

**Annual Report under Section 101(a)(5)(A) of the MMPA for Fisheries and Ecosystem Research
Activities Conducted by Southwest Fisheries Science Center during
January 1, 2018 – December 31, 2018**

On October 30, 2015, the Southwest Fisheries Science Center (SWFSC) received Letters of Authorization (LOA) under section 101 (a)(5)(A) of the Marine Mammal Protection Act (MMPA; 16 U.S.C.1371(a)(5)) to take marine mammals incidental to fishery and ecosystem research activities in the California Current Ecosystem (CCE), the Eastern Tropical Pacific (ETP), and the Antarctic Marine Living Resources Ecosystem (AMLR). Take of marine mammals incidental to SWFSC fishery and ecosystem research activities are subject to the provisions of the MMPA and the regulations governing this take as described in 50 CFR Part 219, Subpart A (CCE), 50 CFR Part 219, Subpart B (ETP), and 50 CFR Part 219, Subpart C (AMLR). These authorizations are valid through October 29, 2020.

In accordance with these authorizations, the SWFSC is required to provide annual reports. The following report will cover the period from January 1, 2018 - December 31, 2018 in the California Current Ecosystem (CCE). The Center did not conduct research in the AMLR or ETP, and thus they will not be included in this report.

The report will be organized into the following sections:

- I. Overview of SWFSC's Required Mitigation Measures
- II. Line-Kilometers Surveyed During Which EK60/80, ME70 and SX90 Were Predominant and Pro-Rated Estimates of Actual Level B Acoustic Take
- III. SWFSC Gear Metadata for All Fisheries and Ecosystem Surveys in the CCE During the Reporting Period
- IV. Accounts of All Incidents of Marine Mammal Interactions in the CCE
- V. Evaluation of Effectiveness of SWFSC Mitigation Strategies
- VI. Final Outcome of Serious Injury Determinations
- VII. Updates of Development / Implementation of Marine Mammal Excluder Devices and Analysis of Bycatch Patterns
- VIII. Training Provided to SWFSC Staff

In each section, a summary for the California Current Research Area will be described in relation to the reporting period.

I. Overview of SWFSC's Required Mitigation Measures

With the issuance of the SWFSC's MMPA LOA's, a set of prescribed mitigation measures were outlined for the Center to follow on all surveys in order to attempt to minimize the likelihood or severity of incidental gear interactions with marine mammals and other protected species. These measures vary slightly depending on the gear type and survey, but are mainly comprised of dedicated marine mammal/protected species watches, an associated exclusion zone, and move-on rule if protected species are seen during watch, and standard operating procedures by gear type.

Below are gear specific descriptions of these conservation measures in trawl-based surveys:

- **30-minute pre-set watch**

During all SWFSC trawl surveys, a dedicated observer must initiate a 30 minute pre-set watch (visual observation) prior to deploying trawl gear. The surrounding waters are scanned with the naked eye and range finding sighting instruments during the day and at night are conducted using the naked eye and available vessel lighting.

- **Move-on rule**

If a marine mammal or other protected species is seen during the pre-set watch within 1 nautical mile (n mi) of the set location (i.e. exclusion zone), the move on rule must be implemented: before starting the haul, the ship must move on to ensure that the observed marine mammal is 1 n mi away from the set location. If, after moving on, the marine mammal remains in the exclusion zone (within that 1 n mi radius of the set location) the ship must move again or skip the station. In 2018, the LOA issued for the California Current Research Area was modified to reduce the exclusionary zone of the move on rule from 1 n mi to 0.25 n mi for baleen whales.

- **Active gear monitoring**

Once trawl net deployment begins, an active gear watch (visual monitoring during gear deployment, fishing, and retrieval) must be conducted by a dedicated observer. If a marine mammal is seen during the active gear watch, the most appropriate action to avoid an interaction will be determined through the use of professional judgement. If professional judgment is employed, it will be recorded, and only to be used in circumstances when the gear is already deployed. Further defined, if a marine mammal is seen during the pre-set watch, the move-on rule must be implemented, but if it is seen during deployment of the net, active fishing or haul back, then professional judgment will be used to determine the best course of action to avoid an interaction.

