HIGHLY MIGRATORY SPECIES MANAGEMENT TEAM REPORT ON SWORDFISH FISHERY MANAGEMENT AND MONITORING PLAN INCLUDING MANAGEMENT ALTERNATIVES

# 1 Introduction

This report updates the description and evaluation of the Council's Swordfish Fishery Management and Monitoring Plan based on Council actions in March 2015. The Plan includes three sets of alternatives for managing and monitoring the California large mesh drift gillnet (DGN) fishery: hard caps for protected species of concern, bycatch performance objectives, and fishery monitoring.

The Plan encompasses a number of additional objectives as described below in Section 2.3. The Council is addressing these objectives through several actions. In March 2015 the Council made recommendations to NMFS on issuing exempted fishing permits to test gear types and methods that could be used to target swordfish. According to Council Operating Procedure 20 the Council reviews EFP applications annually in June and September. The Council would next review new EFP applications in June 2016. The Council is also scheduled to take up 1) scoping for HMS FMP Amendment 3: Authorizing a shallow-set longline fishery outside the EEZ in September 2015 and 2) adopt a range of alternatives for implementing a Federal limited entry permit for DGN vessels in November 2015.

# 2 Proposed Statement of Purpose and Need, Goals and Objectives

## 2.1 *Proposed Action*

While the DGN fishery currently complies with all applicable laws, including the MSA, ESA, and MMPA, the Council seeks to establish more stringent standards with respect to these laws. Therefore, the proposed action is to implement management measures for the California large mesh drift gillnet (DGN) fishery to further reduce 1) bycatch including bycatch mortality, and 2) interactions with of ESA-listed species and other marine mammals. Using MSA authority, bycatch and takes would be reduced below the level currently documented for the DGN, noting that the current level is permitted by applicable law. The proposed action is intended to achieve these reductions while providing an economically viable west coast based swordfish fishery. To promote economic viability, the proposed action will include requirements and incentives to support a swordfish fishery conducted by vessels with west coast home ports and promote increased availability of locally-caught swordfish in the market.

## 2.2 *Purpose and Need*

The purpose of the proposed action is to conserve non-target species and further reduce bycatch, including incidental take of ESA listed species and other marine mammals, in the DGN fishery below levels currently permitted by applicable law while maintaining or enhancing an economically viable west-coast-based swordfish fishery.

The proposed action is needed to better integrate fishery management under the HMS FMP with enhanced protection of ESA-listed species and other marine mammals, and to address National Standard 9 and Section 303 of the Magnuson/Stevens Act to minimize bycatch and bycatch mortality and conserve non-target species to the extent practicable.

## 2.3 *Goals and Objectives*

**Goal 1: Reduce specified protected species takes.**

Objectives (implementation steps):

- Implement hard caps for selected protected species such as ESA-listed sea turtle and marine mammal species and other marine mammals with population concerns. If hard caps are reached or exceeded during a fishing season, the fishery would be closed for the remainder of the season.
- Establish performance standards for other (e.g., non-ESA-listed) marine mammals. The Council will routinely review available information on takes of these species. If performance standards are not met the Council may recommend additional mitigation measures, as appropriate.
- Increase monitoring coverage rates above 2013 levels to facilitate implementation of bycatch reduction measures such as hard caps. The target for implementing full monitoring and accountability through onboard observers and/or electronic monitoring (EM) systems is 2018. The balance of the costs associated with observer coverage/EM requirements, beyond that funded by NMFS, would be non-government funded.
- Remove exemptions for unobservable vessels in the DGN fishery.
- Conduct research to further minimize protected species takes in the DGN fishery

**Goal 2: Reduce finfish bycatch to the degree practicable.**

Objectives:

- Establish performance standards for finfish bycatch. If performance standards are not met the Council will review available information and, as appropriate, recommend additional mitigation measures.
- Conduct research to further minimize bycatch in the DGN fishery.

**Goal 3: Maintain an economically viable west coast swordfish fishery**

Objectives:

- Reduce capacity in the DGN fishery through buyouts or other incentives.
- Implement a federal DGN limited entry program under MSA authority.
- Allow access to Pacific Leatherback Conservation Area (PLCA) with individual vessel and/or fishery accountability for bycatch using limits such as hard caps.
- Support collaboration between fishing communities, agencies, scientists, and nongovernmental organizations to develop alternative fishing gears.

# 3 Alternatives

## 3.1 *Hard Caps for the DGN Fishery*

Hard caps are limits on interactions with selected protected species applied to the DGN fishery. Hard cap management would be aligned with the fishing season (May 1-January 31)[1] and the fishery would be closed as soon as practicable after encounters equal the hard cap value.

For Alternatives 1 through 4, the evaluation of the fishery against hard caps is based on a mortality and serious injury (M&SI) assessment. The cap numbers are expressed in Table 1 as estimated total–not observed–M&SI; if fishery monitoring below 100% then observed M&SI would be expanded to estimated total take based on the level of monitoring to determine whether a cap has been reached or exceeded. Alternative 5 caps levels are based on observed entanglement at an assumed 30% observer coverage level. They are derived by applying a ratio of 0.3 to the cap levels under Alternative 4 and rounding up the fractional results. See Table 8.

**Table 1. Summary of 1-year cap levels under the action alternatives. (Blank cells indicate no cap for that species proposed under the alternative.)**

| Species | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 |
|---|---|---|---|---|---|
| Fin whale | 1 | 11 | | 2 | 1 |
| Humpback whale | 2 | 2 | 5 | 2 | 1 |
| Sperm whale | 2 | | 3 | 2 | 1 |
| Leatherback sea turtle | 3 | 3 | 4 | 3 | 1 |
| Loggerhead sea turtle | 3 | 3 | 4 | 3 | 1 |
| Olive ridley sea turtle | 1 | | | 2 | 1 |
| Green sea turtle | 1 | | | 2 | 1 |
| Short-fin pilot whale C/O/W stock | | 5 | | 5 | 2 |
| Common bottlenose dolphin C/O/W Offshore stock | | | | 6 | 2 |
| Pinniped group | | 4,316 | | | |
| Dolphin group | | 13,582 | | | |

### 3.1.1 No Action Alternative

Status quo with continued management of protected species bycatch through established MMPA and ESA Federal processes.

[1] The fishery is closed February 1-April 30 and prohibited from operating within 75 nm of the mainland shore from May 1 to August 14. Between August 15 and January 31 additional closures are in place including the Pacific Leatherback Conservation Area. Very little, if any, fishing activity occurs between May 1 and August 14.

### 3.1.2 Action Alternative 1

Under this alternative hard caps are established for high priority protected species, which are those listed in the Incidental Take Statement (ITS) in the May 2, 2013, Biological Opinion (BO) for the California DGN fishery.

The evaluation of the fishery against hard caps is based on a mortality and serious injury (M&SI) assessment. The cap numbers are expressed as estimated total–not observed–M&SI; if fishery monitoring is not at 100% then observed M&SI would be expanded to estimated total take based on the level of monitoring to determine whether a cap has been reached or exceeded.

The hard cap values are based on the estimated total amount of expected take listed in Table 12 in the BO.

There are two sub-options: 1) Fishing season (annual) hard caps are assessed based on total estimated M&SI from August 15 each year; and 2) Five-year hard caps are established. The determination of whether a five-year cap has been reached/exceeded would be based on estimated M&SI during the previous five years from the date of the observed take. Table 2 shows the resulting hard cap values under this alternative.

**Table 2. One and five year hard cap values under Alternative 1.**

| Species | One Year Take Cap | Five Year Take Cap | Basis |
|---|---|---|---|
| Fin whale | 1 | 2 | ITS |
| Humpback whale | 2 | 4 | ITS |
| Sperm whale | 2 | 8 | ITS |
| Leatherback sea turtle | 3 | 10 | ITS |
| Loggerhead sea turtle | 3 | 7 | ITS |
| Olive ridley sea turtle | 1 | 2 | ITS |
| Green sea turtle | 1 | 2 | ITS |

### 3.1.3 Action Alternative 2

Under this alternative hard caps are established for marine mammals with documented recent (2001-2013) encounters with the DGN fishery and selected ESA-listed sea turtles for which population status is of greatest concern. For non-ESA listed marine mammals, other than short-fin pilot whales, hard caps are established for grouped dolphins and pinnipeds.

Marine mammal hard caps are based on PBR. For non-ESA listed marine mammals hard caps are established for grouped dolphins and pinnipeds. Hard cap values for ESA-listed sea turtles are based on the expected amount of take of individuals shown in Table 12 in the 2013 DGN fishery BO.

The evaluation of the fishery against hard caps is based on a mortality and serious injury (M&SI) assessment. The cap numbers are expressed as estimated total–not observed–M&SI; if fishery monitoring is not at 100% then observed M&SI would be expanded to estimated total take based on the level of monitoring to determine whether a cap has been reached or exceeded.

Both one-year and five-year cap sub-options are included in this alternative. For the five-year PBR-based hard caps annual PBR values are multiplied by five. Table 3 shows the take cap values for this alternative. Composite hard cap values for dolphins and pinnipeds would be based on summing the PBR values for the constituent stocks. Table 4 shows the constituent stocks and their PBR values for these two composite hard caps

**Table 3. One- and five-year take cap values under Alternative 2.**

| Species | One-Year Take Cap | Five-Year Take Cap | Basis |
|---|---|---|---|
| Humpback whale | 11 | 55 | PBR |
| Sperm whale | 2 | 8 | Rounded up PBR* |
| Short-fin pilot whale | 5 | 23 | PBR |
| Pinniped group | 4,316 | 21,580 | PBR |
| Dolphin group | 13,582 | 67,910 | PBR |
| Leatherback sea turtle | 3 | 10 | ITS |
| Loggerhead sea turtle | 3 | 7 | ITS |

*For the five-year cap value the fractional one-year value is multiplied by five and then rounded up.

