Evaluating Bycatch in the California Halibut Set Gill Net Fishery

California halibut, *Paralichthys californicus*.

(Photo Credit: Marine Applied Research Exploration, CDFW)

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Contributors: Kirsten Ramey, Armand Barilotti, Julia Coates, Miranda Haggerty, Heather Gliniak, Kristine Lesyna, Paul Reilly, Travis Tanaka, and Chuck Valle (2023).

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LIST OF ACRONYMS

ACL	Acceptable Catch Limits
ALDS	Automated License Data System
CCR	California Code of Regulations
CPFV	Commercial Passenger Fishing Vessel
DPS	Distinct Population Segment
ERA	Ecological Risk Assessment
ESA	Endangered Species Act
ESR	Enhanced Status Report
FGC	Fish and Game Code
FIS	Fisheries Information System Program
FMP	Fishery Management Plan
GEMM	Groundfish Expanded Mortality Multiyear
IUCN	International Union for Conservation and Nature
MLDS	Marine Landings Data System
MLMA	Marine Life Management Act
MMPA	Marine Mammal Protection Act
MRC	Marine Resources Committee
MRPZ	Marine Resources Protection Zone
MSE	Management Strategy Evaluation
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
PBR	Potential Biological Removal
PSA	Productivity Susceptibility Analysis
RLF	Resources Legacy Fund
VMS	Vessel Monitoring System
WCROP	West Coast Region Observer Program

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EXECUTIVE SUMMARY

The Marine Life Management Act (MLMA) provides for the conservation, sustainable use, and restoration of California's living marine resources. It requires an ecosystem-based approach for managing the State's fisheries, using the best available science, and involving stakeholders in a comprehensive and transparent process. The 2018 MLMA Master Plan for Fisheries (Master Plan) provides guidance and a toolbox for implementing MLMA goals and objectives, and it is the Department of Fish and Wildlife's (Department) primary guidance document for managing state finfish, invertebrate, and algal commercial and recreational fisheries. The Master Plan requires the Department to prioritize its fisheries for management attention, and this was completed through a process involving the use of Productivity and Susceptibility Analyses (PSA) and Ecological Risk Assessments (ERA) (MRAG 2014 and Ramanujam et al. 2017).

The prioritization process resulted in the identification of several commercial fisheries using set gill net and trawl gear as most in need of management attention. These fisheries target California halibut (*Paralichthys californicus*, halibut), Pacific angel shark (*Squatina californica*), and white seabass (*Atractoscion nobilis*). One of the key ecosystem-based objectives in the Master Plan is to characterize bycatch of nontarget organisms in California's fisheries and develop appropriate management measures to minimize impacts to habitats and species. The Master Plan outlines a four-step process to identify bycatch and assess its potential impacts on sustainability, the ecosystem, and socioeconomics:

1. collection of information on the types and amounts of bycatch;
2. distinguishing target, incidental, and bycatch species;
3. determining "acceptable" types and amounts of bycatch; and
4. addressing unacceptable bycatch.

As part of the implementation of the Master Plan, halibut was identified as a high priority species for management attention, primarily due to the potential risk to the species from fishing activities, and to other species that may be caught as bycatch in the fishery. One of the key ecosystem-based objectives in the Master Plan is to characterize bycatch of nontarget organisms in California's fisheries and develop appropriate management measures to minimize impacts to habitats and species.

In 2020, the Department began, in collaboration with partners and stakeholders, to gather information on bycatch in the trawl and set gill net state-managed fisheries. This report documents the Department's efforts to date to complete the bycatch evaluation for the halibut fishery, with a focus on the set gill net fleet, specifically.

INTRODUCTION

The Marine Life Management Act (MLMA) [Fish and Game Code (FGC) §7050 to 7090], which became law on January 1, 1999, was introduced as Assembly Bill 1241 by Assemblyman Fred Keeley and serves as California's primary fisheries management law. The MLMA includes a number of innovative features:

- the MLMA applies to all marine wildlife, including fish, invertebrates, and algae taken by commercial and recreational fishermen;
- the MLMA shifts the burden of proof toward demonstrating that fisheries and other activities are sustainable, rather than assuming that exploitation should continue until damage has become clear;
- through the MLMA, the Legislature delegates greater management authority to the Fish and Game Commission (Commission) and the California Department of Fish and Wildlife (Department);
- the MLMA requires an ecosystem perspective including the whole environment, rather than focusing on single fisheries management; and
- the MLMA strongly emphasizes science-based management developed with the help of all those interested in California's marine resources (i.e., stakeholders).

The MLMA directs the Department to develop a Master Plan to guide the implementation of the act and the original 2001 Master Plan: A Guide for the Development of Fishery Management Plans (FMPs), as required by FGC §7073, served as a roadmap and specified the process and resources needed to prepare, adopt and implement FMPs for sport and commercial marine fisheries managed by the state. To reflect advancements in management tools, changing ocean conditions, and stakeholder priorities, the Department undertook an effort to improve the roadmap and developed the 2018 Master Plan for Fisheries A Guide for Implementation of the Marine Life Management Act (Master Plan). The 2018 Master Plan replaces the original and is intended to be both a roadmap and a toolbox for implementation of the MLMA. The Master Plan is the Department's primary guidance document for managing state finfish, invertebrate, and algal commercial and recreational fisheries. Specifically, the Master Plan includes: a prioritized list of fisheries in need of FMPs; a process for how the public may be involved in developing fishery management and research plans; a description of the essential fishery information that will be needed to effectively manage the top priority fisheries; and a process of how these various plans will be amended or revised.

The Master Plan calls for a scaled management approach to fisheries management, in which a suite of management alternatives, ranging from the completion of Enhanced Status Reports (ESRs) to rule-makings to more comprehensive FMPs, is considered.

As directed by the Master Plan, the Department began a process to prioritize our state-managed species based on their inherent productivity and their susceptibility to environmental and fishing pressures. The prioritization process is an integral part of the scaled management approach. In December, 2019, the Department presented the prioritization of 17 state-managed commercial fisheries and 14 state-managed recreational fisheries to the Commission (Fish and Game Commission 2019). This prioritization was based primarily on productivity and susceptibility analyses (PSA) and ecological risk assessments (ERA) for those species that contribute to the most valuable commercial and recreational fisheries. Several of the critical attributes in the ERA process related to the type and magnitude of bycatch in the directed fisheries, and these became the driving factors of the Department's streamlined approach to prioritization. The set gill net fisheries for California halibut (*Paralichthys californicus*, halibut), Pacific angel shark (*Squatina californica*), and white seabass (*Atractoscion nobilis*), along with the halibut trawl fishery, rose to the top as fisheries of concern. Risks to these species identified in the Department's prioritization include a changing climate and potential impacts to bycatch species from fishery gear types.

As part of the Master Plan implementation, halibut was identified as a high priority species for management attention, primarily due to the potential risk to the species from fishing activities, and to other species that may be caught as bycatch in the fishery. In 2020, the Department began the initial stages of considering the best scale of management for the fishery and partnered with stakeholders to identify areas of concerns. Guided by the objectives and framework of the MLMA and Master Plan, the Department gathered information about stock depletion, bycatch, changing ocean conditions, and other issues of concern for the halibut fishery. This information gathering stage included an update to the halibut stock assessment, a preliminary Management Strategy Evaluation (MSE), the development of an ESR, exploration of habitat considerations, and an initial bycatch evaluation. Between October 2020 and September 2021, Department staff conducted a stakeholder scoping process, through two public webinars, with the fishing and broader stakeholder community to assess the community's management priorities and concerns for the fishery.

Learning from the knowledge gained in the scoping process and information gathering stage, the Department engaged in an internal strategic planning process from September 2021 to February 2022 to identify management priorities for the halibut fishery. This strategic planning process confirmed six management priorities for the halibut fishery: 1) refinement of the 2020 stock assessment; 2) completion of the ESR; 3) completion of an ecosystem evaluation; 4) conducting a California Halibut Southern Trawl Ground assessment; 5) expansion of the halibut MSE; and 6) performing a bycatch evaluation. This document is focused on the Department's efforts to complete the bycatch evaluation for the halibut fishery, with a focus on the set gill net fleet.

OVERVIEW OF THE SET GILL NET FLEET

Regulatory History

Gear restrictions on the halibut set gill net fishery date back to 1911 and extend through the early-2000s. Through the mid-1980s, several nearshore areas were closed to set gill net fishing, primarily due to concerns of seabird and marine mammal bycatch in the fishery (FGC §8660-8670). In 1989, a minimum mesh-size requirement of 8.5 inches was established for the take of halibut, statewide, in addition to the length of net allowed in certain areas (FGC §8625). In 1994, the use of set gill nets was further restricted through a California constitutional amendment which established the Marine Resources Protection Zone (MRPZ), which prevented the use of set gill nets within one nautical mile (nm), or less than 70 fathoms (420 feet) in depth, whichever is less, around the Channel Islands. Additionally, set gill nets could no longer be used within three nm of the mainland shore, south of Point Arguello, Santa Barbara County to the California/Mexico border (FGC §8610.1-8610.16). The establishment of the MRPZ was not directed at the halibut set gill net fishery, but it did impact the fleet. Most recently, in 2002, the Commission implemented a depth restriction on set gill nets in waters 360 feet (110 meters) or less between Point Reyes headlands, Marin County and Point Arguello (14 CCR §104.1). This limited the use of set gill nets for halibut to waters south of Point Arguello.

Permit History

In 1987, during the peak of the set gill net fishery, there were more than 800 set gill net permittees, with just over 300 permittees actively landing halibut that year. The number of both general set gill nets and those who actively target halibut have steadily declined since the peak in 1987 (Figure 1). As of 2022, there are 100 set gill net permit holders, 32 of which were active, or had at least one halibut landing last year. In 2020, 26 set gill net permits were active, but only 14 made 90% of the halibut landings. In 2021 and 2022, 16 and 13 vessels contributed 90% of the catch, respectively.

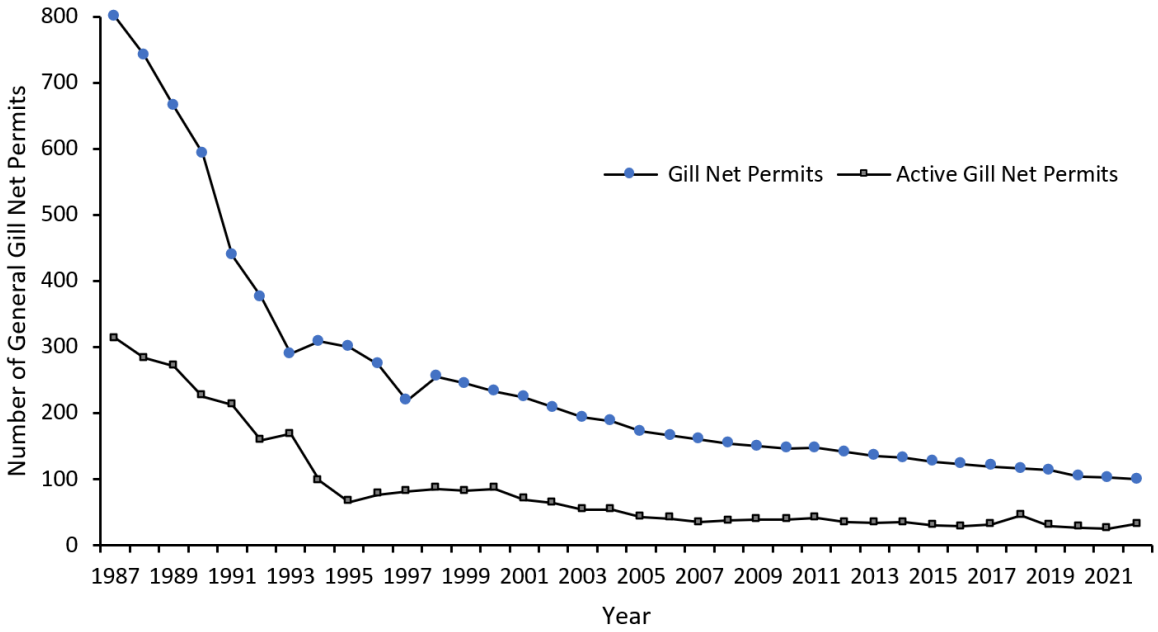

Figure 1 Number of general set gill net permits purchased compared to active halibut set gill net permits, from 1987-2022.

Current Set Gill Net Regulations

Current regulations for the halibut set gill net fleet include a minimum size limit for retained halibut, minimum mesh size, depth and area restrictions, and gear marking requirements. Restricted access permits have been required to use a set gill net since 1980, are issued annually, and are assigned to the fisherman, not the vessel (FGC §8680-8682). The minimum size limit for halibut is 22 inches total length (swinging or fanning the tail is permitted). The minimum mesh size to take halibut with set gill nets is 8.5 inches, with no more than 9,000 feet of net fished in combination each day. No more than 6,000 feet of net may be fished in specified areas of Santa Barbara County (FGC §8625). Set nets and set lines must be marked with buoys displaying the fisherman's identification number and each panel must be marked along the corkline, every 45 fathoms (FGC §8601.5). From December 15 to May 15, breakaway devices must be installed every 45 fathoms (270 feet) or less along the corkline and lead line and in waters shallower than 25 fathoms (150 feet), the corkline and any other line shall have a breaking strength not to exceed 2,400 pounds (lbs) (FGC §8664.13). Set gill nets are banned in waters 60 fathoms or less north of Point Arguello, as well as within nearshore waters, three nm off the mainland and one nm or less than 70 fathoms (420 feet) in depth, whichever is less, around the Channel Islands (FGC §8610.1-8610.4).

Annual Halibut Landings

From about 1978 to 1990, set gill net landings dominated the statewide commercial catch of halibut, with those landings peaking in the 1980s. Coinciding with the nearshore area closures, set gill net landings dropped in the 1990s and the trawl gear type became more popular with halibut fishermen. However, set gill net continues to comprise the majority of the halibut landings in southern California – consisting of the Santa Barbara, Ventura, Los Angeles, and San Diego port complexes (Table 1).

Table 1 Annual halibut landings in southern California for set gill net, 2018 – 2022.

Year	Set gill net halibut landings (lbs)	Number of set gill net permits, targeting halibut	Total halibut landings (lbs) for all commercial gear types combined in southern California	Proportion of southern California landings that are landed by set gill nets
2018	134,788	37	221,139	61%
2019	178,291	30	249,061	72%
2020	118,186	26	203,733	58%
2021	167,428	24	248,916	67%
2022	143,878	32	224,945	64%

METHODS AND RESULTS

One of the key ecosystem-based objectives in the Master Plan is to characterize bycatch of nontarget organisms in California's fisheries and develop appropriate management measures to minimize impacts to habitats and species. The MLMA defines bycatch as "fish or other marine life that are taken in a fishery but are not the target of the fishery. Bycatch includes discards" (FGC §90.5). The MLMA goes on to provide additional clarification on discards to include regulatory discards or discretionary discards. Discarded catch may be returned to the sea alive, dead, or dying, and it is important to assess the mortality rate to evaluate impacts. It is also important to note that while all discards are defined as bycatch under the definition, the discard of live catch may not pose a risk to a bycatch species, and discarding can be an effective management strategy to protect some individuals in which survival is expected to be high. To achieve the goal of minimizing unacceptable bycatch, the MLMA requires that the Department manage every sport and commercial marine fishery in a way that limits bycatch to acceptable types and amounts (FGC §7056). The Master Plan outlines a four-step process to identify bycatch and assess its potential impacts on sustainability, the ecosystem, and socioeconomics:

1. collection of information on the types and amounts of bycatch;

2. distinguishing target, incidental, and bycatch species;

3. determining "acceptable" types and amounts of bycatch; and

4. addressing unacceptable bycatch.

