COMMITTEE STAFF SUMMARY FOR JULY 20, 2023 MRC

3. EVALUATION OF BYCATCH IN THE CALIFORNIA HALIBUT SET GILLNET FISHERY IN SUPPORT OF THE FISHERY MANAGEMENT REVIEW

Today's Item **Information ☐** **Action ☒**

Receive and discuss Department report summarizing its evaluation of fisheries bycatch and acceptability in the California halibut set gillnet fishery, provide committee direction on next steps, and potentially develop committee recommendation.

Summary of Previous/Future Actions

• Commission referred California halibut management review to MRC	Aug 19-20, 2020
• Commission referred bycatch evaluation for California halibut management review to MRC	Dec 15-16, 2021
• MRC received updates on bycatch evaluation for California halibut	Mar 24, 2022 and Jul 14, 2022
• MRC received bycatch evaluation report from Department; MRC recommendation for initial priorities in bycatch acceptability inquiry	Nov 17, 2022
• MRC received Department updates on bycatch inquiries for the California halibut gill net fishery	Mar 14 & 16, 2023
• **Today receive and discuss Department report on bycatch acceptability; potential MRC recommendation**	**Jul 20, 2023**

Background

Management review of the California halibut fishery commenced in late 2020, consistent with the requirements of the Marine Life Management Act (MLMA) and using the framework outlined in the *2018 Master Plan for Fisheries, A Guide for Implementation of the Marine Life Management Act* (master plan) for meeting those requirements. Steps taken by the Department have included pursuing stock assessments for the northern and southern stocks (2020-2021), exploring a scope and potential process for the multi-sector California halibut management review (2021), and, following Commission direction in December 2021, conducting an evaluation of bycatch in the California halibut fishery.

The California halibut fishery management review has presented the first opportunity to use the four-step framework for evaluating bycatch laid out in Chapter 6 of the master plan, to: collect information on the type and amount of catch (Step 1); distinguish target, incidental, and bycatch species (Step 2); determine "acceptable" types and amounts of bycatch (Step 3); and address unacceptable bycatch (Step 4).

At the November 2022 MRC meeting, the Department presented a report completed by a contracted academic scientist that evaluated and summarized catch and bycatch data compiled for the California halibut sectors with greatest bycatch concern: commercial trawl and set gillnet halibut fisheries. Utilizing federal observer data provided by the National Marine

Fisheries Service (NMFS), the Department and the contracted scientist used fishery expertise along with logbook and landings data to differentiate the subsets of observed sets targeting California halibut from other observed trawl and gillnet fishery sets. The report summarized target catch, top incidentally-caught species landed, top incidentally-caught species discarded, and discard mortality, fulfilling the information needs for steps 1 and 2 of the bycatch evaluation framework. See Exhibit 1 for additional background and context.

MRC supported relying on the Department-presented report as the foundation for completing Step 3 – evaluating acceptability of bycatch types and amounts. MRC discussed priorities for completing the detailed bycatch inquiries based on the new evaluation report, favoring an initial focus on top bycatch species from set gill nets targeting California halibut. In December 2022, the Commission approved an MRC recommendation to request the Department to (1) commence the step 3 evaluation of acceptability of bycatch in the *California halibut set gillnet fishery,* using the inquiries outlined in the master plan; (2) focus on completing bycatch inquiries for the *top ten species*; (3) engage stakeholders (halibut gillnet fishermen and stakeholder groups); and (4) bring results back to MRC in March 2023 for discussion and potential committee recommendation.

March MRC

In March 2023, the Department reported that it had completed Step 3 bycatch inquiries for 12 top bycatch species, as requested by the Commission, to help assess acceptability of bycatch types and amounts against the four criteria specified in the MLMA for determining acceptability: (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 (Fish and Game Code Section 7085(b)). The Department presented a summary of the inquiry results during the meeting, and committed to preparing a written report documenting its responses to inquiries and articulating its findings.

Discussion also centered around a separate evaluation conducted by two non-governmental organizations (NGOs), Oceana and Turtle Island Restoration Network (TIRN), in which they evaluated bycatch acceptability in set nets for all gillnet gear combined, in contrast to the subset of halibut sets analyzed by Department. The MRC co-chairs noticed discrepancies between the NGO and Department approaches, reporting and conclusions, and asked questions to help clarify differences in the differing analyses, and sources of divergent data and findings.

Following public discussion, MRC made four requests of the Department.

1. Look more closely at discrepancies between the NGO bycatch data and the Department data, including in relation to marine mammal and leatherback sea turtle entanglement.
2. Create a more comprehensive list of species that are retained and sold as incidental catch, including:
    (a) the percentage of fish that are caught and marketed, and
    (b) the percentage of species caught and discarded.