**Table 4. PBR values for components of the dolphin and pinniped groups.**

| Group / Stock | PBR |
|---|---|
| **Dolphin group** | **4,316** |
| Short-beaked common dolphin | 3,440 |
| Long-beaked common dolphin | 610 |
| Pacific white-sided dolphin | 171 |
| Northern right whale dolphin | 48 |
| Risso's dolphin | 39 |
| Bottlenose dolphin | 7.9 |
| **Pinniped group** | **13,582** |
| California sea lion | 9,200 |
| Northern elephant seal | 4,382 |

### 3.1.4 Action Alternative 3

Hard caps are established for ESA-listed marine mammals (sperm and humpback whales) and sea turtles (leatherback and loggerhead turtles) for which population status is of particular concern.

Hard cap values are based on levels for which takes are unlikely to trigger a jeopardy determination. A jeopardy determination is made on a case-by-case basis. If actual estimated takes exceed the expected take levels listed in the ITS, consultation under section 7 of the ESA is reinitiated. Through that process the jeopardy determination is made. There is no guidance about what specific levels of take above the expected take listed in the BO would result in a jeopardy determination. Therefore, the hard cap values under this alternative have been determined somewhat arbitrarily based on estimated fishery M&SI for marine mammals and values slightly above the expected take listed in the BO.

The evaluation of the fishery against hard caps is based on a mortality and serious injury (M&SI) assessment. The cap numbers are expressed as estimated total–not observed–M&SI; if fishery monitoring is not at 100% then observed M&SI would be expanded to estimated total take based on the level of monitoring to determine whether a cap has been reached or exceeded.

Both one-year and five-year cap sub-options are included in this alternative. Table 5 shows the hard cap values under this alternative.

**Table 5. One and five year hard cap values for Alternative 3.**

| Species: | One-Year Take Cap | Five-Year Take Cap | Basis |
|---|---|---|---|
| Humpback whale | 5 | 25 | Rounded down fishery M&SI |
| Sperm whale | 3 | 15 | Rounded down fishery M&SI |
| Leatherback sea turtle | 4 | 13 | 1.25 X ITS rounded up |
| Loggerhead sea turtle | 4 | 9 | 1.25 X ITS rounded up |

### 3.1.5 Action Alternative 4 (Council Preliminary Preferred Alternative)

Hard caps are established for high priority protected species and marine mammal species with an annual fishery M&SI of greater than or equal to 10% of PBR. In addition, a hard cap is set for short-fin pilot whale. This stock is not ESA-listed and the fishery M&SI is below 10% of PBR; however, the PBR, 4.6 animals, is low. Marine mammals, where annual fishery M&SI exceeds 10% of PBR, were identified based on information provided in Appendix 3 to the 2013 Pacific Marine Mammal Stock Assessment Report. Table 6 shows reported PBR and fishery M&SI values for these stocks. It should be noted that fishery M&SI takes into account the effect of all fisheries, not just the DGN fishery. Therefore, in some cases fishery M&SI is higher than M&SI caused by the DGN fishery.

Hard cap values for ESA-listed species are based on the expected amount of take of individuals shown in Table 12 in the 2013 DGN fishery BO. However, the hard caps for fin whale, olive ridley sea turtle, and green turtle are set above the estimated one-year take in the ITS, recognizing that these species are infrequently encountered in the DGN fishery so expected take is less likely to trigger a jeopardy determination. For non-ESA listed marine mammals PBR is used for the hard cap values.

The evaluation of the fishery against hard caps is based on a mortality and serious injury (M&SI) assessment. The cap numbers are expressed as estimated total–not observed–M&SI; if fishery monitoring is not at 100% then observed M&SI would be expanded to estimated total take based on the level of monitoring to determine whether a cap has been reached or exceeded.

This alternative only includes the one-year cap sub-option. Table 7 shows the one-year hard cap values based on the criteria used for the Council preliminary preferred alternative (PPA).

**Table 6. Information from the 2013 Pacific Stock Assessment Report for stocks where annual fishery M&SI is greater than or equal to 10% of PBR.**

| Species | Stock Area | PBR | Annual Fishery M&SI | 10% PBR |
|---|---|---|---|---|
| Common bottlenose dolphin | C/O/W Offshore | 5.5 | ≥2.0 | 0.55 |
| Sperm whale* | C/O/W | 1.5 | 3.8 | 0.15 |
| Humpback whale | C/O/W | 11 | ≥ 4.4 | 1.1 |

*In the draft 2014 Pacific Marine Mammal Stock Assessment Report the PBR for sperm whale is revised to 2.7 and annual fishery M&SI is revised to 1.7.

**Table 7. Hard cap values for Alternative 4 (PPA)**

| Species | One Year Hard Cap | Basis |
|---|---|---|
| Fin whale | 2 | ITS |
| Humpback whale* | 2 | ITS |
| Sperm whale* | 2 | ITS |
| Leatherback sea turtle | 3 | ITS |
| Loggerhead sea turtle | 3 | ITS |
| Olive ridley sea turtle | 2 | ITS |
| Green sea turtle | 2 | ITS |
| Short-fin pilot whale C/O/W stock | 5 | Rounded up PBR |
| Common bottlenose dolphin C/O/W Offshore stock* | 6 | Rounded up PBR |

*Fishery SI / M ≥ 10% PBR.

### 3.1.6 Action Alternative 5 (California Department of Fish and Wildlife Preliminary Preferred Alternative)

The California Department of Fish and Wildlife (CDFW) recommends implementing annual hard caps for high priority species or species of concern based on entanglement, not mortality/serious injury. DGN observers record entanglements on the Non-Fish Tally Sheet from the West Coast Region Observer Program Field manual. The instructions for this form read: "An entry on this form should be completed for every marine mammal or sea turtle that has been captured." This includes animals captured in any part of the DGN fishing gear. All marine mammals and sea turtles recorded on this form would count as entangled animals under the CDFW PPA.

The CDFW PPA (Table 8) is similar to the Council PPA (Table 7) and includes annual entanglement caps and estimated annual take caps. The estimated annual entanglement caps are set at a value that is equal to or lower than those levels in the applicable ITS and PBR. While ITS and PBR can be informative, establishing hard caps are ultimately a Council policy decision. The hard caps in the CDFW PPA are informed by ITS and PBR but are not directly tied to them; therefore future changes to ITS and/or PBR do not automatically require modifications to hard caps.

Under the CDFW PPA, application of hard caps would be aligned with the fishing season (May 1- January 31) and the fishery would close immediately when estimated entanglements equal the cap for any capped species. CDFW also supports establishing a mechanism within the Highly Migratory Species Fishery Management Plan (HMS FMP) to allow for timely closure of the fishery once species identification has been confirmed. Similar mechanisms are available in both the salmon and groundfish FMPs, so the intent would be to have a similar process available in this fishery if not already available in the HMS FMP.

The March HMSMT Report (Agenda Item H.4.b, HMSMT Report) highlighted challenges assessing fishery interactions without 100% observer coverage. The annual caps under the CDFW PPA were developed assuming 30% observer coverage, which is the National Observer Program objective based on available funding for 2015, and would be applied to any encounter or interaction regardless of the time of year. For example, one fin whale entangled within the first month of fishing would shut down the fishery for most of the season because the Observed Entanglement Cap would be reached.[2] If that same encounter occurred during the last month of fishing, the fishery would close after most of an entire

[2] 1 whale entanglement x 3 (30% observer coverage rate) = 3 takes.

season of fishing effort was achieved. For most of the individual species proposed for hard caps under the CDFW PPA, observed entanglement during a year would close the fishery.

Assuming a fixed observer coverage level at the beginning of the season is a simple and more straightforward approach than trying to determine coverage levels at the moment an encounter occurs and would facilitate a more timely management response.

**Table 8. CDFW Preferred Alternative - annual hard caps ("Observed Entanglement Caps") for high priority species or species of concern. Values in parentheses reflect numbers of observed entanglements that would close the fishery.**

| Species | Observed Entanglement Cap* | Estimated Annual Take** |
|---|---|---|
| Fin whale | 0.6 (1) | 2 |
| Humpback whale | 0.6 (1) | 2 |
| Sperm whale | 0.6 (1) | 2 |
| Leatherback sea turtle | 0.9 (1) | 3 |
| Loggerhead sea turtle | 0.9 (1) | 3 |
| Olive ridley sea turtle | 0.6 (1) | 2 |
| Green sea turtle | 0.6 (1) | 2 |
| Short-fin pilot whale C/O/W | 1.5 (2) | 5 |
| Common bottlenose dolphin C/O/W | 1.8 (2) | 6 |

*The observed entanglement cap is calculated as the product of estimated annual take multiplied by 0.3 (30 % coverage rate).

** The estimated annual take of all species in the incidental take statement of the latest biological opinion for the fishery, except for short-fin pilot whale (C/O/W) and common bottlenose dolphin (C/O/W) which are informed by the latest potential biological removal levels estimated under the Marine Mammal Protection Act.

## 3.2 *Performance Objectives for the DGN Fishery*

Performance objectives are not hard caps. The Council would review fishery performance in relation to the objectives after the end of each fishing season (January 31) and determine what, if any, additional management measures are needed. The alternatives are based on recommendations from the HMSMT, public comment, and Council action.

### 3.2.1 No Action

Do not establish performance objectives for the DGN fishery.