Step 1. Collection of information on the amount and type of catch

The Department, in coordination with partners, undertook a two-part study to begin evaluating bycatch in California state-managed trawl and set gill net fisheries, including halibut. In 2020, with support from the Resources Legacy Fund (RLF), the Department worked with Moss Landing Marine Laboratories researchers to collect information about bycatch of marine species that are harvested with various types of trawl and set gill net gear in California state-managed fisheries. The focus of the study was on the red sea cucumber (*Apostichopus californicus*), ridgeback prawn (*Sicyonia ingentis*), and halibut trawl fisheries, and the set gill net fisheries for halibut, white seabass, barracuda (*Sphyraena argentea*), and other smaller fisheries. The objectives of the study were to: 1) compile relevant fishery catch information from Department records and Federal Observer Program data related to the amount and spatial distribution of bycatch in the focused set gill net and trawl fisheries; 2) conduct first-level analyses of those data to quantify volumes and distribution of bycatch as well as determine the areas of bycatch

that are likely to be impacting other target fisheries and/or having detrimental impacts on ecosystems, and 3) conduct a literature review of bycatch in west coast fisheries. This first phase of the bycatch evaluation compiled available fishery catch information from fishery-dependent logbook data, landing receipts, Groundfish Expanded Mortality Multiyear (GEMM) data, which is a modeled estimate of bycatch in federal commercial groundfish fisheries, and non-confidential Federal Observer Program data from the trawl and set gill net fisheries. The study separated bycatch into three components: targeted species that are discarded because the individuals are not suitable for market, untargeted species that can be sold, and untargeted species that are not retained (i.e., discarded at sea).

Step 2. Distinguishing target, incidental, and bycatch species

As described in the Master Plan under Step 2, once information about the type and amount of catch is identified, it is necessary to determine which species are the target of the fishery, which are incidental catch, and which species are discarded bycatch. The relatively low selectivity of trawl and set gill net gear types means that they are used in multispecies fisheries. In such fisheries, the definition of bycatch or incidental catch may be considered fluid and dependent on seasons, markets, and fisher preferences. However, the high discard rate makes trawl and set gill net sectors vulnerable to bycatch or incidental catch of non-target species. Additionally, discard mortality may be high or unknown depending on the species caught due to the nature of these gear types which warrants investigation.

Based on the prioritization, scoping, and strategic planning processes, Department staff partnered with researchers from UC Santa Barbara, with funding support from RLF, to take a halibut-centric view of the trawl and set gill net gear types to analyze only data where halibut was targeted and caught (Free 2022). The goal of this effort was to evaluate the magnitude and composition of catch in the trawl and set gill net gear types associated with the halibut targeted fishery. This study worked to analyze three categories of catch: 1) retained, landed catch of non-halibut species; 2) discards (live/dead) of non-halibut species; and 3) discards (live/dead) of sub-legal sized halibut. The assessment calculated ratios, in terms of weight, of these categories to legal-sized halibut catch and examine patterns by gear type, location, depth, and day of year. The various datasets assembled included publicly available GEMM data, confidential Federal Observer Program data from halibut trawl and set gill net vessels, Department permit data, landing receipts, logbooks, and Department set gill net observer data. Permit, landing receipt, and logbook data from 2000-2021 were used in the assessment. Set gill net observer data from the Federal Observer Program spanned the years from 1990-2017; however, the program was active for 15 of the 27-year time frame and trawl observer data were available from 2002-2020. The assessment

presented ratios of non-halibut to halibut landings for the most frequently caught species in association with halibut (Free 2002).

Halibut Set gill net

Generally, set gill net landing and logbook data were consistent regarding the species frequently caught and landed in association with halibut, and included Pacific angel shark, white seabass, leopard shark (*Triakis semifasciata*), thresher shark (*Alopias vulpinus*), soupfin shark (*Galeorhinus* galeus), and fantail sole (*Xystreurys liolepis*). However, these results differ from the top species documented in the observer data, which included Pacific angel shark, but also shovelnose guitarfish (*Rhinobatos productus*), Pacific mackerel (*Scomber japonicus*), and brown smoothhound (*Mustelus henlei*). These differences are likely due to the fact that the observer data reports catch in numbers of fish versus landing receipts and logbooks which both report catch in weight and/or numbers. The top species frequently caught and discarded either in a live or dead condition, based on observer data included rock crab (*Cancer productus, Metacarcinus anthonyi, and Romaleon antennarium*), spider crab (*Loxorhynchus grandis*), bat ray (*Myliobatis californica*), California skate (*Beringraja inornate*), halibut, Pacific mackerel, and brown smoothhound shark. Within set gill net logbook data, for sensitive species, only giant sea bass (*Stereolepis* gigas) have ever been reported as bycatch. The observer data documents the most commonly caught marine mammals are California sea lions (*Zalophus californianus*) and Pacific harbor seals (*Phoca vitulina*) (Free 2022).

Halibut Trawl Fishery

The top species frequently caught and landed in association with the northern halibut trawl fishery based on both landing receipts and logbooks, included starry flounder (*Platichthys stellatus*), sand sole (*Psettichthys melanostictus*), petrale sole (*Eopsetta jordani)*, white seabass, curlfin sole (*Pleuronichthys decurrens*), unspecified sole, and turbot. The most common species caught and landed in association with the southern trawl fishery based on these same data sources included unspecified trawl fish, unspecified sole, Pacific angel shark, California scorpionfish (*Scorpaena guttata*), ridgeback prawn, unspecified skate, English sole (*Parophrys vetulus*), and rock sole (*Lepidopsetta bilineata*). Based on Department onboard observations in southern California, unspecified sole are most likely fantail sole and unspecified skates are likely California skates. Additionally, the ridgeback prawn documented in the logs are likely from targeted shrimp tows. The top species frequently caught and discarded in association with northern halibut trawl fishery based on observer data, included Dungeness crab (*Metacarcinus magister*), big skate (*Beringraja binoculata*), halibut, California skate, and English sole. The most commonly discarded species for the

southern trawl fishery included halibut, California skate, hornyhead turbot (*Pleuronichthys verticalis*), longspine combfish (*Zaniolepis latipinnis*), and fantail sole. The halibut that are discarded are likely either sublegal sized fish or unmarketable due to marine mammal predation (Free 2022).

Insights from Steps 1 and 2

Throughout Steps 1 and 2, the analysis to quantify bycatch amounts was affected by data limitations. Landing receipt data only describes landed catch and thus does not provide information about discards. Additionally, logbook data sometimes includes information on discards, but accuracy varies due to self-reporting and non-compliance. Federal Observer Program data, which are independently collected by field biologists, include information on spatial location, effort, and discards. However, the Federal Observer Program only documented a sub-sample of the fleet, and observation assignments were not randomly sampled across the various fishing ports or active permittees. Additionally, effort information in the observer data was combined for both the white seabass and halibut set gill net fleet, which does not allow for extrapolation for the halibut fleet, specifically (pers. comm., Charles Villafana). Landings and logbook data record species in weight compared to the observer data that captures information in total numbers. These data limitations make it difficult to estimate fleetwide bycatch amounts to more directly determine if bycatch amounts are of management concern for the halibut fishery.

Step 3. Determining "acceptable" types and amounts of bycatch

The MLMA assesses the acceptability of the amount and type of bycatch using four criteria: 1) legality of the take of bycatch species; 2) degree of threat to the sustainability of the bycatch species; 3) impacts on fisheries that target the bycatch species; and 4) ecosystem impacts (FGC §7085(b)). The Master Plan outlines a series of inquiries for each of the four criteria to consistently assess what is "acceptable" bycatch. The responses to the questions are not proposed to be used in a formulaic or prescriptive way but are intended to provide a structured basis to consider the issue.

Results of the Department's efforts to complete Steps 1 and 2 of the Master Plan's four-step process were presented to the Commission's Marine Resources Committee (MRC) in November 2022. During that meeting, the MRC recommended the Department begin Step 3 of the process to determine acceptable types and amounts of bycatch with the top ten bycatch species focused on the halibut set gill net fleet. Additionally, the MRC directed the Department to reach out to the set gill net fleet to open dialogue and confer with various stakeholder groups on the outcomes.

Using several sources of information and data, Department staff weighed the following factors to identify twelve bycatch species: how frequently the species is caught in the federal observer data; documented discard mortality; if the species is actively managed or not; whether it has a formal stock assessment; the current population status, conservation status or sensitivity (i.e. marine birds and mammals); whether the bycatch species is a target of an historical or a current commercial fishery; and if the species can be representative of a guild of multiple species observed in the data. An additional consideration was to select a suite of species that would reflect the different aspects of the four criteria: potential legality issues, other fishery impacts, and sustainability and/or ecosystem concerns.

The twelve species evaluated included: Pacific angel shark, brown smoothhound, white shark (*Carcharodon carcharias*), California skate, bat ray, giant sea bass, barred sand bass (*Paralabrax nebulifer*), sublegal-sized halibut, rock crab, California sea lion, humpback whale (*Megaptera novaeangliae*), and Brandt's cormorant (*Phalacrocorax penicillatus*).

For each of the twelve species, Department staff applied the inquiries related to each of the four criteria, that are outlined in Step 3 of the Master Plan, to assess the acceptability of the amounts and types of bycatch. These structured inquiries provide a practical means of conducting the analysis of impacts and a consistent approach to assessing what is "acceptable" for the halibut set gill net fishery.

Department staff consulted a variety of available sources of information and data to walk through the inquiry questions, including: FGC; California Code of Regulations (CCR) Title 14; ESRs; International Union for Conservation and Nature (IUCN) Red List of Threatened Species; Magnuson Stevens Act; Endangered Species Act; Federal Register; Federal Observer Program data; FMPs; stock assessments; scientific literature; vulnerability scores from the PSA and ERA; and results from Steps 1 and 2 of the bycatch evaluation process. Information gathered to answer the inquiry questions are presented in Appendices 1a through 1l, for each bycatch species.

Legality of Take of the Bycatch Species

Under the first criterion in FGC §7085(b)(1): Legality of the bycatch under any relevant law, the inquiry questions are intended to determine if any species are illegal to take or retain under any relevant, state, federal or international law. If legality is not assessed, the Master Plan recommends this be conducted before proceeding. If the take is determined to be illegal or if the rate of mortality exceeds legally-sanctioned injury or mortality rates, the bycatch may be considered unacceptable and Department action or consultation with responsible state or federal agencies may be necessary. If defined rates of mortality exist, the Department should evaluate if the mortality rate is being

exceeded, informing the determination of whether the mortality rate is acceptable or unacceptable for the bycatch species.

For the twelve species analyzed, rock crab, barred sand bass, Brandt's cormorant, sublegal-sized halibut, California sea lions, and humpback whales are illegal to retain with set gill nets under existing law. All other species analyzed can be legally possessed as commercial take and are currently managed with size limits, gear restrictions, possession restrictions, and/or allowed as incidental catch in the set gill net fishery. Department staff considered the documented mortality rates of all species to evaluate whether the mortality rate and catch amounts of the bycatch species exceeds any legally-sanctioned mortality thresholds. Discard mortality rates are determined from the confidential Federal Observer Program data, years 2007-2017, filtered for the halibut set gill net fishery by only selecting trips with both halibut listed as the target species and 8.5-inch mesh, and is calculated by the number of fish discarded in a dead condition over the total number of fish discarded (Table 2 and 3).

Table 2 Legality of possession and mortality rates of top twelve species analyzed in the bycatch evaluation.

Species	Legality of Commercial Possession	Observed Discard Mortality Rate % (discarded dead/total discard)
Pacific angel shark	With size and gear restrictions	12% (18/154[1])
Brown smoothhound	With size restriction	40% (25/62[2])
California skate	With possession restrictions	10% (30/298[2])
Bat ray	No restrictions	26% (61/238[1])
Rock crab	May not be retained under Federal regulations	77% (437/570[1])
Barred sand bass	May not be retained	39% (7/18[3])
Giant sea bass	Incidental catch of one per vessel	Unknown[4]
White shark	Incidental catch allowance	Unknown[5]
Brandt's cormorant	May not be retained	100% (4/4[6])
Sublegal halibut	May not be retained	58% (28/48[7])
California sea lion	May not be retained[8]	100% (34/34[3])
Humpback whale	Not legal to take[9]	Unknown

[1] Years observed: 2007, 2010, 2011, 2012, 2013, and 2017.
[2] Years observed: 2007, 2010, 2012, 2013, and 2017.
[3] Years observed: 2007, 2010, 2011, 2012, and 2017.
[4] From 2007-2017, there were only eight observed giant sea bass and all were kept as incidental.
[5] No white sharks were observed as discarded between 2007-2017. The Monterey Bay Aquarium's sampling program estimated a 49% mortality rate. Lyons et al. (2013) estimated post release survival as 92.9%.
[6] Years observed: 2007, 2010, 2011, and 2013.
[7] Observer data does not differentiate sublegal halibut. Based on industry feedback this includes halibut that were also damaged due to marine mammal predation and not in a condition to be landed for market.
[8] The Marine Mammal Protection Act authorizes incidental take of a marine mammal for Category I and Category II commercial fisheries, with specific reporting conditions.
[9] The Endangered Species Act requires that an incidental take permit and Habitat Conservation Plan be obtained for any "take" of an endangered or threatened species incidental to an otherwise lawful activity.

Degree of threat to the sustainability of the bycatch species

To evaluate the threat to sustainability of the bycatch species (FGC §7085(b)(2)), the inquiry questions are intended to consider the impacts of the relative level of bycatch within the fishery on the biological health of the particular bycatch species. A level of take that compromises the sustainability of the population would be unacceptable under the standards of the MLMA. For species where there is a managed fishery, it is recommended to refer to the state or federal stock assessment or FMP to evaluate whether the level of bycatch of that species compromises the ability of the population to maintain a sustainable level. For many of the species evaluated, there is a paucity of information on the status of the stock, and the Department relied on other sources of information to gain an understanding of the degree of threat. In addition to available status estimates or MSE, vulnerability scores from the PSA and ERA conducted during the Master Plan, the IUCN Red List of Threatened Species, current management measures, and estimated discard mortality rates were compiled to evaluate threats to sustainability (Table 3 and Appendices). Based on discard mortality rates, vulnerability scores, MSE, IUCN classification, and bycatch amounts: brown smoothhound, rock crab, barred sand bass, Brandt's cormorant, and sublegal halibut were considered to have a low threat to sustainability. Pacific angel sharks, California skates, bat rays, giant sea bass, white sharks, and California sea lions were considered to have a moderate threat to sustainability.

Table 3 Threats to sustainability of top twelve bycatch species.

Species	**Observed Discard Mortality Rate %** (number discarded dead/total discard)	**PSA Vulnerability Score**	**IUCN Classification**	**Rate of Catch in Observed Sets**
Pacific angel shark	12% (18/154)	1.80	Near threatened	30%
Brown smoothhound	40% (25/62)	1.77	Least concern	4%
California skate	10% (30/298)	2.12	Least concern	22%
Bat ray	26% (61/238)	Not available	Least concern	26%
Rock crab	77% (437/570)	0.96	Not available	38%
Barred sand bass	39% (7/18)	1.52	Least concern	3%
Giant sea bass	Unknown	Not available	Critically endangered	2%
White shark	Unknown	Not available	Vulnerable	Unknown
Brandt's cormorant	100% (4/4)	Not applicable	Not available	<1%
Sublegal halibut	58% (28/48)	1.50	Least concern	59%
California sea lion	100% (34/34)	Not applicable	Least concern	6%
Humpback whale	Unknown	Not applicable	Least concern	Unknown

Each year, whale interactions and entanglements have been documented along the U.S. West Coast by the National Oceanic and Atmospheric Administration (NOAA).

