Testing of Experimental Deep-set Buoy Gear to Capture Swordfish (Xiphias gladius) off the West Coast of United States

Environmental Assessment

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1.1 Proposed Action

The proposed action is to approve for testing of experimental Deep-set Buoy Gear (DSBG) and Deep-set Linked Buoy Gear (DSLBG) trials off the U.S. West Coast via appropriate permitting, award of financial assistance programs, or both.

If approved, the proposed action is intended to examine the effects conducting gear trials using deep-set daytime techniques for targeting swordfish off the U.S. West Coast. Given that the gear types proposed are novel and currently in the development phase, NMFS uses the following criteria to define the gear types considered in this assessment. Gear used to target swordfish and other marketable HMS species that (1) is fished below the thermocline during the day to avoid non-target interaction, (2) is designed with $\leq$30 hook maximum, and (3) is designed with the capacity to be serviced during fishing operations, which entails the detection of strikes and potential to release non-target species that may be encountered during fishing operations.

1.2 Purpose and Need for Action

The purpose of the action is to test and gather data on the selectivity of deep-set buoy gears to promote the sustainable development of highly migratory species fishing opportunities for U.S. West Coast fishing communities. 'Selectivity' is broadly defined and measured as the fishing gear's ability to attain a catch composition with a high percentage of target catch (e.g. swordfish) while minimizing the catch composition percentage of non-marketable finfish and protected species. According to regulations, a NMFS Regional Administrator may authorize "for limited testing, public display, data collection, exploratory, health and safety, environmental cleanup, and/or hazard removal purposes, the target or incidental harvest of species managed under a fishery management plan (FMP) or fishery regulations that would otherwise be prohibited" (50 CFR 600.745(b)). Issuance of appropriate fishing permits, award of financial assistance, or both, which is the Proposed Action analyzed in this EA, is needed to provide for such testing and data collection. Gathering such information is critical for making informed ecosystem-based decisions on the conservation, management, and sustainable utilization of fish stocks. Further, the Proposed Action is intended to support mandates outlined within the MSA to promote the development and testing of new gear technology, minimization of bycatch and efficient harvest of target species (MSA, Section 104).

2.0 Alternatives

This EA examines an action alternative, which authorizes the use of two types of buoy gear (DSBG and DSLBG) designs (i.e., deep-set daytime fishing). Additionally, a no-action alternative is also analyzed. The deep-set buoy gear iterations proposed under the action alternative are similar in that they are designed to target swordfish and other marketable HMS species below the thermocline (>90m) during daylight hours and fishing may occur year-round. Gear will be set and retrieved predominately during daylight hours. Haul-back procedures will commence by sunset. Testing of gear may occur on research vessels or commercial fishing vessels. To accurately describe the activities included in the Preferred Alternative presented below, definitions of gear types and a list of conservation attributes are described.

1. Alternative 1: Approval of the testing of a combination of deep-set fishing gear techniques (DSLBG and DSBG) via appropriate permitting, such as EFPs, and/or financial assistance awards. (Preferred Alternative) The fishing activities under this alternative are further subject to conservative terms and conditions and are not exempt from existing or future catch limits, harvest guidelines, and compliance with other management measures and authorities for conserving marine resources.
2. Alternative 2: No Action, NMFS would not approve, via appropriate permitting or award of financial assistance programs, the testing of any DSBG or DSLBG gear configurations.

2.0.1 DSBG description

One full set of DSBG consists of up to 10 individual pieces of gear that can be simultaneously individually soaked, over an approximate radius foot-print of 5nm Each buoy gear piece consists of 200 – 400 meters (m) of vertical mainline (2.8 mm or greater) attached to a 3-4 kilogram (kg) lead weight. A maximum of up to three ~8 to 10 m branching gangions can be used at different depths, all of which must be below the mixed layer (>90 m). An illumination source (e.g., cyalume or power light) may be used proximal to each gangion if desired. Two of the branching gangions are considered to be targeting swordfish at depths between 200 m and 400 m. A third optional hook can be fished at >90 m to target opah, common thresher shark or other marketable HMS species.

For one full set of DSBG, total hook count shall not exceed 30. All hooks shall be either 16/0 or 18/0 circle hooks. Bait may consist of either finfish (e.g., mackerel), squid, or artificial lures.

For larger vessels, with more deck space, greater number of crew members, and fishing further offshore, up to 2 full sets of gear may be fished (i.e. 20 individual buoy arrays, with a maximum of 60 hooks).

The DSBG surface floatation and catch identification system consists of a minimum of three floats with a flag and flasher or radar reflector. At least one of the floats shall be a non-compressible buoy with a minimum of 40 pounds (lbs) of buoyancy to prevent gear loss. One of the floats must be designed to be used as a strike indicator to allow for the periodic servicing of gear when a hooked species is on the line. This design follows that of previous DSBG experiments (see, Sepulveda *et al*., 2015).

To facilitate active tending, prevent gear loss, and mitigate the impacts to non-target species, vessels must remain proximal to DSBG at all times. The mandated distance is <3 nautical miles (nm) from any one piece of gear during daytime sets.

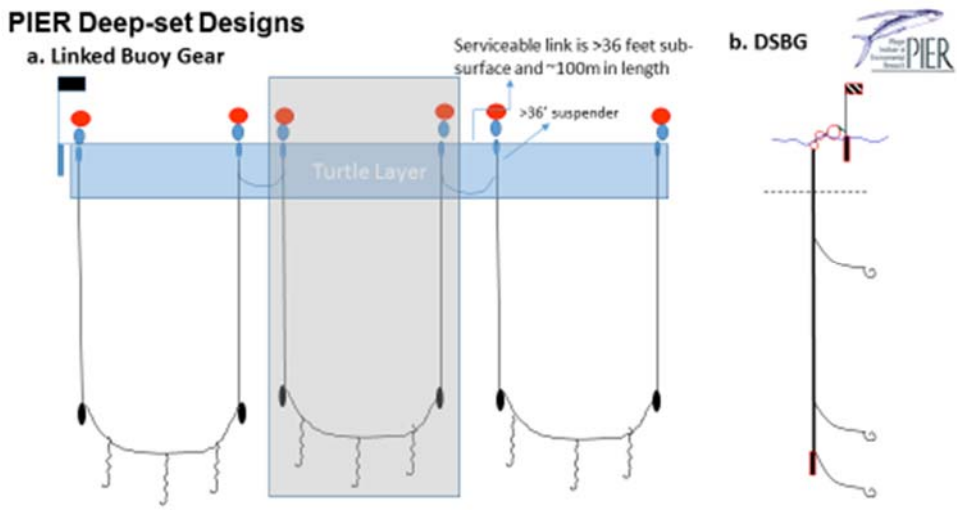

Figure 1. Schematic of both linked and single deep-set buoy gear as described in sections 2.0.1 and 2.0.2.

2.0.2 DSLBG description

One full set of linked buoy gear shall consist of ≤30 individual hooks soaked at one time over a maximum horizontal foot-print of 5nm. A full DSLBG complement is comprised of up to10 sections that individually extend up to 500m each in horizontal length. The terminal junction of each horizontal piece shall be weighted (3.6 kg or 8 lb) and suspended by a vertical leg that is connected to a series of surface buoys that serve as a strike detection system (similar to that currently used in the DSBG design; Figure 1). A maximum of up to three ~8 to 10 m branching gangions are attached to the 500m span at depths of 200 to 400 meters to target swordfish. As with DSBG, all hooks must be fished >90 m. Each section shall be adjoined with a 100-150 m horizontal piece of mainline that is suspended at least 11 m (or approximately 36-feet) below the surface, which can be separated for the servicing of strikes. At least one flag with a flashing locator or radar reflector must be affixed to one of the terminal ends. All hooks employed shall either be 16/0 or 18/0 circle hooks and bait will consist of either finfish (e.g., mackerel), squid, or artificial lures. An illumination source (i.e., calumet or power light) may be used proximal to each gangion, if desired. To increase sink rates, weighted swivels (45 g) and a hydraulic line-shooter will be required. The DSLBG surface floatation and catch identification system consists of a minimum of three floats at each end of a section, with a flag and flasher or radar reflector on the terminal ends of linked sections. At least one of the floats shall be a non-compressible buoy with a minimum of 40 pounds (lbs) of buoyancy to prevent gear loss. One of the floats must be designed to be used as a strike indicator to allow for the periodic servicing of gear when a hooked species is on the line.

For larger vessels, with more deck space, greater number of crew members, and fishing further offshore, up to 2 full sets of gear may be fished (i.e. 20 linked buoy sections, with a maximum of 60 hooks).

To facilitate active tending, prevent gear loss, and mitigate the impacts to non-target species, vessels must remain proximal to DSBG at all times. The mandated distance is <3 nautical miles (nm) from any one piece of gear during daytime sets.

2.1 Alternative 1 (Preferred Alternative)

The preferred alternative is approval via appropriate permitting and/or financial assistance programs the testing of DSBG, DSLBG, and when applicable, the combination of both gear types simultaneously as described above. Testing of gear would occur in the EEZ from the California-Mexico border in the south to the Oregon-Washington border in the north. The state waters of California[1] and Oregon would be excluded. The rationale for simultaneous use is based on the similarities of the gear types and the conservation measures to be imposed. Similarities include: (1) Hook position below the thermocline during the day to avoid non-target interaction, and (2)the capacity to detect strikes and service gear when a hooked species is on the line.

Gear research trials to date have identified that environmental conditions (i.e., currents, wind, sea state) can play a major role in the decision of which gear configuration will perform best (i.e., DSBG or DSLBG). Thus, DSLBG has also been designed so that it can be used with (concurrent deployment) DSBG operations. Concurrent deployment is possible so long as there are no more than 10 pieces of gear (i.e., linked or individual (DSBG) pieces) in the water at the same time, during daylight hours. A piece of gear is defined as either a section or link of DSLBG (Figure 1) or a single piece of DSBG. As with DSBG, any free-floating section (linked or DSBG) must have vessel identification, a flag, and some form of locating device (e.g., radar reflector/strobe).

Under the preferred alternative, an individual vessel could fish up to 20 pieces of DSBG or up to 2 complements of 10 linked sections of DSLBG (as described in the gear descriptions at 2.0.1 and 2.0.2), or some combination, with a maximum of 60 hooks. The average range of deployed gear is expected to be 3-5 nm at the surface with a requirement to maintain all gear within visual range and maintain a vessel position within 3nm from any piece of gear. For example, a vessel could daily deploy 10 pieces of DSBG with 3 hooks each (30 hooks total), and up to 10 linked sections of DSLGB with 3 hooks per section (30 hooks total) while maintaining the vessel within 3 nm of a piece of gear. Vessels would not be prohibited from conducting concurrent fishing activities such as trolling or harpooning of swordfish within the proximity of DSBG and/or DSLGB soaking in the water.

[1] http://www.pcouncil.org/wp-content/uploads/2017/05/H3a_CDFW_Rpt-DSBGROAs_170512_Jun2017BB.pdf

2.1.1 Conservation Measures Included in Action Alternative

Alternative 1 includes two gear configurations with similar conservation measures developed to specifically reduce non-target species interactions off the West Coast EEZ from the California-Mexico border in the south to the Oregon-Washington border in the north, excluding state waters.

Conservation measures applicable to both DSBG and DSLBG:

1. Hooks must be positioned below the thermocline (>90 meters depth) during the day to avoid non-target species interactions.
2. A heavy weighting system (3-4 kg) must be used that:
    a. provides rapid decent rates to avoid non-target species above the thermocline,
    b. maintains hooks at a constant depth throughout deployments, and
    c. maintains vertical lines taught to reduce probability of entanglement.
3. Strike detection must be incorporated into the design to reduce the amount of time non-target species are likely to be on the line with quick release from the hook.
4. Circle hooks (16/0 or 18/0) must be used to reduce post release mortality.
5. Non-compressible surface floats must be used to prevent gear loss (sinking out).
6. Nocturnal locating equipment (i.e., flasher or reflector) must also be used to prevent gear loss.
7. No more than 60 hooks may be used to ensure all gear can be observed and serviced in a timely way.
8. For DSLBG only: A line-shooter, which increases gear decent rates and minimizes the time that hooks fish above the thermocline, must be used during gear deployment.

2.1.2 Catch Disposition for Action Alternative

All swordfish catch aboard research vessels would be tagged, if in lively condition, and released live back into the ocean. Those swordfish not in condition for tagging, but still alive, would be released after biometric and biological data is collected. There is no sale of harvested fish from the research vessel to offset project/vessel costs.