3. Clarify the bycatch percentage relative to pounds and number of individuals, to help reconcile the differences between the percentages reported by the NGOs and fishermen.
4. Provide a written report of the Department's evaluation of 12 top bycatch species that were summarized in the presentation, and return to today's MRC meeting with sufficient information to support a recommended determination regarding acceptability of bycatch types and amounts, to allow the process to advance to Step 4 (*addressing unacceptable bycatch types and amounts*) in the bycatch evaluation framework.

MRC also asked that Commission staff, the Department, and the two NGOs work together to reconcile differences in data and interpretations, where possible, to further advance discussions today.

Update

Since March, Commission and Department staff have strived to meet the MRC requests.

Commission, Department, and NGO Meetings

From April to July 2023, staff from the Commission, the Department, Oceana, and TIRN invested significant time through several meetings, covering multiple hours, to discuss and seek a shared understanding of bycatch within the California halibut set gillnet fishery and an analysis on the set gillnet fishery in general. Oceana and TIRN shared their raw data and methodology for several components of their report, including a description of how they extrapolated the combined California halibut and white seabass observer data to obtain fleetwide estimates. The Department summarized its raw observer data to share overall catch and bycatch rates of California halibut-only set gill nets. Each entity independently followed up with NMFS staff, researchers, and the literature to vet conclusions or interpretations or to clarify inconsistencies or uncertainty.

Commission staff completed an in-depth analysis of the NGO report (formally released in April), which included replicating analyses, evaluating assumptions, and reviewing key conclusions. Commission staff verbally shared with the NGOs where it disputed their conclusions due to inconsistencies with what the cited literature stated, flagged areas where there appeared to be erroneous information, and offered potential recommendations that would allow for a more conducive dialogue.

Overall, there was a collective exploration of respective findings and conclusions and, although there remain disagreements in interpretations, the discussions helped to expose limitations with the various sources of data, highlighted areas of concern related to particular species, and facilitated a deeper understanding of the potential impacts of the fishery. In addition, the dialogue identified areas where it may be possible to move forward with potential management measures; although the potential measures have not yet been formally vetted with fishermen – a crucial step in the overall process – staff have discussed potential management measures that could improve understanding of the impacts of this fishery through increased data collection and monitoring, and options intended to reduce bycatch impacts.

Discussions and Opportunities with Fishermen

Several fishermen in the set gillnet fishery who attended the last two MRC meetings reached out to Commission and Department staff to share their knowledge and expertise of the fishery. They are interested in helping shape future management measures and are offering new ideas to explore. In addition, they invited the MRC co-chairs, and Commission and Department staff to join them on the water to observe fishery operations first-hand. To date, staff from the Department has joined one set gillnet fishing trip, while the MRC co-chairs and Commission staff are scheduling potential dates.

Today's Meeting

The Department prepared a bycatch evaluation report that summarizes the information presented in March (Exhibit 2). The report summarizes the methods and results of the California halibut bycatch evaluations in Step 1 (species type and amount of catch) and Step 2 (distinguish target, incidental and bycatch species), as well as the outcomes of completing Step 3 (determine acceptable types and amounts of bycatch) bycatch inquiries from the master plan for 12 species (spreadsheet copies in report appendix). The report offers movement toward considering management measures under Step 4, to help fill significant data gaps that limit information about the actual impacts of gill nets used in the California halibut fishery, and explores others to minimize bycatch types and amounts found to be unacceptable.

In addition, the Department has shared a table with six years of cumulative observed catch data from the NMFS California Set Gill Net Observer Program filtered for California halibut-targeted sets (447 sets of 1,258 observed sets) (Exhibit 3). The data are in the same format as the summary table of unfiltered set gill net observed catch, prepared by Oceana and shared with the Commission in June, derived from the publicly available observed catch data for all set gill net (1,258 sets) for the same years. Together, these tables assist in differentiating between observed catch data attributable to the California halibut set gillnet fishery specifically.

The Department report acknowledges that "…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" (from Exhibit 2, page 23).

Staff believes that the Department's analyses of the top bycatch species types and amounts as requested by MRC support responding to provide a solid foundation for addressing bycatch in the California halibut fishery through potential management measures, as well as to set additional goals for enhanced understanding of sustainability in the fishery. MRC may wish to clarify what knowledge gaps remain, and identify areas of uncertainty to pursue (e.g., further partitioning incidental catch species to identify those to be managed by target species standards and those to be managed under bycatch management standards, defining what constitutes bycatch "types" and "amounts" for purposes of bycatch acceptability evaluations, etc.).