Between 1982 and 2017, approximately 82 reports of entanglement were attributed to unidentified set gill net gear, with most entanglements being associated with gray whales (70). NOAA reports that 71% (58) of these entanglements were reported prior to the year 2000. Changes in set gill net fishing regulations in the late 1990s have greatly resulted in a decrease in whale entanglements, particularly gray whales. The majority of set gill net entanglements are from an unknown set region (Saez, et al. 2021); since 2015 only one gray whale has been directly attributed to the California set gill net fishery (personal communication, Lauren Saez). In 2022, NOAA reported two humpback whales and one gray whale entangled in unidentified set gill nets (NOAA Fisheries 2023). NOAA's efforts conclude there is potential for whales to be entangled in set gill net gear and gear marking has been identified as an important tool to determine the origin of entangling gear. The opportunity to improve and incorporate gear marking is currently being discussed with permittees and stakeholders as an area of improvement for the halibut set gill net fishery.

Impacts on fisheries that target the bycatch species

Impacts on fisheries (FGC §7085(b)(3)) consider whether the current level of bycatch within the directed fishery negatively impact the management of the bycatch species or the industry participants. Depending on the presence and severity of impacts to the directed fishery, the bycatch may be unacceptable. It is important to evaluate whether the current level of bycatch negatively impacts the management of the bycatch species' directed fishery or the fishermen that target that fishery resource. Factors to consider include whether the bycatch species is managed under a federal rebuilding plan or if there is a management allowance for a percentage of bycatch versus a prohibition on retention.

Five of the evaluated species do not have a directed fishery; thus, the inquiry questions were not applicable to use as part of the evaluation. Based on existing management measures, low bycatch amounts, and/or low discard mortality rates: Pacific angel shark, brown smoothhound, rock crab, barred sand bass, and sublegal halibut were considered at low risk to impacts on their targeted fisheries. While California skates and bat rays do not have directed fisheries, bycatch in the halibut set gill net fishery results in discard mortality, approximately 10% and 26%, respectively, based on observer data (Table 3). For California skate, roughly 85% are discarded and roughly 74% of bat rays are discarded and based on these estimated mortality rates, these two species were considered at moderate risk to impacts.

Ecosystem impacts

The criterion focused on ecosystem impacts (FGC §7085(b)(4)) evaluates whether the level of bycatch within the fishery impedes the ability of the bycatch species to fulfill its

functional role within the ecosystem. If the ecosystem role of the bycatch species is impeded, then bycatch of that species may be unacceptable under this criterion. For most species, this is difficult to assess given the paucity of scientific evidence on whether the amount of bycatch mortality significantly increases the risk that the bycatch species will be unable to serve its ecosystem role.

Department staff compiled information from ESRs and scientific literature to gain a better understanding of each species' role in the ecosystem. As apex predators, sharks play an important role in regulating trophic interactions. Pacific angel shark prey on common reef fish, and thus probably exert some top-down regulation on the distribution and abundance of lower trophic level fishes and invertebrates in inshore food webs (Pittenger 1984). Brown smoothhound mainly feed on bottom dwelling prey and may impact lower trophic level organisms that reside in this area such as shrimp, crabs, and small fish (Talent 1982). Young of the year and juvenile white sharks are known to feed on invertebrates, small elasmobranchs (sharks and rays), and bony fishes. Adult sharks (>3 meters) expand their diets to include marine mammals, such as seals and sea lions (Dewar, et al. 2013). California sea lions, Brandt's cormorant, California skates, and bat rays are defined as mesopredators, feeding primarily on fish and invertebrates, such as crustaceans and mollusks. Giant sea bass, barred sand bass, rock crab, and halibut are generalist predators that feed on many prey types. Humpback whales feed primarily on krill and small fish.

There is a lack of scientific evidence that concludes the amount of bycatch mortality is significantly impacting the role that each bycatch species is serving in the ecosystem. For those species where little or no information was available on whether the level of bycatch is unacceptable, including brown smoothhound, giant sea bass, white sharks, Brandt's cormorant, sublegal halibut, and humpback whales, the risk is unknown and considered moderate. There is no scientific literature to suggest California sea lions are a keystone species; however, other types of pinnipeds are considered keystone species, meaning they have a large effect on the natural environment relative to their abundance. Given the possible role that California sea lions serve in the ecosystem, the potential impact on ecosystems was considered moderate. For Pacific angel shark, California skate, bay rat, rock crabs, and barred sand bass, the risk was considered low or moderate based on the generalist roles these species play in the ecosystem.

Step 4. Addressing unacceptable bycatch

Based on the four criteria above, if the current type and amount of bycatch is determined to be unacceptable, the final step in the bycatch process is to develop conservation and management measures to minimize bycatch and discard mortality. There are several main strategies, outlined in the Master Plan Appendix M, that can

potentially reduce bycatch and discard mortality; however, considerations of efficacy of the mitigation, economic impacts on industry, and enforcement requirements are an important aspect of Step 4 and require input from all stakeholders and close collaboration with the fishing participants. Step 4 has not been completed, but is part of ongoing discussion at the MRC, with industry participants, and other interested stakeholders.

CONCLUSIONS

Consistent with the MLMA mandate that California's fisheries be managed in a way that limits bycatch to acceptable types and amounts, Department staff completed Steps 1 and 2 and answered the inquiry questions in Step 3, as outlined in the Master Plan for twelve bycatch species in the halibut set gill net fishery. In March 2023, Department staff presented an update on the bycatch evaluation process for the twelve bycatch species to the MRC, including the methods and results described above.

During the MRC meeting, Department staff summarized the results of the inquiry questions for each species and provided recommendations on potential next steps (Table 4). In summary, the majority of the elasmobranchs evaluated are considered to have moderate or unknown risks of threats to sustainability, fisheries, and ecosystems. Additionally, the bycatch of marine mammals is also considered moderate or unknown. Marine birds are caught in very small numbers, four total in six observed years. However, recognizing there is a small amount of interaction and 100% mortality, it is important to track any interactions of marine birds with the fishery. For the finfish species (barred sand bass, giant sea bass, and sublegal halibut), the overall risk of threats were considered low to moderate.

Table 4 Summary of the four bycatch criteria for the twelve species evaluated.

Species	Legality of Commercial Possession	Risk to Sustainability	Risk of Impacts on Fisheries	Risk of Impacts on Ecosystems
Pacific angel shark	Legal with size and gear restrictions	Moderate	Low	Low
Brown smoothhound	Legal with size limit	Low	Low	Unknown
California skate	Legal	Moderate	Moderate	Low
Bat ray	Legal	Moderate	Moderate	Low
Rock crab	May not be retained under Federal Regulations	Low	Low	Low
Barred sand bass	May not be retained	Low	Low	Low
Giant sea bass	Legal as incidental	Moderate	No directed fishery	Unknown
White shark	Legal as incidental	Moderate	No directed fishery	Unknown
Brandt's cormorant	May not be retained	Low	No directed fishery	Unknown
Sublegal halibut	May not be retained	Low	Low	Unknown
California sea lion	May not be retained	Moderate	No directed fishery	Moderate
Humpback whale	Not legal to take	Unknown	No directed fishery	Unknown

It is important to recognize the bycatch criteria have not been defined in regulation and a uniform definition of “unacceptable” has not been identified. However, the MLMA mandates that unacceptable amounts or types of bycatch be addressed through conservation and management measures. There are significant data limitations and knowledge gaps to determine amounts and types of bycatch and potential risks to sustainability, fisheries, and ecosystems. Lack of data to understand the total amount of bycatch in an individual fishery may potentially be considered “unacceptable” under the MLMA and could lead to discussions with industry, stakeholders, and managers to address the insufficient and uncertain sources of data. Regardless of an acceptability determination, Department staff continue to move forward towards solutions and have identified potential management measures to address information gaps related to data limitations and interactions with some bycatch species in the set gill net fishery.

RECOMMENDATIONS

Department staff have engaged key representatives in the halibut set gill net fleet and interested stakeholders throughout the bycatch evaluation process to discuss results of the analysis and potential improvements to data collection and management measures to fill information gaps and address potential bycatch concerns. Key industry members have expressed willingness to participate in discussions to brainstorm ideas on how to further reduce bycatch of species with a moderate level of sustainability risk.

Preliminary discussions and ideas have focused on pathways for improved gear marking, reducing net soak times, potential spatial and/or temporal closures to avoid sensitive species, improved data collection through electronic technology or independent observer coverage, gear loss reporting, and consideration of creating non-transferable permits. Potential improvement to gear marking, electronic technology and non-transferable permits are described in additional details below.

Gear Marking

As defined in FGC §8601.5, set gill nets are required to be marked at both ends with buoys displaying the fisherman's identification number, as well as along the corkline of the net, every 45 fathoms. However, there may be opportunities to improve gear marking in the California set gill net fishery to address concerns related to unidentified set gill nets in marine mammal entanglements. In discussions with industry participants, more frequent identification numbers or weaving patterns and/or colors along or into the corkline are possible ways to uniquely identify set gill nets. Additionally, set gill net webbing can be manufactured in a variety of colors, such as green, blue, clear, purple, pink, etc. A standard color across all California permittees, along with additional corkline markings could assist in identifying set gill nets involved in potential marine mammal entanglements. Staff will continue to consider gear marking changes with industry participants, gear manufactures, marine mammal managers, and other interested stakeholders.

Electronic Technology

Staff are also in the process of evaluating the gill and trammel net logbook as part of an effort to improve at-sea data collection activities and are considering data needs for management and enforcement, including the potential use of electronic technology.

Electronic technology has great potential to track a vessels' geographic location (vessel tracking), catches, and discards of fish. Electronic technology is emerging as a more effective and efficient tool to meet the challenges and demands for greater monitoring, documentation of bycatch, and catch accounting. Advances in electronic technology in

fisheries offers near real-time reporting of retained and discarded catch, and includes technology such as, vessel monitoring systems (VMS), electronic logbooks (e-logs), video cameras for observer-type electronic monitoring (EM), and electronic fish tickets (e-tickets).

The Fisheries Information System Program (FIS) is a state-regional-federal partnership program, sponsored by NOAA, to fund innovative projects to improve the quality of fisheries-dependent data collection. The FIS Program offers an annual, competitive request for funding proposal process to support initiatives that improve the quality and effectiveness of collecting, reporting, and managing fisheries-dependent data. This is a collaborative program that invests in addressing data gaps and data quality; efficient technology and data integration; and coordination and communication in the design, collection, and uses of fisheries data. Additionally, the National Fish and Wildlife Foundation offers a Fisheries Innovation Fund that supports effective participation of fishermen and communities in sustainable fisheries management through a call for proposals annually, including an Electronic Monitoring and Reporting Grant Program.

A next step for the Department is to evaluate whether electronic technology is an efficient solution to address the data collection needs for managing this fishery and the costs for implementing this new technology for the set gill net fleet. Both of these funding opportunities could be considered as a financial means for participating set gill net permittees to test a pilot electronic monitoring program for the halibut gill net fleet. California state fisheries potentially offers a great opportunity to create a new integrated data monitoring program that explores different modes of data collection that meets management needs.

Non-transferable Permits

Prohibiting or limiting the transfer of permits could guard against increased effort in the fishery and/or reduce effort over time. Limitations on permit transfers could be short-term (e.g., 3-5 years) with the intent to be revisited, or longer-term so that all permits would eventually sunset over time. FGC §8681.5 allows for any person who has an existing, valid permit and presents evidence that he or she has landed fish for commercial purposes in at least 15 of the preceding 20 years, to transfer that permit to any person otherwise qualified under the regulations adopted pursuant to FGC §8682. A few key representatives have expressed support for a potential change in permit transferability and staff will continue to discuss this with industry and other stakeholders. Ultimately, a change to the permitting structure will require amending the regulations and/or legislation that establishes the permit transfer authority.

NEXT STEPS

The Department continues to explore opportunities to improve management of the halibut fishery, including addressing potential concerns surrounding bycatch in the set gill net fleet. This report will be provided to the MRC in July 2023 and offers additional insights to continue open discussions with fleet participants and other interested stakeholders around future management measures for the halibut fishery.

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APPENDICES

Appendix 1a. Evaluation of Pacific angel shark based on MLMA Master Plan bycatch criteria

Category and question	Response	Comments
A. Legality of take		
A1. Under what laws, regulations, or guidance documents is species covered?	Fish and Game Code	There are gear restrictions placed on the commercial California halibut set gill net fishery which lands Pacific angel shark, including minimum mesh size and total maximum net length. FGC §8625: "(a) Except as otherwise provided in this code, set gill nets and trammel nets with mesh size of not less than 8 ½ inches may be used to take California halibut. (b) Except as provided in subdivision (c), not more than 1,500 fathoms (9,000 feet) of set gill net or trammel net shall be fished in combination each day for California halibut from any vessel in ocean waters. (c) Not more than 1,000 fathoms (6,000 feet) of set gill net or trammel net shall be fished in combination each day for California halibut from any vessel in ocean waters between a line extending due west magnetic from Point Arguello in Santa Barbara County and a line extending 172° magnetic from Rincon Point in Santa Barbara County to San Pedro Point at the east end of Santa Cruz Island in Santa Barbara County, then extending southwesterly 188° magnetic from San Pedro Point on Santa Cruz Island. A commercial minimum size limit established in 1986 was created to ensure that sharks had a chance to reproduce at least once before being retained in the catch. FGC §8388(a) states "No female angel shark measuring less than 42 inches in total length or 15 ¼ inches in alternate length and no male angel shark measuring less than 40 inches in total length or 14 ½ inches in alternate length may be possessed, sold, or purchased, except that 10 percent of the angel sharks in any load may measure not more than ½ inch less than the minimum size specified herein." There is a restricted access fishery for set gill nets (FGC §8610, 8680, 8681, and 8682).
	IUCN Red List of Threatened Species	The species is listed as "Near threatened" on the IUCN Red List of Threatened Species in 2014. This category is between "Least concern" and "Vulnerable". Source: https://www.iucnredlist.org/species/39328/177163701
A2. Are there prohibitions against take using specific gear type?	Yes	The set gill net fishery requires the use of a minimum mesh size and a maximum net length. See above.
A3. Is the species a target species that requires discard of individuals based on size limits, seasons, or gear type restrictions?	Yes	There is a minimum size limit which requires discard of undersize fish. See above.
A4. Is the discard mortality rate known?	Yes	The discard mortality rate is 12%, based on 2007-2017 NMFS observer data in which 136 fish were discarded alive and 18 were discarded dead.
A5a. Are special permits required to retain or interact with the species?	No	Only a general set gill net permit is required, although these are of limited number since this is a restricted access fishery.
A5b. If yes, does the fishery currently have such permits?	Not applicable	
A5c. If yes, do the levels of bycatch comply with them?	Not applicable	
A6a. Does the species have an incidental catch allowance, ACL, or other restrictions on the amount, size, or sex of catch allowed?	Yes	There is a minimum legal size; see question 1 above.
A6b. If yes, does the catch comply with them?	Yes	Fishermen may not legally land undersize fish.