All marketable species caught onboard a commercial fishing vessel will be sold. Non-marketable finfish catch will be released; strike detection capabilities allow for live releases.

2.2 Alternative 2 (No Action)

Under the no action alternative, NMFS would not approve or finance the testing any of the gear configurations described above.

2.3 Alternatives Considered, but Not Further Analyzed

Two additional alternatives were considered, but are not further analyzed in this EA; 1) the use of DSBG only, and 2) the use of DSLBG only. Given the available information about the use of these gear types in the action area, NMFS does not anticipate variation in the expected environmental impacts to target, non-target, and protected species under these action alternatives versus the preferred alternative.

3.0 Affected Environment

In consideration of data collected from DSBG trials from 2011 through 2017 (see sections 4.1 and 4.2), it is evident that DSBG affects a limited species assemblage. DSBG trials have been conducted off the West Coast by research and cooperative fisher vessels since 2011. There have been >520 eight-hour soak days that provide a collective hook-soak hour estimate of >41,600 hook soak hours. Catch composition has resulted in the capture of an estimated 97 percent marketable catch, with swordfish making up over 79 percent of the catch (refer to table in Chapter 4).

3.1 Action Area

The action area of the proposed alternative includes federal waters of the west coast United States EEZ off California and Oregon. The action area is as far south as the California-Mexico border and as far north as the Oregon-Washington. . The state waters of California[2] and Oregon would be excluded. The action area also includes both depth and surface components, each of which are discussed separately below.

Depth: For the gear configuration alternative examined in this EA (DSBG, DSLBG, and the combination of gear types), the proposed action would occur in the water column below the depth of the upper mixed layer, which for the purpose of this EA is considered to be the waters below the thermocline. Off California, there is a relatively pronounced thermocline that typically increases in depth with distance from shore (Palacios *et al*., 2004). Based on a 50-year dataset, the average thermocline depth for coastal waters was 22–33 m and offshore it ranged from 43–73 m (Palacios *et al*., 2004). Similarly, the average thermocline depth for waters off of Oregon have been reported at depths <50 m (Huyer *et al*., 2007). Hook position under the proposed action is to be maintained at >90 m, a depth that corresponds to the waters below the thermocline for the entire action area.

[2] http://www.pcouncil.org/wp-content/uploads/2017/05/H3a_CDFW_Rpt-DSBGROAs_170512_Jun2017BB.pdf

Figure 2 Map of Action Area, EEZ off of California and Oregon

Surface Action Area: The proposed action is to occur within federal waters (i.e., >3nm and <200nm from shore) off the coast of California and Oregon. Precise set locations and fishing activities will likely be determined based on seasonal abundance, ocean conditions, water temperature and weather. Given the similarities of DSLBG and DSBG, similar boundaries are proposed for both DSBG and DSLBG operations.

3.2 HMS FMP Prohibited Species in the Proposed Action Area

Given the rarity of encounters and entanglements for these species and the lack of any records for their interactions with hook and line gear, the potential for prohibited species interactions with the proposed action are negligible.

There are records of great white shark interactions with net gear in the SCB, but none for hook and line gear. The great white shark preys primarily on pinnipeds and is not expected to depredate the squid or mackerel baits that are proposed to be fished at depths below the thermocline. As such, potential interactions for these species will not be further analyzed in this EA.

Table 1. HMS FMP prohibited species.

Common Name	Scientific Name
Great white shark	*Carcharodon carcharias*
Basking shark	*Cetorhinus maximus*
Megamouth shark	*Megachasma pelagio*
Pacific halibut	*Hippoglossus stenolepis*
Pink salmon	*Onchorhynchus gorbuscha*
Chinook salmon	*O. tshawytscha*
Chum salmon	*O. keta*
Sockeye salmon	*O. nerka*
Coho salmon	*O. kisutch*

3.3 Current Stock Status of Target Swordfish (Xiphias gladius)

The Western and Central North Pacific Ocean (WCNPO) swordfish stock off the U.S. West Coast is an underutilized domestic resource (Berube *et al*., 2015). The most recent stock assessment for swordfish in the North Pacific identifies two stocks: a WCNPO stock and an Eastern Pacific Ocean (EPO) stock. The action alternative includes fishing within the WCNPO stock boundary area. The WCNPO stock is healthy, while the EPO stock is subject to overfishing. The WCNPO stock has been in a healthy condition for over a decade (Sippel, 2015). In 2012, the terminal year of the assessment, the relative stock biomass (B/BMSY; where B is the biomass, MSY is the maximum sustainable yield, and BMSY is the stock biomass that would produce MSY) for the WCNPO stock was estimated at 1.20 and the relative harvest rate (H/HMSY, where H is the harvest level) was 0.58. Additionally, the probability of the annual harvest rate exceeding HMSY was zero.

Prior research and cooperative fishing activities in the action area indicate that the vast majority of swordfish spend the day at depth feeding in association with the deep scattering layer (Figure 3; depths from 200-500m; Sepulveda *et al*., 2010; Dewar *et al*., 2011). The ambient conditions at depth (200-400m) are relatively cold (~°8C) and oxygen-poor, a scenario that is inhospitable to most pelagic species (Musyl *et al*., 2004; Bernal *et al*., 2009). Several depth distribution studies have corroborated this diurnal depth distribution, confirming that swordfish occupy a unique niche to capitalize on prey resources that are inaccessible to most other pelagic species (Musyl *et al*., 2004; Takahashi *et al*., 2003; Bernal *et al*., 2009). An exception to this diel pattern can be observed when swordfish ascend to the surface and periodically bask during the day. This is the portion of the day that they are susceptible to harpoon gear. Basking activity has been proposed to be as little as eight percent of the daily depth distribution (Sepulveda *et al*., 2010).

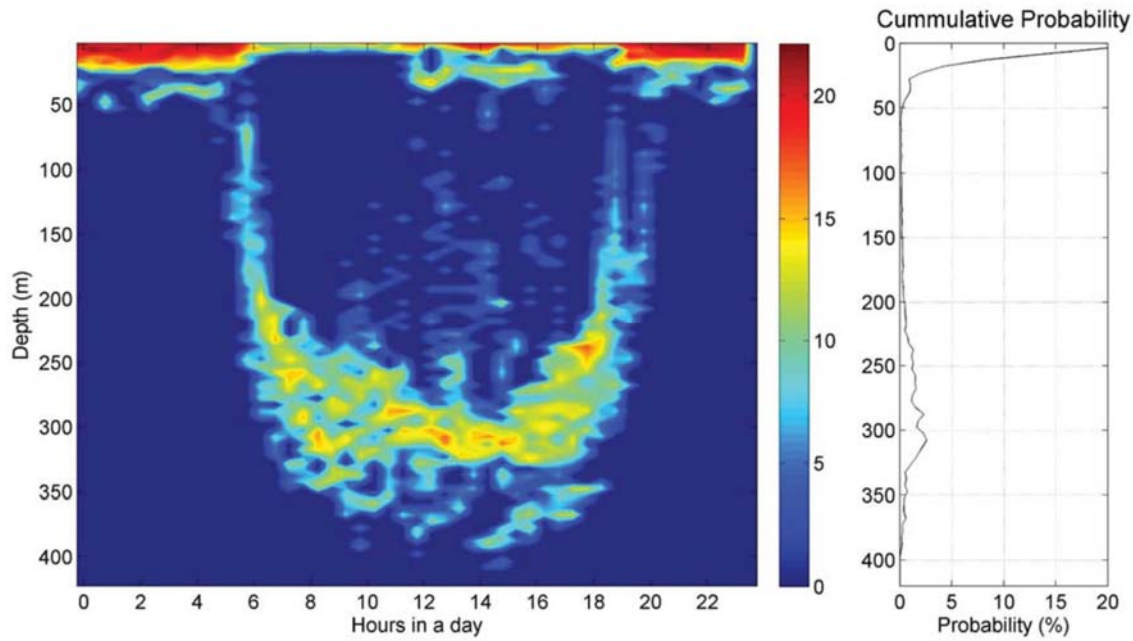

Figure 3. Daily depth distribution of swordfish within the action area. Note: During the night swordfish are within the mixed layer, spending nearly all of their time above 60m. During the day the average depth ranges from 250-400m. Data from Sepulveda *et al*., 2015.

3.4 Target and Non-Target Finfish Species Most Likely to be Affected by the Action

Past DSBG and DSLBG research off of California demonstrated similar catch compositions among the two gear types, with marketable species (i.e., swordfish, thresher shark species, opah, and escolar (snake mackerel) comprising over 90 percent of catch (Figures 4 and 5). Swordfish have constituted 76 percent of DSBG catch and 68 percent of DSLBG catch, with negligible catches of non-target species, including secondary marketable HMS species. (Figures 4 and 5, Tables 4 and 5). Based on catch composition data from 520 days of DSBG effort to date, catch has been limited to nine species of finfish other than swordfish (Tables 4). Finfish catch of DSLBG research trials through January, 2017 (n=40 days) have been limited to five species of finfish other than swordfish (Table 5). All five

species were also caught with DSBG. Based on DSBG and DSLBG catch history to date as well as the life history traits of finfish species within the proposed action area, it is practical to assume that the only finfish species with a reasonable probability of capture using these two gear designs are listed in Table 2. Just two species of finfish captured on DSBG and DSLBG are currently not considered to be marketable in the United States (i.e., common mola and blue sharks).

Table 2. Selected finfish species present in the action area with a reasonable probability of capture under the proposed action.

Common name	Species
Bigeye thresher shark	*Alopias superciliosus*
Common thresher shark	*Alopias vulpinus*
Pelagic thresher shark	*Alopias pelagicus*
Shortfin mako shark	*Isurus oxyrinchus*
Opah	*Lampris guttatus*
Snake Mackerel	*Gempylidae spp.*
Yellowfin tuna	*Thunnus albacares*
Blue shark	*Prionace glauca*
Common mola	*Mola mola*

3.4.1 Stock Status of Non-Target Finfish and Marketable HMS Species Most Likely to be Affected by the Action

The following section provides an overview of the stock status for those species listed in Table 2 The 2016 HMS Stock Assessment and Fishery Evaluation Report (SAFE) provides an update and detailed account of the status of the HMS FMP management unit species, which includes some of the species listed in Table 2 including common thresher shark, shortfin mako shark, blue shark and yellowfin tuna (PFMC 2017).

3.4.1.1 Bigeye Thresher Shark

The bigeye thresher is found in warm, temperate and tropical oceanic and coastal waters from the surface to depths of 500 m. Very little information exists on the life history and habits of the bigeye thresher shark in general and specifically within the proposed action area and overlaps with the depths targeted using DSBG and DSLBG. It is known that bigeye thresher sharks typically inhabit the deeper water column where they forage on deep scattering layer (DSL) organisms including schooling fish and squid. At this time, there are no measures under the MSA in place and the status of the stock is unknown due in part to the lack of a current stock assessment for this species. NMFS recently completed a Status Review Report on the bigeye thresher shark and the available abundance indices have not shown any significant population

decline; thus, it was concluded that overutilization of bigeye thresher sharks from commercial fisheries is not likely occurring within the Pacific, including the action area described in section 3.1 (NMFS 2016[3]). This species is currently not the target of any large scale pelagic fisheries and is typically released when encountered in the EPO.

3.4.1.2 Common Thresher Shark

Common threshers are migratory animals that inhabit both coastal and pelagic waters in tropical and temperate worldwide. Off the U.S. west coast, this species is present in the water column from the surface to depths below the thermocline. The common thresher shark is found year round in the action area with peak aggregations forming in the spring months with the arrival/availability of their preferred prey (sardines, anchovies, squid). Common thresher sharks occur off southern California during the spring and early summer and have been shown to move up the coast as far north as San Francisco, with some moving as far north as the Oregon, Columbia River area. Subadults and adults are thought to migrate southward with declining water temperatures, moving through southern California again during the fall. The HMS FMP includes an annual harvest guideline of 340 metric tons (mt) for the common thresher shark. The combined domestic commercial and recreational take of common thresher shark has not exceeded the established harvest guideline since it was established in 2004 (NMFS 2016). NMFS recently completed a Status Review Report on common thresher sharks and determined that the common thresher shark is not considered overfished at this time and may have recovered to approximately 94 percent of its pre-fished level (NMFS 2016). It was estimated that annual landings of common thresher sharks in the EPO have recently decreased to around 115 mt, which is well below the estimated 806 mt maximum sustainable yield (MSY) for the west coast North American stock.