The Department's presentation for today's meeting (Exhibit 4) will highlight species that are caught and landed in the fishery, species that are caught and discarded in the fishery, and potential management measures for MRC and the Commission to consider if they support advancing to Step 4 without additional analyses.

Significant Public Comments

The Commission received nine comment letters related to bycatch with California set gillnet fisheries. General themes of the comments are summarized below; see Exhibit 5 for all comment letters combined.

Comments about the Department's California Halibut Bycatch Report

1. Oceana and TIRN express appreciation for the amount of work Department and Commission staff and MRC have dedicated to addressing the concerns arising from California set gill nets, including understanding data complexities, listening to stakeholder concerns, and undertaking California's first bycatch acceptability determination. However, they critique several aspects of the Department's recent bycatch evaluation report for California halibut set gill net (in Exhibit 2), expressing concern that it deviates from the MLMA standards and falls short on appropriate and precautionary management actions to reduce unacceptable bycatch. They also recommend three alternatives for potential comprehensive management pathways, which include specific management actions such as full observer coverage, hard bycatch caps, reduced soak time, and temporary or long-term phase-out of permits (see comment letters 3 and 8 in Exhibit 5).

Comments Regarding Bycatch Concerns in Set Gillnet Fisheries (All Targets)

2. Oceana completed a white paper with analysis on bycatch within the set gill net fishery (all targets) using publicly available federal observer data. The report investigates soak time, catch composition, discard mortality, and post-release mortality, and suggests bycatch mitigation measures as options to reduce overall bycatch and discard mortality. In addition, for incidentally caught and retained species, it highlights those species most commonly retained as 'secondary targets' and evaluates which target species have or lack management measures to ensure sustainability. The analysis includes appendices of observer data and extrapolates total estimates of catch, discard, and discard mortality for all observed species across 15 years combined. See comment letter 3 in Exhibit 5.
3. An academic research scientist expresses concern over take with set gill net of two protected species: giant sea bass – a species he actively studies – and juvenile white sharks. He underscores the importance of having management plans and stock assessments that can inform catch limits and sustainable harvests (comment letter 1 in Exhibit 5). An individual also expressed concern over set gill net impacts on highly impaired giant sea bass in Santa Barbara, is concerned that recent observer coverage has been minimal, and would like to see a transition away from this gear type (comment letter 2).
4. A joint letter from 5 California senators and 14 assembly members expresses concern about the types and rates of bycatch in California's set gillnet gear fishery, and urges the Commission and Department to follow the approach and criteria laid out in the MLMA

regarding determining acceptable bycatch. They acknowledge the management measures taken thus far in the fishery but believe further management measures are needed to protect California's biodiversity (comment letter 6).

5. Four comments letters coalesce around similar key points, such as the historical and global threat of set gill nets to regional population levels; the effects of set gill nets on the health and biodiversity of southern California's unique ecosystem; the high discard rate and discard mortality recorded by federal observers; and a request to the Commission to formally determine that the types and amounts of bycatch in set gill nets are unacceptable. One commenter is specifically concerned about the threat to pinnipeds, cetaceans, and elasmobranchs (comment letter 5), while another expresses that ecosystem-based fisheries management should take a precautionary approach (comment letter 4). Two commenters contrast set gill net gear with the lower bycatch rate of California halibut caught with hook and line gear (comment letters 7 and 9).

Recommendation

Commission staff: Initiate discussions about potential management measures that may improve set gill net data collection and fill data gaps, and aid in reducing impacts of bycatch types and/or amounts that the Commission finds to be potentially unacceptable in the California halibut fishery. Request that the Department continue exploring possible management options with fishery participants and stakeholders, and provide an update for discussion at the November 2023 MRC meeting.

Department: Discuss potential improvements to data collection and fill information gaps, and support Department to continue stakeholder discussions and prioritize management actions.

Exhibits

1. Staff summary from November 17, 2022 MRC meeting, Agenda Item 5 (for background purposes only)
2. Department bycatch evaluation report, dated June 2023
3. NMFS observed catch in the set gill net sets targeting California halibut, 2007-2017
4. Department presentation on its evaluation of bycatch in the California halibut set gill net fishery, received July 7, 2023
5. Compilation of comment letters received between June 20 and July 7, 2023

Committee Direction/Recommendation

The Marine Resources Committee recommends that the Commission support the Department exploring potential management measures with fishery participants and stakeholders to improve set gill net data collection, fill information gaps, and aid in reducing unacceptable bycatch impacts in the California halibut set gillnet fishery; and schedule the topic for discussion at the November 2023 MRC meeting.