### 3.2.2 Action Alternative 1

A performance objective for total finfish bycatch is calculated as landed catch during the baseline period divided by total catch (retained catch plus alive/dead/unknown discards) during the baseline period. Table 9 below shows calculated values for the performance objective proposed under this alternative. Note that observer data reports number of animals, so the metric is based on this unit also.

### 3.2.3 Action Alternative 2

A performance objective for total finfish bycatch is calculated as landed catch during the baseline period divided by total catch mortality (retained catch plus dead/unknown discards) during the baseline period. Table 9 below shows calculated values for the performance objective proposed under this alternative.

**Table 9. Performance objectives for finfish bycatch (no. of individuals) in the DGN fishery, Alternative 1 and Alternative 2. Based on expanded average annual catch rates (2004-2014) from NMFS observer data.**

| Species | Estimated average annual **caught** | Estimated average annual **retained** | Estimated average annual **discarded** | Estimated average annual **discarded dead** | Estimated average annual **discarded alive** | Estimated average annual **discarded unknown** | Alternative 1: Estimated Percentage **retained/caught** | Alternative 2: Estimated Percentage **retained/retained+ dead+unkn** |
|---|---|---|---|---|---|---|---|---|
| Albacore | 590 | 563 | 27 | 27 | 0 | 0 | 95.4% | 95.4% |
| Bigeye Thresher Shark | 116 | 59 | 57 | 55 | 1 | 1 | 51.0% | 51.4% |
| Blue Marlin | 1 | 0 | 1 | 1 | 0 | 0 | 0.0% | 0.0% |
| Blue Shark | 962 | 1 | 961 | 593 | 343 | 25 | 0.1% | 0.1% |
| Bluefin Tuna | 384 | 365 | 19 | 19 | 0 | 0 | 94.9% | 94.9% |
| Bullet Mackerel | 101 | 41 | 60 | 59 | 0 | 1 | 40.9% | 40.9% |
| Common Mola | 8,910 | 7 | 8,919 | 331 | 8,520 | 69 | 0.1% | 1.8% |
| Common Thresher Shark | 846 | 813 | 33 | 22 | 11 | 0 | 96.1% | 97.3% |
| Opah | 1,066 | 1,035 | 31 | 28 | 3 | 0 | 97.1% | 97.3% |
| Pacific Bonito | 352 | 111 | 241 | 228 | 13 | 0 | 31.5% | 32.7% |
| Pacific Mackerel | 632 | 95 | 537 | 501 | 36 | 0 | 15.1% | 16.0% |
| Shortfin Mako Shark | 998 | 932 | 66 | 40 | 26 | 1 | 93.4% | 95.8% |
| Skipjack Tuna | 1,142 | 417 | 725 | 710 | 12 | 3 | 36.5% | 36.9% |
| Striped Marlin | 36 | 0 | 36 | 36 | 0 | 0 | 0.0% | 0.0% |
| Swordfish | 2,131 | 2,070 | 62 | 58 | 4 | 0 | 97.1% | 97.3% |
| Yellowfin Tuna | 28 | 21 | 6 | 6 | 0 | 0 | 76.7% | 76.7% |
| Other Finfish (40 species)* | 327 | 179 | 150 | 91 | 55 | 5 | 54.6% | 65.1% |
| Total Billfish (including swordfish) | 2,168 | 2,070 | 99 | 95 | 4 | 0 | 95.4% | 95.6% |
| Total Billfish (excluding swordfish) | 37 | 0 | 37 | 37 | 0 | 0 | 0.0% | 0.0% |
| Total Sharks (including blue) | 2,953 | 1,813 | 1,140 | 730 | 383 | 27 | 61.4% | 70.5% |
| Total Sharks (excluding blue) | 1,991 | 1,812 | 179 | 137 | 40 | 2 | 91.0% | 92.9% |
| Total Finfish Catch | 18,622 | 6,708 | 11,933 | 2,806 | 9,022 | 105 | 36.0% | 69.7% |

Data source: NMFS Observer Data for CA DGN Fishery, 5/1/2003 - 1/31/2013. Estimated annual averages projected based on % observer coverage.

*Other finfish include species which had an annual average of less than 100 individuals caught, except for management unit species and blue marlin.

### 3.2.4 Action Alternative 3

Performance objectives are established for selected bycatch species and/or set targets for groups of species as shown in Table 10. The performance objectives are the number of animals discarded during a fishing season or the estimated number of animals that are subject to post-release mortality. The species/species groups and performance objective values are taken from the August 8, 2014, public comment letter from Oceana, included in Agenda Item G.4.c, Public Comment, September 2014.

**Table 10. Performance objectives based on Oceana public comment, September 2014 Council meeting.**

| Species/Species Group | Performance Objective | |
|---|---|---|
| | # of animals | Type |
| Billfish other than swordfish | 28 | Total discards |
| Megamouth, basking, and white sharks | 2 | Total discards |
| Hammerhead sharks | 5 | Total discards |
| Blue sharks | 611 | Discard mortality |
| Ocean sunfish (mola mola) | 139 | Discard mortality |

### 3.2.5 Action Alternative 4 (Council PPA)

Performance objectives for non-ESA-listed marine mammals are included in the PPA. The performance objective is defined as observed M&SI. These objectives are based on the 10-year maximum observed interactions (in any one season) over the 10 fishing seasons, 2004-2014. As discussed above with respect to hard caps, observed takes vary with respect to actual maximum takes in any one season because observer coverage has varied from one fishing season to the next. When observer coverage is relatively lower, the actual take level could be higher, and when the observer coverage rate is higher, the actual take level could be relatively lower. This means that the observed maximum take level during this period could have occurred in a different year than the true maximum take level. In Table 11 below the HMSMT provides the expanded values based on observer coverage rates for each fishing season during the 10-year period. As discussed above, without 100% monitoring, observed takes would need to be converted to estimated total takes based on the observer coverage rate at the time that the take occurred if estimated maximum total takes are to be used as performance objectives.

These objectives could be lowered in future years (noting that objectives cannot be less than zero).

**Table 11. Performance objectives under Alternative 4 (Council PPA).**

| Species | Annual performance objective based on maximum annual observed take | Annual performance objectives based on maximum estimated total takes |
|---|---|---|
| Minke whale | 1 | 5 |
| Short beaked common dolphin | 9 | 66 |
| Long beaked common dolphin | 5 | 24 |
| Risso's dolphin | 1 | 7 |
| California sea lion | 18 | 97 |
| Northern elephant seal | 1 | 6 |
| Northern right whale dolphin | 3 | 11 |
| Gray whale | 1 | 5 |
| Pacific white-sided dolphin | 3 | 22 |

### 3.2.6 Action Alternative 5 (CDFW PPA)

<u>Non-ESA-listed marine mammals</u>

The CDFW PPA would establish performance objectives based on observed M&SI for non-ESA-listed marine mammals. These objectives are based on the five-year maximum observed interactions (in any one season) over the five fishing seasons, 2009-2014 (see Table 12).

**Table 12. Performance objectives under CDFW PPA.**

| Species | Annual performance objective based on maximum annual observed take | CDFW PPA - Annual performance objectives based on estimated total takes 2009/10-2013/14 |
|---|---|---|
| Minke whale | 1 | 5 |
| Short beaked common dolphin | 9 | 26 |
| Long beaked common dolphin | 5 | 15 |
| Risso's dolphin | 1 | 5 |
| California sea lion | 18 | 97 |
| Northern elephant seal | 1 | 1* |
| Northern right whale dolphin | 3 | 11 |
| Gray whale | 1 | 3 |
| Pacific white-sided dolphin | 3 | 15 |

*There were no observed takes of Northern elephant seals in the 2009/10 to 2013/14 seasons

Finfish

The CDFW PPA does not specify performance objectives for finfish. While performance objectives for finfish are important, there is insufficient information at this time to inform what the appropriate levels should be. CDFW supports continued work on this performance standard, with the possible inclusion of results from EFPs. CDFW recommends the Council affirm its commitment to continue to make progress on this topic with the intent of revisiting it at a future date.

The HMSMT plans to provide data on finfish bycatch during the past five years in a supplemental report.

## *3.3 DGN Fishery Monitoring*

Under all these alternatives, prior to each fishing year, NMFS would inform the Council of the level of observer coverage and/or electronic monitoring (EM) that NMFS would be able to fund. The balance of the costs associated with observer coverage/EM requirements would be non-government funded.

### 3.3.1 No Action

Maintain the current 30% target observer coverage level.

### 3.3.2 Alternative 1

Target observer coverage to a level sufficient for biological sampling and require EM on all vessels that fish.

### 3.3.3 Alternative 2

Maintain a minimum of 50% observer coverage level, remove the unobservable vessel exemption, and allow individual vessels the flexibility to contract with an approved observer provider company.

### 3.3.4 Alternative 3 (Council PPA)

Maintain the 30% target observer coverage level and/or require EM (for the purpose of catch and bycatch accounting) but remove the unobservable vessel exemption. Achieve 100% monitoring by 2018.

# 4 Evaluation of the Alternatives

## *4.1 Hard Caps*

The March 2015 HMSMT Report (Agenda Item H.4.b) discussed logistical issues related to basing hard caps on total estimated M&SI.

### 4.1.1 Process for Closing the Fishery Based on Entanglement Criterion

Under the CDFW PPA for hard caps, it may take between five and twenty business days to close the DGN fishery once an observer returns to port with a report of an entanglement, which meets or exceeds a hard cap. This timeline includes:

- Observer travel and debriefing, 2 – 5 days
- Species identification, 1 – 10 days depending if genetic identification is required

- Publication of FR notice closing the fishery, 2 – 5 days

Under the Council's hard cap PPA (Alternative 4), an additional ten to fifteen business days would be required to make a serious injury determination for an injured marine mammal. A serious injury determination process does not exist for sea turtles.