3.4.1.3 Pelagic Thresher Shark

Pelagic thresher sharks (*Alopias pelagicus*) are distributed worldwide throughout temperate and tropical waters. Although pelagic threshers have a more tropical and subtropical distribution relative to common threshers, *A. pelagicus* occurs within the action area during the late summer and fall months, particularly during warmer water years. Pelagic threshers are commonly associated with subsurface pinnacles and ridges, where they aggregate around cleaning stations or to feed upon anchovy, herring, mackerel, hake, and squids. Although limited information is available on their habitat utilization and depth distribution, pelagic threshers are considered to predominately occur within the epipelagic zone. Few fisheries target pelagic threshers although they represent a valuable bycatch species for longline fisheries in the central Pacific. Like other thresher shark species, pelagic threshers are ovoviviparous and typically give live birth to 2 pups upon reaching sexual maturity at approximately 250-300 cm total length. While this reproductive strategy is considered to enhance the vulnerability of a species towards overexploitation, pelagic thresher sharks are not considered to be overfished; however, limited information is available on their population structure or status.

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[3] http://www.nmfs.noaa.gov/pr/species/Status%20Reviews/common_and_bigeye_thresher_sharks_sr_2016.pdf

3.4.1.4 Shortfin Mako Shark

The shortfin mako shark is a predominantly pelagic species found worldwide in tropical and temperate seas. In the EPO, makos are distributed from Oregon to Chile and it has been hypothesized that this species migrates seasonally from the coast of California along the Baja peninsula following favorable seasonal water conditions (Cailliet and Bedford 1983). Juvenile makos are common along California during the summer months as water temperatures increase. Like the common thresher and blue sharks, they may be utilizing the SCB as a pupping and rearing ground. Tagged juvenile shortfin mako sharks spent less than 1 percent of their time below 200 m; however, they have been recorded down to depths of 740 m (Sepulveda *et al*., 2004). Mako sharks are a common non-target catch in the swordfish drift gillnet fishery (DGN) and other net fisheries operating in the SCB with predominantly juvenile age classes being captured. Shortfin mako is an important component of California's ocean recreational fishery. The majority of makos are caught by anglers fishing with rod-and-reel gear from private vessels in the Southern California Bight from June through October, with a peak in August. Basic population dynamic parameters for mako sharks are unknown. Catch statistics from the swordfish DGN fishery suggest that the shortfin mako was not overexploited through the 1990s; however, CPUE rates indicated a possible overall decrease (PFMC 2003). Clear effects of overexploitation have not been shown, and it is tentatively assumed that overfishing of the local stock is not occurring. To date, there has been no assessment of the EPO stock of species. However, the HMS FMP establishes a precautionary harvest guideline of 150 mt. The overall commercial catch of mako shark taken by the DGN fishery has declined as a result of state and Federal regulatory action (e.g., time/area closures to promote sea turtle conservation).

3.4.1.5 Opah

Opah is a pelagic species found worldwide in tropical and temperate waters. Opah prefer a deeper water habitat, just below the thermocline in the action area. Opah are commonly caught on tuna longlines in the Pacific as well as occasionally on albacore and salmon gear (Barut 1999). Opah are considered a commercially important non-target catch by the DGN fishery ranking third in value following swordfish and thresher shark. Opahs are caught to a lesser extent by recreational anglers fishing for tuna off California. Very little is known regarding the life history and ecology of this species, including seasonality. While fish tagged in the EPO primarily occur within the upper 200 m of the water column, these studies also found vertical habitat use by opah to vary with local oceanic conditions. Opah is thought to feed primarily on midwater fishes and invertebrates, mainly squids. Opah has been one of the more common finfish catch species (along with bigeye thresher sharks) encountered during DSBG trials to date. The majority of opah catch has occurred on the upper hook (100 m) of DSBG, which was implemented to target this species. The size of the opah population off the west coast of the U.S., and whether local subpopulations exist, is not known at this time. To date, there has been no stock assessment of this species.

3.4.1.6 Snake mackerels

The two predominant species of snake mackerel that occur within the proposed action area are escolar (*Lepidocybium flavobrunneum*) and oilfish (*Ruvettus pretiosus*), both of which have been caught in small numbers on DSBG and DSLBG. Escolar and oilfish are captured as bycatch in both shallow-set nighttime and deep-set daytime longline fisheries throughout the Pacific, although they are solitary, deep-water predators that make up a very small percentage of overall catch. Because of the vast amount of available habitat combined with the minimal capture rate of snake mackerel, they are listed as species of least concern and are not considered to be overexploited.

3.4.1.7 Yellowfin tuna

Stock status of yellowfin tuna in the EPO is assessed every one to two years by the IATTC. The IATTC conducted the latest stock assessment of EPO yellowfin tuna in May 2015 (Maunder and Aires-Da-Silva, 2015). The 2015 base case assessment indicates that recent levels of spawning potential are most likely above a level that can support the maximum sustainable yield of yellowfin in the EPO, but also that recent catches marginally exceed MSY. Nonetheless, the recent fishing morality rate (*F)* was below the level corresponding to MSY, thus the stock is not subject to overfishing. Under current levels of fishing mortality, the spawning biomass is predicted to slightly decrease, but remain above the level corresponding to MSY. Catch of yellowfin tuna by U.S. West Coast fisheries constitutes less than one percent of the EPO-wide catch.

3.4.1.8 Blue Shark

In the EPO, blue sharks (*Prionace glauca*) range from the Gulf of Alaska down to Chile, migrating to higher latitudes during the summer, and lower latitudes during the winter. Within the proposed action area, blue sharks are found year round and captured as bycatch in the DGN fishery, but rarely taken by other commercial HMS fisheries. Recreationally, blue sharks are considered a sport fish in the SCB and larger individuals provide a catch-and-release challenge for fishermen using light tackle. Recent blue shark stock assessments occurred in 2013 and 2014. These models calculated a range of MSY for the north Pacific blue shark stock using catch, effort, and size composition data for the period 1972 to 2012, and accounted for a broad range of uncertainties about blue shark stock dynamics. The data were grouped into 18 fisheries; however, Japan, Chinese Taipei, Mexico, and the United States account for 95 percent of the estimated catch. Both assessments indicate that, relative to MSY, the north Pacific blue shark stock is not overfished and overfishing is not occurring. In 2011, stock biomass and spawning biomass exceeded MSY, and annual fishing mortality was estimated to be well below the fishing mortality rate that would produce MSY when stock biomass is sufficient for producing MSY on a continuing basis (or FMSY; where F is a measurement of the rate of removal of fish from a population by fishing) (ISC 2013; Rice *et al*., 2014).

3.4.1.9 Common mola

The common mola (*Mola mola*) is distributed worldwide throughout temperate and subtropical seas. Molas are not marketable in the United States; thus, this species generally is not consumed. Molas occupy a broad vertical distribution, from the surface to depths exceeding 450m, where

they feed on a variety of marine invertebrates. Their diet primarily consists of gelatinous zooplankton and jellyfish; therefore, they are not commonly encountered in longline or hook and line fisheries. Molas are a common bycatch species in the DGN fishery. Only several individuals have been captured during DSBG and DSLBG trials; all of which were released alive. Because molas are considered to be extremely resilient and do not need to swim forward to breath (ram ventilate), it is likely that the post-release survivorship is extremely high for hook and line fisheries. A large adult female can produce in excess of 300 million eggs per spawn and is capable of spawning multiple times per season. Considering the fecund reproductive strategy of common molas combined with the lack of any targeted fishery in the EPO, the population is not vulnerable to overexploitation.

3.5 Protected Species Most Likely to be Affected by the Action

The U.S. West Coast hosts a wide array of species protected under the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA). A full description of all marine mammal species likely to occur in the proposed action area can be found in the 2008 U.S. Marine Mammal Stock Assessments (SARs)[4] (Carretta *et al.,* 2009). A comprehensive review of the status of sea turtles can be found in the most recent the Five Year Sea Turtle Status Review Reports published by the U.S. Fish and Wildlife Service and NMFS (NMFS and FWS, 2013-2015) and in the HMS FMP Biological Opinion (NMFS 2004). Given the availability of these comprehensive background materials, detailed information on the life history for the species likely to be found in the action area will not be repeated in this EA.

For the purposes of this EA, only protected species that have been determined to have the potential to interact with the proposed action/gear type are listed (Table 3) and discussed in this section. The list was compiled considering a number of factors including the natural history and behavior of the species, spatial and temporal distribution, interactions with or interaction avoidance during DSBG and DSLBG research and EFP trials to date, and relative abundance within the proposed action area. Although Table 3 contains a comprehensive list of protected species with potential for interaction with the proposed gear, only a single protected species (northern elephant seal) has interacted with DSBG during 520 set days (eight-hour soak time) since 2011. No protected species interactions have occurred during 40 DSLBG set days to date. Additionally, DSBG and DSLBG trials have not resulted in any interactions with any species of concern, endangered species, or sea turtles to date.

Under the MMPA, a "strategic stock" is defined as a marine mammal stock for which the best scientific information available indicates that: (1) the level of direct human-caused mortality exceeds the potential biological removal (PBR)[5] level, (2) the stock is declining and is likely to

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[4] http://www.nmfs.noaa.gov/pr/sars/region

[5] PBR Level: defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. The PBR level is the product of the following factors—1)the minimum population estimate of the stock;

be listed as a threatened species under the ESA within the foreseeable future, or (3) the stock is listed as a threatened or endangered species under the ESA, or is designated as "depleted" under the MMPA.

Under the MMPA, a 'depleted stock' is defined as any case in which a marine mammal stock is:

(1) determined by the Secretary, after consultation with the Marine Mammal Commission and the Committee of Scientific Advisors on Marine Mammals established under MMPA title II, to be a species or population stock below its optimum sustainable population, (2) determined by a State, to which authority for the conservation and management of a species or population stock is transferred under section 109, to be a species or stock that is below its optimum sustainable population, or (3) a species or population stock is listed as an endangered species or a threatened species under the ESA.

Table 3. Protected Species with the Potential for Interaction under the proposed action. Note: All marine mammals are protected under the MMPA. Those that are listed as a strategic stock and/or a depleted stock under the MMPA are designated in the table as S (strategic) and/or D (depleted). Those stocks listed under the ESA are listed as E.

Marine Mammals	**Designation Status**
Cetaceans	
Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)	None
Risso's dolphin (*Grampus griseus*)	None
Short-beaked common dolphin (*Delphinus delphis*)	None
Long-beaked common dolphin (*Delphinus capensis*)	None
Blue whale (*Balaenoptera musculus*)	S, D, E
Fin whale (*Balaenoptera physalus*)	S, D, E
Gray whale (*Eschrictius robustus*)	None
Humpback whale (*Megaptera novaeangliae*)	S, D, E
Pinnipeds	
California sea lion – US Stock (*Zalophus californianus californianus*)	None
Northern elephant seal – California breeding stock (*Mirounga angustirostris*)	None
Sea Turtles	

2)one-half the maximum theoretical or estimated net productivity rate of the stock at a small population size; and 3)a recovery factor of between 0.1 and 1.0.

Leatherback turtle (*Dermochelys coriacea*)	E
Loggerhead turtle (*Carretta Carretta*)	E
Olive ridley (*Lepidochelys olivacea*)	E
Green turtle (*Chelonia mydas*)	E

3.5.1 Stock Status of Protected Species Most Likely to be Affected by the Action

3.5.1.1 Marine Mammals

The population abundance indices and the PBR estimates for the marine mammal species cited in the following section are reported in the 2009 U.S. Marine Mammal Stock Assessment Report (Carretta *et al.,* 2009) and from NMFS Marine Mammal Stock Assessment Reports (SARs)[6], unless otherwise cited. The PBR provides an estimate of the number of individuals that can be removed from a particular marine mammal stock while allowing the stock to maintain or increase its population.