- **Marine mammal excluder device (MMED)**

On the Nordic 264 trawl, a marine mammal excluder device is used at all times. This device was developed to allow marine mammals to escape from the net without losing target catch. The modified cobb trawl is not equipped with a MMED.

- **Acoustic deterrent devices**

On all SWFSC trawl nets, 2-4 acoustic deterrent devices, or pingers, are placed along the head rope and footrope to deter marine mammals from entering the net. On Rockfish Recruitment and Ecosystem Assessment Survey (RL-18-02), two DDD-03 pingers were attached to the trawl net. On the California Current Ecosystem Survey (RL-18-07), two to four pingers (3kHz @ 135 dB, 10 kHz @ 132 dB, and 70 kHz @ 145 dB) were placed along the footrope and/or head rope for all trawls. Pingers are tested for functionality upon each haulback of the net.

- **Other standard trawl survey protocols**

The SWFSC also employs several standard survey protocols to attempt to minimize impacts to protected species: 1) the gear will be emptied as quickly as possible upon retrieval in order to determine whether to or not protected species are present, and 2) care will be taken when emptying the trawl to avoid damage to protected species that may be caught, but not visible during retrieval of the net.

II. Line-Kilometers Surveyed During Which EK60/EK80, ME70, and SX90 Were Predominant and Pro-Rated Estimates of Actual Level B Acoustic Take

Two trawl-based surveys were conducted in the California Current Ecosystem during the reporting period. The Rockfish Recruitment and Ecosystem Assessment Survey (RL-18-02), and the California Current Ecosystem Survey (RL-18-07). The tables below are the combined acoustic data from both surveys for the reporting period. Additionally, a Saildrone (autonomous surface vehicle) was introduced and operated in shallow waters to compliment RL-18-07's coastal pelagic species portion of the survey.

Table 1. Total line-kilometers (kms) surveyed during the reporting period for which the SX90, EK60/EK80, or ME70 echosounder was the predominant acoustic source in the CCE compared to the totals calculated in the SWFSC's MMPA LOA application (Appendix C of SWFSC's National Environmental Policy Act (NEPA) Programmatic Environmental Assessment (PEA). Included in the 'EK60/EK80 - Summed line-kms of reporting period/source (0-200 m)' column are a fraction of Saildrone line-kms, which operated with an EK80 WBT mini echosounder. The acoustic output for this source operates with less power at 38kHz (500W), less frequent intervals (~2 seconds) and a wider bandwidth (18 degrees) than that of the echosounder on the ship. To calculate the difference in acoustic output between the WBT Mini echosounder vs. the ship's EK60/80 echosounder, the following equation was used: (Total Saildrone kms) *(Change in beamwidth 7/18) * (Change in power 500/2000) for operation at 38 kHz. The resulting number obtained was approximately 10% of the total Saildrone line-kms, which was added to the total line kms reported for the ship, and subsequently analyzed. The totals below include both ship and drone acoustic sources for the estimation of Level B take.

California Current Ecosystem				
Echosounder	EA Estimated summed dominant line kms/source (0-200 m)	Summed line-kms of reporting period / source (0-200 m)	EA Estimated summed dominant line-kms/source (>200 m)	Summed line-kms of reporting period / source (>200 m)
SX90	33,880	1680	33,880	4577
EK60/EK80	79,912	6883	99,640	24248
ME70	19,728	725	0	0

Table 2. SWFSC’s annual Level B harassment by acoustic sources by sound type for each marine mammal species in the CCE. For each species and predominant source, the cross-sectional area for the relevant depth strata (Table 6.5 of SWFSC’s PEA Appendix C) was multiplied by the actual line-km for each respective strata (Table 1), and the volumetric density (shown here) to assess Level B harassment for the reporting period.