### 4.1.2 Evaluation of Historical Fishery Performance for the CDFW PPA (Alternative 5)

Agenda Item H.4.b, Supplemental HMSMT Report 2, March 2015, contains an evaluation of historical fishery performance under hard cap alternatives. Per Council guidance, Table 13 displays an equivalent analysis for Alternative 5 (CDFW PPA) based on estimates of entanglement/M&SI during past fishing seasons.

Since the hard caps for ESA-listed species are based on the ITS, using entanglement as the hard cap criterion produces the same results as using M&SI. For the non-ESA-listed cetaceans, the HMSMT reviewed NMFS observer data to determine the frequency of live releases of small cetaceans. There have been 613 small cetaceans observed entangled in the DGN fishery, three of which were released alive. The number of entanglements versus serious injury/mortality of small cetaceans is essentially the same.

Under the proposed entanglement caps identified in the California PPA, the DGN fishery would have closed 7 out of 13 seasons (54%) since the PLCA was put into place. Looking back farther, the fishery would have closed 17 out of 21 seasons (81%) had these caps been in place. Either scenario is likely not conducive to an economically viable swordfish fishery.

Further examination of the fishery's performance had it been operating under the entanglement caps specified by the CDFW PPA, reveals that hard caps placed on marine turtle species only, would close the fishery 4 out of 13 seasons (31%). The additional three years with interactions would have been managed through the MMPA Pacific Offshore Cetacean Take Reduction Team process.

**Table 13. Historical performance of the DGN fishery under Hard Cap Alternative 5 (CDFW PPA) proposed entanglement caps. Shaded cells denote season closures due to attainment of a hard cap for one or more species.**

| Species | Observed Entanglement Cap* | Estimated Annual Take** | OBSERVED NUMBER OF TAKES Season: | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 90/91 | 91/92 | 92/93 | 93/94 | 94/95 | 95/96 | 96/97 | 97/98 | 98/99 | 99/00 | 00/01 | 01/02 | 02/03 | 03/04 | 04/05 | 05/06 | 06/07 | 07/08 | 08/09 | 09/10 | 10/11 | 11/12 | 12/13 | 13/14 |
| Fin whale | 0.6 (1) | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Humpback whale | 0.6 (1) | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sperm whale | 0.6 (1) | 2 | 0 | 0 | 3 | 3 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| Leatherback sea turtle | 0.9 (1) | 3 | 1 | 1 | 5 | 2 | 1 | 5 | 2 | 4 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| Loggerhead sea turtle | 0.9 (1) | 3 | 0 | 0 | 5 | 2 | 0 | 0 | 0 | 4 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Olive ridley sea turtle | 0.6 (1) | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Green sea turtle | 0.6 (1) | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Short-fin pilot whale C/O/W | 1.5 (2) | 5 | 0 | 0 | 1 | 8 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Common bottlenose dolphin C/O/W | 1.8 (2) | 6 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| | | *Estimated number of sets:* | ***4,375*** | ***4,578*** | ***4,755*** | ***5,652*** | ***3,689*** | ***3,918*** | ***3,389*** | ***3,436*** | ***2,959*** | ***2,401*** | ***1,953*** | ***1,678*** | ***1,673*** | ***1,433*** | ***1,022*** | ***1,075*** | ***1,353*** | ***998*** | ***1,060*** | ***832*** | ***396*** | ***525*** | ***408*** | ***559*** |

### 4.1.3 Projected Socioeconomic Fishery Performance

At their March 2015 meeting, the SSC reviewed a proposed bootstrap methodology for evaluating performance of the drift gillnet fishery under hard caps alternatives and offered recommendations for improvement. This revision of the analysis addresses SSC recommendations to show the observed number of interactions that would trigger a closure, and to use alternative time periods as sensitivity analyses to bracket uncertainty.

Table 14 shows the observed numbers of M&SI (Alternatives 1-4) or entanglements (Alternative 5) that would trigger a closure. The observed cap numbers are the product of 0.3 (30% coverage rate) times the corresponding expanded values in Table 1, rounded up to the nearest whole number (parenthesized values). The analysis considers the operation of the DGN fishery under these caps at both the anticipated current 30% and proposed future 100% observer coverage levels.

**Table 14. Observed hard cap levels that would trigger a DGN fishery closure.**

| | Alternative 1 | | Alternative 2 | | Alternative 3 | | Alternative 4 | Alternative 5 |
|---|---|---|---|---|---|---|---|---|
| Number of Years | 1 | 5 | 1 | 5 | 1 | 5 | 1 | 1 |
| Fin Whale | 0.3 (1) | 0.6 (1) | | | | | 0.6 (1) | 0.6 (1) |
| Humpback Whale | 0.6 (1) | 1.2 (2) | 3.3 (4) | 16.5 (17) | 1.5 (2) | 7.5 (8) | 0.6 (1) | 0.6 (1) |
| Sperm Whale | 0.6 (1) | 2.4 (3) | 0.6 (1) | 2.4 (3) | 0.9 (1) | 4.5 (5) | 0.6 (1) | 0.6 (1) |
| Leatherback Turtle | 0.9 (1) | 3.0 (3) | 0.9 (1) | 3.0 (3) | 1.2 (2) | 3.9 (4) | 0.9 (1) | 0.9 (1) |
| Loggerhead Turtle | 0.9 (1) | 2.1 (3) | 0.9 (1) | 2.1 (2) | 1.2 (2) | 2.7 (3) | 0.9 (1) | 0.9 (1) |
| Olive Ridley Turtle | 0.3 (1) | 0.6 (1) | | | | | 0.6 (1) | 0.6 (1) |
| Green Turtle | 0.3 (1) | 0.6 (1) | | | | | 0.6 (1) | 0.6 (1) |
| Short-fin Pilot Whale | | | 1.5 (1) | 6.9 (7) | | | 1.5 (2) | 1.5 (2) |
| Bottlenose Dolphin | | | | | | | 1.8 (2) | 1.8 (2) |
| Pinniped Group | | | 1,294.8 (1,295) | 6,474.0 (6,474) | | | | |
| Dolphin Group | | | 4,074.6 (4,075) | 20,373.0 (20,373) | | | | |

Table 15 shows results for the no-action ("no caps") alternative, the Council's PPA (Alternative 4), and the CDFW PPA (Alternative 5). Hard caps under Alternatives 4 and 5 are analyzed based on 30% observer coverage. Observer data for seasons after 2000 are used to represent recent operation of the fishery. The results summarize 10,000 bootstrap replicates, under the scenario of 20 DGN vessels fishing.

Columns Q5 through Q95 represent quantiles of simulation results. For instance, Q95 is the 95$^{th}$ percentile of bootstrap replicates, which means that 95 percent of simulated seasons showed replicates at this level or lower. The rightmost two columns give the mean and standard deviation of simulation results. Economic results in the first four rows include numbers of sets, total revenues, total profits and average profits. The remaining rows provide summary statistics for annual (full season) M&SI of high priority protected species for the entire fleet.

For example, in Table 15 under no caps and 30% observer coverage, the value of "2" shown for sperm whale under the 95th quantile (Q95) means that 2 or fewer sperm whales were estimated to be taken during at least 95% of the seasons. The neighboring value of 0 for the 75th quantile (Q75) means that 0 sperm whales were estimated to be taken during at least 75% of seasons.

The economic results show relatively small declines in numbers of sets, total revenues, total profits and average profits in moving from the "No Action" case to Alternative 4. A relatively more substantial decline in economic results is seen in moving to Alternative 5, particularly at lower bootstrap quantiles, reflecting that caps based on entanglements will be triggered more frequently than caps based on M&SI if at least some entanglements are released alive, which is the case for the DGN fishery. Differences in simulation results between Alternatives 4 and 5 reflect that historically observed entanglements and M&SI differ for a number of species proposed for caps, including humpback whale, sperm whale, leatherback turtle, loggerhead turtle and olive ridley turtle, due to animals released alive.

Quantiles of M&SI are unchanged across the three scenarios shown in Table 15. Table 15 quantiles are the same moving from Alternatives 4 to Alternative 5 except that Q75 changes from 1 to 0 for short-fin pilot whales. Most M&SI rates are zero, reflecting zero observed DGN mortalities since 2000 for many high priority protected species. Sperm whale and short-fin pilot whale M&SI were slightly lower for Alternative 4 than for the "No Caps" scenario. Under Alternative 5, sperm whales, short-fin pilot whales and bottlenose dolphins showed a more substantial decline in M&SI rates, likely reflecting caps for these species being reached more often when counted against entanglements.