COMMITTEE STAFF SUMMARY FOR NOVEMBER 17, 2022 MRC
For background purposes only

5. ASSESSING AND ADDRESSING BYCATCH IN CALIFORNIA FISHERIES

Today's Item **Information ☐** **Action ☒**

(A) ***Overview of process for evaluating and addressing fishery bycatch***
Review the four-step process for limiting bycatch to acceptable types and amounts as outlined in the 2018 Marine Life Management Act (MLMA) master plan for fisheries.

(B) ***Evaluating bycatch in the California halibut fishery***
Receive Department update on analysis of bycatch data for the California halibut fishery to support fishery management review.

(C) ***Determining acceptable bycatch types and amounts***
Discuss potential approaches to completing inquiries for determining what bycatch is "acceptable" within a specific fishery and develop potential committee recommendation.

Summary of Previous/Future Actions

• FGC referred California halibut management review to MRC	Aug 19-20, 2020; Webinar/Teleconference
• DFW update on California halibut stock assessment and management review	Mar 16, 2021; MRC, Webinar/Teleconference
• DFW update; MRC recommendation to schedule bycatch review discussion	Nov 9, 2021; MRC, Webinar/Teleconference
• FGC referred bycatch review to MRC	Dec 15-16, 2021; Webinar/Teleconference
• FGC received update on bycatch evaluation for California halibut management review	Mar 24, 2022; MRC, Webinar/Teleconference
• DFW written update on bycatch evaluation for California halibut	Jul 14, 2022; MRC, Santa Rosa
• **Today's update and discussion on bycatch evaluation for halibut; potential MRC recommendation**	**Nov 17, 2022; MRC, San Diego**

Background

The California halibut fishery is a multi-sector commercial and recreational fishery managed under FGC authority. In 2019, as part of the fisheries prioritization process required by the Marine Life Management Act (MLMA) and outlined in *2018 Master Plan for Fisheries, A Guide for Implementation of the Marine Life Management Act*, California halibut was prioritized for management review. In Aug 2020, DFW recommended that it initiate the management review process for California halibut; FGC concurred and referred the topic to MRC.

One key driver in halibut's high priority ranking included potential risks to bycatch species (including sub-legal-sized halibut) in commercial trawl and set gillnet fisheries. Bycatch, as defined by MLMA for state-managed fisheries, means "…*fish or other marine life that are taken in a fishery but are not the target of the fishery. Bycatch includes discards*" (California Fish and Game Code Section 90.5). MLMA requires that DFW manage every sport and commercial

marine fishery in a way that *limits bycatch to acceptable types and amounts* (Fish and Game Code Section 7056(d)), and specifies information, analysis, and management measures required to accomplish this for each fishery (Fish and Game Code Section 7058).

The master plan established a bycatch evaluation framework in Chapter 6 ("Ecosystem-based objectives") as guidance for achieving the requirements of Section 7058. The framework is detailed in a section titled "Limiting bycatch to acceptable types and amounts" (Exhibit 1). The section draws largely from the work of a group of diverse stakeholders, called the Bycatch Working Group, convened by FGC in 2015 to help inform review of bycatch management. The framework in the master plan is, in part, designed to help determine what constitutes "acceptable types and amounts" of bycatch for each fishery evaluated.

The California halibut fishery management review presents the first opportunity to utilize the master plan's bycatch evaluation framework. In Dec 2021, FGC requested that MRC pursue the halibut bycatch evaluation as a separate work plan topic from the related fishery management review that the bycatch evaluation will inform, to ensure robust public engagement through this first evaluation process. In Mar 2022, DFW presented MRC with its approach to evaluating halibut fishery bycatch and, in Jul 2022, DFW provided a written update about its continued efforts and hurdles it is facing in analyzing halibut bycatch from the available data.

Today's meeting is an opportunity to focus on the master plan guidance and discuss options for how to complete the steps in the process.

(A) ***Overview of process for evaluating and addressing fishery bycatch***

FGC staff will recap the four-step process laid out in the master plan framework to identify bycatch and consider its impacts (Exhibit 1):

Step 1 – Collect information on the amount and type of catch

Step 2 – Distinguish target, incidental, and bycatch species

Step 3 – Determine "acceptable" types and amounts of bycatch

Step 4 – Address unacceptable bycatch

Note that today's meeting is focused on steps 1-3.