Category and question	Response	Comments
B. Threats to sustainability		
B1. Has a peer-reviewed risk assessment of the vulnerability of the particular bycatch species to overfishing been conducted (e.g., PSA)	Yes	Department PSA completed in 2019 indicated angel shark ranked first in vulnerability among 36 fish and invertebrate species analyzed.
B2a. Does a population status estimate or stock assessment exist for this species?	No	However, relatively few fish are taken annually in the fishery (ESR).
B2b. If yes, is there confidence in the underlying data such that a reasonable determination can be made if the stock is considered healthy, overfished, or depleted?	Not applicable	However, the Pacific angel shark is largely protected from fishing pressure. Therefore, it is presumed that the population remains relatively stable in California (ESR).
B3a. Are there any existing state and/or federal management measures?	Yes	No commercial set gill net fishing is allowed in their primary inshore sandy-bottom habitat.
B3b. If yes, are they effective in ensuring sustainability?	Yes	The Pacific angel shark is largely protected from fishing pressure. Therefore, it is presumed that the population remains relatively stable in California (ESR).
B4. Is the bycatch the product of recreational catch-and-release practices?	No	Recreational anglers do not target this species.
B5. What is the estimated discard mortality rate given the characteristics of the fishery and gear type?	12%	This is based on 2007-2017 NMFS observer data in which 136 fish were discarded alive and 18 were discarded dead.
B6. Do any post-release studies exist to verify the estimated mortality rate?	No	There have been no post-release studies for this species.
B7. What is the probability of mortality exceeding levels that have been scientifically determined to be necessary for the continued viability of the species?	Low	The Pacific angel shark is largely protected from fishing pressure. Therefore, it is presumed that the population remains relatively stable in California (ESR).
C. Impacts on fisheries		
C1. Does a directed fishery exist for the bycatch species?	Yes	It is taken as an incidentally caught species in the halibut set gill net fishery.
C2. Has the bycatch and associated discard mortality been accounted for?	Yes	2000 to 2016 observed bycatch summary from NMFS indicated 103 angel sharks kept, 136 released alive, and 18 released dead.
C3. Is bycatch affecting the directed fishery management strategy (i.e., restrictions on size, sex, or season)?	No	The bycatch is incidental catch since this is a desirable and marketable species.
C4. Are the impacts of bycatch considered and made explicit in an ESR or FMP?	Yes	This is discussed in the Pacific angel shark ESR.
C5a. Is the species constrained under a federal rebuilding plan?	No	This is not a federally managed species.

Category and question	Response	Comments
C5b. If yes, will bycatch compete with fleets that target the species?	Not applicable	
C6. Is there a management allowance for percent of catch or a prohibition on retention?	Yes	There is a prohibition on landing fish below the minimum legal size.
C7. If there is a directed fishery for the species, have there been any of the following?		
C7a. Reductions in opportunities or income for participants in fisheries that target the bycatch species	Yes	A ban on set gill netting in state waters and north of Point Conception, and closure of primary processing plant for angel sharks, led to a significant decline in catch and effort in the 1990s.
C7b. Reductions in fishery quotas or opportunities (e.g., time and area closures) based on bycatch issues?	No	There is no quota for this species.
C7c. Early closures of a fishery based on higher-than-expected bycatch?	No	There are no early closures based on the amount of bycatch.
C7d. Changes in fishing, processing, disposal, and marketing costs due to bycatch?	No	There have been no changes for which the Department is aware.
C7e. Changes in the social or cultural value of fishing activities due to bycatch?	No	There have been no changes for which the Department is aware.
C7f. Negative socioeconomic impacts from bycatch on fisheries and/or fishing communities which target or need incidental catch of this species?	Yes	A ban on set gill netting in state waters and north of Point Conception, and closure of primary processing plant for angel sharks, led to a significant decline in catch and effort in the 1990s.
C7g. Negative impacts to juveniles of a species targeted by another fishery?	No	A minimum size limit offers some protection to juveniles.
D. Impacts on ecosystem		
D1. What is the ecosystem role of the bycatch species?	See comments	"As apex predators, sharks play an important role in regulating trophic interactions. In California, Pacific angel shark prey on common reef fish, and thus probably exert some top-down regulation on the distribution and abundance of lower trophic level fishes and invertebrates in inshore food webs (Pittenger 1984, cited in ESR)."
D2. Does scientific evidence show the amount of bycatch mortality significantly increases the risk that a bycatch species will be unable to serve its ecosystem role?	No	"There are no formal overfishing threshold criteria for Pacific angel shark. However, landings are tracked in both the commercial and recreational sectors, and, given the low landings that have occurred since the ban on set gill net and trammel nets in the early 1990s, there are currently no concerns about overfishing occurring on this stock." (ESR)
References		Pittenger G.G. 1984. Movements, distribution, feeding, and growth of the Pacific angel shark, *Squatina californica*, at Catalina Island, California. Long Beach, California. California State University. 83 p.

Appendix 1b. Evaluation of brown smoothhound based on MLMA Master Plan bycatch criteria

Category and question	Response	Comments
A. Legality of take		
A1. Under what laws, regulations, or guidance documents is species covered?	Fish and Game Code	§8597.b(3) brown smoothhound under 18: may be taken or possessed under marine aquaria collector permit. §8598 None less than 18" in whole condition or with head & tail removed for commercial.
	Title 14 CCR	§27.60. There is a recreational limit of 10 per day, 10 in possession
	Title 50 of the Code of Federal Regulations	No fin removal is permitted (part §600-subpart N).
A2. Are there prohibitions against take using specific gear type?	No	There is a commercial prohibition from take for brown smoothhound 18" or longer. §8597.b smoothhound under 18: may be taken or possessed under marine aquaria collector permit. §8598 None less than 18" in whole condition or with head & tail removed for commercial.
A3. Is the species a target species that requires discard of individuals based on size limits, seasons, or gear type restrictions?	No	Retention under 18" is prohibited regardless of method of take
A4. Is the discard mortality rate known?	Yes	The discard mortality rate is 40%, based on 2007-2017 NMFS observer data in which 37 fish were discarded alive and 25 were discarded dead
A5a. Are special permits required to retain or interact with the species?		A Marine Aquaria Permit is required for retention of under 18", §8597.b
A5b. If yes, does the fishery currently have such permits?		No such permits are required for commercial or recreational fisheries.
A5c. If yes, do the levels of bycatch comply with them?	Not applicable	
A6a. Does the species have an incidental catch allowance, ACL, or other restrictions on the amount, size, or sex of catch allowed?	Yes	There is no annual catch limit (ACL). Brown smoothhound sharks are legal to retain if 18" or longer.
A6b. If yes, does the catch comply with them?	Not applicable	
B. Threats to sustainability		
B1. Has a peer-reviewed risk assessment of the vulnerability of the particular bycatch species to overfishing been conducted (e.g., PSA)	No	The brown smoothhound PSA pertains to hook/line, but was 1.766
B2a. Does a population status estimate or stock assessment exist for this species?	No	There is no status estimate or stock assessment
B2b. If yes, is there confidence in the underlying data such that a reasonable determination can be made if the stock is considered healthy, overfished, or depleted?	Not applicable	With limited incidental take and no directed fishery, it is reasonable to consider this a healthy stock.
B3a. Are there any existing state and/or federal management measures?	Yes	A minimum length of 18" is established in FGC §8598.
B3b. If yes, are they effective in ensuring sustainability?	Yes	The above measure appears effective. Annual recreational and commercial take is low and consistent.

Category and question	Response	Comments
B4. Is the bycatch the product of recreational catch-and-release practices?	No	
B5. What is the estimated discard mortality rate given the characteristics of the fishery and gear type?	40%	This is based on 2007-2017 NMFS observer data in which 37 fish were discarded alive and 25 were discarded dead.
B6. Do any post-release studies exist to verify the estimated mortality rate?	No	
B7. What is the probability of mortality exceeding levels that have been scientifically determined to be necessary for the continued viability of the species?	Low	There is no directed fishery for brown smoothhound and 8.5" halibut gillnet mesh has low risk of entanglement as indicated by observer data. The species is fast growing, matures early, and has a relatively large number of pups compared to other shark species. Fishbase.org lists brown smoothhound as having a high vulnerability to fishing.
C. Impacts on fisheries		
C1. Does a directed fishery exist for the bycatch species?	No	Catch is incidental to other targets.
C2. Has the bycatch and associated discard mortality been accounted for?	Yes	If retained, brown smoothhound is documented on Department fish tickets. Recreational catch is documented dockside and onboard CPFVs. Based on 2007-2017 NMFS observer data, 37 fish were discarded alive and 25 were discarded dead.
C3. Is bycatch affecting the directed fishery management strategy (i.e., restrictions on size, sex, or season)?	No	Brown smoothhound bycatch does not affect directed halibut/ white seabass gillnet fisheries management.
C4. Are the impacts of bycatch considered and made explicit in an ESR or FMP?	Yes	Bycatch and fishery impacts are considered as "no concern" in the brown smoothhound ESR. There is an FMP for brown smoothhound.
C5a. Is the species constrained under a federal rebuilding plan?	No.	
C5b. If yes, will bycatch compete with fleets that target the species?	Not applicable	
C6. Is there a management allowance for percent of catch or a prohibition on retention?	No	Brown smoothhound less than 18" TL are prohibited from retention except under a Marine Aquaria Permit.
C7. If there is a directed fishery for the species, have there been any of the following?	No	There is no directed fishery for brown smoothhound. Most are commercially caught and are released.
C7a. Reductions in opportunities or income for participants in fisheries that target the bycatch species	Not applicable	
C7b. Reductions in fishery quotas or opportunities (e.g., time and area closures) based on bycatch issues?	Not applicable	
C7c. Early closures of a fishery based on higher-than-expected bycatch?	Not applicable	
C7d. Changes in fishing, processing, disposal, and marketing costs due to bycatch?	Not applicable	
C7e. Changes in the social or cultural value of fishing activities due to bycatch?	Not applicable	

Category and question	Response	Comments
C7f. Negative socioeconomic impacts from bycatch on fisheries and/or fishing communities which target or need incidental catch of this species?	Not applicable	
C7g. Negative impacts to juveniles of a species targeted by another fishery?	Not applicable	
D. Impacts on ecosystem		
D1. What is the ecosystem role of the bycatch species?	See comments	From the brown smoothhound ESR- "As apex predators, sharks play an important role in regulating trophic interactions by controlling the abundance of secondary carnivores. Since brown smoothhound mainly feed on bottom dwelling prey, they probably impact lower trophic level organisms that reside in this area such as shrimp, crabs and small fish." A study off Costa Rica (Espinosa et al. 2012) showed that immature smoothhound feed on benthic crustaceans and invertebrates. Mature brown smoothhound fed on small fish and crustaceans.
D2. Does scientific evidence show the amount of bycatch mortality significantly increases the risk that a bycatch species will be unable to serve its ecosystem role?	Unknown	
References		Espinoza, M., Clarke, T. M., Villalobos-Rojas, F., and Wehrtmann, I. S. (2012). Ontogenetic dietary shifts and feeding ecology of the rasptail skate, Raja velezi, and the Brown Smoothhound Shark, *Mustelus henlei*, along the Pacific coast of Costa Rica, Central America. Journal of Fish Biology, 81(5), 1578–1595.

Appendix 1c. Evaluation of California skate based on MLMA Master Plan bycatch criteria

Category and question	Response	Comments
A. Legality of take		
A1. Under what laws, regulations, or guidance documents is species covered?	Fish and Game Code	Possession of skate wings on any boat is prohibited as there are no equivalents or conversion factors established in statute or regulation under which other than whole skates may be brought ashore (FGC §§5508, 8042). §8597.b(3) skates under 18 inches may be taken or possessed under marine aquaria collector permit. Federal groundfish seasonal closures, Title 14 CCR, §27.60 28.49(a); general bag limit of 10, §27.60
A2. Are there prohibitions against take using specific gear type?	No	
A3. Is the species a target species that requires discard of individuals based on size limits, seasons, or gear type restrictions?	No	
A4. Is the discard mortality rate known?	Yes	There is a 10% estimated mortality rate from NMFS set gill net observer data 2007-2017.
A5a. Are special permits required to retain or interact with the species?	No	
A5b. If yes, does the fishery currently have such permits?	Not applicable	
A5c. If yes, do the levels of bycatch comply with them?	Not applicable	
A6a. Does the species have an incidental catch allowance, ACL, or other restrictions on the amount, size, or sex of catch allowed?	No	
A6b. If yes, does the catch comply with them?	Not applicable	
B. Threats to sustainability		
B1. Has a peer-reviewed risk assessment of the vulnerability of the particular bycatch species to overfishing been conducted (e.g., PSA)	Yes	A vulnerability score of 2.12 indicates relatively high concern (Status of the Pacific Coast Groundfish Fishery 2020).
B2a. Does a population status estimate or stock assessment exist for this species?	No	
B2b. If yes, is there confidence in the underlying data such that a reasonable determination can be made if the stock is considered healthy, overfished, or depleted?	Not applicable	
B3a. Are there any existing state and/or federal management measures?	Yes	Possession of skate wings on any boat is prohibited as there are no equivalents or conversion factors established in statute or regulation under which other than whole skates may be brought ashore (FGC §§5508, 8042). §8597.b(3) skates under 18 inches may be taken or possessed under marine aquaria collector permit. Federal groundfish seasonal closures, Title 14 CCR, §27.60 28.49(a); general bag limit of 10, §27.60
B3b. If yes, are they effective in ensuring sustainability?	Not applicable	

Category and question	Response	Comments
B4. Is the bycatch the product of recreational catch-and-release practices?	No	
B5. What is the estimated discard mortality rate given the characteristics of the fishery and gear type?	10%	This is based on NMFS set gill net observer data 2007-2017 in which 268 California skates were discarded alive and 30 were discarded dead.
B6. Do any post-release studies exist to verify the estimated mortality rate?	No	
B7. What is the probability of mortality exceeding levels that have been scientifically determined to be necessary for the continued viability of the species?	Not applicable	
C. Impacts on fisheries		
C1. Does a directed fishery exist for the bycatch species?	No	
C2. Has the bycatch and associated discard mortality been accounted for?	Yes	From the NMFS set gill net observer data 2007-2017, California skates make up 4.7% of the total catch by individuals. 14.6% are kept and sold and the remaining 85.4% are discarded.
C3. Is bycatch affecting the directed fishery management strategy (i.e., restrictions on size, sex, or season)?	No	
C4. Are the impacts of bycatch considered and made explicit in an ESR or FMP?	No	
C5a. Is the species constrained under a federal rebuilding plan?	No	
C5b. If yes, will bycatch compete with fleets that target the species?	Not applicable	
C6. Is there a management allowance for percent of catch or a prohibition on retention?	No	
C7. If there is a directed fishery for the species, have there been any of the following?	Not applicable	
C7a. Reductions in opportunities or income for participants in fisheries that target the bycatch species	Not applicable	
C7b. Reductions in fishery quotas or opportunities (e.g., time and area closures) based on bycatch issues?	Not applicable	
C7c. Early closures of a fishery based on higher-than-expected bycatch?	Not applicable	
C7d. Changes in fishing, processing, disposal, and marketing costs due to bycatch?	Not applicable	

Category and question	Response	Comments
C7e. Changes in the social or cultural value of fishing activities due to bycatch?	Not applicable	
C7f. Negative socioeconomic impacts from bycatch on fisheries and/or fishing communities which target or need incidental catch of this species?	Not applicable	
C7g. Negative impacts to juveniles of a species targeted by another fishery?	Not applicable	
D. Impacts on ecosystem		
D1. What is the ecosystem role of the bycatch species?	See comments	Big skates are mesopredators; they eat primarily crustaceans and fishes.
D2. Does scientific evidence show the amount of bycatch mortality significantly increases the risk that a bycatch species will be unable to serve its ecosystem role?	No	
References		Status of the Pacific Coast Groundfish Fishery Stock Assessment and Fishery Evaluation September 2020, https://www.pcouncil.org/documents/2020/09/status-of-the-pacific-coast-groundfish-fishery-stock-assessment-and-fishery-evaluation-september-2020.pdf/