**Table 15. Bootstrap Results Based on Post-2000 Observer Data and 30% Observer Coverage.**

| | No Action: No Caps | | | | | | |
|---|---|---|---|---|---|---|---|
| | Q5 | Q25 | Q50 | Q75 | Q95 | Mean | StdDev |
| Sets | 389 | 477 | 542 | 610 | 712 | 545 | 99 |
| Total Revenues | $527,826 | $655,493 | $747,780 | $846,749 | $995,750 | $753,691 | $141,905 |
| Total Profits | $7,031 | $77,848 | $128,652 | $182,877 | $267,252 | $132,139 | $78,977 |
| Average Profits | $352 | $3,892 | $6,433 | $9,144 | $13,363 | $6,607 | $3,949 |
| Leatherback Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Loggerhead Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Olive Ridley Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Green Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Fin Whales | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Humpback Whales | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Sperm Whales | 0 | 0 | 0 | 0 | 2 | 0.45 | 0.95 |
| Short-fin Pilot Whales | 0 | 0 | 0 | 1 | 2 | 0.64 | 0.81 |
| Bottlenose Dolphins | 0 | 0 | 0 | 0 | 1 | 0.22 | 0.46 |
| | Alternative 4: 1-year Caps, 30% Observed | | | | | | |
| | Q5 | Q25 | Q50 | Q75 | Q95 | Mean | StdDev |
| Sets | 367 | 462 | 531 | 603 | 707 | 533 | 104 |
| Total Revenues | $501,631 | $636,355 | $734,639 | $835,421 | $987,341 | $737,653 | $149,942 |
| Total Profits | -$5,163 | $69,308 | $121,755 | $177,497 | $262,792 | $124,246 | $82,737 |
| Average Profits | -$258 | $3,465 | $6,088 | $8,875 | $13,140 | $6,212 | $4,137 |
| Leatherback Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Loggerhead Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Olive Ridley Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Green Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Fin Whales | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Humpback Whales | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Sperm Whales | 0 | 0 | 0 | 0 | 2 | 0.43 | 0.90 |
| Short-fin Pilot Whales | 0 | 0 | 0 | 1 | 2 | 0.61 | 0.78 |
| Bottlenose Dolphins | 0 | 0 | 0 | 0 | 1 | 0.22 | 0.46 |

| | Alternative 5: 1-year Caps, 30% Observed | | | | | | |
|---|---|---|---|---|---|---|---|
| | Q5 | Q25 | Q50 | Q75 | Q95 | Mean | StdDev |
| Sets | 18 | 285 | 476 | 567 | 682 | 415 | 211 |
| Total Revenues | $6,982 | $347,172 | $656,353 | $786,267 | $951,693 | $561,323 | $309,497 |
| Total Profits | -$250,585 | -$98,323 | $79,365 | $150,276 | $243,932 | $29,662 | $166,010 |
| Average Profits | -$12,529 | -$4,916 | $3,968 | $7,514 | $12,197 | $1,483 | $8,300 |
| Leatherback Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Loggerhead Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Olive Ridley Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Green Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Fin Whales | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Humpback Whales | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Sperm Whales | 0 | 0 | 0 | 0 | 2 | 0.31 | 0.78 |
| Short-fin Pilot Whales | 0 | 0 | 0 | 1 | 2 | 0.47 | 0.72 |
| Bottlenose Dolphins | 0 | 0 | 0 | 0 | 1 | 0.17 | 0.42 |

Table 16 shows results for hard caps Alternatives 4 and 5 based on 100% observer coverage. There is little difference under the Alternative 4 between the 30% and 100% observer coverage cases, but a substantial decline in economic performance under Alternative 5 and a large increase in variability (StdDev), reflecting a much greater risk of reaching an entanglement cap based on 100% observer coverage.

**Table 16. Bootstrap results based on post-2000 observer data and 100% observer coverage.**

| | Alternative 4: 1-year Caps, 100% Observed | | | | | | |
|---|---|---|---|---|---|---|---|
| | Q5 | Q25 | Q50 | Q75 | Q95 | Mean | StdDev |
| Sets | 369 | 472 | 539 | 607 | 710 | 535 | 117 |
| Total Revenues | $501,190 | $647,803 | $743,236 | $843,428 | $992,493 | $739,258 | $169,558 |
| Total Profits | -$7,979 | $74,122 | $126,075 | $180,998 | $265,785 | $124,395 | $93,013 |
| Average Profits | -$399 | $3,706 | $6,304 | $9,050 | $13,289 | $6,220 | $4,651 |
| Leatherback Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Loggerhead Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Olive Ridley Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Green Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Fin Whales | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Humpback Whales | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Sperm Whales | 0 | 0 | 0 | 0 | 2 | 0.44 | 0.94 |
| Short-fin Pilot Whales | 0 | 0 | 0 | 1 | 2 | 0.63 | 0.78 |
| Bottlenose Dolphins | 0 | 0 | 0 | 0 | 1 | 0.21 | 0.46 |
| | Alternative 5: 1-year Caps, 100% Observed | | | | | | |
| | Q5 | Q25 | Q50 | Q75 | Q95 | Mean | StdDev |
| Sets | 12 | 50 | 134 | 508 | 646 | 266 | 240 |
| Total Revenues | $3,160 | $32,323 | $121,661 | $699,873 | $893,355 | $344,768 | $349,972 |
| Total Profits | -$253,399 | -$247,782 | -$215,299 | $102,875 | $211,958 | -$83,982 | $185,367 |
| Average Profits | -$12,670 | -$12,389 | -$10,765 | $5,144 | $10,598 | -$4,199 | $9,268 |
| Leatherback Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Loggerhead Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Olive Ridley Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Green Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Fin Whales | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Humpback Whales | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Sperm Whales | 0 | 0 | 0 | 0 | 2 | 0.19 | 0.66 |
| Short-fin Pilot Whales | 0 | 0 | 0 | 0 | 2 | 0.32 | 0.61 |
| Bottlenose Dolphins | 0 | 0 | 0 | 0 | 1 | 0.09 | 0.31 |

## Appendix: Bootstrap Results Based on All NMFS Observer Data Since 1990

To address the SSC's suggestion to use alternative time periods as sensitivity analyses, bootstrap results were also produced using all available observer data back to 1990. Since the alternatives do not include options for reopening the PLCA during the closed season, the pre-2001 data were limited to non-PLCA closure effort as an implicit control on the operating characteristics of the fishery. While pre-2001 data may be less representative of the recent operation of the fishery, the longer period of observer data may produce more reliable estimates of rates of entanglement and M&SI for species with rare event interactions, such as the high priority protected species proposed for hard caps.

Table 17 shows bootstrap results comparable to those in Table 13, but using all observer data. The economic results, which average pre-2001 retained market species catch rates, are slightly less favorable than if data are limited to post-2000 observations. M&SI statistics are higher for a number of species when pre-2000 data are included; it is not clear whether this reflects significant differences in M&SI for these species over the two periods, or a lack of sufficient data in the post-2000 period to accurately measure M&SI rates for species with rare event interactions.

The economic performance under Alternatives 4 and 5 deteriorates more sharply when moving from 30% to 100% observer coverage than was the case for estimates based on post-2000 observer data, particularly under Alternative 5. This reflects in part a larger number of species with observed entanglements greater than 0 when all the data are reflected in the analysis than just the post-2000 observations. The larger number of species with nonzero entanglement observations back to 1990 results in a greater number of species for which a cap can be reached in bootstrap replicates, resulting in shorter seasons and poorer economic performance on average when all entanglements (and M&SIs) are observed.

Planned Revisions

The remaining recommendations in the March 2015 SSC report will be addressed in the version for the September 2015 Council meeting. While implementing the remaining SSC recommendations may change the means and variances of simulation results, the direction of the effects of hard caps alternatives on economic performance and M&SI are expected to be the same.

Another potential revision to the bootstrap results may be warranted based on clarification of how M&SI would be determined for purposes of administering hard caps under Alternatives 1-4. For purposes of this version of the analysis, all interactions coded in the NMFS observer database as “Injured” or “Unknown” were conservatively classified as “M&SI”. However, ancillary records on post-season determination of marine mammal injuries as “serious” or “not serious” could potentially be used to sharpen the classification used in the bootstrap analysis. A further question is how the Council would apply caps to sea turtles classified by observers as “injured,” given that there is no existing process for classifying sea turtle injuries as “serious” or “not serious.” Reducing the number of historic interactions classified as M&SI could widen the gap in results between Alternative 4 and Alternative 5, since observed entanglements (and Alternative 5 results) would be unaffected, while the risk of closure would go down under Alternative 4 with a higher rate of live release. It is noteworthy that basing a decision whether to close a fishery on M&SI rather than entanglement would create an incentive for fishermen to increase the rate of live releases for any entanglements that occur.

The HMSMT has discussed extending the bootstrap analysis to include observer data for the pre-2000 period for time-area combinations which were subject to the PLCA closure in 2001 and later seasons. The analysis would need to consider the differences between the current and former fishery, including different population statuses for various protected species, substantially different fleet sizes, pre and post implementation of bycatch mitigation measures (net extenders, pingers, etc.), and differing incentive to avoid protected species bycatch. The different conditions under which the pre-PLCA and post-PLCA DGN fleets operate—and the lack of any data since 2000 for time-area combinations closed in 2001 and later seasons—would likely be important caveats to making direct comparisons and discussion at the June 2015 Council meeting with the SSC could help guide this effort.