(B) ***Evaluating bycatch in the California halibut fishery (steps 1 and 2)***

Consistent with MRC discussion in Jul 2022, DFW has provided the recently-completed bycatch assessment report for the trawl and set gillnet California halibut fisheries that DFW developed in collaboration with an academic partner, which authored the final report (Exhibit 2). DFW believes that the report accomplishes the goals of steps 1 and 2 and is adequate to support the Step 3 analysis. DFW will present an overview of the complex assessment, methods and results—to help build a common understanding of the foundational data that can support the Step 3 evaluation of bycatch acceptability—and potential next steps for MRC consideration (Exhibit 3).

(C) ***Determining acceptable bycatch types and amounts (Step 3)***

The master plan specifies that DFW will determine if the amount and type of bycatch is unacceptable for a particular fishery using four criteria mandated in MLMA (Fish and Game Code Section 7058):

1. Legality of take of bycatch species
2. Degree of threat to the sustainability of the bycatch species
3. Impacts on fisheries that target the bycatch species
4. Ecosystem impacts

The master plan bycatch evaluation framework (Exhibit 1) lays out a detailed series of inquiries and recommended actions for each criterion under Step 3 that would be applied to each species of bycatch. The inquiries provide a structural basis for managers to consistently assess each criterion to determine what is "acceptable" bycatch in the fishery and to articulate the findings. However, given the number of bycatch species and the detailed inquiries that would need to be applied to each, it is necessary to prioritize which species to include in the Step 3 assessment. It is possible that selecting a handful of representative species for the assessment would be sufficient, as the benefit of proposed management actions will likely have benefits across multiple species.

Today's meeting provides an opportunity to explore how DFW might accomplish the bycatch inquiries for California halibut in a manner that is transparent, inclusive and timely. This discussion will inform MRC's direction or potential recommendation regarding an approach.

Significant Public Comments

A joint comment from two environmental non-governmental organizations emphasizes the importance of FGC's commitment to minimize fishery bycatch, with an initial focus on California halibut trawl and gill net gears, consistent with DFW's ecological risk assessment and prioritization. The organizations have conducted their own bycatch assessments of trawl and set gillnet gear in California using federal observer data and request a collaborative approach to implementing the bycatch inquiry. They also request that MRC provide direction on what additional analyses are needed and to outline the public process and timeline MRC will follow to make a recommendation to FGC (Exhibit 4).

Recommendation

FGC staff: (1) Recommend FGC support DFW moving forward with Step 3 of the bycatch evaluation to determine bycatch acceptability, using the bycatch analysis report DFW provided today (Exhibit 2) and a DFW-led workgroup of key communicators representing various interests to provide a forum for discussing responses to the Step 3 inquiries prior to bringing recommendations to MRC. (2) Recommend using MRC as a forum for broader discussion and, ultimately, MRC recommendation to FGC on DFW's findings. (3) Provide guidance on selection of bycatch species to begin Step 3.

COMMITTEE STAFF SUMMARY FOR NOVEMBER 17, 2022 MRC
For background purposes only

DFW: Move forward with Step 3 of the framework in the master plan analysis based on the information contained in the steps 1 and 2 bycatch analysis report (Exhibit 2), and provide guidance on options for public engagement in determining bycatch acceptability.

Exhibits

1. Chapter 6 – "Ecosystem-based objectives: Limiting bycatch to acceptable types and amounts", extracted from *2018 Master Plan for Fisheries, A Guide to Implementation of the Marine Life Management Act*, dated June 2018
2. Report by Christopher M. Frees, DFW contractor: *Assessment of associated landed species and bycatch discards in the California halibut gill net and trawl fisheries*, received Nov 4, 2022
3. DFW presentation
4. Letter from Geoff Shester, Oceana, and Scott Webb, Turtle Island Restoration Network, received Nov 3, 2022

Committee Direction/Recommendation

The Marine Resources Committee recommends that the Commission (1) support the Department moving forward with evaluation of bycatch acceptability based on the analysis report submitted by the Department at the committee's November 2022 meeting; and (2) request that the Department pursue the following approach for completing the inquiries within the Step 3 evaluation framework and engaging stakeholders in the process: _____
_____.

Evaluating Bycatch in the California Halibut Set Gill Net Fishery

California halibut, *Paralichthys californicus*.

(Photo Credit: Marine Applied Research Exploration, CDFW)

California Department of Fish and Wildlife
Marine Region

June 2023

Citation: California Department of Fish and Wildlife. 2023. Evaluating Bycatch in the California Halibut Set Gill Net Fishery.

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

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.