Appendix 1d. Evaluation of bat ray based on MLMA Master Plan bycatch criteria

Category and question	Response	Comments
A. Legality of take		
A1. Under what laws, regulations, or guidance documents is species covered?	Fish and Game Code	According to §8597.b(3) rays under 18 inches may be taken or possessed under a marine aquaria collector permit. According to Title 14 §27.6, the recreational bag limit is 10 per day.
A2. Are there prohibitions against take using specific gear type?	No	
A3. Is the species a target species that requires discard of individuals based on size limits, seasons, or gear type restrictions?	No	
A4. Is the discard mortality rate known?	Yes	There is a 26% estimated mortality rate based on NMFS set gill net observer data from 2007-2017.
A5a. Are special permits required to retain or interact with the species?	No	
A5b. If yes, does the fishery currently have such permits?	Not applicable	
A5c. If yes, do the levels of bycatch comply with them?	Not applicable	
A6a. Does the species have an incidental catch allowance, ACL, or other restrictions on the amount, size, or sex of catch allowed?	No	
A6b. If yes, does the catch comply with them?	Not applicable	
B. Threats to sustainability		
B1. Has a peer-reviewed risk assessment of the vulnerability of the particular bycatch species to overfishing been conducted (e.g., PSA)	No	
B2a. Does a population status estimate or stock assessment exist for this species?	No	
B2b. If yes, is there confidence in the underlying data such that a reasonable determination can be made if the stock is considered healthy, overfished, or depleted?	Not applicable	
B3a. Are there any existing state and/or federal management measures?	Yes	According to §8597.b(3) rays under 18 inches may be taken or possessed under marine aquaria collector permit. According to Title 14 §27.6, the recreational bag limit is 10 per day.
B3b. If yes, are they effective in ensuring sustainability?	Not applicable	
B4. Is the bycatch the product of recreational catch-and-release practices?	No	
B5. What is the estimated discard mortality rate given the characteristics of the fishery and gear type?	26%	This is based on NMFS set gill net observer data from 2007-2017 in which 173 bat rays were discarded alive and 61 were discarded dead.
B6. Do any post-release studies exist to verify the estimated mortality rate?	No	
B7. What is the probability of mortality exceeding levels that have been scientifically determined to be necessary for the continued viability of the species?	Not applicable	

Category and question	Response	Comments
C. Impacts on fisheries		
C1. Does a directed fishery exist for the bycatch species?	No	
C2. Has the bycatch and associated discard mortality been accounted for?	Yes	From the NMFS observer data, bat rays make up 4.3% of the total catch by individuals. Roughly 25% of those caught are kept and sold and the other 75% is discarded.
C3. Is bycatch affecting the directed fishery management strategy (i.e., restrictions on size, sex, or season)?	No	
C4. Are the impacts of bycatch considered and made explicit in an ESR or FMP?	No	
C5a. Is the species constrained under a federal rebuilding plan?	No	
C5b. If yes, will bycatch compete with fleets that target the species?	Not applicable	
C6. Is there a management allowance for percent of catch or a prohibition on retention?	No	
C7. If there is a directed fishery for the species, have there been any of the following?	Not applicable	
C7a. Reductions in opportunities or income for participants in fisheries that target the bycatch species	Not applicable	
C7b. Reductions in fishery quotas or opportunities (e.g., time and area closures) based on bycatch issues?	Not applicable	
C7c. Early closures of a fishery based on higher-than-expected bycatch?	Not applicable	
C7d. Changes in fishing, processing, disposal, and marketing costs due to bycatch?	Not applicable	
C7e. Changes in the social or cultural value of fishing activities due to bycatch?	Not applicable	
C7f. Negative socioeconomic impacts from bycatch on fisheries and/or fishing communities which target or need incidental catch of this species?	Not applicable	
C7g. Negative impacts to juveniles of a species targeted by another fishery?	Not applicable	
D. Impacts on ecosystem		
D1. What is the ecosystem role of the bycatch species?		Bat rays are mesopredators; they eat primarily crustaceans, mollusks, and echiuran worms.
D2. Does scientific evidence show the amount of bycatch mortality significantly increases the risk that a bycatch species will be unable to serve its ecosystem role?	No	
References		Gray, Ann E., Timothy J. Mulligan, and Robert W. Hannah. 1997. "Food habits, occurrence, and population structure of the bat ray, *Myliobatis californica*, in Humboldt Bay, California." Environmental Biology of Fishes 49.2: 227-238.

Appendix 1e. Evaluation of rock crab based on MLMA Master Plan bycatch criteria

Category and question	Response	Comments
A. Legality of take		
A1. Under what laws, regulations, or guidance documents is species covered?	Fish and Game Code	Section 9000 describes rules associated with trap gear; specifically, §9011(b)(2) describes rock crab dimensions. §8275 defines rock crab. §8282 provides the authority to regulate. §8285 relates to domoic acid rules. §125 describes permit requirements for northern and southern regions. §125.1 describes size limit and incidental take provisions.
A2. Are there prohibitions against take using specific gear type?	No	
A3. Is the species a target species that requires discard of individuals based on size limits, seasons, or gear type restrictions?	Yes	There is a size limit but no season restriction.
A4. Is the discard mortality rate known?	Yes	The discard mortality rate is 77% based on NMFS set gill net observer data from 2007-2017.
A5a. Are special permits required to retain or interact with the species?	No	
A5b. If yes, does the fishery currently have such permits?	Not applicable	
A5c. If yes, do the levels of bycatch comply with them?	Not applicable	
A6a. Does the species have an incidental catch allowance, ACL, or other restrictions on the amount, size, or sex of catch allowed?	No	
A6a. If yes, does the catch comply with them?	Not applicable	
B. Threats to sustainability		
B1. Has a peer-reviewed risk assessment of the vulnerability of the particular bycatch species to overfishing been conducted (e.g., PSA)	Yes	See reference below: Fitzgerald. 2018. Fisheries Research. 208:133-144.
B2a. Does a population status estimate or stock assessment exist for this species?	No	However, data-limited assessment methods were applied by Fitzgerald (2018). A Management Strategy Evaluation also indicated that the risk of overfishing is low but vulnerable biomass has declined leading to dissatisfaction in the fishery.
B2b. If yes, is there confidence in the underlying data such that a reasonable determination can be made if the stock is considered healthy, overfished, or depleted?	Not applicable	
B3a. Are there any existing state and/or federal management measures?	Yes	There are size and permit limits.
B3b. If yes, are they effective in ensuring sustainability?	Yes	There does not appear to be a threat to sustainability. However, that conclusion is uncertain and there is some threat of serial depletion among the three target species.
B4. Is the bycatch the product of recreational catch-and-release practices?	No	
B5. What is the estimated discard mortality rate given the characteristics of the fishery and gear type?	77%	This is based on NMFS set gill net observer data 2007-2017, in which 133 rock crabs were discarded alive and 437 were discarded dead.

Category and question	Response	Comments
B6. Do any post-release studies exist to verify the estimated mortality rate?	No	Second-hand reports indicate that rock crabs do not regenerate claws the way some other stone crab species do.
B7. What is the probability of mortality exceeding levels that have been scientifically determined to be necessary for the continued viability of the species?	No	The probability is low, SWFSC observer data from 1994-2017 indicate the median ratio of rock crab to California halibut landings is about 1:1. Landings of California halibut by set gill net during that time were averaged approximately 250,000 lb while the rock crab fishery landings were an approximate average of 1,250,000 lb. Therefore, bycatch from the set gill net fishery could represent approximately 1/5 of fishery landings.
C. Impacts on fisheries		
C1. Does a directed fishery exist for the bycatch species?	Yes	
C2. Has the bycatch and associated discard mortality been accounted for?	No	
C3. Is bycatch affecting the directed fishery management strategy (i.e., restrictions on size, sex, or season)?	No	Rock crab landings are not restricted by season or sex. They are restricted by size and incidental landings of rock crab in other fisheries are held to the same size limit.
C4. Are the impacts of bycatch considered and made explicit in an ESR or FMP?	No	The ESR discusses catch of incidental species while targeting rock crab and the reduction of bycatch of undersized rock crabs due to trap configuration rules. It does not discuss bycatch of rock crab in other fisheries.
C5a. Is the species constrained under a federal rebuilding plan?	No	
C5b. If yes, will bycatch compete with fleets that target the species?	Not applicable	
C6. Is there a management allowance for percent of catch or a prohibition on retention?	No	State regulations do not prohibit incidental take of crab in set gill nets. Department staff believe federal rules prohibit targeting crabs with set gill net.
C7. If there is a directed fishery for the species, have there been any of the following?	Yes	
C7a. Reductions in opportunities or income for participants in fisheries that target the bycatch species	Yes	Permits were made transferrable in 2010 which led to transfer of latent capacity, crowded fishing grounds, and lower catch rates, according to participants.
C7b. Reductions in fishery quotas or opportunities (e.g., time and area closures) based on bycatch issues?	No	There are no quotas or seasons.
C7c. Early closures of a fishery based on higher-than-expected bycatch?	No	
C7d. Changes in fishing, processing, disposal, and marketing costs due to bycatch?	No	
C7e. Changes in the social or cultural value of fishing activities due to bycatch?	No	
C7f. Negative socioeconomic impacts from bycatch on fisheries and/or fishing communities which target or need incidental catch of this species?	No	
C7g. Negative impacts to juveniles of a species targeted by another fishery?	No	
D. Impacts on ecosystem		

Category and question	Response	Comments
D1. What is the ecosystem role of the bycatch species?	See comments	The rock crab is a benthic predator and scavenger.
D2. Does scientific evidence show the amount of bycatch mortality significantly increases the risk that a bycatch species will be unable to serve its ecosystem role?	No	No research exists on this aspect, but ecosystem impacts are considered unlikely.
References		Fitzgerald, Sean P., Jono R. Wilson, and Hunter S. Lenihan. 2018. "Detecting a need for improved management in a data-limited crab fishery." *Fisheries Research* 208: 133-144.

Appendix 1f. Evaluation of barred sand bass based on MLMA Master Plan bycatch criteria

Category and question	Response	Comments
A. Legality of take		
A1. Under what laws, regulations, or guidance documents is species covered?	Fish and Game Code	§8372 states that barred sand bass shall not be sold or purchased or possessed in any place where fish are purchased, possessed for sale, or sold
	Title 14 CCR	§27.65 states that fillets shall be minimum of 7.5 inches. §28.30 establishes a minimum size of 14 inches or 10 inches alternate length
	Title 50 of the Code of Federal Regulations	There is a limit of 5 in any combination of kelp, barred sand, and spotted sand bass. §105 states that dead barred sand bass maybe imported into CA for sale (must have tags and proof of catch outside CA). §705 describes the price of tags.
A2. Are there prohibitions against take using specific gear type?	Yes	Barred sand bass are prohibited from all methods of take for commercial purposes.
A3. Is the species a target species that requires discard of individuals based on size limits, seasons, or gear type restrictions?	Yes	The recreational limit is 5 in any combination of kelp, barred sand, and spotted sand bass. The minimum legal size is 14 inches
A4. Is the discard mortality rate known?	Yes	Relatively few are caught in set gill nets; NMFS observer set gill net data from 2007 to 2017 show discard mortality of 39% (7/18).
A5a. Are special permits required to retain or interact with the species?	No	
A5b. If yes, does the fishery currently have such permits?	Not applicable	
A5c. If yes, do the levels of bycatch comply with them?	Not applicable	
A6a. Does the species have an incidental catch allowance, ACL, or other restrictions on the amount, size, or sex of catch allowed?	No	
A6b. If yes, does the catch comply with them?	Not applicable	
B. Threats to sustainability		
B1. Has a peer-reviewed risk assessment of the vulnerability of the particular bycatch species to overfishing been conducted (e.g., PSA)	Yes	Department Productivity Susceptibility Analysis in 2019 indicated a high rank of vulnerability to sport fishing.
B2a. Does a population status estimate or stock assessment exist for this species?	No	
B2b. If yes, is there confidence in the underlying data such that a reasonable determination can be made if the stock is considered healthy, overfished, or depleted?	Not applicable	
B3a. Are there any existing state and/or federal management measures?	Yes	Commercial take is prohibited; set gill nets were moved offshore in 1994 with Proposition 132, minimizing bycatch of nearshore species such as barred sand bass; sport fishing regulations include a minimum size limit and bag limit.
B3b. If yes, are they effective in ensuring sustainability?	Yes	However, it is believed that additional recreational management measures are needed to protect stock once its biomass increases again.
B4. Is the bycatch the product of recreational catch-and-release practices?	No	

Category and question	Response	Comments
B5. What is the estimated discard mortality rate given the characteristics of the fishery and gear type?	39%	This is based on NMFS set gill net observer data from 2007-2017, in which 11 barred sand bass were discarded alive and 7 were discarded dead.
B6. Do any post-release studies exist to verify the estimated mortality rate?	No	
B7. What is the probability of mortality exceeding levels that have been scientifically determined to be necessary for the continued viability of the species?	Unknown	
C. Impacts on fisheries		
C1. Does a directed fishery exist for the bycatch species?	Yes	There is a directed sport fishery (hook and line) for barred sand bass.
C2. Has the bycatch and associated discard mortality been accounted for?	No	
C3. Is bycatch affecting the directed fishery management strategy (i.e., restrictions on size, sex, or season)?	No	
C4. Are the impacts of bycatch considered and made explicit in an ESR or FMP?	No	
C5a. Is the species constrained under a federal rebuilding plan?	No	
C5b. If yes, will bycatch compete with fleets that target the species?	Not applicable	
C6. Is there a management allowance for percent of catch or a prohibition on retention?	Yes	Barred sand bass are prohibited from commercial take.
C7. If there is a directed fishery for the species, have there been any of the following?		There is a directed sport fishery (hook and line) for barred sand bass.
C7a. Reductions in opportunities or income for participants in fisheries that target the bycatch species	No	
C7b. Reductions in fishery quotas or opportunities (e.g., time and area closures) based on bycatch issues?	No	
C7c. Early closures of a fishery based on higher-than-expected bycatch?	No	
C7d. Changes in fishing, processing, disposal, and marketing costs due to bycatch?	No	
C7e. Changes in the social or cultural value of fishing activities due to bycatch?	No	
C7f. Negative socioeconomic impacts from bycatch on fisheries and/or fishing communities which target or need incidental catch of this species?	No	
C7g. Negative impacts to juveniles of a species targeted by another fishery?	No	
D. Impacts on ecosystem		

Category and question	Response	Comments
D1. What is the ecosystem role of the bycatch species?	See comments	Barred sand bass is a generalist carnivore. The formation of large spawning aggregations can contribute substantial nutrients in the form of egg masses and nitrogen and phosphorous waste products (ESR).
D2. Does scientific evidence show the amount of bycatch mortality significantly increases the risk that a bycatch species will be unable to serve its ecosystem role?	No	

Appendix 1g. Evaluation of giant sea bass based on MLMA Master Plan bycatch criteria

Category and question	Response	Comments
A. Legality of take		
A1. Under what laws, regulations, or guidance documents is species covered?	Fish and Game Code	§7350: giant sea bass may not be taken under a sport fishing license except by hook and line when engaged in the taking of other fish. §8380: a) giant sea bass may not be taken for any purpose, except that not more than one fish per vessel may be possessed or sold if taken incidentally in commercial fishing operations by gill or trammel net. b) above restrictions do not apply to 1000 lbs per trip taken in waters south of international boundary line. Fish taken under this provision are limited to a maximum aggregate of 3000 pounds per vessel in any calendar year.
	Title 14 CCR	§28.10: a) may not be taken off California. All fish taken incidental to other fishing activity shall be immediately returned to the water where taken. b) limit two per angler per trip when fishing south of US-Mexico border. Need valid fishing permit or license from Mexican government.
	IUCN Red List of Threatened Species	IUCN Red List of Threatened Species listed giant sea bass as critically endangered in 1996 (2004) but acknowledged a lack of information on the Mexican population. Current research indicates the population is much larger than previously thought and suggests re-evaluating designation (Ramírez-Valdez et al.).
A2. Are there prohibitions against take using specific gear type?	Yes	Sport take of giant sea bass is prohibited by all gear. §28.90 and §28.95 specifically list that giant sea bass cannot be taken by spear or bow and arrow, respectively.
A3. Is the species a target species that requires discard of individuals based on size limits, seasons, or gear type restrictions?	No	
A4. Is the discard mortality rate known?	No	No discards were observed as discarded in the NMFS observer data from 2007 to 2017.
A5a. Are special permits required to retain or interact with the species?	Yes	A general set gill net permit is required as the incidental take of one giant sea bass per vessel is only allowed by set gill net or trammel net (see FGC §8380 above).
A5b. If yes, does the fishery currently have such permits?	Yes	
A5c. If yes, do the levels of bycatch comply with them?	Yes	
A6a. Does the species have an incidental catch allowance, ACL, or other restrictions on the amount, size, or sex of catch allowed?	Yes	Incidental take of one giant sea bass per vessel is allowed by set gill net or trammel net.
A6a. If yes, does the catch comply with them?	Yes	However, landings are listed in pounds and not by numbers.
B. Threats to sustainability		
B1. Has a peer-reviewed risk assessment of the vulnerability of the particular bycatch species to overfishing been conducted (e.g., PSA)	No	
B2a. Does a population status estimate or stock assessment exist for this species?	No	There is no formal population status or stock assessment however Ramirez-Valdez et al. 2021 estimated population size much larger than thought. About 75% of population resides in Mexican waters. Author suggests IUCN Red List of Threatened Species re-evaluate designation of critically endangered to endangered or vulnerable.
B2b. If yes, is there confidence in the underlying data such that a reasonable determination can be made if the stock is considered healthy, overfished, or depleted?	No	However, it seems reasonable to conclude that giant sea bass populations are steady or increasing. More information is needed.