Common name	Volumetric Density (#/km ³)	Typical vertical habitat		SWFSC Reporting Period Acoustic Takes (# of animals)			Reporting Period Total Takes	EA Estimated Annual Takes
		0-200 m	>200 m	EK60/EK80	ME70	SX90		
<i>CCE Cetaceans</i>								
Harbor porpoise	0.188725	X		17	2	21	40	682
Dall’s porpoise	0.37765	X		33	5	41	80	1365
Pacific white-sided dolphin	0.10465	X		9	1	11	22	378
Risso’s dolphin	0.0523	X		5	1	6	11	189
Bottlenose dolphin	0.0089	X		1	0	1	2	32
Striped dolphin	0.08335	X		7	1	9	18	301
Short-beaked common dolphin	1.54675	X		139	20	170	329	5591
Long-beaked common dolphin	0.0962	X		9	1	11	20	348
Northern right-whale dolphin	0.04875	X		4	1	5	10	176
Killer whale	0.00355	X		0	0	0	1	13
Short-finned pilot whale	0.00062		X	2	0	0	2	12
Baird’s beaked whale	0.00176		X	6	0	1	7	34
Mesoplodon beaked whales	0.00206		X	7	0	2	8	39
Cuvier’s beaked whale	0.00764		X	25	0	6	31	146
Pygmy sperm whale	0.00218		X	7	0	2	9	42
Dwarf sperm whale	0.00218		X	7	0	2	9	42
Sperm whale	0.0034		X	11	0	3	14	65
Humpback whale	0.00415	X		0	0	0	1	15
Blue whale	0.0068	X		1	0	1	1	25
Fin whale	0.0092	X		1	0	1	2	33
Sei whale	0.00045	X		0	0	0	0	2
Common Minke whale	0.0036	X		0	0	0	1	13
Gray whale	0.09565	X		9	1	10	20	346
<i>CCE Pinnipeds</i>								
California sea lion	1.19	X		107	16	130	253	4302
Steller sea lion, eastern subspecies	0.29165	X		26	4	32	62	1054

Guadalupe fur seal	0.03705	X		3	0	4	8	134
Northern fur seal	1.68275	X		151	22	185	358	6083
Harbor seal	0.252	X		23	3	28	54	911
Northern elephant seal	0.248		X	814	0	185	1000	4744

III. SWFSC Gear Metadata for All Fisheries and Ecosystem Surveys in the CCE During the Reporting Period

Table 3. SWFSC trawl survey metadata for the reporting period by trawl net and research area.

Research Area	Trawl Net	Total # tows	Fishing Depth Range (m)	Average Tow Duration of active fishing (minutes)
<i>California Current Ecosystem</i>	Modified cobb	136	3-50	15
	Nordic 264	169	0-15	45

In the CCE, the modified cobb net was used during the Juvenile Rockfish Recruitment Survey (RL-18-02) and the Nordic 264 net was used for the California Current Ecosystem Survey (RL-18-07).

Table 4. SWFSC reporting period hook and line metadata in the CCE.

Gear Type	Survey	Total # Drifts	# Hooks	Total Hook Hours	Hook Type	Fishing Depth Range (m)
<i>Hook and Line</i>	Life History and Reproductive Ecology Investigations of Rockfish	76	-	-	-	46-214

The Life History and Reproductive Ecology Investigations of Rockfish project is a cooperative study conducted to collect adult rockfish for reproduction studies. The study does not use standard fishing, rather incorporates drift fishing using sabiki rigs with up to 5 hooks to shrimp flies (in a range of hook sizes, generally two hooks per rig). Occasionally deckhands will increase the amount of hooks on a line, as this can be variable. Effort for this project is monitored via the number of drifts, and anglers per trip.

Longline gear was not used during the reporting period.

