality/injury.

Alternative 1	***Q5***	***Q25***	***Q50***	***Q75***	***Q95***	***Mean***	***SD***
Sets	21	77	180	717	1907	518	637
Total Revenue	$29,910	$133,519	$346,332	$1,350,865	$3,598,672	$967,945	$1,200,954
Total Profits	-$1,611	$49,050	$164,767	$638,088	$1,703,447	$445,480	$570,262
Avg. Profits	-$806	$21,716	$42,243	$63,048	$127,577	$48,732	$42,619
Landings (mt)	4.33	18.76	48.19	189.06	503.92	135.62	168.16
Leatherback M/I	0	0	0	0	1	0.23	0.55
Loggerhead M/I	0	0	0	0	2	0.31	0.67
Olive Ridley M/I	0	0	0	0	0	0.00	0.00
Green Turtle M/I	0	0	0	0	1	0.08	0.29
Fin Whale M/I	0	0	0	0	1	0.08	0.29
Humpback M/I	0	0	0	0	0	0.00	0.00
Sperm Whale M/I	0	0	0	0	2	0.39	0.89
SF Pilot Whale M/I	0	0	0	1	2	0.39	0.78
Bottlenose M/I	0	0	0	0	1	0.08	0.30

Alternative 2	***Q5***	***Q25***	***Q50***	***Q75***	***Q95***	***Mean***	***SD***
Sets	14	68	156	611	1798	453	585
Total Revenue	$15,679	$115,078	$297,074	$1,147,609	$3,403,397	$845,477	$1,104,588
Total Profits	-$2,919	$38,475	$139,929	$526,998	$1,601,564	$388,798	$526,241
Avg. Profits	-$1,040	$17,435	$39,505	$61,611	$127,103	$46,394	$43,396
Landings (mt)	2.30	16.40	41.55	160.53	476.22	118.64	154.75
Leatherback M/I	0	0	0	0	1	0.19	0.50
Loggerhead M/I	0	0	0	0	2	0.28	0.62
Olive Ridley M/I	0	0	0	0	0	0.00	0.00
Green Turtle M/I	0	0	0	0	1	0.07	0.28
Fin Whale M/I	0	0	0	0	1	0.07	0.28
Humpback M/I	0	0	0	0	0	0.00	0.00
Sperm Whale M/I	0	0	0	0	2	0.33	0.78
SF Pilot Whale M/I	0	0	0	0	2	0.34	0.72
Bottlenose M/I	0	0	0	0	1	0.07	0.28

Violin plots under Scenario 3 (Figure 5) again show little discernible difference in the distributions of ex-vessel revenues between Alternatives 1 and 2. In both cases, the distributions are again highly skewed, with the highest density near zero and a very long tail at the high end of the distributions. The outliers under Alternative 1 (left plot) appear slightly more densely distributed than those under Alternative 2 (right plot), reflecting a disallowance of some effort in simulated seasons when a cap is reached.

Figure 5. Violin plot showing the distribution of ex-vessel revenue across bootstrap replicates for Alternatives 1 and 2 under Scenario 3.