Category and question	Response	Comments
B3a. Are there any existing state and/or federal management measures?	Yes	Sport take is prohibited, except no more than two per angler per trip can be taken in Mexican waters. Commercial take is limited to incidental catch of one per vessel (see A. legality of take).
B3b. If yes, are they effective in ensuring sustainability?	Unknown	However, anecdotal evidence suggests the population in California has been increasing since 2004 (House et al. 2016, Ramirez-Valdez et al. 2021).
B4. Is the bycatch the product of recreational catch-and-release practices?	No	
B5. What is the estimated discard mortality rate given the characteristics of the fishery and gear type?	Unknown	No giant sea bass were observed as discarded in the 2007-2017 NMFS observer set gill net data
B6. Do any post-release studies exist to verify the estimated mortality rate?	No	
B7. What is the probability of mortality exceeding levels that have been scientifically determined to be necessary for the continued viability of the species?	Unknown	
C. Impacts on fisheries		
C1. Does a directed fishery exist for the bycatch species?	No	
C2. Has the bycatch and associated discard mortality been accounted for?	No	No GSB were observed as discarded in the NMFS observer data from 2007-2017.
C3. Is bycatch affecting the directed fishery management strategy (i.e., restrictions on size, sex, or season)?	No	
C4. Are the impacts of bycatch considered and made explicit in an ESR or FMP?	No	
C5a. Is the species constrained under a federal rebuilding plan?	No	
C5b. If yes, will bycatch compete with fleets that target the species?	Not applicable	There is no ESR or FMP for giant sea bass.
C6. Is there a management allowance for percent of catch or a prohibition on retention?	Yes	See A1 legality of take; giant sea bass is prohibited in the sport fishery and commercial take is limited to incidental catch of one per set gill net vessel
C7. If there is a directed fishery for the species, have there been any of the following?	No	There was once a historical directed fishery but not since 1981.
C7a. Reductions in opportunities or income for participants in fisheries that target the bycatch species	Not applicable	
C7b. Reductions in fishery quotas or opportunities (e.g., time and area closures) based on bycatch issues?	Not applicable	
C7c. Early closures of a fishery based on higher-than-expected bycatch?	Not applicable	
C7d. Changes in fishing, processing, disposal, and marketing costs due to bycatch?	Not applicable	
C7e. Changes in the social or cultural value of fishing activities due to bycatch?	Not applicable	

Category and question	Response	Comments
C7f. Negative socioeconomic impacts from bycatch on fisheries and/or fishing communities which target or need incidental catch of this species?	Not applicable	
C7g. Negative impacts to juveniles of a species targeted by another fishery?	Not applicable	
D. Impacts on ecosystem		
D1. What is the ecosystem role of the bycatch species?		Giant sea bass is a high trophic level predator and a generalist. Giant sea bass feed on many different prey types within kelp forests and other areas. A recent paper (Blincow et al. 2022) suggests loss of kelp forests may not have the serious impact on giant sea bass as once thought since their prey are not obligate kelp forest inhabitants and neither are giant sea bass.
D2. Does scientific evidence show the amount of bycatch mortality significantly increases the risk that a bycatch species will be unable to serve its ecosystem role?	Unknown	
References		Ramírez-Valdez, A., Rowell, T.J., Dale, K.E., Craig, M.T., Allen, L.G., Villaseñor-Derbez, J.C., Cisneros-Montemayor, A.M., Hernández-Velasco, A., Torre, J., Hofmeister, J. and Erisman, B.E., 2021. Asymmetry across international borders: Research, fishery and management trends and economic value of the giant sea bass (*Stereolepis gigas*). Fish and Fisheries, 22(6), pp.1392-1411. Blincow, K.M., Swalethorp, R., Ramírez-Valdez, A. and Semmens, B.X., 2022. Giant appetites: exploring the trophic ecology of California's largest kelp forest predator, the giant sea bass *Stereolepis gigas*. Marine Ecology Progress Series, 695, pp.157-171. House, P.H., Clark, B.L. and Allen, L.G., 2016. The return of the king of the kelp forest: distribution, abundance, and biomass of giant sea bass (*Stereolepis gigas*) off Santa Catalina Island, California, 2014-2015. Bulletin, Southern California Academy of Sciences, 115(1), pp.1-14.

Appendix 1h. Evaluation of white shark based on MLMA Master Plan bycatch criteria

Category and question	Response	Comments
A. Legality of take		
A1. Under what laws, regulations, or guidance documents is species covered?	Magnuson-Stevens Fishery Conservation and Management Act (MSA)	White Shark management requirements are specified in the Highly Migratory Species Fishery Management Plan, which prohibits the commercial fishing of White Sharks. If fishermen catch a White Shark, it must be released immediately unless other provisions for their disposition are established, such as for scientific study (Pacific Fishery Management Council, 2007).
	Fish and Game Code	Section §8599: It is unlawful to take any white shark for commercial purposes, except under permits issued pursuant to §1002 for scientific or educational purposes or pursuant to subdivision (b) for scientific or live display purposes. b) Notwithstanding subdivision (a), white sharks may be taken incidentally by commercial fishing operations using set gill nets, drift gill nets, or roundhaul nets. White shark taken pursuant to this subdivision shall not have the pelvic fin severed from the carcass until after the white shark is brought ashore. White shark taken pursuant to this subdivision, if landed alive, may be sold for scientific or live display purposes. c) Any white shark killed or injured by any person in self-defense may not be landed. 5517: (a) Except as authorized by a permit issued pursuant to §1002, or as provided in subdivision (b) of §8599, it is unlawful to do any of the following: (1) Take any white shark (Carcharodon carcharias). (2) Use any shark bait, shark lure, or shark chum to attract any white shark. (3) Place any shark bait, shark lure, or shark chum into the water within one nautical mile of any shoreline, pier, or jetty when a white shark is either visible or known to be present. (4) Place any shark bait, shark lure, or shark chum into the water for the purpose of viewing any shark when a white shark is visible or known to be present. (b) For purposes of this section, “shark bait, shark lure, or shark chum” means any natural or manufactured product or device used to attract sharks by the sense of taste, smell, or sight, including, but not limited to, blood, fish, or other material upon which sharks may feed, and surface or underwater decoys. (Amended by Stats. 2022, Ch. 437, Sec. 1. (AB 2109) Effective January 1, 2023.)
	Title 14 CCR	Recreational regulations prohibit the take of white sharks: §28.06: white shark may not be taken, except under a permit issued by the Department pursuant to FGC §1002 for scientific or educational purposes
	Title 50 of the Code of Federal Regulations	660.705 (e) When fishing for HMS, a prohibited species must be returned to the sea immediately with a minimum of injury, except under the following circumstances: (3) White sharks, basking sharks, and megamouth sharks may be retained if incidentally caught and subsequently sold or donated to a recognized scientific or educational organization for research or display purposes.
	an existing FMP	No, not directly but it is mentioned in the Federal fishery management plan for U.S. West Coast Fisheries for Highly Migratory Species. This FMP prohibits retention of white shark (except for sale or donation of incidentally caught specimens to recognized scientific and educational organizations).
A2. Are there prohibitions against take using specific gear type?	Yes.	White sharks have been protected in California since 1994. Only incidental take is allowed in commercial fisheries using set gill nets, drift gill nets or roundhaul nets (see above). White sharks may not be recreationally taken with spear, harpoon or bow and arrow (§28.95).
A3. Is the species a target species that requires discard of individuals based on size limits, seasons, or gear type restrictions?	No	

Category and question	Response	Comments
A4. Is the discard mortality rate known?	Yes	No white sharks were observed as discarded in the 2007-2017 NMFS observer set gill net data. The Monterey Bay Aquarium's sampling program estimated a 49% mortality rate based on the number of live and dead sharks reported in the program. Research on juvenile white shark interactions with set gill net fishery estimated post release survival of sharks retrieved live in gillnets was high (92.9%) (Lyons et al. 2013).
A5a. Are special permits required to retain or interact with the species?	No	
A5b. If yes, does the fishery currently have such permits?	Yes	
A5c. If yes, do the levels of bycatch comply with them?	Yes	
A6a. Does the species have an incidental catch allowance, ACL, or other restrictions on the amount, size, or sex of catch allowed?	No	
A6b. If yes, does the catch comply with them?	Not applicable	
B. Threats to sustainability		
B1. Has a peer-reviewed risk assessment of the vulnerability of the particular bycatch species to overfishing been conducted (e.g., PSA)	Yes	A risk assessment was conducted in response to a petition to list the Northeastern Pacific population of white shark under the California Endangered Species Act (CESA). Based on a multitude of factors including decreased risk of set gill net interactions it was determined listing the population of white shark as threatened or endangered was not warranted. IUCN Red List of Threatened Species categorized white shark as vulnerable.
B2a. Does a population status estimate or stock assessment exist for this species?	Yes.	The stock status for white shark populations in U.S. waters is unknown and no stock assessments have been completed. However, according to a NOAA Fisheries status review and recent research, the northeastern Pacific white shark population appears to be increasing and is not at risk of becoming endangered in U.S. waters. There are multiple white shark population estimates with the status review estimating a total population estimate of ~3000 males and females across size classes.
B2b. If yes, is there confidence in the underlying data such that a reasonable determination can be made if the stock is considered healthy, overfished, or depleted?	Yes.	
B3a. Are there any existing state and/or federal management measures?	Yes	White sharks are federally managed under the Magnuson Stevens Act with requirements specified in the Highly Migratory Species FMP. White sharks are protected in California.
B3b. If yes, are they effective in ensuring sustainability?	Yes	
B4. Is the bycatch the product of recreational catch-and-release practices?	No	
B5. What is the estimated discard mortality rate given the characteristics of the fishery and gear type?		No white sharks were observed as discarded in the 2007-2017 NMFS observer set gill net data. Based on the Status Review of the Northeastern Pacific Population of White Sharks, the expected mortality of white sharks captured in the set gill net fishery was estimated to be 49% through the Monterey Bay Aquarium's sampling program. Research on juvenile white shark interactions with set gill net fishery estimated post release survival of sharks retrieved live in gillnets was high (92.9%) (Lyons et al. 2013).

Category and question	Response	Comments
B6. Do any post-release studies exist to verify the estimated mortality rate?	Yes	From status review report, ~98% of sharks released survived if caught in nets with soak 24 hours or less (C. Lowe per comm.)
B7. What is the probability of mortality exceeding levels that have been scientifically determined to be necessary for the continued viability of the species?		There is a low to very low risk, determined during "Status Review of Northeastern Pacific Population of White Sharks under the Endangered Species Act"
C. Impacts on fisheries		
C1. Does a directed fishery exist for the bycatch species?	No	
C2. Has the bycatch and associated discard mortality been accounted for?	Yes, see below	
C3. Is bycatch affecting the directed fishery management strategy (i.e., restrictions on size, sex, or season)?	Not applicable	
C4. Are the impacts of bycatch considered and made explicit in an ESR or FMP?	No	However, separate federal (2013) and state (2014) reviews of white shark status, which included analyses of bycatch and other impacts, concluded they did not warrant listing under federal or California Endangered Species Acts.
C5a. Is the species constrained under a federal rebuilding plan?	No	
C5b. If yes, will bycatch compete with fleets that target the species?	Not applicable	
C6. Is there a management allowance for percent of catch or a prohibition on retention?	Yes	White shark may not be taken, except in specified commercial fisheries or under permit issued by the Department pursuant to FGC §1002 for scientific or educational purposes. See section A1 for more details.
C7. If there is a directed fishery for the species, have there been any of the following?	Not applicable	
C7a. Reductions in opportunities or income for participants in fisheries that target the bycatch species	Not applicable	
C7b. Reductions in fishery quotas or opportunities (e.g., time and area closures) based on bycatch issues?	Not applicable	
C7c. Early closures of a fishery based on higher-than-expected bycatch?	Not applicable	
C7d. Changes in fishing, processing, disposal, and marketing costs due to bycatch?	Not applicable	
C7e. Changes in the social or cultural value of fishing activities due to bycatch?	Not applicable	

Category and question	Response	Comments
C7f. Negative socioeconomic impacts from bycatch on fisheries and/or fishing communities which target or need incidental catch of this species?	Not applicable	
C7g. Negative impacts to juveniles of a species targeted by another fishery?	Not applicable	
D. Impacts on ecosystem		
D1. What is the ecosystem role of the bycatch species?	See comments	The white shark is an apex predator. Juveniles prey on larger fishes; and adults prey upon seals and sea lions
D2. Does scientific evidence show the amount of bycatch mortality significantly increases the risk that a bycatch species will be unable to serve its ecosystem role?	No	Recent research and status reviews show white shark populations are increasing which indicates the ecosystem role is being fulfilled.
References		Dewar, Heidi, Tomoharu Eguchi, John Hyde, Douglas H. Kinzey, Suzanne Kohin, Jeff Moore, Barbara Louise Taylor, and Russ Vetter. "Status review of the northeastern Pacific population of white sharks (*Carcharodon carcharias*) under the Endangered Species Act." (2013). Lyons, K., Jarvis, E. T., Jorgensen, S. J., Weng, K., O'Sullivan, J., Winkler, C., & Lowe, C. G. (2013). The degree and result of gillnet fishery interactions with juvenile white sharks in southern California assessed by fishery-independent and-dependent methods. Fisheries Research, 147, 370-380.