**Table 17. Bootstrap results based on all observer data and 30% observer coverage.**

| | No Action: No Caps | | | | | | |
|---|---|---|---|---|---|---|---|
| | Q5 | Q25 | Q50 | Q75 | Q95 | Mean | StdDev |
| Sets | 389 | 477 | 542 | 610 | 712 | 545 | 99 |
| Total Revenues | $479,671 | $594,859 | $682,587 | $772,928 | $907,477 | $687,262 | $130,283 |
| Total Profits | -$41,262 | $17,650 | $62,320 | $110,394 | $183,129 | $65,710 | $68,376 |
| Average Profits | -$2,063 | $882 | $3,116 | $5,520 | $9,156 | $3,286 | $3,419 |
| Leatherback Turtles | 0 | 0 | 0 | 0 | 1 | 0.25 | 0.49 |
| Loggerhead Turtles | 0 | 0 | 0 | 1 | 1 | 0.32 | 0.56 |
| Olive Ridley Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Green Turtles | 0 | 0 | 0 | 0 | 1 | 0.08 | 0.28 |
| Fin Whales | 0 | 0 | 0 | 0 | 1 | 0.08 | 0.28 |
| Humpback Whales | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Sperm Whales | 0 | 0 | 0 | 1 | 2 | 0.40 | 0.76 |
| Short-fin Pilot Whales | 0 | 0 | 0 | 1 | 2 | 0.41 | 0.65 |
| Bottlenose Dolphins | 0 | 0 | 0 | 0 | 1 | 0.08 | 0.28 |
| | Alternative 4: 1-year Caps, 30% Observed | | | | | | |
| | Q5 | Q25 | Q50 | Q75 | Q95 | Mean | StdDev |
| Sets | 43 | 414 | 506 | 583 | 691 | 475 | 170 |
| Total Revenues | $17,941 | $524,172 | $640,263 | $739,447 | $878,109 | $597,977 | $226,657 |
| Total Profits | -$251,739 | -$14,832 | $42,325 | $95,780 | $171,812 | $24,967 | $112,413 |
| Average Profits | -$12,587 | -$742 | $2,116 | $4,789 | $8,591 | $1,248 | $5,621 |
| Leatherback Turtles | 0 | 0 | 0 | 0 | 1 | 0.20 | 0.44 |
| Loggerhead Turtles | 0 | 0 | 0 | 1 | 1 | 0.29 | 0.52 |
| Olive Ridley Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Green Turtles | 0 | 0 | 0 | 0 | 1 | 0.07 | 0.26 |
| Fin Whales | 0 | 0 | 0 | 0 | 1 | 0.07 | 0.26 |
| Humpback Whales | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Sperm Whales | 0 | 0 | 0 | 0 | 2 | 0.34 | 0.67 |
| Short-fin Pilot Whales | 0 | 0 | 0 | 1 | 2 | 0.35 | 0.61 |
| Bottlenose Dolphins | 0 | 0 | 0 | 0 | 1 | 0.07 | 0.27 |

| | Alternative 5: 1-year Caps, 30% Observed | | | | | | |
|---|---|---|---|---|---|---|---|
| | Q5 | Q25 | Q50 | Q75 | Q95 | Mean | StdDev |
| Sets | 18 | 141 | 425 | 541 | 662 | 364 | 221 |
| Total Revenues | $5,345 | $112,647 | $536,874 | $686,082 | $849,292 | $450,516 | $295,362 |
| Total Profits | -$257,790 | -$225,129 | -$6,214 | $67,912 | $154,097 | -$46,238 | $145,192 |
| Average Profits | -$12,890 | -$11,256 | -$311 | $3,396 | $7,705 | -$2,312 | $7,260 |
| Leatherback Turtles | 0 | 0 | 0 | 0 | 1 | 0.15 | 0.39 |
| Loggerhead Turtles | 0 | 0 | 0 | 0 | 1 | 0.26 | 0.49 |
| Olive Ridley Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Green Turtles | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.22 |
| Fin Whales | 0 | 0 | 0 | 0 | 0 | 0.05 | 0.22 |
| Humpback Whales | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Sperm Whales | 0 | 0 | 0 | 0 | 2 | 0.22 | 0.57 |
| Short-fin Pilot Whales | 0 | 0 | 0 | 0 | 1 | 0.29 | 0.56 |
| Bottlenose Dolphins | 0 | 0 | 0 | 0 | 1 | 0.05 | 0.23 |

**Table 18. Bootstrap results based on all observer data and 100% observer coverage.**

| | Alternative 4: 1-year Caps, 100% Observed | | | | | | |
|---|---|---|---|---|---|---|---|
| | Q5 | Q25 | Q50 | Q75 | Q95 | Mean | StdDev |
| Sets | 20 | 119 | 481 | 572 | 684 | 396 | 235 |
| Total Revenues | $6,771 | $90,200 | $602,233 | $722,434 | $870,343 | $488,498 | $312,656 |
| Total Profits | -$258,888 | -$235,472 | $21,496 | $83,925 | $164,601 | -$30,114 | $152,509 |
| Average Profits | -$12,944 | -$11,774 | $1,075 | $4,196 | $8,230 | -$1,506 | $7,625 |
| Leatherback Turtles | 0 | 0 | 0 | 0 | 1 | 0.18 | 0.41 |
| Loggerhead Turtles | 0 | 0 | 0 | 1 | 1 | 0.27 | 0.45 |
| Olive Ridley Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Green Turtles | 0 | 0 | 0 | 0 | 1 | 0.05 | 0.23 |
| Fin Whales | 0 | 0 | 0 | 0 | 1 | 0.05 | 0.23 |
| Humpback Whales | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Sperm Whales | 0 | 0 | 0 | 0 | 2 | 0.28 | 0.65 |
| Short-fin Pilot Whales | 0 | 0 | 0 | 1 | 2 | 0.31 | 0.57 |
| Bottlenose Dolphins | 0 | 0 | 0 | 0 | 1 | 0.05 | 0.23 |
| | **Alternative 5: 1-year Caps, 100% Observed** | | | | | | |
| | Q5 | Q25 | Q50 | Q75 | Q95 | Mean | StdDev |
| Sets | 10 | 24 | 61 | 473 | 635 | 219 | 240 |
| Total Revenues | $2,106 | $9,580 | $37,654 | $590,449 | $807,530 | $256,249 | $315,872 |
| Total Profits | -$260,591 | -$253,076 | -$245,090 | $17,514 | $130,162 | -$139,781 | $151,681 |
| Average Profits | -$13,030 | -$12,654 | -$12,254 | $876 | $6,508 | -$6,989 | $7,584 |
| Leatherback Turtles | 0 | 0 | 0 | 0 | 1 | 0.09 | 0.30 |
| Loggerhead Turtles | 0 | 0 | 0 | 0 | 1 | 0.20 | 0.40 |
| Olive Ridley Turtles | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Green Turtles | 0 | 0 | 0 | 0 | 0 | 0.03 | 0.17 |
| Fin Whales | 0 | 0 | 0 | 0 | 0 | 0.03 | 0.17 |
| Humpback Whales | 0 | 0 | 0 | 0 | 0 | 0.00 | 0.00 |
| Sperm Whales | 0 | 0 | 0 | 0 | 1 | 0.14 | 0.47 |
| Short-fin Pilot Whales | 0 | 0 | 0 | 0 | 1 | 0.18 | 0.45 |
| Bottlenose Dolphins | 0 | 0 | 0 | 0 | 0 | 0.03 | 0.16 |

## *4.2 Performance Objectives*

### 4.2.1 Historical Fishery Performance

As tasked by the Council, the HMSMT evaluated historical fishery performance for the preliminary preferred alternatives. Using historical data on takes since the PLCA was implemented in 2001, under Alternative 4 (Council PPA) the fishery would have exceeded the performance standard levels in two out of 13 seasons (16%) and under Alternative 5 (CDFW PPA) 7 of 13 seasons (54%). See Table 19.

**Table 19. Historical estimated interactions compared to Alternative 4 (Council PPA) and California PPA performance objectives. Darkly shaded cells denote seasons when the performance objective would be attained under either Alternative. Lightly shaded cells denote seasons when the performance objective would be attained only under Alternative 5.**

| Species | Alt. 4 - PPA | CA PPA | ESTIMATED NUMBER OF TAKES | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Annual Performance Objectives - based on estimated total takes* | | Season: | | | | | | | | | | | | | | | | | | | | | | | |
| | 2004/05 - 2013/14 | 2009/10 - 2013/14 | 90/91 | 91/92 | 92/93 | 93/94 | 94/95 | 95/96 | 96/97 | 97/98 | 98/99 | 99/00 | 00/01 | 01/02 | 02/03 | 03/04 | 04/05 | 05/06 | 06/07 | 07/08 | 08/09 | 09/10 | 10/11 | 11/12 | 12/13 | 13/14 |
| Minke whale | 5 | 5 | 0 | 0 | 0 | 0 | 6 | 0 | 7 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 |
| Short beaked common dolphin | 66 | 26 | 0 | 384 | 346 | 120 | 129 | 268 | 212 | 87 | 106 | 153 | 75 | 42 | 36 | 93 | 18 | 42 | 24 | 44 | 66 | 0 | 15 | 22 | 15 | 26 |
| Long beaked common dolphin | 24 | 15 | 0 | 0 | 14 | 0 | 6 | 27 | 0 | 18 | 6 | 5 | 0 | 5 | 0 | 0 | 0 | 24 | 10 | 0 | 0 | 0 | 15 | 5 | 0 | 0 |
| Risso's dolphin | 7 | 5 | 0 | 29 | 58 | 38 | 0 | 40 | 0 | 14 | 0 | 0 | 9 | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 5 | 0 | 0 |
| California sea lion | 97 | 97 | 45 | 38 | 72 | 98 | 17 | 34 | 0 | 179 | 118 | 36 | 48 | 42 | 54 | 20 | 32 | 9 | 58 | 44 | 51 | 39 | 0 | 97 | 29 | 9 |
| Northern elephant seal | 6 | 1* | 112 | 125 | 115 | 128 | 112 | 80 | 0 | 37 | 18 | 14 | 22 | 5 | 5 | 5 | 0 | 5 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| Northern right whale dolphin | 11 | 11 | 0 | 58 | 22 | 53 | 34 | 60 | 37 | 23 | 0 | 14 | 48 | 31 | 9 | 5 | 0 | 0 | 0 | 6 | 7 | 0 | 8 | 11 | 0 | 9 |
| Gray whale | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 6 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Pacific white-sided dolphin | 22 | 15 | 0 | 67 | 14 | 8 | 17 | 7 | 22 | 14 | 0 | 5 | 4 | 10 | 5 | 0 | 0 | 0 | 0 | 19 | 22 | 15 | 0 | 0 | 0 | 0 |
| | | ***Estimated number of sets:*** | ***4,375*** | ***4,578*** | ***4,755*** | ***5,652*** | ***3,689*** | ***3,918*** | ***3,389*** | ***3,436*** | ***2,959*** | ***2,401*** | ***1,953*** | ***1,678*** | ***1,673*** | ***1,433*** | ***1,022*** | ***1,075*** | ***1,353*** | ***998*** | ***1,060*** | ***832*** | ***396*** | ***525*** | ***408*** | ***559*** |

## 4.3 *Observer Coverage Levels and Estimating Rare Event Bycatch*

In March 2015, the Council tasked the HMSMT with examining appropriate observer (or monitoring) levels appropriate for implementing hard caps. The HMSMT reviewed available observer data, including observer data submitted by WDFW (Agenda Item H.3.b, Supplemental WDFW Report, March 2015), data from the 1980s reported in Hanan, et al. (1993)[3], and NMFS observer data from 1990 to 2014. While the pre-1990 CDFG data currently exists only on paper (i.e., not electronically), an effort is underway to digitize the data so it can be included in analyses and stored securely.