3.5.1.1.1 Pacific white-sided dolphin

Pacific white-sided dolphins (*Lagenorhyncus obliquidens*) range in the EPO Ocean from the Gulf of Alaska to the Gulf of California. They are most common between the latitudes of 38°N and 47°N. Sighting patterns from recent aerial and shipboard surveys conducted in California, Oregon and Washington suggest seasonal north-south movements, with animals found primarily off California during the colder water months and shifting northward into Oregon and Washington as water temperatures increase in late spring and summer (Green *et al*. 1992; 1993; Barlow 1995; Forney 1994; Forney *et al*. 1995). Seasonal abundance estimates off the entire coast of California are an order of magnitude higher in February through April than August through November. Off San Clemente Island, California, Pacific white-sided dolphins were present only during the cold-water months of November through April (Carretta *et al.,* 2000). Brownell *et al.* suggested that their occurrence off Southern California appears to be variable, possibly relating to changes in oceanographic conditions on seasonal or inter-annual time scales (*i.e.,* El Niño events) (1999). The estimated population range-wide (including the North Pacific stock) is more than 900,000 animals with the California/Oregon/Washington stock estimated to be 26,930 animals. The PBR for this stock is 171 animals per year. The mean annual serious injury and mortality in United States commercial fisheries for this stock is estimated to be 11.8 (CV = 0.88) animals per year, based on data from 2007 to 2011, with 11.6 (CV = 0.88) attributed to the DGN fishery. This stock of Pacific white-sided dolphins is not classified as a strategic stock under the MMPA (Carretta *et al.* 2015).

[6] http://www.nmfs.noaa.gov/pr/sars/species.htm

3.5.1.1.2 Risso's dolphins

Risso's dolphins (*Grampus griseus*) are found in temperate, subtropical and tropical waters and their spatial distribution may be limited by water temperature (preferred range 15-20°C). Very little is known of their migration patterns, but movements can be affected by oceanic conditions and availability of spawning squid. Risso's dolphins are capable of diving to at least 300 m for up to 30 minutes, but more commonly make shorter dives of 1-2 minutes to lesser depths. They feed on fish (e.g., anchovies), krill, and cephalopods (e.g., squid, octopus and cuttlefish) mainly at night when their prey is closer to the surface. The majority of their diet consists of squid, and they have been known to move into continental shelf waters when following their preferred prey. Risso's dolphins in California/Oregon/Washington waters are considered one stock in the SARs. The best estimate of population abundance for this stock is 6,272 (CV = 0.30), with a minimum population estimate of 4,913 animals. PBR for this stock is estimated to be 39 animals per year. Risso's dolphins have been observed taken in the Swordfish DGN fishery and the deep-set tuna longline fishery. The mean annual serious injury and mortality in commercial fisheries for this stock is estimated to be 1.6 (CV = 0.99) animals, based on data from 2004 through 2008. This stock is not classified as a strategic stock under the MMPA (Carretta *et al.,* 2014).

3.5.1.1.3 Short-beaked common dolphin

Short-beaked common dolphins (*Delphinus delphis*) are the most abundant cetacean off California, especially during the warm-water months. Common dolphins are widely distributed along the continental slope from coastal water to 300 miles offshore throughout temperate and tropical waters. Short-beaked common dolphins occur within the upper 200 m of the water column where they primarily feed upon epipelagic schooling fish and squid but are also known to feed on fish from the deep scattering layer at night. Short-beaked common dolphins commonly associate with schools of tuna and feeding flocks of seabirds, especially in the eastern tropical Pacific Ocean. Although common dolphin abundance off California changes seasonally and inter-annually, the California/Oregon/Washington stock is estimated between 343,990-450,000 (mean 411,211) animals. Short-beaked common dolphins have been observed taken in the DGN fishery. The current estimated PBR is 3,440 animals annually. The total estimated fishery mortality and injury for short-beaked common dolphins is less than 10 percent of the calculated PBR. Therefore, fishery mortality can be considered to be insignificant and approaching zero mortality and serious injury rate. This stock is not classified as a strategic stock under the MMPA (Carretta *et al.,* 2014).

3.5.1.1.4 Long-beaked common dolphin

Long-beaked common dolphins (*Delphinus capensis*) generally prefer shallow, tropical, subtropical and warmer temperate waters closer to the coast and on the continental shelf. They are commonly found along the U.S. west coast, from Baja California northward to central California. Long-beaked common dolphins primarily feed on small schooling prey (e.g., anchovies, hake, pilchards, sardines, and squid) during short (<8 min) dives to a maximum depth of 280 m. Long-beaked common dolphins are not as abundant as short-beaked common dolphins, but they are not considered threatened or endangered. For management purposes, long-beaked common dolphins inhabiting U.S. waters have been placed in a single California

Stock. The most recent abundance estimates for the long-beaked common dolphin stock are 62,447 (CV = 0.80) and 183,396 (CV = 0.41) dolphins, based on 2008 and 2009 ship line-transect surveys, respectively. PBR is estimated to be 610 animals per year. The estimated mean annual take (serious injury and mortality) for long-beaked common dolphins in United States commercial fisheries is 13 animals, based on data from 2006 to 2010. Fisheries threats include the DGN fishery, the California angel shark/halibut and other species large mesh set gillnet fishery, tuna purse seine, and other unknown fisheries. This stock is not classified as a strategic stock under the MMPA (Carretta *et al.,* 2014). Long-beaked common dolphins are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. The average total fishery mortality and injury for long-beaked common dolphins (13.0) is less than 10 percent of the PBR. Therefore, fishery mortality is considered to be insignificant and approaching zero mortality and serious injury rate.

3.5.1.1.5 Blue whales

Blue whales (*Balaenoptera musculus*) are found seasonally in the SCB (June-November) and are considered part of the Eastern North Pacific strategic stock. The current estimate of abundance for the Eastern North Pacific blue whale stock is 2,842 animals (CV=0.22). The PBR for this stock is currently set at 2.3 animals per year. Calambokidis and Barlow (2013) estimated an abundance of 1,551 to 2,300 (mean 1,647) blue whales based on photographic mark-recapture and line-transect methods. There is evidence that the stock is increasing in abundance (Carretta *et al.,* 2009). The PBR for this stock is estimated at 9.3 animals per year; however, because this stock spends three-quarters of their time outside of the U. S. EEZ, PBR is 2.3 animals per year. The mean annual serious injury and mortality in known U. S. commercial fisheries is zero blue whales, based on data from 2001 through 2013. Documented mortalities of blue whales as a result of ship strikes have occurred during 1980, 1986, 1987, 1993, and 2002. Ship strikes were implicated in the deaths of four blue whales and serious injury of a fifth whale from 2009 to 2013 (Carretta *et al.,* 2015). Five deaths occurred in 2007, the highest number recorded for any year. One additional whale was seriously injured in 2010 and its prorated serious injury value is 0.56. During 2009 to 2013, there were an additional two serious injuries of unidentified large whales attributed to ship strikes, some of which may have been blue whales (Carretta *et al.,* 2016). Blue whale mortality and injuries attributed to ship strikes in California waters averaged 0.9 per year for 2009 to 2013. The blue whale is listed as endangered under the ESA; therefore, this stock is classified as a depleted and strategic stock under the MMPA (Carretta *et al.,* 2016). Although number of blue whales struck by ships in the California Current likely exceeds the PBR for this stock, no blue whale mortality has been associated with California gillnet fisheries. Total fishery mortality is approaching zero mortality and serious injury rate.

3.5.1.1.6 Fin whales

Fin whales (*Balaenoptera physalus*) are found almost year round off the west coast U.S. and are considered part of the CA/OR/WA strategic stock. Fin whales primarily feed on krill, small schooling fish (e.g., herring, capelin, and sand lance), and squid and they fast in the winter. The current estimate of abundance for the CA/OR/WA fin whale stock is 2,598 to 3,051 animals. There is strong evidence that the population has increased since the early 1990s and PBR is

currently set at 16 animals per year. Ship strikes likely resulted in the mortality of seven fin whales and the serious injury of another from 2007-2011, with no observed takes of fin whales in the DGN fishery during this period. Total fishery mortality is less than 10 percent of PBR and, therefore, may be approaching zero mortality and serious injury rate. Fin whales are listed as endangered under the ESA; therefore, this stock of fin whales is classified as depleted and strategic under the MMPA (Carretta *et al.,* 2015).

3.5.1.1.7 Gray whales

Gray whales (*Eschrichtius robustus*) transit through the waters off the west coast U.S. on their way to and from their principal calving and breeding grounds in the lagoons and nearshore waters of Baja Mexico (southbound November through January; northbound March through May). Gray whales are primarily bottom feeders that eat "benthic" amphipods. They are considered part of the Eastern North Pacific (ENP) strategic stock. The current estimate of abundance for the ENP stock of gray whales is 20,990 animals. Using a 23 year time series of shore-based counts of southbound migrating whales passing Carmel, California, Laake *et al.* (2007) produced an abundance estimate of 19,126 ENP gray whales (CV=0.071). They concluded that the ENP stock of gray whales may have achieved an optimal population size following a high rate of increase in the late 1990s and early 2000s. Total human-caused mortality of Pacific Coast Feeding Group (PCFG) gray whales during the period 2008 to 2012 was 0.25 whales annually, including deaths due to commercial fisheries (0.15/yr), and ship strikes (0.1/yr). The mean annual serious injury and mortality in known U. S. commercial fisheries is greater than 4.4 gray whales, based on data from 2008 through 2012 (Carretta *et al.,* 2015). The gray whale was removed from the endangered species list in 1994 as a result of its strong recovery, and it is not classified as a strategic stock under the MMPA (Angliss and Outlaw 2005). This does not exceed the PBR level of 3.1 whales for this population.

3.5.1.1.8 Humpback whales

Humpback whales (*Megaptera novaeangliae*) typically appear in the SCB in the fall as they migrate to winter mating and birthing season off the coasts of Mexico and Central America. They are considered part of the Eastern North Pacific strategic stock. The current estimates of abundance for the Eastern North Pacific stock of humpback whales is 1,876 to 1,918 animals with a long-term increase of approximately 7.5 percent per year. Population estimates for the entire North Pacific have also increased substantially from 1,200 in 1966 to approximately 18,000 - 20,000 whales in 2004 to 2006. Because this stock spends approximately half its time outside the U.S. EEZ, the PBR allocation for U.S. waters is 11 whales per year. In recent years, the most common source of serious injury and mortality of humpback whales in U.S. west coast waters results from entanglement in pot and trap fisheries, although gillnet fisheries and ship strikes also cause humpback mortality. The estimated annual mortality and serious injury due to entanglement (4.4/yr), plus ship strikes (1.1/yr) in California is less than the PBR. Because the humpback whale is listed as an endangered species under the ESA, the stock is classified as strategic and depleted under the MMPA (Carretta *et al.,* 2015). Although the best population estimates were given above, NMFS recently completed a comprehensive status review of the humpback whale under the ESA to determine whether an endangered listing for the entire

species was still appropriate. On September 8, 2016, NMFS announced a final rule to revise the listing status of the species and divide the globally listed endangered species into 14 distinct population segments (DPSs), remove the current species-level listing, and in its place list four DPSs as endangered and one DPSs as threatened (81 Fed. Reg. 62259, September 8, 2016). The remaining nine DPSs are listed based on their current statuses. Two of the DPSs (the Mexico DPS and the Central America DPS) occur in the action area. The Mexico DPS is listed as threatened and the Central America DPS is listed as endangered. Note the population and PBR estimates above are the best available science, but are based on stock delineations under the MMPA as opposed to DPS delineations. Future SARs will reflect the new stock delineations (or DPSs).

3.5.1.1.9. California sea lion

California sea lions (*Zalophus californianus*) comprise a single stock ranging from the Pacific coast of Central Mexico north to British Columbia, Canada. Their primary breeding range is from the Channel Islands in Southern California to Central Mexico. The stock-wide abundance is estimated to be 153,337 to 296,750 sea lions. The population has been increasing since at least 1975, with an estimated annual growth rate from 1983 to 2003 of about 6.5 percent; however, the growth rate has decreased since the 1990s as the population approaches the carrying capacity of its environment. California sea lions feed mainly in upwelling areas on a variety of prey such as squid anchovies, mackerel, rockfish, and sardines. They also take fish from commercial fishing gear, sport-fishing lines, and at fish passage facilities at dams and rivers. Under authorization of MMPA Section 120, individually identifiable California sea lions have been killed or relocated since 2008 in response to their predation on endangered salmon and steelhead stocks in the Columbia River. The average annual research-related mortality and serious injury of California sea lions from 2008 to 2012 is 4.0 animals with observed takes in the California DGN and trawl fisheries. Total human-caused mortality of this stock is at least 389 animals per year. California sea lions in the United States are not listed as "endangered" or "threatened" under the ESA or as "depleted" under the MMPA, nor considered "strategic" under the MMPA (Carretta *et al.,* 2015) because total human-caused mortality is less than the PBR (9,200). The total fishery mortality and serious injury rate (389 animals/year) for this stock is less than 10 percent of the calculated PBR and, therefore, is considered to be insignificant and approaching a zero mortality and serious injury rate.