IV. Accounts of All Incidents of Marine Mammal Interactions in the CCE

The following section will detail the SWFSC Level A marine mammal interaction events in the CCE.

Table 5. SWFSC’s take table from the MMPA LOA for the CCE (Table 1 in the authorization) displays the takes issued to the Center by gear type in that ecosystem over the five year authorization period (October 2015 - October 2020).

Species	Authorized Take		
	M/SI + Level A ¹		Level B ²
	Trawl	Longline	
Gray whale (<i>Eschrichtius robustus</i>)	-	-	346
Humpback whale (<i>Megaptera novaeangliae</i>)	-	-	14
Minke whale (<i>Balaenoptera acutorostrata</i>)	-	-	13
Sei whale (<i>Balaenoptera borealis</i>)	-	-	1
Fin whale (<i>Balaenoptera physalus</i>)	-	-	33
Blue whale (<i>Balaenoptera musculus</i>)	-	-	24
Sperm whale (<i>Physeter macrocephalus</i>)	-	-	65
Pygmy or dwarf sperm whale (<i>Kogia</i> spp.)	-	1	42
Cuvier’s beaked whale (<i>Ziphius cavirostris</i>)	-	-	146
Baird’s beaked whale (<i>Berardius bairdii</i>)	-	-	34
Hubbs’, Blainville’s, ginkgo-toothed, Perrin’s, lesser, or Stejneger’s beaked whales (<i>Mesoplodon</i> spp.)	-	-	40
Bottlenose dolphin (<i>Tursiops truncatus</i>)	CA/OR/WA stock	8	32
	CA coastal stock	3	
Striped dolphin (<i>Stenella coeruleoalba</i>)	11	1	301
Long-beaked common dolphin (<i>Delphinis capensis</i>)	11	1	348
Short-beaked common dolphin (<i>Delphinis delphis</i>)	11	1	5,592
Pacific white-sided dolphin (<i>Lagenorhynchus obliquidens</i>)	35	-	378
Northern right whale dolphin (<i>Lissodelphis borealis</i>)	10	-	176
Risso’s dolphin (<i>Grampus griseus</i>)	11	1	188
Killer whale (<i>Orcinus orca</i>)	-	-	13
Short-finned pilot whale (<i>Globicephala macrorhynchus</i>)	-	1	12
Harbor porpoise (<i>Phocoena phocoena</i>)	5	-	682
Dall’s porpoise (<i>Phocoenoides dalli</i>)	5	-	1,365
Guadalupe fur seal (<i>Arctocephalus philippii townsendi</i>)	-	-	134
Northern fur seal (<i>Callorhinus ursinus</i>)	California stock	-	236
	Pribilof Islands/ Eastern Pacific stock	5	11,555
California sea lion (<i>Zalophus californianus</i>)	20	5	4,302
Steller sea lion (<i>Eumetopias jubatus</i>)	9	1	1,055
Harbor seal (<i>Phoca vitulina</i>)	9	-	910

Northern elephant seal (<i>Mirounga angustirostris</i>)	5	-	4,743
Unidentified cetacean (Family Delphinidae or Family Phocoenidae)	1	-	-
Unidentified pinniped	1	1	-

¹ These takes may be by mortality or any lesser intensity, including serious injury and Level A harassment, and are apportioned by gear type. The number represents the total authorization over five years. ² These takes may be by Level B harassment only. The number represents the annual take authorization for five years.

Table 6. SWFSC’s Level A take in trawl gear (modified Cobb and Nordic 264 nets) for the reporting period and the remaining takes left for trawl surveys during the authorization period.