Appendix 1i. Evaluation of Brandt's cormorant based on MLMA Master Plan bycatch criteria

Category and question	Response	Comments
A. Legality of take		
A1. Under what laws, regulations, or guidance documents is species covered?	Migratory Bird Treaty Act	This Act prohibits the take of protected migratory birds without the prior authorization by the Department of Interior U.S. Fish and Wildlife Service.
	Title 50 of the Code of Federal Regulations	This species is included in Title 50 §10.13 List of Migratory Birds, which lists the specific species of birds that are covered under the Migratory Bird Treaty Act.
	IUCN Red List of Threatened Species	The last IUCN Red List of Threatened Species evaluation in 2018 listed this species as Least Concern.
A2. Are there prohibitions against take using specific gear type?	No	There is not a fishery for this species.
A3. Is the species a target species that requires discard of individuals based on size limits, seasons, or gear type restrictions?	Not applicable	There is not a fishery for this species.
A4. Is the discard mortality rate known?	Yes	A rate of 100% was estimated, but only four birds were observed returned dead from set gill nets targeting California halibut.
A5a. Are special permits required to retain or interact with the species?	No	
A5b. If yes, does the fishery currently have such permits?	Not applicable	
A5c. If yes, do the levels of bycatch comply with them?	Not applicable	
A6a. Does the species have an incidental catch allowance, ACL, or other restrictions on the amount, size, or sex of catch allowed?	Not applicable	These apply only to fishery species and there is not a fishery for Brandt's cormorant.
A6b. If yes, does the catch comply with them?	Not applicable	
B. Threats to sustainability		

Category and question	Response	Comments
B1. Has a peer-reviewed risk assessment of the vulnerability of the particular bycatch species to overfishing been conducted (e.g., PSA)	Not applicable	There is not a fishery for this species.
B2a. Does a population status estimate or stock assessment exist for this species?	Yes	An estimate was made of 230,000 individuals in 2006, but there are no recent estimates (Delany and Scott 2006).
B2b. If yes, is there confidence in the underlying data such that a reasonable determination can be made if the stock is considered healthy, overfished, or depleted?	Yes	
B3a. Are there any existing state and/or federal management measures?	Yes	See Legality of Take questions.
B3b. If yes, are they effective in ensuring sustainability?	Yes	Measures appear effective. 'Despite the fact that the population trend appears to be decreasing, the decline is not believed to be sufficiently rapid to approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or three generations). The population size is very large, and hence does not approach the thresholds for Vulnerable under the population size criterion (<10,000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure).' (IUCN Red List of Threatened Species)
B4. Is the bycatch the product of recreational catch-and-release practices?	No	
B5. What is the estimated discard mortality rate given the characteristics of the fishery and gear type?	100%	However, only four returned dead were recorded from set gill nets targeting California halibut, based on NMFS set gill net observer data from 2007 to 2017.
B6. Do any post-release studies exist to verify the estimated mortality rate?	No	
B7. What is the probability of mortality exceeding levels that have been scientifically determined to be necessary for the continued viability of the species?	Unknown	The population is listed as Least Concern (IUCN Red List of Threatened Species).
C. Impacts on fisheries		

Category and question	Response	Comments
C1. Does a directed fishery exist for the bycatch species?	No	There is not a fishery for this species.
C2. Has the bycatch and associated discard mortality been accounted for?	Yes	A total of 11 were returned dead recorded from set gill nets (four when specifically targeting California halibut) (West Coast Region Observer Program (WCROP) 2020) for the years 2007, 2010-2013, 2017 (California halibut ESR Fig 3-3).
C3. Is bycatch affecting the directed fishery management strategy (i.e., restrictions on size, sex, or season)?	No	
C4. Are the impacts of bycatch considered and made explicit in an ESR or FMP?	Yes	See the California halibut ESR.
C5a. Is the species constrained under a federal rebuilding plan?	No	
C5b. If yes, will bycatch compete with fleets that target the species?	Not applicable	
C6. Is there a management allowance for percent of catch or a prohibition on retention?	Yes	There is a prohibition on retention
C7. If there is a directed fishery for the species, have there been any of the following?	Not applicable	There is not a fishery for this species
C7a. Reductions in opportunities or income for participants in fisheries that target the bycatch species	Not applicable	
C7b. Reductions in fishery quotas or opportunities (e.g., time and area closures) based on bycatch issues?	Not applicable	
C7c. Early closures of a fishery based on higher-than-expected bycatch?	Not applicable	
C7d. Changes in fishing, processing, disposal, and marketing costs due to bycatch?	Not applicable	

Category and question	Response	Comments
C7e. Changes in the social or cultural value of fishing activities due to bycatch?	Not applicable	
C7f. Negative socioeconomic impacts from bycatch on fisheries and/or fishing communities which target or need incidental catch of this species?	Not applicable	
C7g. Negative impacts to juveniles of a species targeted by another fishery?	Not applicable	
D. Impacts on ecosystem		
D1. What is the ecosystem role of the bycatch species?	See comments	This species is a mesopredator that eats primarily small fishes, such as herring and rockfishes, as well as shrimp and crabs. (https://www.nps.gov/places/000/brandts-cormorant.htm)
D2. Does scientific evidence show the amount of bycatch mortality significantly increases the risk that a bycatch species will be unable to serve its ecosystem role?	No	
References		Delany, S. and Scott, D. 2006. Waterbird population estimates. Wetlands International, Wageningen, The Netherlands.

Appendix 1j. Evaluation of sublegal California halibut based on MLMA Master Plan bycatch criteria

Category and question	Response	Comments
A. Legality of take		
A1. Under what laws, regulations, or guidance documents is species covered?	Fish and Game Code	Summary of relevant FGC sections: FGC §8392: No California halibut may be taken, possessed, or sold that measures less than 22 inches in total length. Total length means the shortest distance between the tip of the jaw or snout, whichever extends farthest while the mouth is closed, and the tip of the longest lobe of the tail, measured while the halibut is lying flat in natural repose, without resort to any force other than the swinging or fanning of the tail. From CA halibut ESR: Commercial halibut gill and trammel net gear must meet certain design requirements: A set gill net becomes a trammel net (see Figure 2-16) when a line on the net causes the webbing to hang slack (FGC §8700). Set gill and trammel nets (which are not free to drift with tide or current) may be used to target halibut in certain areas if the mesh size is at least 8.5 in (216 mm) (FGC §8625(a)). No more than 9,000 ft (2,744 m) of gill or trammel net may be fished in combination each day (FGC §8625(b)), except no more than 6,000 ft (1,829 m) may be fished in a specified area in Santa Barbara county. In waters shallower than 150 ft (45.7 m), the cork line or other line across the top of the net must have a breaking strength of no more than 2,400 lb (FGC §8664.13(a)) and breakaway devices must be installed every 270 ft (82.3 m) along the cork line and lead line (FGC §8664.13(b)). Gill and trammel nets are currently prohibited in the following state waters: in all waters from Point Reyes headlands (Marin County) to the California-Oregon Border; in 240 ft or less from Point Reyes headlands (Marin County) to Pillar Point in Half Moon Bay (San Mateo County); in 360 ft (109.8 m) or less from Pillar Point to Waddell Creek (Santa Cruz County); within 3 nm of the Farallon Islands and the Noonday Rock Buoy (San Francisco County) and; in waters less than 180 ft (54.9 m) north of Point Sal (Santa Barbara County). The set gill net depth restrictions in northern California effectively prohibit set gill nets from being a viable method of take in this region. Currently the halibut set gill net fishery operates only in southern California. In southern California, gill and trammel nets may not be used within 1 nm or 420 ft (128.0 m), whichever is less, around the Channel Islands, or within 3 nm of the mainland shore south of Point Arguello to the California/Mexico border. The commercial trawl and set gill and trammel net halibut fisheries are restricted access. Trawl (FGC §8494) and set gill net (FGC §8681.5) permits are transferable if certain conditions are met. Permits have been required since 1980 for the general gill and trammel net fishery and since 2006 for the trawl fishery. These gear types are not selective, and permits are required to limit halibut effort and catch, and to reduce bycatch.
	Title 14 CCR	California halibut is covered under title 14, however none of these regulations refer to commercial halibut set gill net fishing: see §27.65 (rec fileting of fish on vessels), §28.15 (rec bag/possession limit and minimum size limit), §124 (halibut trawl grounds and trawl gear), §124.1 (California Halibut Bottom Trawl Vessel Permits), §163.1 (halibut may not be retained in herring set gill net fishery if caught as bycatch), §176 (Trawl Fishing Activity Records)
A2. Are there prohibitions against take using specific gear type?	Yes	The minimum size limit for halibut is 22 in. (559 mm) total length, in all commercial and recreational fisheries, regardless of the gear type used.
A3. Is the species a target species that requires discard of individuals based on size limits, seasons, or gear type restrictions?	Yes	California halibut is the target species of the fishery, however all sublegal halibut must be discarded. The minimum size limit for halibut is 22 in. (559 mm) total length. This fishery may swing or fan the caudal fin to reach the minimum size.

Category and question	Response	Comments
A4. Is the discard mortality rate known?	Yes	See row B5.
A5a. Are special permits required to retain or interact with the species?	No	No special permits/incidental take permits are required. A general set gill net permit is required to target halibut using set gill nets, however sublegal halibut still may not be retained with a set gill net permit.
A5b. If yes, does the fishery currently have such permits?	Not applicable	
A5c. If yes, do the levels of bycatch comply with them?	Not applicable	
A6a. Does the species have an incidental catch allowance, ACL, or other restrictions on the amount, size, or sex of catch allowed?	Yes	There is a minimum legal size limit.
A6b. If yes, does the catch comply with them?	No	All sublegal halibut do not comply with the size allowance.
B. Threats to sustainability		
B1. Has a peer-reviewed risk assessment of the vulnerability of the particular bycatch species to overfishing been conducted (e.g., PSA)	Yes	See links to PSA and ERA for halibut: https://www.oceansciencetrust.org/wp-content/uploads/2016/11/PSA-test-on-CA-Fisheries-Report-April2014.pdf https://www.oceansciencetrust.org/wp-content/uploads/2017/11/Ecological-Risk-Assessment-report-OST-2017.pdf
B2a. Does a population status estimate or stock assessment exist for this species?	Yes	See links to relevant documents: 2011 California Halibut Stock Assessment (The southern population is estimated to be depleted to about 14% of its unexploited spawning biomass level): https://wildlife.ca.gov/Conservation/Marine/CA-Halibut-FMP/Assessment 2020 California Halibut Stock Assessment, Executive Summary: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=193616&inline California Halibut 2020 Stock Assessment Review Panel Report: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=193537&inline

Category and question	Response	Comments
B2b. If yes, is there confidence in the underlying data such that a reasonable determination can be made if the stock is considered healthy, overfished, or depleted?	No	California halibut ESR: Results of the 2020 efforts were reviewed by a panel of stock assessment experts and found not to be ready for use in management, particularly for the northern stock. The California Halibut 2020 Stock Assessment Review Panel Report outlined recommendations for additional data collection, analysis, and model improvements, including reconstructing historical halibut landings to reflect an unfished or nearly unfished condition and initial population estimates.
B3a. Are there any existing state and/or federal management measures?	Yes	California halibut ESR: The minimum size limit is intended to allow halibut the opportunity to reproduce at least once before they become eligible for take by the fishery. Set gill net fisheries are required to complete logbooks and under certain conditions they are subject to the requirements of the federal observer program and Vessel Monitoring Systems (VMS), which allows for monitoring of these gear types. Area closures and gear restrictions are intended to protect the halibut population, incidental co-occurring species, and habitat.
B3b. If yes, are they effective in ensuring sustainability?	Yes	California halibut ESR: The Department has not established formal overfishing criteria for the halibut resource. The MLMA defines overfishing as a rate or level of take that the best available scientific information, and other relevant information, indicates is not sustainable or that jeopardizes the capacity of a marine fishery to produce the maximum sustainable yield on a continuing basis. Department staff continue to monitor catch, effort, and life history trends with fishery-dependent and fishery-independent datasets on a monthly to annual basis. These data are evaluated relative to historic trends and environmental factors. If a problem is detected by the Department or reported by stakeholders, Department resources and management attention focus on the situation. The halibut fishery is currently being evaluated with a MSE using the Data Limited Methods Toolkit framework which is intended to establish formal overfishing rules. Should the MSE or the stock assessment indicate that the halibut population is overfished, a rebuilding plan will be required. There are currently no formal indications that the halibut resource is overfished, although the stock status may be different north compared to south of Point Conception.
B4. Is the bycatch the product of recreational catch-and-release practices?	No	
B5. What is the estimated discard mortality rate given the characteristics of the fishery and gear type?	58%	According to WCROP observer data filtered by halibut targeted trips, 58% of returned halibut were returned dead as observed in the California set gill net fishery. Halibut are likely discarded because they are sublegal or damaged by sea lions or other marine mammals. This mortality rate is based on a total of 48 discarded halibut.
B6. Do any post-release studies exist to verify the estimated mortality rate?	No	

Category and question	Response	Comments
B7. What is the probability of mortality exceeding levels that have been scientifically determined to be necessary for the continued viability of the species?	Low	This fishery is undergoing attrition. California halibut ESR: A restricted access permit has been required to use gill and trammel nets since 1980 (FGC §8681(a); Schultze 1990). Permits are issued annually and were established using criteria of minimum landing requirements for initial issuance. The permit is issued to the fisherman, not the vessel. Between 1919 and 1929, halibut trammel net vessels averaged 35 ft (11 m) in length with a beam of about 8 to 10 ft (2 to 3 m) and an average net tonnage of about 4 to 5 per boat (Clark 1931). In 2000, there were 231 general set gill net permittees, with 64 landing halibut at least once. Through attrition these permits have decreased in number. As of 2019, 114 general set gill net permits remain for the commercial halibut set gill and trammel net fishery (Automated License Data System (ALDS); December 2020), and according to MLDS, 29 vessels used set gill nets to land halibut in 2019. Since 2005, an average of 36 vessels per year landed halibut using set gill nets.
C. Impacts on fisheries		
C1. Does a directed fishery exist for the bycatch species?	Yes	Legal sized halibut are the target of this fishery and other halibut fisheries (trawl/H&L)
C2. Has the bycatch and associated discard mortality been accounted for?	No	Sublegal halibut are accounted for in the stock assessment. However, results were found not to be ready for use in management.
C3. Is bycatch affecting the directed fishery management strategy (i.e., restrictions on size, sex, or season)?	Yes	Bycatch of sublegal halibut directly affects the management strategy of this fishery. For example, gear restrictions and area restrictions are intended to minimize the take of sublegal halibut.
C4. Are the impacts of bycatch considered and made explicit in an ESR or FMP?	No	Bycatch impacts of sublegal halibut are not explored in detail in the ESR.
C5a. Is the species constrained under a federal rebuilding plan?	No	
C5b. If yes, will bycatch compete with fleets that target the species?	Not applicable	
C6. Is there a management allowance for percent of catch or a prohibition on retention?	Yes	There is a prohibition on all retention of sublegal halibut
C7. If there is a directed fishery for the species, have there been any of the following?		

Category and question	Response	Comments
C7a. Reductions in opportunities or income for participants in fisheries that target the bycatch species	Yes	Bycatch likely results in a reduction in income for this fishery and other commercial halibut fisheries (trawl/H&L) because sublegal halibut are the future of the targeted resource. For the same reason, it also likely results in reduced opportunity for recreational halibut fisheries.
C7b. Reductions in fishery quotas or opportunities (e.g., time and area closures) based on bycatch issues?	Yes	Minimum mesh size requirements were intended to avoid/minimize accidental capture of sublegal halibut. Nearshore area closures protect immature halibut.
C7c. Early closures of a fishery based on higher-than-expected bycatch?	No	
C7d. Changes in fishing, processing, disposal, and marketing costs due to bycatch?	No	
C7e. Changes in the social or cultural value of fishing activities due to bycatch?	No	
C7f. Negative socioeconomic impacts from bycatch on fisheries and/or fishing communities which target or need incidental catch of this species?	Yes	Impacts include reduced income for commercial halibut fishermen and reduced opportunity for recreational fishermen
C7g. Negative impacts to juveniles of a species targeted by another fishery?	Yes	Bycatch of sublegal halibut in the set gill net fishery impacts the halibut trawl and hook & line fisheries who also rely on these sublegal fish as the future of the targeted resource
D. Impacts on ecosystem		

Category and question	Response	Comments
D1. What is the ecosystem role of the bycatch species?	See comments	Halibut are described as a carnivorous cryptic top predator in the California halibut ESR: In the marine ecosystem, halibut occur in shallow nearshore, bay, and estuary waters, and are strongly affiliated benthically with soft bottom habitat. They are not known to play any special ecosystem roles, and they have not been documented as an important food source for other marine species, in any life stage. Large adult halibut are considered aggressive and carnivorous cryptic top predators that feed on other fishes and invertebrates. They have a long and varied list of documented prey items, however availability of forage fish (such as anchovy and squid), likely results in favorable ecosystem conditions for this species. Due to varying tolerances and life histories, associated species differ across the geographic range of halibut and are influenced by a wide variety of factors including latitude, depth, habitat, water temperature, season, and salinity. Species that are commonly associated with halibut can be categorized as fish and invertebrates with benthic soft bottom affiliation that occur in shallow nearshore, bay, and estuary waters. This includes other flatfish, some cartilaginous fishes (sharks, skates, and rays), croakers, sturgeon, some of the basses, and certain surfperch. Invertebrate species that co-occur with halibut generally include various species of crab, shrimp, prawns, sand dollars, sea cucumber, octopus, sea stars, snails, and sea pens.
D2. Does scientific evidence show the amount of bycatch mortality significantly increases the risk that a bycatch species will be unable to serve its ecosystem role?	No	Little evidence to draw conclusions on this exists
References		California Department of Fish and Wildlife. 2022. California halibut, *Paralichthys californicus*, Enhanced Status Report. MRAG Americas, Inc. 2014. Productivity and Susceptibility Analysis with Next Step Recommendations, Test Cases for Selected California Fisheries. Report to California Ocean Science Trust. Ramanujam, E., Samhouri, J., Bizzarro, J., and Carter, H. 2017. Ecological Risk Assessment as a Prioritization Tool to Support California Fisheries Management. Oakland, California, USA. West Coast Region Observer Program. 2020. California Set Gillnet Fishery Catch Summaries: 2007, 2001-2013, 2017.