Takes have been documented in the DGN fishery, the California halibut and white seabass set gillnet fishery, the California small-mesh drift gillnet, the California purse-seine fishery, and the California/Oregon/Washington groundfish trawl fishery. Other threats to this stock include shooting, power plant entrainment, marine debris, and boat collisions.

3.5.1.1.10 Northern elephant seal

Northern elephant seals (*Mirounga angustirostris*) breed and give birth in California and Baja California, from December to March, although the California breeding population is considered to be a separate stock. Populations of northern elephant seals in the United States and Mexico

have recovered. The population continues to grow, with most births occurring at southern California rookeries. The population is reported to have grown at 3.8 percent annually since 1988 to a current estimate of approximately 179,000 animals. Northern elephant seals are not listed as "endangered" or "threatened" under the ESA nor designated as "depleted" under the MMPA. The PBR level for this stock is calculated at 4,882 animals per year. Because their annual human-caused mortality (≥8.8) is much less than the calculated PBR for this stock (4,882), northern elephant seals are not considered a "strategic" stock under the MMPA (Carretta *et al*. 2015). The average rate of incidental fishery mortality for this stock over the last five years ≥4.0) also appears to be less than 10 percent of the calculated PBR; therefore, the total fishery mortality appears to be insignificant. Takes have been documented in the DGN fishery, the California halibut and white seabass set gillnet fishery, the California small-mesh drift gillnet, and the California/Oregon/Washington groundfish trawl fishery. Other threats include shooting, entanglement in marine debris, power plant entrainment, tar, and boat collisions.

An elephant seal interaction occurred during DSBG research trials in 2014 and another during DSBG EFP trials in 2015, for a total of 2 interactions to date. Following strike detection, both elephant seals were retrieved alive and alert prior to release alongside the vessel (at-sea observer indicated that hook was shed from the animal adjacent to the fishing vessel during 2015 interaction). The DSBG strike detection system functioned as designed and allowed the vessel to actively service the gear within a reasonable amount of time to ensure a live release. These two incidences represent the only protected species interactions incurred during DSBG and DSLBG research and EFP trials since 2011.

3.5.1.2 Sea Turtles

The life history and population dynamics information presented in the following section was cited principally from the Five-Year Sea Turtle Status Review Reports published by the U.S. Fish and Wildlife Service and NMFS[7] unless otherwise noted.

3.5.1.2.1 Leatherback sea turtles

Leatherback sea turtles (*Dermochelys coriacea*) are highly migratory, exploiting convergence zones and upwelling areas in the open ocean, along continental margins, and in archipelagic waters (Morreale, *et al*., 1994; Eckert, 1998; Eckert, 1999). Based on limited telemetry tracking data, there is evidence that on rare occasion leatherback turtles will transit through the SCB from March through July on their way to and/or from preferred jellyfish rich feeding grounds in central California and points north. Available dive data suggests that these transiting animals do not typically perform deep dives (>250 m) while transiting through these waters (Scott Benson, personal communication). The leatherback turtles that are encountered in the SCB belong to the western Pacific population. Recently published estimates of breeding females suggest that the western Pacific population is 2,700 to 4,500 adult females (Dutton, *et al*. 2007). This number is substantially higher than the population estimate of 1,775 to 1,900 western Pacific breeding

[7] http://www.nmfs.noaa.gov/pr/listing/reviews.htm#seaturtles

females published in 2000 and used to predict possible extinction in the Pacific (Spotila, 2000). The larger population estimate is due to adding in a number of nesting females from beaches that were not previously included in population estimates and thus is not indicative of a positive growth trend in the population. Leatherback turtles have been observed taken in the DGN fishery.

Based on satellite tracking data from leatherbacks nesting on western Pacific beaches or foraging off California, some leatherback sea turtles will move into U.S. coastal waters as early as spring, often coming directly from foraging areas in the eastern equatorial Pacific (Benson *et al.,* 2011).

Three main areas of foraging have been documented on the U.S. West Coast: in California over the coastal shelf in waters of 57.2° to 60.8° F (14 to 16° C), particularly off central California; along the continental shelf and slope off Oregon and Washington, particularly off the Columbia River plume; and offshore of central and northern California at sea surface temperature fronts in deep offshore areas, although this area was not regularly used (Benson *et al.,* 2011). Researchers estimated an average of 178 leatherback sea turtles (CV = 0.15) were present between the coast and roughly the 50 fathom isobath off California. Abundance over the study period was variable between years, ranging from an estimated 366 leatherbacks (1990) to 20 leatherbacks (1995) (Benson *et al.,* 2007).

3.5.1.2.2 Loggerhead sea turtles

Loggerhead sea turtles (*Caretta caretta*) are circumglobal, inhabiting continental shelves, bays, estuaries, and lagoons in temperate, subtropical, and tropical waters. In the EPO, the waters off Baja, California, Mexico, have been identified as a key foraging area for juvenile and sub-adult loggerheads that feed on pelagic red crabs (Polovina, *et al.*, 2004). Loggerhead turtles are not likely to occur in the proposed action area in any significant numbers as the SCB is well north of their preferred habitat. Loggerheads have been shown, however, to push north into the SCB during El Nino events most likely following blooms of pelagic red crabs. Polovina, *et al.*, found that 90 percent of loggerhead dives occurred within the top 40 m of water (2003). Loggerhead turtles have been observed taken in the DGN fishery.

North Pacific Ocean DPS Loggerhead Turtles On September 22, 2011, the United States Fish and Wildlife Service (USFWS) and NMFS published a final rule listing nine DPSs of loggerhead sea turtles (76 Fed. Reg. 58868). The North Pacific Ocean DPS of loggerheads was listed as endangered. In the action area, loggerheads compose the North Pacific Ocean DPS.

Loggerhead sea turtles that have been documented off the U.S. West Coast are primarily found south of Point Conception, California in the Southern California Bight. In Oregon and Washington, records have been kept since 1958, with nine strandings recorded over approximately 54 years (less than one stranding every 6 years) (NMFS Northwest Region stranding records database, 1958 to 2012, unpublished data, in NMFS 2015).

3.5.1.2.3 Olive Ridley Sea Turtles

The olive ridley sea turtle (*Lepidochelys olivacea*) has an extensive global distribution and is considered the most abundant sea turtle in the world, with an estimated 800,000 nesting females annually. In the EPO, they occur from Northern Chile to southern California, at the far northern extent of their range. The olive ridley is mainly a pelagic sea turtle, but has been known to inhabit coastal areas, including bays and estuaries. The olive ridley is omnivorous feeding on a wide variety of food items, including algae, lobster, crabs, tunicates, mollusks, shrimp, and fish. Olive ridleys can dive to depths of about 150 m to forage on benthic invertebrates. Olive ridleys mostly breed annually and have an annual migration from pelagic foraging, to coastal breeding and nesting grounds, back to pelagic foraging. They prefer water temperatures in the, 23-28° C range with preferred foraging grounds primarily in the North Pacific (Polovina, *et al*., 2004). (Márquez, *et al*., 2005). Olive ridley turtles that nest on the Pacific Coast of Mexico are listed as endangered. However this species is not likely to occur in the proposed action area in any significant numbers as the action area is well north of their preferred habitat.

3.5.1.2.4 Green Sea Turtles

Green sea turtles (*Chelonia mydas*) are found throughout the world, occurring primarily in tropical and, to a lesser extent, subtropical waters. Green turtles spend the majority of their time in coastal foraging zones with some limited use of more offshore oceanic habitat by oceanic-stage juveniles and migrating adults. The coastal-oceanic connection is not well understood and the presence of green turtles in the SCB is highly variable. They are thought to leave the SCB sometime in the spring (March-April) and possibly return in the fall (September-October). Using a precautionary approach, Seminoff estimates that the global green turtle population has declined by 34 percent to 58 percent over the last three generations (approximately 150 years) (2002); although, actual declines may be closer to 70 percent to 80 percent. In the Pacific Ocean nesting aggregations occur within the eastern, central, and western regions. In the EPO, green turtles nest in the Galapagos Islands, along the Pacific Coast of Central America and Mexico. Current abundance estimates are 1,650 nests in Galapagos, 184-344 nests in Central America, and 1,485 nests in Mexico. Green turtles have been observed to be taken in the DGN fishery in the action area.

On April 6, 2016, the USFWS and NMFS published a final rule listing eleven DPSs of green sea turtles (81 Fed. Reg. 20057) that changed the listing status of some of the populations (similar to the agency's action on loggerhead sea turtles). In the action area, green sea turtles compose the EPO DPS. The EPO DPS of green sea turtles is listed as threatened under the final rule.

The range of the EPO DPS extends from 41° N southward along the Pacific coast of the Americas to central Chile (40° S longitude) and westward to 142° W longitude and 96° W longitude. The offshore boundary of this DPS is a straight line between these two coordinates. Two populations of green sea turtles are found in two areas adjacent to the action area and may be affected by the Proposed Action. South San Diego Bay serves as important habitat for a resident population of up to about 60 juvenile and adult green sea turtles in this area (Eguchi *et al.,* 2010). There is also an aggregation of green sea turtles that appear to be persistent in the San

Gabriel River and surrounding coastal area in the vicinity of Long Beach (Lawson *et al.,* 2011). This group of green sea turtles has only recently been identified and very little is known about their abundance, behavior patterns, or relationship with the population in San Diego Bay.

3.6 Economics of Current Swordfish Fisheries off U.S. West Coast

Three commercial fisheries account for the majority of swordfish landings to U.S. West Coast ports: drift gillnet, harpoon, and high seas longline. Limited entry permits are required to fish for HMS with drift gillnet and longline gear. Longline gear is currently prohibited from being used in the U.S. West Coast EEZ. While permits for the use of harpoon gear are not limited, the use of this gear does not offer the same level of productivity as the other gear types and is used to catch only swordfish during specific environmental conditions. The number of active vessels in the harpoon fishery has remained below 20 and annual landings of swordfish have remained below 20 round mt from 2011 to 2016. Despite the ability to use drift gillnet gear in the U.S. West Coast EEZ south of the Oregon-Washington border to catch swordfish and other marketable HMS, these activities have become spatially constrained as regulations, including time-area closures have been put in place to reduce the likelihood of interactions occurring between this gear and protected species. As a result, the drift gillnet fishery has experienced a high degree of attrition the number of active vessels remaining below 22 and annual landings of swordfish and other marketable HMS remaining below 175 and 95 round mt, respectively, in any given year between 2011 and 2016. Detailed descriptions of these fisheries can be found in the Pacific Fishery Management Council's annual HMS Stock Assessment and Fishery Evaluation (SAFE) Report (PFMC 2017).[8]

A summary of swordfish average ex-vessel price by select HMS gears for 2011- 2016 can be found in the following table:

Table 4

Year	DGN $/Lb	HPN $/Lb	LL $/Lb	DSBG $/Lb
2011	$4.63	$7.38	$3.47	-
2012	$4.76	$9.94	$3.05	-
2013	$4.59	$9.25	$3.16	-
2014	$4.41	$9.02	$3.28	-
2015	$4.01	$9.03	$3.78	$6.60
2016	$4.18	$7.53	$3.29	$7.22

[8] http://www.pcouncil.org/highly-migratory-species/stock-assessment-and-fishery-evaluation-safe-documents/current-hms-safe-document/

DGN – Drift Gillnet, HPN- Harpoon, LL – both Deep-set and Shallow-set Longline, DSBG – Deep-set Buoy Gear Exempted Fishing Permitted activity.
Data Source: CDFW CFIS database, extracted 10/13/2017
128 Records with a price of $0 were removed
Price adjusted for inflation

In addition to the three major commercial swordfish fisheries described above, DSBG exempted fishing permit activity has been occurring since 2015. DSBG EFP landings in 2015 for four vessels fishing were a round weight equivalent of 13.28 mt. Similar landings in 2016 for six vessels fishing were 34.48 mt, for a 2 year total of 47.76 mt valued at $495, 217 (reference as extracted from PacFin May 2017).

4.0 Impact Analysis

Research trials of DSBG have been ongoing since 2011, and research trials of DSLBG have been occurring since 2015. The following impact analysis is based on the data and results of both research and EFP trials of DSBG, and research trials of DSLBG, through 2016.