Takes of high priority protected species identified for the implementation of hard caps can be classified as "rare event" bycatch. As a rule of thumb, rare event bycatch can be classified as events observed, on average, less than once in every 100 sets within the DGN fishery. At this rate of incidence, the Poisson probability model, which is a standard probability model for rare event phenomena[4], often provides a close fit to empirical data. For example, Figure 1 compares a frequency histogram for counts of set-level leatherback sea turtle interactions over all observer data back to 1990 for non-PLCA effort to a Poisson probability distribution fitted to the maximum likelihood estimator of the set-level interaction rate. With 7 observed interactions over 6,742 sets, the maximum likelihood estimate of the rate is 7/6742 = 1.0383 per 1000 sets. The figure shows a near exact fit of the Poisson model to the observed set-level interactions data, reflecting the typical pattern for rare event phenomena at low risk exposure (i.e., a high rate of 0 observations or interactions, a low rate of 1 interactions, and an extremely low rate of 2 or more interactions (none observed in this case).

[3] Hanan, Doyle, D. B. Holts, and L. Atilio Coan, Jr. 1993 The California Drift Gill Net Fishery For Sharks and Swordfish, 1981–82 Through 1990–91. *Fish Bulletin* vol. 175. Scripps Institution of Oceanography Library, Scripps Institution of Oceanography, UC San Diego

[4] Cameron, A. C., & Trivedi, P. K. (2013). *Regression analysis of count data* (Vol. 53). Cambridge University Press.

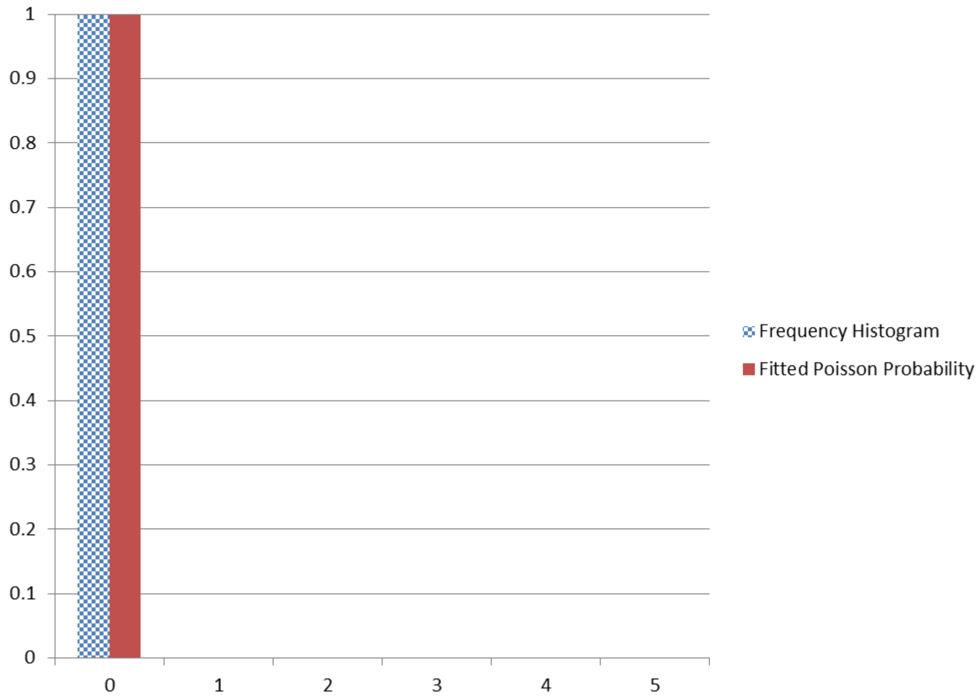


**Figure 1. Comparison of frequency histogram for leatherback sea turtle interactions to fitted Poisson probabilities.**

Furthermore, for rare events there are long intervals between incidents (i.e., the average interval between sets with an interaction is 100 or more sets). Table 20 displays the observed bycatch rate per 500 sets fished in the California swordfish drift gillnet fishery over different time scales; 500 sets corresponds to the approximate current level of annual fishing effort. For each of the high priority species proposed for hard caps, annual bycatch rates over recent years in the observed portion of the fishery are less than 1 in 500 sets (Table 20, Figure 2). The DGN fishery has averaged only slightly more than 100 observed sets per fishing season over the past five seasons, so the number of observed sets in any one year is quite small in relation to the frequency (or infrequency) of these rare events.

**Table 20. Bycatch per 500 sets fished in the CA large-mesh drift gillnet fishery. Observed set sample sizes for this table are as follows: all years: 8,637, pre-PLCA: 6,007, post-PLCA: 2,630, without pingers: 3,906, with pingers: 4,731.**

| Species | All Years 1990–2014 | Pre–PLCA 1990–2000 | Post–PLCA 2001–2014 | Without Pingers 1990–96 | With Pingers 1996–2014 |
|---|---|---|---|---|---|
| Minke Whale | 0.2320 | 0.2500 | 0.19 | 0.256 | 0.211 |
| Blue Whale | 0.0000 | 0.0000 | 0.00 | 0.000 | 0.000 |
| Fin Whale | 0.0579 | 0.0832 | 0.00 | 0.000 | 0.106 |
| Gray Whale | 0.2320 | 0.1660 | 0.38 | 0.000 | 0.423 |
| Humpback Whale | 0.1740 | 0.1660 | 0.19 | 0.128 | 0.211 |
| Common Dolphin (short–beaked) | 23.5000 | 25.7000 | 18.40 | 29.700 | 18.400 |
| Common Dolphin (long–beaked) | 1.2700 | 0.9990 | 1.90 | 1.410 | 1.160 |
| Risso's Dolphin | 2.0300 | 2.4100 | 1.14 | 3.070 | 1.160 |
| Short–finned Pilot Whale | 0.8100 | 0.9160 | 0.57 | 1.410 | 0.317 |
| Pacific White–Sided Dolphin | 2.0800 | 2.0800 | 2.09 | 2.690 | 1.590 |
| Northern Right Whale Dolphin | 4.2300 | 4.6600 | 3.23 | 4.860 | 3.700 |
| Killer Whale | 0.0579 | 0.0832 | 0.00 | 0.128 | 0.000 |
| Dall's Porpoise | 1.3300 | 1.8300 | 0.19 | 2.690 | 0.211 |
| Harbor Porpoise | 0.0000 | 0.0000 | 0.00 | 0.000 | 0.000 |
| Striped Dolphin | 0.0579 | 0.0832 | 0.00 | 0.128 | 0.000 |
| Bottlenose Dolphin | 0.2320 | 0.2500 | 0.19 | 0.384 | 0.106 |
| Pygmy Sperm Whale | 0.1160 | 0.1660 | 0.00 | 0.256 | 0.000 |
| Bairds Beaked Whale | 0.0579 | 0.0832 | 0.00 | 0.128 | 0.000 |
| Hubbs Beaked Whale | 0.2890 | 0.4160 | 0.00 | 0.640 | 0.000 |
| Stejnegers Beaked Whale | 0.0579 | 0.0832 | 0.00 | 0.128 | 0.000 |
| Sperm Whale | 0.5790 | 0.6660 | 0.38 | 0.768 | 0.423 |
| Cuviers Beaked Whale | 1.2200 | 1.7500 | 0.00 | 2.690 | 0.000 |
| Unidentified Beaked Whale | 0.1740 | 0.2500 | 0.00 | 0.384 | 0.000 |
| Unidentified Mesoplodon Beaked Whale | 0.1160 | 0.1660 | 0.00 | 0.256 | 0.000 |
| CA Sea Lion | 12.5000 | 10.2000 | 17.90 | 8.700 | 15.600 |
| Stellers Sea Lion | 0.1160 | 0.1660 | 0.00 | 0.256 | 0.000 |
| Unid. Pinniped | 0.1160 | 0.1660 | 0.00 | 0.000 | 0.211 |
| Harbor Seal | 0.0000 | 0.0000 | 0.00 | 0.000 | 0.000 |
| Northern Elephant Seal | 6.6600 | 9.0700 | 1.14 | 12.300 | 2.010 |
| Loggerhead Sea Turtle | 0.9260 | 1.1700 | 0.38 | 1.540 | 0.423 |
| Green Sea Turtle | 0.0579 | 0.0832 | 0.00 | 0.000 | 0.106 |
| Leatherback sea Turtle | 1.4500 | 1.9100 | 0.38 | 2.560 | 0.528 |
| Olive Ridley Sea Turtle | 0.0579 | 0.0832 | 0.00 | 0.000 | 0.106 |
| Unid. Sea Turtle | 0.1740 | 0.2500 | 0.00 | 0.384 | 0.000 |

Figure 2 depicts entanglement rates before 2001 and after 2000 for the species included in the Council's PPA for hard caps. The bycatch rates per 500 sets in the post-2001 period are in each case considerably lower than proposed cap levels (below 0.6 per 500 sets in all cases).