Authorized Trawl Species	# of Level A (M/SI) authorized incidental takes (2015-2020)	SWFSC Trawl Takes for the reporting period	Remaining Takes
Bottlenose dolphin (<i>Tursiops truncatus</i>) CA/OR/WA offshore	8	0	8
Bottlenose dolphin (<i>Tursiops truncatus</i>) CA coastal	3	0	3
Striped dolphin (<i>Stenella coeruleoalba</i>)	11	0	11
Short-beaked common dolphin (<i>Delphinis delphis</i>)	11	0	11
Long-beaked common dolphin (<i>Delphinis capensis</i>)	11	0	11
Pacific white-sided dolphin (<i>Lagenorhynchus obliquidens</i>)	35	3	23
Northern right whale dolphin (<i>Lissodelphis borealis</i>)	10	0	10
Risso’s dolphin (<i>Grampus griseus</i>)	11	0	11
Harbor porpoise (<i>Phocoena phocoena</i>)	5	0	5
Dall’s porpoise (<i>Phocoenoides dalli</i>)	5	0	5
Northern fur seal (<i>Callorhinus ursinus</i>) – California Stock & Pribilof Islands/ Eastern Pacific stock	5	0	5
California sea lion (<i>Zalophus californianus</i>)	20	1	19
Steller sea lion (<i>Eumetopias jubatus</i>)	9	0	9
Harbor seal (<i>Phoca vitulina</i>)	9	0	9
Northern elephant seal (<i>Mirounga angustirostris</i>)	5	0	5
Unidentified pinniped	1	0	1
Unidentified cetacean (Family Delphinidae or Family Phocoenidae)	1	0	1

Level A Marine Mammal Interactions

During the reporting period, SWFSC had 4 separate interaction events with marine mammals that resulted in a total of 3 Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) and 1 California sea lion (*Zalophus californianus*) being taken. All interaction events occurred on the NOAA Reuben Lasker fisheries research vessel (FSV) during nighttime trawl operations. All required mitigation measures were followed each event. Pingers were tested for functionality, a dedicated observer performed the pre-set, gear deployment, active fishing, and gear retrieval watch. Watch logs and anecdotal narratives of this event indicate that no protected species were seen during these watches. Therefore, the move-on rule was not implemented and no professional judgement decisions were made. The modified Cobb net was deployed with two STM Products DDD-03 dolphin pingers on the mouth of the net. There is no requirement for the modified Cobb to use a MMED, and to date, SWFSC has not developed or tested a MMED for this gear type. The scientists followed SWFSC's Detailed Sampling Protocol for Marine Mammal and Sea Turtle Incidental Takes During SWFSC Research Cruises (PSIT-002.02) to determine species ID and sex, and they took photographs and measurements prior to freezing the carcass.

Incidental takes occurred during both the RL-18-02 and RL-18-07 surveys. The first of the four incidental takes occurred on June 14, 2018 on RL-18-02, using the midwater modified Cobb trawl net to sample for pelagic juvenile rockfish (*Sebastes* spp.) and other epi-pelagic micronekton.

Incidental take of a Pacific white-sided dolphin occurred off the coast of Central California (35.01983°N, -120.98433° W) during trawling operations (Haul 108) between the time period of 2:46 am, the start of the sampling event and 3:30am, the completion of the sampling event. Prior to the sampling event, a 32 minute protected species watch was conducted, and no protected species were seen. Similarly, a protected species watch was conducted during active fishing (depth: 30 m) and gear retrieval. A deceased male dolphin, 175 cm in length, was found in the codend of the modified cobb trawl upon gear retrieval. A laceration was present on the left pectoral fin, proximally located to the body. A noticeable abrasion was present on the medial edge of the right fluke tip. Abrasion marks were visible on the dorsal and pectoral fins, along with the fluke. The dorsal fin had a notch in the trailing edge. Photographs were taken, and reported to the Protected Species Incidental Take (PSIT) database. Pingers were tested, and found to be functional during the sampling event. The animal was stored frozen and subsequently transferred to the Marine Mammal and Turtle Division at SWFSC for necropsy and analysis.