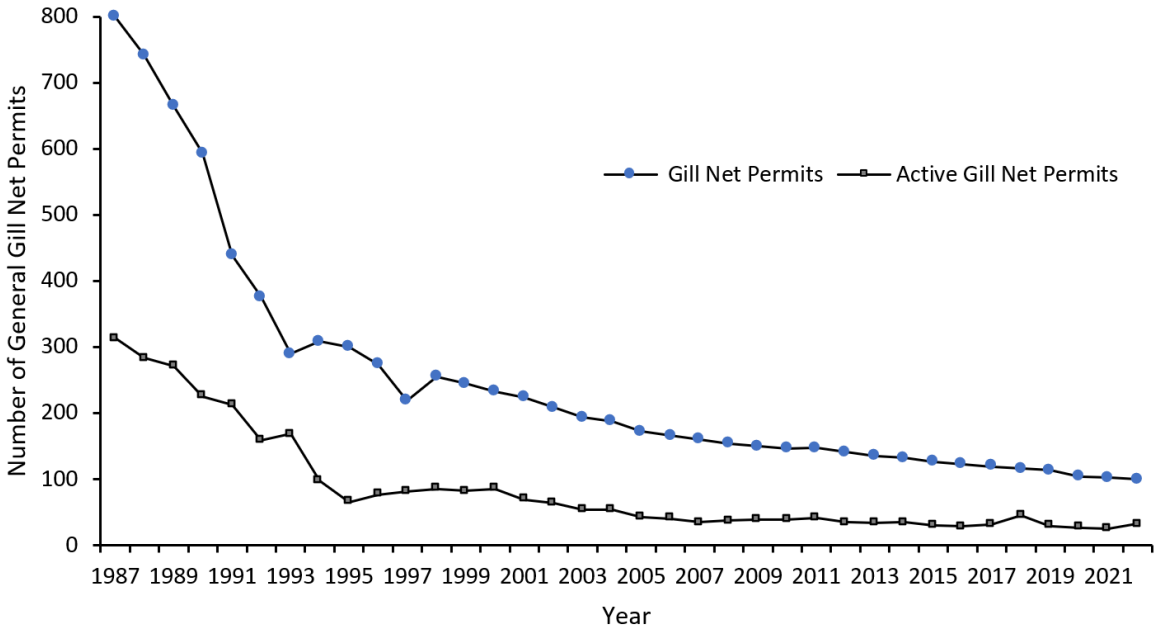

Figure 1 Number of general set gill net permits purchased compared to active halibut set gill net permits, from 1987-2022.

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.)

NMFS California Set Gill Net Observer Program Observed Catch, filtered for California halibut 8.5-inch mesh

(447 sets in 2007, 2010, 2011, 2012, 2013, and 2017)

Species	Total Caught*	Number Kept*	Number Discarded*	Number Returned Dead*	Number Returned Alive*	Number Returned Unknown*	Observed Discard Mortality Rate	Rate of Catch in Observed Sets
Mackerel, Pacific	1863	206	1657	1654	3	0	99.8%	21.9%
Halibut, California	775	727	48	28	20	0	58.3%	59.1%
Crab, Rock	749	179	570	437	131	2	76.7%	37.6%
Crab, Spider	558	151	407	250	147	10	61.4%	37.8%
Crab, Pointer	397	16	381	321	60	0	84.3%	18.1%
Skate, California	349	51	298	30	268	0	10.1%	21.7%
Ray, Bat	321	83	238	61	173	4	25.6%	26.0%
Shark, Pacific Angel	257	103	154	18	136	0	11.7%	30.0%
Skate, Longnose	218	65	153	22	126	5	14.4%	16.6%
Whelk	182	72	110	0	110	0	0.0%	5.4%
Crab, Red Rock	160	1	159	148	8	3	93.1%	8.5%
Sea Star	142	0	142	0	141	1	0.0%	10.1%
Ratfish, Spotted	118	0	118	103	15	0	87.3%	7.6%
Shark, Swell	112	9	103	4	98	1	3.9%	9.8%
Guitarfish, Shovelnose	65	49	16	0	16	0	0.0%	7.6%
Skate, Big	63	3	60	0	60	0	0.0%	4.3%
Shark, Brown Smoothhound	62	0	62	25	37	0	40.3%	4.5%
Shark, Leopard	61	27	34	13	20	1	38.2%	10.1%
Crab, Yellow Rock	60	2	58	31	25	2	53.4%	5.4%
Crab, Unidentified	59	0	59	56	3	0	94.9%	2.2%
Shark, Soupfin	52	19	33	20	13	0	60.6%	7.4%
Shark, Spiny Dogfish	47	2	45	10	35	0	22.2%	7.4%
Tunicates, Pelagic	45	0	45	20	0	25	44.4%	1.6%
Scorpionfish, California	41	11	30	2	28	0	6.7%	3.8%
Thornback	41	1	40	3	37	0	7.5%	2.0%
Seabass, White	39	22	17	17	0	0	100.0%	7.2%
Barracuda, California	37	25	12	11	1	0	91.7%	4.7%
Sea Cucumber	36	0	36	5	24	7	13.9%	4.0%
Sea Lion, California	34	0	34	34	0	0	100.0%	5.6%