Figures 4 and 5 and table 5 show catch composition from past DSBG and DSLBG trials. This information was used in determining the anticipated impacts of the proposed action.

Figure 4. Collective catch composition for >520 DSBG sets during RIFP research and

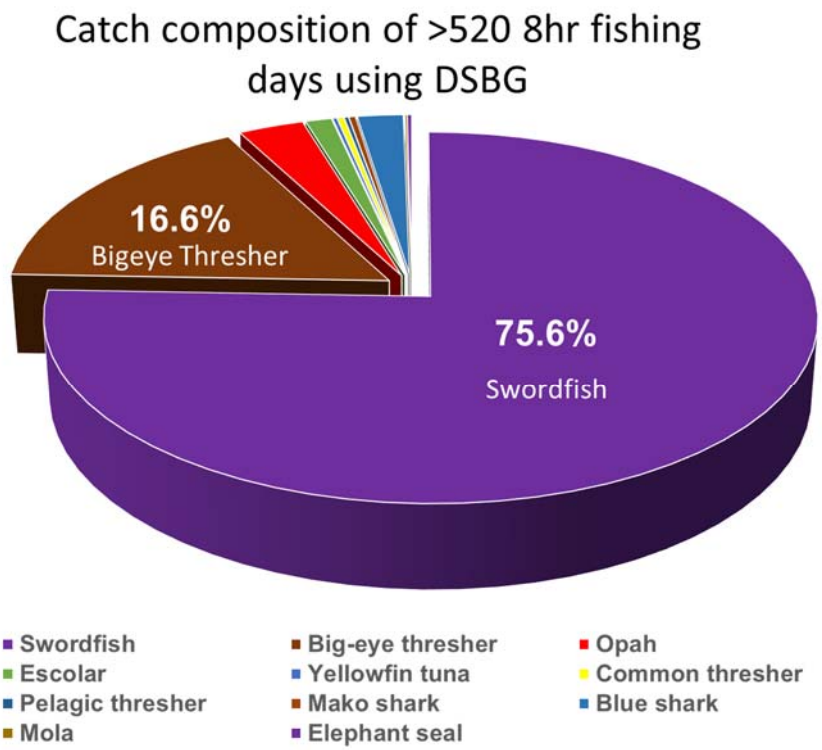

Table 5. Total DSBG catch from research and cooperative fishers from 2011-2016.

DSBG Catch Species	PIER Research Catch (2011-16)	Cooperative Fisher Catch (2014-2016)	Total Catch (# fish)	% Catch
Swordfish	66	667	733	**75.6%**
Opah	10	20	30	**3.1%**
Bigeye thresher shark	30	131	161	**16.6%**
Common thresher shark	3	0	3	**0.3%**
Pelagic thresher shark	0	2	2	**0.2%**
Mako shark	2	1	3	**0.3%**
Escolar	2	10	12	**1.2%**
Yellowfin tuna	1	1	2	**0.2%**
Blue shark	11	10	21	**2.2%**
Common Mola	0	1	1	**0.1%**
Protected Species				
Elephant seal*	1	1	2	**0.2%**
Other Species of Concern	0	0	0	**0.0%**
Total Catch	**126**	**844**	**970**	**100%**

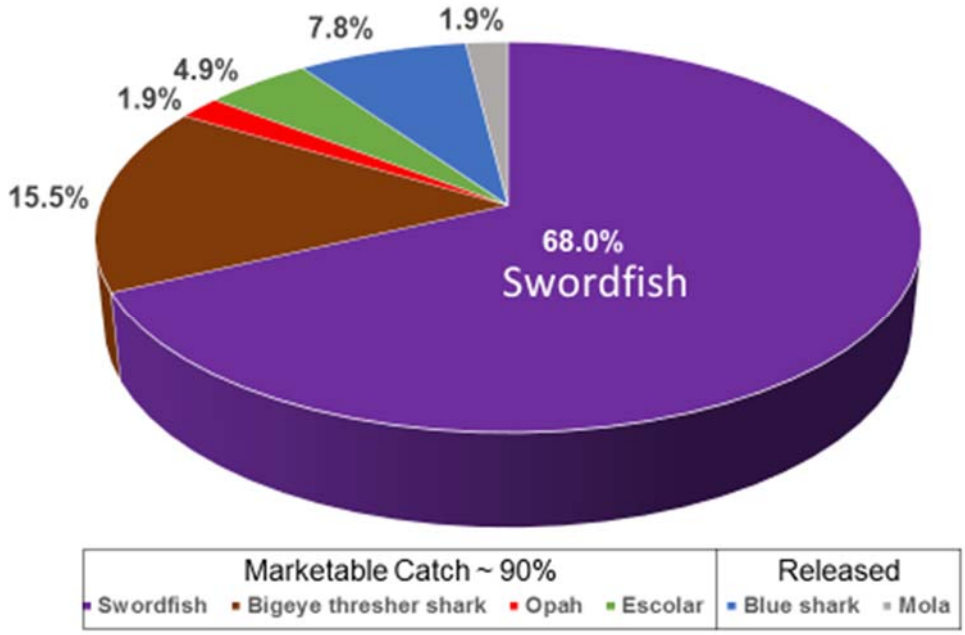

Figure 5. Catch composition for 40 DSLBG sets conducted from 10/21/2015 through 1/31/2017 aboard the PIER Research Vessel Malolo.

Table 6. DSLBG catch from 2015-2017 (research vessel only).

LBG Catch Species	PIER Research Catch (2015-2017)	% Catch
Swordfish	70	**68.0%**
Opah	2	**1.9%**
Bigeye thresher shark	16	**15.5%**
Escolar	5	**4.9%**
Blue shark	8	**7.8%**
Common Mola	2	**1.9%**
Protected Species	0	**0.0%**
Total Catch	**103**	**100.0%**

4.1 Impacts of Alternative 1

Alternative 1, the preferred alternative, is approval via appropriate permitting or financial assistance programs or both for the testing of DSBG, DSLBG, and when applicable, the combination of both gear types simultaneously as described above.

4.3.1. Target and Non-target Species Interactions

4.3.1.1. Swordfish

Based on the number of sets and hooks and swordfish catch rates of past DSBG and DBLBG trials, it is not expected that this alternative would result in a significant increase in the annual swordfish catch levels. Further, the harvest rate would not exceed HMSY, and total catch is expected to be a small percentage of MSY. The WCNPO stock is not subject to overfishing, and this action would not result in the WCNPO stock becoming overfished. There would be no significant adverse impacts to swordfish.

4.3.1.2. Bigeye Thresher Shark

Depending upon market price and other factors (i.e. size, swordfish catch), bigeye thresher sharks captured on DSBG and DSLBG may be retained or released. Because both DSBG and DSLBG incorporate strike detection and are readily serviceable, all non-marketable catch can be released alive.

177 Bigeye Thresher Shark have been caught in trials to date. Federally funded research on post release survival of bigeye thresher sharks from DSBG is currently underway (NOAA Grant award # NA16NMF4720371). To date, all tagged bigeye thresher sharks (n=3) have survived capture and handling on DSBG. Based on field observations and laboratory experiments, it has been determined that bigeye thresher sharks are extremely resilient to capture and handling stress. Thus, an approximately 90 percent post-release survivorship rate is expected.

No significant adverse impacts to bigeye thresher shark are anticipated.

4.3.1.3. Common Thresher Shark

Because common thresher sharks have been shown to primarily occur within the upper 200 m of the water column, 3 common thresher shark have been caught in trials to date. It is anticipated that harvest rates will remain negligible. It is expected that post-capture survival rates are likely high, and comparable to bigeye thresher shark. No significant adverse impacts to common thresher shark are anticipated.

4.3.1.4. Pelagic Thresher Shark

Because pelagic thresher sharks rarely occur within the proposed action area and due to their relatively shallow distribution within the epipelagic zone, 2 pelagic thresher shark have been caught in trials to date. It is expected that post-capture survival rates are likely high, and comparable to bigeye thresher shark. It is highly improbable that pelagic thresher shark populations will be negatively impacted by DSBG and DSLBG.

4.3.1.5 Shortfin Mako Shark

Because mako sharks have been shown to primarily occur within the upper 200 m of the water column and interactions have only occurred during gear retrieval, and on the upper baited gangion that is set approximately 100 m from the surface, 3 shortfin mako shark have been caught in trials to date. It is anticipated that harvest rates on DSBG and DSLBG will remain negligible. No significant adverse impacts to shortfin make shark are anticipated.

4.3.1.6 Opah

Within the action area, it is anticipated that opah harvest on DSBG primarily will occur by fishers that opt to use the upper baited gangion that is set approximately100 m from the surface to target opah. 32 opah have been caught and released in trials to date. It is anticipated that opah harvest on DSLBG will remain negligible. No significant adverse impacts to opah are anticipated.

4.3.1.7 Snake Mackerels

Based on the deep daytime distribution at greater than 250 m of escolar and oilfish and the observed minimal capture rates on DSBG and DSLBG to date, 17 escolar have been caught and released in trials to date. Fishery impacts are expected to be minimal and should be considered negligible.

4.3.1.8 Yellowfin Tuna

Catch rates of yellowfin tuna on DSBG and DSLBG are negligible and capture is only likely to occur on the upper gangion of DSBG or during gear retrieval. 2 yellowfin tuna have been caught and released in trials to date. Thus, it is anticipated that harvest rates on DSBG and DSLBG will remain insignificant. No significant adverse impacts to yellowfin tuna are anticipated.

4.3.2 Non Target Finfish Species

Although there is no recent stock assessment for some of the species from Table 2, considering the extensive range and available offshore habitat for HMS and the minimal catch rates of these species on DSBG and DSLBG, the overall impacts of the proposed activity on the population structure of species listed in Table 2 are assumed to be negligible. In DSBG and DSLBG trials to date, no interactions have been observed with the HMS FMP prohibited species listed in Table 1. Since both DSBG and DSLBG incorporate strike detection and are readily serviceable, non-marketable catch has the potential to be released alive.

4.3.2.1 Common Mola

Due to their feeding habits predominately on jellyfish, catch of common mola on DSBG and DSLBG is considered an anomaly, 3 common mola have been caught and released in trials to date. Thus, impact to common mola are considered negligible.

4.3.2.1 Blue Sharks

Blue shark has been incidentally caught during the exempted DSBG trials, and has not been retained for sale. Collectively, 21 individuals have been released during DSBG trials to date. 8 blue sharks have been caught and released in DSLBG trials to date. Although there are no studies to document post-release survival, observer and research records suggest that most blue sharks are alive at the time of release. No significant adverse impacts to blue sharks are anticipated.

4.3.3 Protected Species Interactions

Table 3 contains a comprehensive list of protected species with potential for interaction with the proposed gear; however, there has been only two interactions among protected species (i.e., northern elephant seal (*M. angustirostris*) and DSBG during 520 set days (8-hour soak time) since 2011. No protected species interactions have occurred during the 40 DSLBG set days to date. Additionally, DSBG and DSLBG trials have not resulted in any interactions with any species of concern, endangered species, or sea turtles to date.

4.3.3.1 Marine Mammals

Based on the results of research and EFP activity to date (Sections 4.1 and 4.2), and the required conservation measures listed in 2.1.1 to decrease the likelihood of marine mammal interactions, the proposed action is not expected to result in interactions with marine mammals, and thus will have a negligible impact on marine mammals.

4.3.3.1.1 Pacific white-sided dolphins

The majority of DSBG and DSLBG fishing for swordfish occurs during the summer and fall (July-November) and no interactions have occurred within the proposed action area to date. Fishing with DSBG and DSLBG will have a negligible impact on the Pacific white-sided dolphin population.

4.3.3.1.2 Risso's dolphins

Considering that no interactions have occurred within the proposed action area to date with DSBG and DSLBG, the proposed action is not expected to impact the Risso's dolphin population.

4.3.3.1.3 Short-beaked common dolphins

No interactions with common dolphins have occurred on DSBG and DSLBG within the proposed action area to date; thus, the proposed action is expected to have a negligible, if any, impact on the short-beaked common dolphin population.

4.3.3.1.4 Long-beaked common dolphins

No interactions with common dolphins have occurred on DSBG and DSLBG within the proposed action area to date; thus, the proposed action is expected to have negligible, if any, impact on the long-beaked common dolphin population.

4.3.3.1.5 Blue Whales

There have been no observed takes of blue whales in any DSBG or DSLBG trials to date; thus, the proposed action is expected to have a negligible, if any, impact on the blue whale population.