A second incidental take during RL-18-02 was a California sea lion, which occurred on June 21, 2018 during trawl operations (Haul 136) between the time period of 2:05 am, the start of the sampling event, and 2:58 am, the end of the sampling event. Prior to the sampling event, a 30 minute protected species watch was conducted, and no protected species were seen. Similarly, a protected species watch was conducted during gear deployment, active fishing (tow speed: 2 kts; depth: 30 m), and during gear retrieval. The 115.57 cm sea lion was discovered deceased in the codend upon gear retrieval. Photographs were taken, and reported to PSIT. Two DDD pingers located on the headrope were tested, and deemed functional during the sampling event. The whole carcass was stored frozen for subsequent transfer to the Marine Mammal and Turtle Division at SWFSC for necropsy and analysis.

A third incidental take was reported from RL-18-07 on July 24, 2018, when a Pacific white-sided dolphin was taken during trawl operations (Haul 47) between 2:48 am, the start of the sampling event, and 3:33 am, the completion of the sampling event. Prior to haulback of the trawl, a 125 minute protected species watch, including the mandatory 30 minute watch, was performed during pre-set, gear deployment (tow speed: 3.7 kts) and gear retrieval. No protected species were seen during this time.

Watch logs of this event indicate that no dolphins had been observed for two days prior to the take. A deceased male, 183 cm Pacific white-sided dolphin was discovered entangled in 8 inch mesh, just forward of the MMED. A superficial laceration of unknown origin was observed. Some Level A data, photos and a skin sample were taken upon discovery. Pingers were tested, and found to be functional during the sampling event. The whole carcass was stored frozen for transfer to the Marine Mammal and Turtle Division at SWFSC for subsequent necropsy and analysis.

A final incidental take was reported on August 27, 2018 from RL-18-07 when a Pacific white-sided dolphin was taken during trawl operations (Haul 120) between 11:38 pm, the beginning of the sampling event, and 12:23 am, the end of the sampling event. Prior to the sampling event, a 30 minute protected species watch was performed, with no protected species seen. The watch continued during gear deployment, active fishing (tow speed: 3.8 kts) and gear retrieval, for a total watch time of 150 minutes in which no protected species were seen. Upon retrieval of the gear, a deceased, female, 186 cm Pacific white-sided dolphin was found entangled forward of the MMED in 4 x 4 inch mesh. Pingers were immediately tested, and deemed functional. Some Level A data and photos were taken upon discovery. The carcass was stored frozen for transfer to the Marine Mammal and Turtle Division at SWFSC for subsequent necropsy and analysis.

All accounts of incidental take were reported to the Protected Species Incidental Take (PSIT) database within 48 hours. Notifications were then administered to appropriate parties. See Appendix A for Map 1 depicting location of SWFSC marine mammal take events from reporting period.

V. Evaluation of Effectiveness of SWFSC Mitigation Strategies

An evaluation of the mitigation measures employed by the SWFSC to reduce potential impacts to marine mammals is outlined below for trawl gear. For detailed mitigation measure descriptions, please see Section 1 of this report.

Trawl Marine Mammal Mitigation Measures

The SWFSC uses two types of trawl nets that require the implementation of mitigation measures, the Nordic 264 surface trawl, and the modified Cobb midwater trawl net. During use of any of these nets, the following mitigation protocols must be observed: protected species watches (30 minute and active gear), move-on rule, use of acoustic pingers, use of a MMED on Nordic 264 net only, use of professional judgement, and standard survey protocols (all described in detail in Section 1).

To ensure compliance with these regulations, SWFSC implemented the use of boilerplate language in all cruise/project instructions for trawl surveys that use the Nordic 264 or modified Cobb nets. The boilerplate language provides detail and instruction on the required mitigation measures and other standard trawl protocols. In addition, the Center has continued collecting data in watch logs during each survey to record sightings of marine mammals or other protected species during required watches, and if they were, what actions were implemented to mitigate potential interactions (e.g. move-on rule, or professional judgement decisions.)