Species	Total Caught*	Number Kept*	Number Discarded*	Number Returned Dead*	Number Returned Alive*	Number Returned Unknown*	Observed Discard Mortality Rate	Rate of Catch in Observed Sets
Crustacean, Unidentified	34	6	28	20	8	0	71.4%	0.9%
Shark, Common Thresher	22	19	3	0	3	0	0.0%	3.4%
Butterfish, Pacific	22	12	10	7	3	0	70.0%	2.5%
Sardine, Pacific	20	0	20	20	0	0	100.0%	2.2%
Lobster, California Spiny	19	0	19	0	19	0	0.0%	2.9%
Bass, Barred Sand	18	0	18	7	11	0	38.9%	3.4%
Hake, Pacific	18	0	18	18	0	0	100.0%	1.8%
Invertebrate, Unidentified	18	9	9	8	1	0	88.9%	1.1%
Sculpin, Cabezon	17	0	17	2	15	0	11.8%	2.7%
Lingcod	17	0	17	11	6	0	64.7%	2.0%
Squid, Jumbo	17	0	17	13	0	4	76.5%	0.7%
Shark, Horn	14	3	11	1	10	0	9.1%	2.7%
Crab, California King	13	10	3	0	3	0	0.0%	1.6%
Rockfish, Bocaccio	12	0	12	5	7	0	41.7%	0.9%
Whitefish, Ocean	12	0	12	2	10	0	16.7%	0.2%
Octopus, Unidentified	11	1	10	0	10	0	0.0%	1.6%
Sole, Fantail	9	1	8	3	5	0	37.5%	1.8%
Rockfish, Vermillion	9	0	9	7	2	0	77.8%	0.9%
Stingray, Round	9	0	9	1	8	0	11.1%	0.5%
Bass, Giant Sea	8	8	0	0	0	0	0.0%	1.8%
Shark, Gray Smoothhound	8	5	3	2	1	0	66.7%	1.3%
Sheephead, California	7	2	5	2	3	0	40.0%	0.9%
Crab, Dungeness	6	0	6	5	1	0	83.3%	1.1%
Ray, California Butterfly	6	0	6	1	5	0	16.7%	0.9%
Shad, American	6	4	2	2	0	0	100.0%	0.9%
Sanddab, Longfin	6	0	6	6	0	0	100.0%	0.5%
Flatfish, Unidentified	5	2	3	0	3	0	0.0%	1.1%
Rockfish, Copper	5	0	5	2	2	1	40.0%	1.1%
Sole, English	5	0	5	1	4	0	20.0%	0.9%
Flounder, Starry	5	5	0	0	0	0	0.0%	0.7%
Sanddab, Pacific	5	0	5	2	3	0	40.0%	0.7%
Bonito, Pacific	5	5	0	0	0	0	0.0%	0.5%

Species	Total Caught*	Number Kept*	Number Discarded*	Number Returned Dead*	Number Returned Alive*	Number Returned Unknown*	Observed Discard Mortality Rate	Rate of Catch in Observed Sets
Skate, Starry	5	0	5	1	3	1	20.0%	0.5%
Cormorant, Brandt's	4	0	4	4	0	0	100.0%	0.9%
Ray, Pacific Electric	4	0	4	1	3	0	25.0%	0.9%
Seal, Harbor	4	0	4	4	0	0	100.0%	0.9%
Fish, Unidentified	4	0	4	4	0	0	100.0%	0.7%
Lizardfish, California	4	2	2	2	0	0	100.0%	0.7%
Sea Urchin	4	2	2	1	1	0	50.0%	0.7%
Snail, Unidentified	4	0	4	0	4	0	0.0%	0.7%
Yellowtail	4	2	2	2	0	0	100.0%	0.7%
Croaker, White	4	0	4	3	1	0	75.0%	0.5%
Skate, Unidentified	4	0	4	1	2	1	25.0%	0.5%
Turbot, Curlfin	4	0	4	3	1	0	75.0%	0.5%
Shark, Sevengill	3	0	3	3	0	0	100.0%	0.7%
Sole, Sand	3	1	2	1	1	0	50.0%	0.7%
Anchovy, Northern	3	0	3	3	0	0	100.0%	0.5%
Turbot, Diamond	3	0	3	0	3	0	0.0%	0.2%
Gull, Unidentified	2	0	2	2	0	0	100.0%	0.5%
Mackerel, Jack	2	0	2	1	0	1	50.0%	0.5%
Rockfish, Canary	2	0	2	1	0	1	50.0%	0.5%
Crab, Opossum	2	0	2	2	0	0	100.0%	0.2%
Shark, Unidentified	2	0	2	0	2	0	0.0%	0.2%
Surfperch, Pink	2	0	2	2	0	0	100.0%	0.2%
Bass, Kelp	1	0	1	0	1	0	0.0%	0.2%
Cormorant, Double-crested	1	0	1	1	0	0	100.0%	0.2%
Crab, Marble	1	0	1	0	1	0	0.0%	0.2%
Crab, Northern Kelp	1	0	1	1	0	0	100.0%	0.2%
Croaker, Spotfin	1	0	1	1	0	0	100.0%	0.2%
Dolphin, Short-Beaked Common	1	0	1	1	0	0	100.0%	0.2%
Midshipman, Specklefin	1	0	1	0	1	0	0.0%	0.2%
Octopus, Tuberculate Pelagic	1	0	1	0	1	0	0.0%	0.2%
Pinniped, Unidentified	1	0	1	1	0	0	100.0%	0.2%
Rockfish, Brown	1	0	1	0	1	0	0.0%	0.2%