Appendix 1k. Evaluation of California sea lion based on MLMA Master Plan bycatch criteria

Category and question	Response	Comments
A. Legality of take		
A1. Under what laws, regulations, or guidance documents is species covered?	Fish and Game Code	This species is not listed, but it falls under the general term 'sea lions.' Take is described as unlawful in accordance with other existing laws. FGC § 4500: '(a) It is unlawful to take any marine mammal except in accordance with provisions of the Marine Mammal Protection Act of 1972 (Chapter 31 (commencing with §1361) of Title 16 of the United States Code) or provisions of Title 50 of the Code of Federal Regulations, or pursuant to subdivision (b) of this section. (b) At such time as federal laws or regulations permit the state to assume jurisdiction over marine mammals, the commission may adopt regulations governing marine mammals and the taking thereof. (c) For purposes of this chapter, "marine mammals" means sea otters, whales, dolphins, porpoises, seals, and sea lions'; § 10843 'Fishermen, however, may not take any seal or sea lion while in this refuge, notwithstanding the provisions of §4500 or 4500.5.'
	Marine Mammal Protection Act	This Act, established in 1972, protects all marine mammals.
	IUCN Red List of Threatened Species	The last IUCN Red List of Threatened Species evaluation in 2014 listed this species as Least Concern.
A2. Are there prohibitions against take using specific gear type?	No	There is not a fishery for this species.
A3. Is the species a target species that requires discard of individuals based on size limits, seasons, or gear type restrictions?	Not applicable	There is not a fishery for this species.
A4. Is the discard mortality rate known?	Yes	See question B5.
A5a. Are special permits required to retain or interact with the species?	No	These permits are only issued when sea lions are threatening protected salmon, which would not occur in the California halibut set gillnet fishery.
A5b. If yes, does the fishery currently have such permits?	Not applicable	
A5c. If yes, do the levels of bycatch comply with them?	Not applicable	

Category and question	Response	Comments
A6a. Does the species have an incidental catch allowance, ACL, or other restrictions on the amount, size, or sex of catch allowed?	Not applicable	These are only for fishery species and there is not a fishery for California sea lion.
A6b. If yes, does the catch comply with them?	Not applicable	
B. Threats to sustainability		
B1. Has a peer-reviewed risk assessment of the vulnerability of the particular bycatch species to overfishing been conducted (e.g., PSA)	Not applicable	There is not a fishery for this species.
B2a. Does a population status estimate or stock assessment exist for this species?	Yes	Population size in 2014 was estimated at 257,606 animals, which corresponded with a pup count of 47,691 animals along the U.S. west coast (NOAA 2018).
B2b. If yes, is there confidence in the underlying data such that a reasonable determination can be made if the stock is considered healthy, overfished, or depleted?	Yes	The population is considered to be at or above carrying capacity.
B3a. Are there any existing state and/or federal management measures?	Yes	See Legality of Take questions.
B3b. If yes, are they effective in ensuring sustainability?	Yes	California Sea Lions have recovered from historical exploitation and their population is now large and still expanding slowly. Beyond the temporal effects of El Niño events, no other major threats are apparent. They should be listed by IUCN Red List of Threatened Species as of Least Concern (IUCN Red List of Threatened Species).
B4. Is the bycatch the product of recreational catch-and-release practices?	No	
B5. What is the estimated discard mortality rate given the characteristics of the fishery and gear type?	100%	A total of 34 were returned dead recorded from set gill nets targeting CA halibut for years 2007, 2010-2013, 2017. (NMFS observer data)
B6. Do any post-release studies exist to verify the estimated mortality rate?	No	

Category and question	Response	Comments
B7. What is the probability of mortality exceeding levels that have been scientifically determined to be necessary for the continued viability of the species?	Very low	'The fishery mortality and serious injury rate (197 animals/year) for this stock is less than 10% of the calculated Potential Biological Removal (PBR) and, therefore, is considered to be insignificant and approaching a zero mortality and serious injury rate.'(NOAA 2018)
C. Impacts on fisheries		
C1. Does a directed fishery exist for the bycatch species?	No	There is not a fishery for this species.
C2. Has the bycatch and associated discard mortality been accounted for?	Yes	A total of 34 California sea lions were document as discarded dead in the Federal Observer Program data for the targeted California halibut set gill net fishery for years 2007, 2010-2013, 2017 (WCROP 2020).
C3. Is bycatch affecting the directed fishery management strategy (i.e., restrictions on size, sex, or season)?	No	
C4. Are the impacts of bycatch considered and made explicit in an ESR or FMP?	Yes	See the California halibut ESR.
C5a. Is the species constrained under a federal rebuilding plan?	No	
C5b. If yes, will bycatch compete with fleets that target the species?	Not applicable	
C6. Is there a management allowance for percent of catch or a prohibition on retention?	Yes	There is a prohibition on retention.
C7. If there is a directed fishery for the species, have there been any of the following?	Not applicable	There is not a fishery for this species.
C7a. Reductions in opportunities or income for participants in fisheries that target the bycatch species	Not applicable	
C7b. Reductions in fishery quotas or opportunities (e.g., time and area closures) based on bycatch issues?	Not applicable	
C7c. Early closures of a fishery based on higher-than-expected bycatch?	Not applicable	

Category and question	Response	Comments
C7d. Changes in fishing, processing, disposal, and marketing costs due to bycatch?	Not applicable	
C7e. Changes in the social or cultural value of fishing activities due to bycatch?	Not applicable	
C7f. Negative socioeconomic impacts from bycatch on fisheries and/or fishing communities which target or need incidental catch of this species?	Not applicable	
C7g. Negative impacts to juveniles of a species targeted by another fishery?	Not applicable	
D. Impacts on ecosystem		
D1. What is the ecosystem role of the bycatch species?	See Comments	This species is a mesopredator and feeds on a variety of prey, including squid, anchovies, mackerel, rockfishes, and sardines. (https://www.fisheries.noaa.gov/species/california-sea-lion)
D2. Does scientific evidence show the amount of bycatch mortality significantly increases the risk that a bycatch species will be unable to serve its ecosystem role?	No	
References		California Department of Fish and Wildlife. 2022. California halibut, *Paralichthys californicus,* Enhanced Status Report. National Oceanic and Atmospheric Administration. U.S. Department of Commerce. 2018. CALIFORNIA SEA LION (*Zalophus californianus*): U.S. Stock. (Revised 3/18/2019).

Appendix 1l. Evaluation of humpback whale based on MLMA Master Plan bycatch criteria

Category and question	Response	Comments
A. Legality of take		
A1. Under what laws, regulations, or guidance documents is species covered?	Endangered Species Act (ESA)	The species was initially listed in Federal Register 35 18319 in 1970, revised in Federal Register 80 FR 22304 in 2015.
	Marine Mammal Protection Act (MMPA)	This Act, established in 1972, protects all marine mammals.
	Magnuson-Stevens Fishery Conservation and Management Act (MSA)	Indirectly- §403 of the Act establishes guidelines for federal observers on fishing vessels
	Fish and Game Code	Take is described as unlawful in accordance with other existing laws. FGC § 4500: '(a) It is unlawful to take any marine mammal except in accordance with provisions of the Marine Mammal Protection Act of 1972 (Chapter 31 (commencing with §1361) of Title 16 of the United States Code) or provisions of Title 50 of the Code of Federal Regulations, or pursuant to subdivision (b) of this section. (b) At such time as federal laws or regulations permit the state to assume jurisdiction over marine mammals, the commission may adopt regulations governing marine mammals and the taking thereof. (c) For purposes of this chapter, "marine mammals" means sea otters, whales, dolphins, porpoises, seals, and sea lions'; §10843 'Fishermen, however, may not take any seal or sea lion while in this refuge, notwithstanding the provisions of §4500 or 4500.5.' Indirectly-§8276.1 provides for delay of Dungeness crab trap fishery opener due to risk of marine life entanglement. Indirectly- §8664.5 established the set gill net closure in waters north of Point Sal, which reduced risk of entanglement. §8664.5(d) allows the Director to restrict the use, method of use, size, or materials used in construction of any net used in the set gill net fishery if it is determined that it is having an adverse impact on any marine mammal species.

Category and question	Response	Comments
	Title 14 CCR	Indirectly- §104.1 established the set gill net closure in waters north of Point Arguello, which reduced risk of entanglement.
	IUCN Red List of Threatened Species	The humpback whale is considered to be a species of Least Concern by IUCN Red List of Threatened Species. The Mexico population, which feeds off California, the Pacific Northwest, and Alaska, has been downlisted to threatened.
A2. Are there prohibitions against take using specific gear type?	Yes	The set gill net fishery requires the use of a minimum mesh size and a maximum net length. See above.
A3. Is the species a target species that requires discard of individuals based on size limits, seasons, or gear type restrictions?	No	
A4. Is the discard mortality rate known?	Not applicable	
A5a. Are special permits required to retain or interact with the species?	No	However, the Department believes technically that a 1013e ESA Permit (negligible impact determination) is required. The NMFS believes that the set gill net permittees do not possess these.
A5b. If yes, does the fishery currently have such permits?	Not applicable	
A5c. If yes, do the levels of bycatch comply with them?	Not applicable	
A6a. Does the species have an incidental catch allowance, ACL, or other restrictions on the amount, size, or sex of catch allowed?	No	
A6b. If yes, does the catch comply with them?	Not applicable	
B. Threats to sustainability		
B1. Has a peer-reviewed risk assessment of the vulnerability of the particular bycatch species to overfishing been conducted (e.g., PSA)	Yes	In 2016 NOAA listed the Mexico Distinct Population Segment (DPS) as threatened. All threats are considered likely to have no or minor impact on population size and/or the growth rate of this DPS or are unknown, with the following exception: Fishing gear entanglements are still considered likely to moderately reduce the population size or the growth rate of the Mexico DPS. (Federal Register).

Category and question	Response	Comments
B2a. Does a population status estimate or stock assessment exist for this species?	Yes	Humpback whales found in California waters are considered part of the Mexico DPS. A federal stock assessment concluded that the species is depleted. The minimum population estimate for humpback whales in the California/Oregon/Washington stock is taken as the lower 20th percentile of the mark-recapture estimate, or 4,776 whales (Federal Register, Calambokidis, J. and J. Barlow. 2013)
B2b. If yes, is there confidence in the underlying data such that a reasonable determination can be made if the stock is considered healthy, overfished, or depleted?	Yes	See above- stock is considered depleted. NOAA concluded that the Mexico DPS is likely to become endangered throughout its range within the foreseeable future, i.e., that it is a threatened species. (source https://www.fisheries.noaa.gov/topic/laws-policies/marine-mammal-protection-act Federal Register)
B3a. Are there any existing state and/or federal management measures?	Yes	Humpback whales are fully protected under the ESA and MMPA. Set gill nets have been restricted within California to a small portion of federal waters in the southern part of the state (Title 14, §104), and the fishery is restricted access. In addition, the Dungeness crab trap fisheries have built-in conservation measures to reduce the probability of whales encountering trap gear, including the ability of the Department Director to close the recreational and/or commercial fishery early if there is a significant presence of whales in the area. Sanctuaries have established voluntary speed reduction measures for large vessels in their waters to reduce the likelihood of ship strikes on whales.
B3b. If yes, are they effective in ensuring sustainability?	Uncertain	NOAA concluded that the Mexico DPS is likely to become endangered throughout its range within the foreseeable future, i.e., that it is a threatened species. (Federal Register).
B4. Is the bycatch the product of recreational catch-and-release practices?	No	
B5. What is the estimated discard mortality rate given the characteristics of the fishery and gear type?	Not applicable	No humpback whale has been documented as bycatch in the halibut set gill net fishery in California by federal observers; thus, no estimated of discard mortality is possible.
B6. Do any post-release studies exist to verify the estimated mortality rate?	Not applicable	No humpback whale has been documented as bycatch in the halibut set gill net fishery in California.
B7. What is the probability of mortality exceeding levels that have been scientifically determined to be necessary for the continued viability of the species?	Low	No humpback whale has been documented as bycatch in the halibut set gill net fishery in California.
C. Impacts on fisheries		
C1. Does a directed fishery exist for the bycatch species?	No	

Category and question	Response	Comments
C2. Has the bycatch and associated discard mortality been accounted for?	Not applicable	
C3. Is bycatch affecting the directed fishery management strategy (i.e., restrictions on size, sex, or season)?	No	No humpback whale has been documented as bycatch in the halibut set gill net fishery in California.
C4. Are the impacts of bycatch considered and made explicit in an ESR or FMP?	Not applicable	
C5a. Is the species constrained under a federal rebuilding plan?	Not applicable	
C5b. If yes, will bycatch compete with fleets that target the species?	Not applicable	
C6. Is there a management allowance for percent of catch or a prohibition on retention?	Not applicable	
C7. If there is a directed fishery for the species, have there been any of the following?		
C7a. Reductions in opportunities or income for participants in fisheries that target the bycatch species	Not applicable	
C7b. Reductions in fishery quotas or opportunities (e.g., time and area closures) based on bycatch issues?	Not applicable	
C7c. Early closures of a fishery based on higher-than-expected bycatch?	Not applicable	
C7d. Changes in fishing, processing, disposal, and marketing costs due to bycatch?	Not applicable	
C7e. Changes in the social or cultural value of fishing activities due to bycatch?	Not applicable	

Category and question	Response	Comments
C7f. Negative socioeconomic impacts from bycatch on fisheries and/or fishing communities which target or need incidental catch of this species?	Not applicable	
C7g. Negative impacts to juveniles of a species targeted by another fishery?	Not applicable	
D. Impacts on ecosystem		
D1. What is the ecosystem role of the bycatch species?	See Comments	Humpback whales are both predators and prey, feeding on krill and small fish, and being preyed upon by killer whales and sharks. When they die, their carcasses sink and provide food to many scavenger species which decompose them into nutrients available for other organisms. Through defecation, they recirculate nitrogen-enriched nutrients into the water column, which are then used in primary production. As the base of the marine food web, phytoplankton takes in carbon dioxide, phytoplankton sequester hundreds of thousands of tons of carbon each year in the world's oceans, helping to reduce impacts of climate change.
D2. Does scientific evidence show the amount of bycatch mortality significantly increases the risk that a bycatch species will be unable to serve its ecosystem role?	No	No humpback whale has been documented as bycatch in the halibut set gill net fishery in California.
References		Calambokidis, J. and J. Barlow. 2013. Updated abundance estimates of blue and humpback whales off the US west coast incorporating photo-identifications from 2010 and 2011. Document PSRG-2013-13 presented to the Pacific Scientific Review Group, April 2013. 7 p.)