Over the reporting period, our watch logs showed that during nighttime surveys, we are often able to see or hear animals in close proximity to the ship, and subsequently implement the move-on rule in order to avoid interaction. Through anecdotal descriptions, we know that these sightings typically occur

in good conditions, i.e., no clouds, moonlight, low sea state (beaufort), etc. and most importantly, when the animals are near the ship. However, once the net is out fishing, it is located far from the ship and therefore, even in the good nighttime conditions, it is nearly impossible to see if there are marine mammals close by the net while it is actively fishing. This is evidenced by the fact that on the four trawl events that took marine mammals during this reporting period, no marine mammals were seen during the pre-set, gear deployment, active fishing and gear retrieval watches, however, the animals were found deceased in the net upon retrieval.

Table 7. Implementation and effect of marine mammal (MM) watches and move-on rule on SWFSC Trawl surveys during the reporting period.

Trawl Survey	Total # tows	Move-on Implemented	% total tows that had to move-on	Trawl aborted due to MM	% of total tows cancelled due to MM	Interaction events w/ MM
<i>Nordic 264 Net</i>						
California Current Ecosystem Survey RL-18-07	169	5	3%	3	1%	2
<i>Modified Cobb Net</i>						
Rockfish Recruitment and Ecosystem Assessment- RL-18-02	136	7	5%	2	2%	2

The column labeled ‘Move-on Implemented’ represents the number of hauls where marine mammals were seen within 1 n mi of the set location during the pre-set watch, resulting in the ship moving on to exclude them from the restricted radius. The column labeled ‘% of total tows that had to move on’ represents the percentage of total tows that the ship moved to exclude marine mammals. The column labeled ‘Trawl aborted due to MM’ reflects the number of times that a station was skipped due to the prolonged presence of marine mammals within the 1 n mi radius, and associated percentage in the column to the right labeled ‘% of total tows cancelled due to MM.’ The column labeled ‘Interaction events w/MM’ reflects the number of times when marine mammals directly interacted with trawl gear.

In some instances of marine mammal sightings, the move-on rule was successful in avoiding marine mammal interactions and the net was subsequently set. But, in others, the haul was cancelled due to the continued presence of marine mammals within the restricted 1 n mi radius. Additionally, tow cancellation could have been the result of marine mammal sightings when the net was already set, before the doors were deployed and the mouth of the net was opened, indicating the commencement of active fishing. In such instances, a professional judgement call was made, and the net was immediately hauled back to avoid an interaction (trawl aborted).

During the RL-18-02 survey, there was one instance where ~5 dolphins were seen off the stern at the start of the protected species watch, yet far from the designated station. The ship slowed, and dolphins left the area. No protected species were seen for the remainder of the watch. During the RL-18-07 survey, there were 2 separate occasions during the protected species watch, the bongo nets were

actively fishing, and ship lights were turned on. Observers spotted dolphins feeding in close proximity. In both events, ship lights were turned off, the ship remained in transit, and the dolphins did not follow.

It can be noted from the watch logs that there were many occasions where California sea lions and dolphins were seen during the haul back portion of the active gear watch. These animals were typically seen swimming around the hull of the ship, or codend of the net as it is towed back and brought aboard the ship. In all of these instances when marine mammals were seen, haul back continued as usual, i.e., no alternative action was taken, and none of these instances resulted in a marine mammal take. During the RL-18-07 survey, professional judgement was practiced in one instance when a dolphin was seen during active fishing, and after the net was open. Collapsing of the net, in this case, could have resulted in a fatal incidental take. Therefore, a professional judgement call was made to proceed with the sampling event. Additionally, on three separate occasions, observers witnessed California sea lions depredating fish being released from the codend. The sea lion(s) were observed once during gear retrieval/haul back, and the other two occasions, during active fishing. A professional judgement call was made to continue fishing, with no resulting incidental takes.