4.3.3.1.6 Fin Whales

There have been no fin whale interactions during DSBG or DSLBG trials to date; thus, the proposed action is expected to have a negligible, if any, impact on the fin whale population within the action area.

4.3.3.1.7 Gray Whales

There have been no gray whale interactions during DSBG or DSLBG trials to date; thus, the proposed action is expected to have a negligible, if any, impact on the gray whale population within the action area.

4.3.3.1.8 Humpback Whales

There have been no humpback whale interactions during DSBG or DSLBG trials to date; thus, the proposed action is expected to have a negligible, if any, impact on the humpback whale population within the action area.

4.3.3.1.9 Northern elephant seals

To date there have been 2 interactions with northern elephant seals and DSBG. Both interactions were bait predation with mouth hooking. One interaction occurred with an elephant seal during DSBG research trials in 2014 and another occurred during DSBG EFP trials in 2015. Following strike detection, both elephant seals were retrieved alive and alert prior to release alongside the vessel (i.e., an at-sea observer indicated that the hook was shed from the animal adjacent to the fishing vessel during 2015 interaction). The DSBG strike-detection system functioned as

designed and allowed the vessel to actively service the gear within a reasonable amount of time to ensure live releases. These two incidences represent the only protected species interactions incurred during DSBG and DSLBG research and EFP trials since 2011. The average rate of incidental fishery mortality for this stock over the last five years ($\leq$ 4.0) also appears to be less than 10 percent of the calculated PBR of 4,882 animals; therefore, the total fishery mortality appears to be insignificant. Within the proposed action area, fishing with DSBG and DSLBG will have negligible impact on the northern elephant seal population.

4.3.3.2 Sea Turtle Interactions

Several recent studies have identified direct correlations between bycatch rate and the specific depth placement of hooks within the water column (Beverely *et al*., 2004; Gilman *et al*., 2006; Gilman *et al*., 2007). In the eastern North Pacific, research with the Hawaiian longline fishery has been used to show that increasing hook depth can significantly reduce sea turtle catch (Polovina *et al*., 2002; Swimmer *et al*., 2002; Gilman *et al*., 2006). This is primarily because most of the sea turtle daytime depths are within the top 40 m of the water column (Swimmer *et al*., 2002).

4.3.3.2.1 Leatherback sea turtles

Critical habitat for leatherback turtles (*Dermochelys coriacea*) or Leatherback Critical Habitat (LCH) for waters off the west coast United States is defined at 50 CFR 226.207. Critical habitat extends to a water depth of 80 m from the ocean surface. All hooks of the proposed alternative will be fished below 80 m, and at average depths of 250-400 meters deep. Quick sink rates to depth (~2 minutes) and quick retrieval rates minimize the time baited hooks will be shallower than 80 m depth. Considering this, and that no sea turtle interactions have occurred during DSBG and DSLBG research and EFP trials to date within the action area, the proposed action will likely have no impact, or a negligible impact, on the leatherback sea turtle population.

4.3.3.2.2 Loggerhead sea turtles

Considering that no sea turtle interactions have occurred during DSBG and DSLBG research and EFP trials to date within the action area, the proposed activity will likely have no impact, or a negligible impact, on the loggerhead sea turtle population.

4.3.3.2.3 Olive ridley sea turtles

Although the olive ridley sea turtle is regarded as the most abundant sea turtle in the world, olive ridley nesting populations on the Pacific coast of Mexico are listed as endangered under the ESA. Because the proposed action is most likely to occur primarily east of 140° W longitude, thus closer to the EPO nesting and foraging sites, it is reasonable to assume that this EPO population is more likely to be affected by the proposed action. Considering that no sea turtle interactions have occurred during DSBG and DSLBG research and EFP trials to date within the

action area, the proposed activity is expected to have a negligible, if any, impact on the loggerhead sea turtle population.

4.3.3.2.4. Green sea turtles

Considering that no sea turtle interactions have occurred during DSBG and DSLBG research and EFP trials to date within the action area, the proposed activity will likely have no impact, or a negligible impact, on the loggerhead sea turtle population.

4.4 Anticipated Economic Impacts of the Action Alternative

In section 3.6, the average ex-vessel prices for 2015 and 2016 DSBG EFP activity were summarized. DSBG EFP activity continues and is ongoing in 2017 with very similar target and marketable HMS species catch composition and landings for 5 vessels. The average daily catch of swordfish continues to be 1-3 swordfish daily and a landed weight ex-vessel average price of $6-9 per pound.

Startup gear purchase costs are estimated to be $8,000 to $10,000 for new DSBG EFP vessels (e.g. for buoys, monofilament line, hooks and weights, hydraulic line haul reel) and to be $15, 000 to $20,000 for new DSLBG EFP vessels (e.g. in addition to all similar DSBG, add hydraulic monofilament mainline reel and a hydraulic line shooter) (personal communication with Dr Sepulveda).

DSBG EFP activity in 2015 through 2016 did not result in an appreciable amount of landings of other marketable HMS species. With new participants trialing the gear, landings of other marketable HMS species (e.g bigeye thresher sharks, tunas, opah, mako sharks, etc) may increase to help cover costs. However, swordfish is still expected to make up the bulk of the landings under the proposed action.

The proposed action would have minor beneficial economic impacts.

4.5 Impacts of the No Action Alternative

Under Alternative 2, no EFP permits or awards of financial assistance to further test DSBG and DSLBG would be granted. Alternative 2 would not impact target, non-target, or protected species other than they would have zero potential to be caught by DSBG or DSLBG. Further, there would be no changes to economics. Under this alternative, NMFS would not receive further data on the effectiveness of DSBG or DSLBG. The effects of Alternative 2 are expected to be insignificant.

5.0 Cumulative Impacts

5.1 Past, Present, and Reasonably Foreseeable Future Actions Other than the Proposed Action

The scope of past and present actions for the affected resources encompasses actions that occurred after FMP implementation in 2004 (PFMC 2003) For endangered species and other protected resources, the scope of past and present actions is determined by analysis pursuant to the ESA and MMPA, including biological opinions for the highly migratory species fishery and marine mammal SARs. The temporal scope of future actions for all affected resources extends 10 years, until 2027, into the future. This period was chosen to characterize conditions during potential periods for which permits or financial assistance for DSBG and DSLBG fishing activities in the EEZ may be considered and/or granted.

5.1.1 Fishing-Related Actions

Fishery management measures contribute to the current status of managed stocks. Management measures directly or indirectly control catch and thereby affect stock status, fishing opportunity, harvester costs and net revenue, and personal income and employment in fishing communities. Because of the transboundary nature of highly migratory species stocks and fisheries, management measures affecting these stocks and fisheries occur at both domestic and international scales. Management measures implemented for fisheries that target highly migratory species in the EPO are codified in regulations at 50 CFR 660 Subpart K and 50 CFR 300 Subparts B, C, and O. Ongoing and reasonably foreseeable actions with potentially detectable effects are summarized below.

5.1.1.1 Regulatory Adjustments in HMS Fisheries

To guide domestic management activities for highly migratory species fisheries occurring in the U.S. West Coast EEZ, the PFMC developed the HMS FMP to coordinate state, Federal, and international management. NMFS, on behalf of the U.S. Secretary of Commerce, partially approved the Management Plan on February 4, 2004. The majority of the implementing regulations became effective on April 7, 2004. The reporting and recordkeeping provisions became effective February 10, 2005. The PFMC and NMFS regularly consider modifications, changes, or updates to management measures prescribed in the HMS FMP, which are codified in the corresponding regulations. NMFS implements these decisions under the MSA.

- **Biennial Management:** The PFMC's biennial management process includes consideration of updates or changes to measures in the HMS FMP for determining the status of stocks based on reference points or adjusting various catch limits or harvest guidelines for management unit species or both. NMFS then works on implementing any such recommendations resulting from that process. A primary goal for conducting the biennial management process is to comply with National Standard 1 by adopting conservation and management measures that prevent overfishing while achieving optimum yield on an ongoing basis.

- **Other Research and EFPs to Target Swordfish and other HMS Species:** The PFMC and NMFS have solicited for, and are in the process of reviewing and administering EFPs, or financial assistance, or both for other fishing activities that target HMS species, including swordfish. Therefore, there may be some additional vessels operating in the action area. Currently, other vessels have requested to fish in the U.S. West Coast EEZ using longline gear and modified drift gillnet gear. Issuance of permits for use of longline gear would allow vessels to target tuna during the day and swordfish at night using deep set and shallow set gear respectfully. Issuance of permits for use of drift gillnet gear would allow vessels to target swordfish in accordance with use of dynamic ocean modeling tools to assist in protected species avoidance. Though these activities are set to occur within the proposed action area and target swordfish, these activities should have minimal impact with the Proposed Action as DSBG and DSLBG are set much deeper than the gear requested in these other permit proposals. For any other experimental or exempted permits that are administered, both vessel participation and the operational period are severely limited to minimize risk of unintended or unforeseen consequences. Despite that, these permits often provide for exemptions from current regulations, such exemptions are typically minimal to the extent that permitted vessels are expected to operate within the confines of current regulations from which they have not explicitly been exempted. Further, these activities must be conducted consistent with all other applicable laws.

In addition to domestic fishery management processes, the United States (along with many other fishing nations) participates in international organizations (e.g. RFMOs) to support the conservation and management of highly migratory species on larger geographic scales. RFMOs adopt living marine resource conservation and management measures for oceanic regions (i.e. including multiple national jurisdictions and the high seas) through consensus on resolutions. The measures in these resolutions are binding for their members. The United States is a member of the IATTC, which is the RFMO responsible for the conservation and management fisheries for tunas and other species taken by tuna-fishing vessels in the EPO (generally east of the 150° W meridian). The United States is also a member of the Western and Central Pacific Fisheries Commission (WCPFC), which plays a parallel role in the western and central Pacific Ocean (generally west of the 150° W meridian). The United States' obligations under the IATTC and WCPFC are most pertinent to consider with regard to cumulative effects on fisheries and resources in the action area. The IATTC and WCPFC have adopted resolutions to control catch of highly migratory species. Similar to the domestic management process, the RFMOs renegotiate catch controls on an ongoing basis.

5.1.1.2 Illegal, Unregulated, and Unreported (IUU) Fishing

Some IUU fishing may occur in the vicinity of the action area with some effects to marketable highly migratory species, non-target finfish, and protected species. Information on catch, effort, and protected species interactions for these activities is sparse and difficult to obtain. Nonetheless, it is expected that these activities may contribute some negative impacts on [the?] species described in Section 3, Affected Environment.

5.1.1.3 Protected Species Avoidance

Other Federal fisheries target highly migratory species within the U.S. West Coast EEZ and may interact with ESA-listed sea turtles and other ESA-listed species. These fisheries were considered in the 2004 Biological Opinion on the HMS FMP (NMFS 2004). Additionally, NMFS Protected Resources Division issued a Biological Opinion for the west coast drift gillnet fishery and amended the associated incidental take statement in 2013 (NMFS 2013). Biological opinions provide terms and conditions intended to ensure monitoring and avoidance of interactions with protected species, namely marine mammals and sea turtles. Many of these terms and conditions have been implemented as regulations for HMS fisheries at 50 CFR 660 Subpart K. Other protected species avoidance measures for fisheries that occur in the vicinity of the action area and that target highly migratory species have been implemented as regulations at 50 CFR 300 Subparts B, C, and O.

5.1.1.4 Ecosystems

The PFMC developed measures to protect unfished and unmanaged forage fish species pursuant to an initiative identified in the Pacific Coast Fishery Ecosystem Plan for the United States Portion of the California Current Large Marine Ecosystem (California Current FEP). This action involves amending all current FMPs to prohibit targeted harvest of specified forage species. These protections could benefit both currently unmanaged fish stocks and managed stocks that depend on forage fish.

5.1.2 Non-Fishing Related Actions

In addition to fishery management actions, other past, present, and reasonably foreseeable future actions are considered (e.g. water pollution and climate change).

5.1.2.1 Water Pollution

A variety of activities introduce chemical pollutants and sewage into the marine environment and cause changes in water temperature, salinity, dissolved oxygen, and suspended sediment. Although these activities tend to affect nearshore waters, they adversely impact identified affected biological resources if a substantial part of these resources' life cycles occur in these waters. Examples of these activities include, but are not limited to, agriculture, port maintenance, coastal development, marine transportation, marine mining, dredging, the disposal of dredged material, and natural and human-induced disasters in the coastal zone. Wherever these activities co-occur, they are likely to work additively or synergistically to decrease habitat quality and may indirectly constrain the sustainability of the managed resources, non-target or prey species, and protected resources.