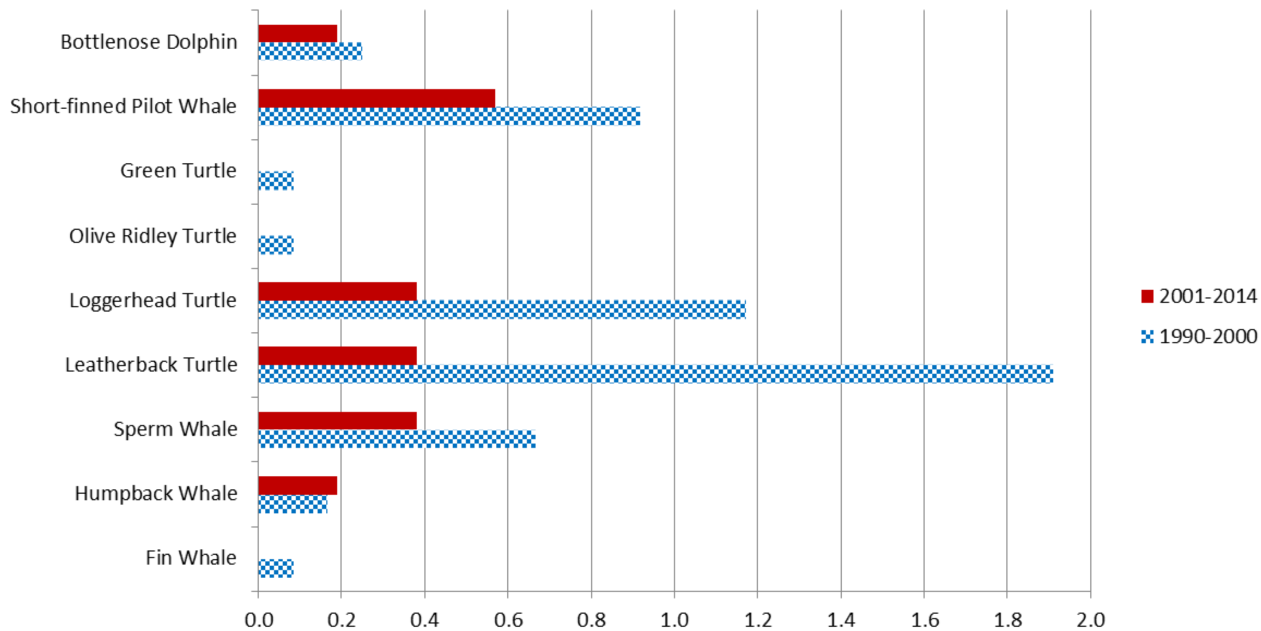


**Figure 2. Observed HMS drift gillnet entanglement rates per 500 sets.**

Any bycatch that is not observed is effectively undetectable. The amount of bycatch occurring in the unobserved portion of the fishery may be estimated, but these estimates should not be confused with "detection;" rather, they are inferred from the bycatch that is observed. While simple expansion techniques may reliably estimate bycatch of commonly-caught species with a low level of uncertainty, this is not the case with rare event bycatch. The sample size (i.e., number of observed sets) and observation period (i.e., number of fishing seasons) needed to obtain reliable estimates is generally larger for species with rare event interactions than for frequently-observed species.

A given set has a very high probability of zero takes, a low probability of one or more takes, and close to zero probability of many takes (e.g., all sets of DGN fishing with a leatherback or humpback interaction had a single interaction). This makes it very difficult to estimate rare event bycatch, because very large sample sizes are needed to accurately estimate rates of interaction or mortality. The method of annual ratio estimates (linear expansion from observed bycatch based on a single season's observations) results in a very large coefficient of variation around estimates for species subject to rare event bycatch.

A recent paper by Martin, et al. (2015)[5] explains alternative estimation procedures employing Bayesian statistics. Bayesian methods allow the integration of information from other sources (in this case, observed bycatch from past fishing seasons) into current estimates of bycatch rates or counts over a time period of interest (e.g., a recent fishing season). This approach can produce probability-based estimates of bycatch and mortality counts or rates where estimation uncertainty is quantified, and which avoid overreliance on one seasons' observer sample. One potential application would be to use the posterior predictive distribution to manage the fishery by limiting fishing effort rather than imposing hard caps when observer coverage is less than 100%. Effort-based management could achieve bycatch reductions comparable to

[5] Martin, Summer L., Stephen M. Stohs, and Jeffrey E. Moore. 2015. Bayesian inference and assessment for rare-event bycatch in marine fisheries: a drift gillnet fishery case study. *Ecological Applications*, 25(2), 2015, pp. 416–429

hard caps while being less potentially disruptive since the fishery would not have to unpredictably close when a hard cap is reached.

The appropriate level of observer coverage depends on both the frequency of bycatch (BPUE), the level of fishery participation, and the management objective. For example, if the question regards the probability that bycatch is below a management threshold (e.g., limit reference point), less observer coverage would be needed to provide a higher degree of confidence the threshold is not exceeded for an incidence rate far below the threshold than for a rate near the threshold.

SWFSC scientist Jim Carretta recommended that managers focus on sample size considerations related to observer coverage, rather than considering specific percentage coverage levels. The rationale for focusing on sample size is this: 20% observer coverage in a fishery with 1,000 sets fished annually yields 200 observations, whereas the same 20% observer coverage applied to a larger fishery with 10,000 sets fished annually yields 2,000 observations. There is no single level of observer coverage that is appropriate for all rare event bycatch management, since the sample sizes required to detect rare events can be quite large. In fisheries with low to modest participation (such as the DGN fishery with approximately 500 annual sets), even 100% observer coverage would require multiple years of observation before a rare event is detected.

Mr. Caretta provided the following example to clarify his point: 10 sperm whales were observed caught from 8,637 fishing sets over a period of 25 years in the DGN observer data. 4000 additional sets of observed fishing effort would be needed to detect a doubling of the observed rate of 1.16 animals per 1,000 observed sets (10 whales / 8,637 sets) with 80% probability. At current levels of fishery participation (500 sets annually) the reliable detection of a doubling of the bycatch rate would require 8 years of observations with 100% observer coverage. This is an important point, because the ability to observe fisheries at 100% is difficult and at that point, the manager's biggest assets are knowledge of the long-term bycatch rate for rare species and levels of fishery effort. The long-term bycatch rate can be used in concert with annual fishing effort to project annual fishing bycatch mortality (in the absence of large changes in the underlying rate of bycatch, which requires many more years of data collection). By managing fishing effort, the manager can then effectively manage bycatch, given some confidence in measured long-term bycatch rates in the fishery. This is true whether or not observer coverage is zero or 100%.

Mr. Carretta recommends managers observe as much fishing effort as possible, given resource constraints, when attempting to document rare event bycatch, rather than focusing on a percentile level of observer coverage that may be insufficient to detect differences when fishery participation is low or modest.

Table 21 provides published bycatch rate estimates over the most recent five year period for which they are available, from 2008-2012. Confidence intervals for the estimates were produced using bootstrap simulation. Data sources and methodology are documented in a series of NOAA Technical Memoranda.

**Table 21. Marine mammal and sea turtle bycatch estimates for HMS drift gillnet fishery, 2008-2012.**

| Year | Species | Observed | Estimated | Coefficient of Variation (CV) |
|---|---|---|---|---|
| 2008 (n=149 observed sets) | Common dolphin, short-beaked | 8 | 59 | 0.43 |
| | Common dolphin, long-beaked | 1 | 7 | 1.08 |
| | Pacific white-sided dolphin | 5 | 37 | 0.7 |
| | Northern right whale dolphin | 1 | 7 | 0.99 |
| | Risso's dolphin | 1 | 7 | 0.99 |
| | California sea lion | 7 | 51 | 0.52 |
| 2009 (n=101 observed sets) | Common dolphin, short-beaked | 1 | 7 | 1.11 |
| | Pacific white-sided dolphin | 2 | 15 | 1.01 |
| | California sea lion | 5 | 37 | 0.83 |
| 2010 (n=59 observed sets) | Common dolphin, short-beaked | 3 | 25 | 0.64 |
| | Common dolphin, long-beaked | 1 | 8 | 1 |
| | Northern right whale dolphin | 1 | 8 | 0.98 |
| | Bottlenose dolphin | 1 | 8 | 0.96 |
| | Sperm whale | 2 | 16 | 0.95 |
| 2011 (n=85 observed sets) | Common dolphin, short-beaked | 2 | 10 | 0.69 |
| | Common dolphin, long-beaked | 1 | 5 | 1.02 |
| | Northern right whale dolphin | 1 | 5 | 1.05 |
| | Risso's dolphin | 1 | 5 | 1.02 |
| | California sea lion | 18 | 92 | 0.79 |
| 2012 (n=83 observed sets) | Common dolphin, short-beaked | 5 | 26 | 0.78 |
| | Northern right whale dolphin | 1 | 5 | 1.01 |
| | California sea lion | 6 | 32 | 0.6 |
| | Leatherback sea turtle | 1 | 5* | 1.09 |

* Estimate of entanglements, including animals released alive: 2.6 dead, 2.2 alive, 0.2 unknown, based on prorated fractions from observer data.

PFMC
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