For all trawl surveys, pre-set and active gear watches were conducted 100% of the time for the reporting period. In every instance during all surveys where the move-on rule was implemented, and a trawl followed, there was no interaction with protected species. Pingers were deployed and functioning on every tow for both nets throughout the reporting period.

VI. Final Outcome of Serious Injury Determinations

No serious injury determinations were made during the reporting period. However, there were four instances of final outcome determination, resulting in fatal incidental take, as described in Section 4. A total of 3 Pacific white-sided dolphins and one California sea lion were taken incidentally in the California Current Ecosystem Survey and Juvenile Rockfish Survey trawl activities. Photographs of these events were taken immediately after the event. No video is available from the events.

VII. Updates of Development / Implementations of Marine Mammal Excluder Devices and Analysis of Bycatch Patterns

There is currently no analysis of SWFSC's bycatch patterns being conducted. However, a major part of implementing EC / ITA compliance throughout the Center has been devoted to data collection to aid in the understanding of the practical impacts of our mitigation measures on limiting survey impacts to protected species. With additional years of data collection, we may be able to develop a more informed view of the efficacy of our mitigation strategies.

The use of passive acoustics as a potential mitigation measure to aide with detecting marine mammals in close proximity of trawl gear is in consideration for reliability and feasibility. The use of ship-mounted hydrophones, along with a species-specific model and vocalization recognition could provide an additional layer of detection during nighttime trawl operations, complementing the 30 minute protected species watch prior to set, during gear deployment and during retrieval.

VIII. Training Provided to SWFSC Staff

The SWFSC is required to conduct annual training for chief scientists and other personnel responsible for implementing mitigation measures, data collection, and reporting requirements. A portion of the training must be dedicated to discussion on the use of best professional judgement to avoid marine mammal interactions to gain an understanding of successful versus unsuccessful decisions.

Annual training occurred on May 1, 2018 at SWFSC in La Jolla, CA, and included the following topics: overview and background of statutory requirements, SWFSC's incidental take history, development of the Center's mitigation measures, scope of coverage for the Center's authorized takes and implementation of the authorization conditions (mitigation measures, reporting requirements, data collection, etc), discussion of the use of professional judgement in interactions/avoidance practices with protected species, and review of handling and sampling methodologies for marine mammal and sea turtles (in coordination with the SWFSC Marine Mammal and Turtle Division).

After completion of the field season, a SWFSC Fisheries & Ecosystem Environmental Compliance Forum was held on December 13, 2018. This forum focused on 2018 field season debrief and discussed the implementation of mitigation measures. A survey was designed, and distributed to staff listed on 2018 cruise / project instructions prior to the forum.

The survey results highlighted the following key topics that were covered in forum discussions:

- 1) Overview of current mitigation measures and effect on data collection
- 2) Need / want for improvements of required EC/ITA measures
- 3) New / additional mitigation measures

During the 2018 field season, the LOA issued for the California Current Research Area was modified to reduce the exclusionary zone of the move on rule from 1 n mi to 0.25 n mi for baleen whales. Trawl surveys with special interest areas off the coast of California (Gulf of the Farallone and Monterey Bay) operate where large whales often aggregate to forage. The modification allowed scientists to meet survey objectives without having to skip a multitude of stations due to the whales' aggregation and locations. The use of professional judgement continued to be enforced if a baleen whale appeared within the 0.25 n mi exclusionary radius during active fishing. The Coastal Pelagic Species Survey, due to their survey design comprised of non-fixed stations, did not experience a measurable change in data collection efforts.

Additionally, PSIT database training and authorizations were given to selected staff on each leg of the survey for ease of reporting any protected species that are incidentally taken. This newly modified system generated positive feedback. Future incidental takes of protected species will continue to be reported by staff as outlined in PSIT 001.02.

Appendix A

Figure 1. This map displays SWFSC's take of protected species protected under the MMPA and Endangered Species Act (ESA) over the reporting period.