5.1.2.3 Cyclical and Ongoing Climate Change

Two mesoscale climate phenomena likely affect frontal activity and the distribution of species located off the western coast of the United States. The first is the El Niño-Southern Oscillation (El Niño), which is characterized by a relaxation of the Indonesian Low and subsequent weakening or reversal of westerly trade winds that cause warm surface waters in the western Pacific to shift eastward. Although the effects can be global, an El Niño event brings warm waters and a weakening of coastal upwelling off the West Coast. La Niña, a related condition, results in inverse conditions, including cooler water in the eastern tropical Pacific and California Current System (CCS). The second mesoscale climate phenomenon likely to affect the distribution of species in the eastern Pacific is the Pacific Decadal Oscillation (PDO). It has important ecological effects in the CCS. Regime shifts indicated by the PDO have a periodicity operating at both 15- to 25-year and 50- to 70-year intervals (Schwing 2005). The PDO indicates shifts between warm and cool phases. The warm phase is characterized by warmer temperatures in the northeast Pacific (including the West Coast), and cooler-than-average sea surface temperatures and lower-than-average sea level air pressure in the central north Pacific; opposite conditions prevail during cool phases.

Studies conducted by Perry *et al.* (2005) indicate that climate change is affecting marine fish distributions in ways that may have important ecological impacts on fish as well as important impacts on commercial fisheries. Impacts to commercial fisheries include: increases in ocean stratification leading to less primary production, which in turn leads to less overall energy for fish production; shifts in mixing areas of water zones leading to decreases in spawning habitat and decreased stock sizes; and changes in currents that may lead to changes in larval dispersals and retention among certain habitats, which could lead to decreases in stock sizes or availability of resources to certain fisheries (Roessig *et al.,* 2004).

As a result of climate change, catch rates in the EPO are expected to increase, while catch rates in the WCPO are expected to decrease. That is, over the entire North Pacific region, catch rates are predicted to decrease by 7.5 percent by 2100 (Lehodey *et al.,* 2011). This is due largely to changes in distribution of these species as a result of climate change, which will likely impact the management procedures to ensure these stocks are not over exploited as well as the economics associated with fishing these species. Geographic shifts in the range of target, non-target or prey, and protected species may cause the biggest climate change related impact on fisheries.

5.2 Effects of Past, Present, and Reasonably Foreseeable Future Actions and Net Cumulative Effects

Cumulative effects have been considered principally in terms of any increase in catch, take, or mortality to various species that may be caught or taken during the trials, including such impacts on other HMS fisheries. Subsection 5.1.1, Fishing-Related Actions, and Subsection 5.1.2, Non-Fishing Related Actions, describe the range of other actions and activities contributing to or diminishing catch, take, or mortality. Because the cumulative effects of past and present actions

and likely conditions that are described for the alternatives in Section 3, Affected Environment, this section focuses on the likely impacts of the reasonably foreseeable actions described in Subsection 5.1, Past, Present, and Reasonably Foreseeable Future Actions Other than the Proposed Action, that may occur and the expectations for cumulative effects under the different alternatives. Overall, the incremental effects of the action alternatives are very small relative to baseline levels and cumulative effects are not expected to be significant.

5.2.1 Alternative 1, Preferred Alternative

Under the preferred alternative, permits and/or financial assistance would be granted for the use both DSBG and DSLBG in the Proposed Action Area. Under this alternative, additional catch of target and non-target finfish species is likely to occur in the action area. This catch with that of other authorized U.S. fisheries for targeting highly migratory species in the area, other EFPs that may be issued, and IUU activities is not expected to have significant cumulative impacts on these stocks. This is, in part, due to the fact that fishing activities under this alternative are further subject to conservative terms and conditions and are not exempt from existing or future catch limits and harvest guidelines. Additionally, the ongoing monitoring of stock health and regulatory adjustments that occur as a result of the HMS FMP biennial management cycle to prevent overfishing and California Current FEP management activities to protect unfished and forage finfish species makes it unlikely that significant cumulative impacts would result from cyclical climate activities, climate change, or effects of water pollution as any changes in the distributions of target and non-target finfish species in the action area are likely to be detected and accounted for in these management processes.

With increased catch of commonly caught fish species, there is a potential of incidental catch and/or take of protected species; as a result, the negative effects of this action, if any, for these species could increase when considered in cumulative with other fishing-related and non-fishing-related activities occurring in the action area. However, such a scenario is unlikely as fishing activities proposed under Alternative 1, like for other U.S. fishing activities in the action area, are not be exempt from compliance with other management measures and activities under alternative authorities for conserving marine resources (e.g., recovery planning under ESA and stock assessments and fishery authorizations under MMPA). Further, the fishing gear proposed to be used under this alternative is specifically designed to target swordfish and other commonly-caught highly migratory species with little to no interaction with other protected species. The gear is also actively tended; therefore, should any interactions with protected species occur, notification of a catch on the line would be immediate and the gear would be retrieved quickly, reducing incidents of bycatch. Lastly, the voluntary use of new tools designed to assist fishermen in detecting conditions preferred by protected species and in avoiding protected species hot spots is likely to further reduce the potential for the effects of Alternative 1 to yield significant effects in cumulative with other fishing-related and non-fishing-related activities occurring in the action area. Thus, the cumulative effects to protected species of Alternative 1 are expected to be insignificant.

Alternative 1 could have positive effects for the U.S. swordfish industry; however, these effects are unlikely to be cumulatively significant given timing limitations on funding and permitting

activities proposed under this alternative and management measures in place to control other fishing-related activities. Due to the regulations on the drift gillnet fishery and other U.S. fisheries that target HMS species, swordfish catch rates have greatly been reduced. By using DSBG and DSLBG, swordfish are able to be caught in the U.S. West Coast EEZ in fishing areas and during times of that year that are inaccessible to drift gillnet fishing, which could increase the revenue generated by increased landings of domestically-caught swordfish in the U.S., as well as benefit U.S. fishermen and fishing communities in which those fish are landed. While non-fishing related phenomena, such as climate and water quality conditions, have the potential to dampen or emphasize (depending on the nature of their impacts to swordfish stocks) these positive effects for the U.S. swordfish industry, Alternative 1 would provide additional opportunities for data collection on the distribution of this target species under a variety of conditions. Such information could inform future business decisions regarding and fishing efficiencies.

5.2.2 Alternative 2

Under Alternative 2, no further permits or financial assistance would be issued to test DSBG and DSLBG. Alternative 2 would not introduce any additional impacts to the environment, including protected species beyond the cumulative impacts of past, present, and reasonably foreseeable future actions described in Section 5.1. Under this alternative, the WCNPO stock of swordfish off the U.S. West Coast may continue to be underexploited. There would be no benefit to fishing communities where landings permitted under the proposed action would have occurred. The cumulative effects of Alternative 2 are expected to be insignificant.

References

Howell, EA, Kobayashi, DR, Parker, DM, Balazs, GH, Polovina, JJ (2008) Turtle Watch: A Tool to Aid in the Bycatch Reduction of Loggerhead Turtles *Caretta caretta* in the Hawaii-based Pelagic Longline Fishery. Endangered Species Research.

ISC, 2014. North Pacific Swordfish (Xiphiaus gladius) stock assessment in 2014. https://www.wcpfc.int/system/files/SC10-SA-WP-641 13%20North%20Pacific%20Swordfish%20Assmt%20Report%202014.pdf

ISC16 Plenary Report (2016) Report of the Sixteenth Meeting of the International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean. Plenary Session, Sapporo, Hokkaido, Japan, July 13-18.

Lehodey, P, Calmettes, B, Portner, HO, Bopp, L (2011) Vulnerability of oceanic fisheries in the tropical Pacific to climate change. *Vulnerability of tropical Pacific fisheries and aquaculture to climate change* 433-492.

NMFS (2013) Biological Opinion on the Continued Management of the Drift Gillnet Fishery under the Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species. National Marine Fisheries Service, Southwest Region. May 2013.

NMFS (2004) Biological Opinion on the Adoption of (1) Proposed Highly Migratory Species Fishery Management Plan; (2) Continued Operation of Highly Migratory Species Fishery Vessels Under Permits Pursuant to the High Seas Fishery Compliance Act; and (3) Endangered Species Act Regulation on the Prohibition of Shallow Set Longline Sets East of the 150° West Longitude. National Marine Fisheries Service, Southwest Regional Office. February 4, 2004.

NOAA (2016) NOAA Turtle Watch. January 24, 2016. Accessed online at: http://www.pifsc.noaa.gov/eod/turtlewatch.php

Perry, AL, Low, PJ, Ellis, JR, Reynolds, JD (2005) Climate change and distribution shifts in marine fishes. *Science* 308:1912-1915.

PFMC (2016) EcoCast March 2016. http://www.pcouncil.org/wp-content/uploads/2016/02/F2c_PubCom_MAR2016BB.pdf.

PFMC (2003) Fishery Management Plan and Environmental Impact Statement for U.S. West Coast Fisheries for Highly Migratory Species. August, 2003.

Schwing, F (2005) Decadal-scale Climate Events. In: King, J, Report of the Study Group on Fisheries and Ecosystem Responses to Recent Regime Shifts. PICES Scientific Report 28:9-36.

Roessig, JM, Woodley, CM, Cech, JJ, Hansen, LJ (2004) Effects of global climate change on marine and estuarine fishes and fisheries. *Reviews in Fish Biology and Fisheries* 14:251-275.

Sepulveda, C. A., S. Kohin, C. Chan, R. Vetter, and J. B. Graham. 2004. Movement patterns, depth preferences, and stomach temperatures of free-swimming juvenile mako sharks, Isurus oxyrinchus, in the Southern California Bight. Mar. Biol. 145:191-199.

Sepulveda, C. A., A. Knight, N. Nasby-Lucas, and M. L. Domeier. 2010. Fine-scale movements and temperature preferences of swordfish in the Southern California Bight. Fish. Oceanogr. 19(4):279-289.

Sepulveda, C. A., C. Heberer, and S. A. Aalbers. 2014. Development and Trial of Deep-set 684 Buoy Gear for Swordfish, Xiphias gladius, in the Southern California Bight. Mar. Fish. 685 Rev. 76:28-36. doi: dx.doi.org/10.7755/MFR.76.4.2

Palacios, D. M., S. J. Bograd, R. Mendelssohn, and F. B. Schwing. 2004. Long-term and seasonal trends in stratification in the California Current, 1950–1993. J. Geophys. Res.109:C10016.

Huyer, A. , P. A. Wheeler, P. T.Strub, R. L. Smith, R. Letelier, P. M. Kosro. 2007. The Newport line off Oregon – Studies in the North East Pacific. Progress in Oceanography 75 (2007) 126–160.

Bernal, D., C. A. Sepulveda, M. Musyl, and R. Brill. 2009. The eco-physiology of swimming and movement patterns of tunas, billfishes and large pelagic sharks. In: P. Domenic and B. Kapoor (Editor), Fish locomotion—an etho-ecological approach, p. 437-483. Sci. 590 Publ., Einfeld.009

Pacific Fishery Management Council. (2016) HMS Stock Assessment and Fishery Evaluation 671 Report: Status of the U.S. west coast fisheries for highly migratory species through 2015. 672 PFMC Stock Assessment and Fishery Evaluation, 29-58 pp.

Beverly, S. and E. Robinson. 2004. New deep setting longline technique for bycatch mitigation. Australian Fish. Manage. Authority Report R03/1398. Secretariat of the Pacific Community, Noumea:

Gilman, E., E. Zollett, S. Beverly, H. Nakano, K. Davis, D. Shiode, P. Dalzell, and I. Kinan2006. Reducing sea turtle by-catch in pelagic longline fisheries. Fish Fish. 7(1):2-23.

Gilman, E., D. Kobayashi, T. Swenarton, N. Brothers, P. Dalzell, and I. Kinan-Kelly. 2007. Reducing sea turtle interactions in the Hawaii-based longline swordfish fishery. Biol. Conserv. 139:19–28.

Cailliet, G. M., & Bedford, D. W. (1983). The biology of three pelagic sharks from California waters and their emerging fisheries: A review. California Cooperative Oceanic Fisheries Investigations Report, 24, 57-69.