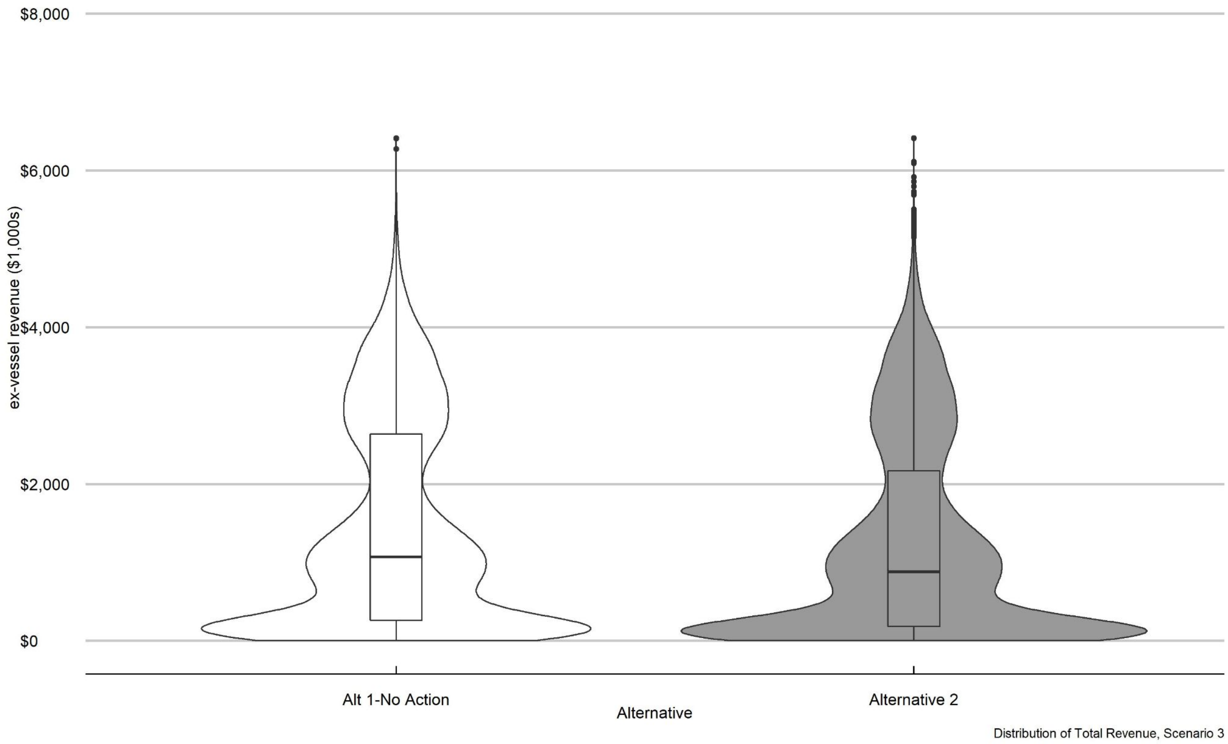
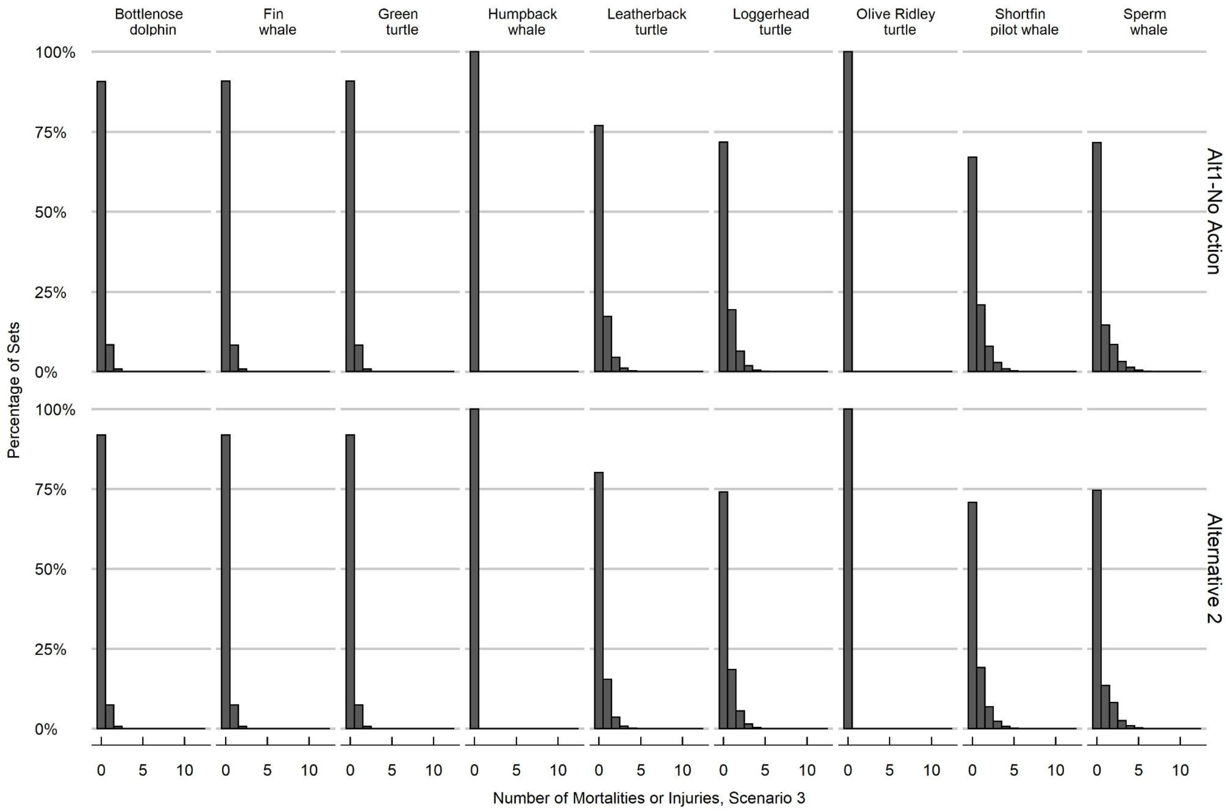


Figure 6 compares the distributions of simulation results for the numbers of mortalities and injuries for each capped species, with numbers of mortalities or injuries (M/I) for each species on the horizontal scale and frequencies given as percentages of the vertical scale. Alternative 1 simulation results are shown in the top part of the figure and Alternative 2 results in the bottom. As in the violin plots for Scenarios 1 and 2, there is very little discernible difference between results for the two alternatives. The similarity of results between Alternatives 1 and 2 under Scenario 3 again likely reflect a very low probability of hitting a fleet cap, even with up to 24 observable vessels fishing.

Figure 6. Distributions of hard cap species mortality/injury under Alternatives 1 and 2 for Scenario 3.



Preliminary Model Results Summary

A key feature of the preliminary bootstrap simulation results between Alternatives 1 and 2 for the three vessel size scenarios is the degree of similarity between the simulation outcomes, particularly with respect to conservation impacts on capped species. There is a discernible trend towards increasing levels of economic impacts as the fleet size increases, reflecting that hard caps put an upper bound on conservation impacts but do not constrain economic impacts. Increasing economic impacts with a larger fleet size reflects the greater likelihood of hitting a cap under Alternative 2 for scenarios with more observed vessels. By contrast, there is little if any discernible trend in conservation impacts with increasing fleet size, likely reflecting the rare event occurrence of interactions in observer data with species subject to caps in observer data.

Next Steps

The HMSMT is working towards finalizing the methodology to analyze Alternative 3 and will provide an update on these efforts in a supplemental HMSMT report. We do not expect to include data through 2021 for the June 2022 Council meeting version of the ROA analysis.

Given the extension of the 2015 ROA methodology to include the options and sub-options under Alternative 3, the HMSMT discussed the potential need for SSC review. The HMSMT could develop a full description of the revised approach to facilitate SSC review at a future Council meeting.