Species	Total Caught*	Number Kept*	Number Discarded*	Number Returned Dead*	Number Returned Alive*	Number Returned Unknown*	Observed Discard Mortality Rate	Rate of Catch in Observed Sets
Rockfish, Rosy	1	0	1	0	0	1	0.0%	0.2%
Rockfish, Unidentified	1	0	1	0	1	0	0.0%	0.2%
Salmon, Other Identified	1	0	1	1	0	0	100.0%	0.2%
Sandab, Unidentified	1	0	1	0	1	0	0.0%	0.2%
Sculpin, Unidentified	1	0	1	0	1	0	0.0%	0.2%
Searobin, Lumptail	1	0	1	0	1	0	0.0%	0.2%
Shark, Sixgill	1	0	1	0	1	0	0.0%	0.2%
Sole, Bigmouth	1	0	1	0	1	0	0.0%	0.2%
Sole, Rex	1	0	1	1	0	0	100.0%	0.2%
Sole, Rock	1	1	0	0	0	0	0.0%	0.2%
Sole, Slender	1	0	1	0	1	0	0.0%	0.2%
Turbot Hornyhead	1	0	1	0	1	0	0.0%	0.2%
Turbot, C-O	1	0	1	1	0	0	100.0%	0.2%

* NMFS Observer Program captures information in total numbers (counts).

Evaluation of Bycatch in the California Halibut Gill Net Fishery

20 July 2023

Presented to:

Marine Resources Committee

Presented by:

Kirsten Ramey
Environmental Program Manager
Marine Region

Outline

- Bycatch Evaluation Report
- Understanding bycatch
  - Caught and landed
  - Caught and discarded
- Stakeholder discussions
- Recommendations
- Next Steps

Bycatch Evaluation Report

- Four-step process:
  1. Collection of information on types and amounts of bycatch
  2. Distinguishing target, incidental, and bycatch species
  3. Determining “acceptable” types and amounts of bycatch
  4. Addressing unacceptable bycatch

Understanding Bycatch in the Gill Net Fishery

- Caught and landed
  - Landing receipts (pounds)
  - Gill net logbooks (pounds or counts)
- Caught and landed or discarded
  - Federal Observer data (counts)


Photo Credit: CDFW

Species Caught and Landed – Landing Receipts

Species	Total Pounds	Proportion of landings		Species	Total Pounds	Proportion of landings
California halibut	655,866	47.88		Unspecified rock crab	769	0.06
White seabass	184,387	13.46		Sevengill shark	736	0.05
Pacific angel shark	127,413	9.30		Lingcod	586	0.04
Thresher shark	88,836	6.49		Swell shark	574	0.04
Bat ray	75,968	5.55		Stingray	539	0.04
Soupfin shark	58,886	4.30		Crab claws	528	0.04
California barracuda	24,876	1.82		California sheephead	511	0.04
Leopard shark	22,259	1.63		Unspecified sole	489	0.04
Giant sea bass	19,941	1.46		Ocean whitefish	482	0.04
Yellowtail	16,358	1.19		Pacific sanddab	449	0.03
Spider crab	15,813	1.15		Brown smoothhound shark	424	0.03
California skate	12,716	0.93		Vermilion rockfish	280	0.02
Yellow rock crab	11,613	0.85		Sanddab	226	0.02
Shortfin mako shark	11,200	0.82		Bigeye thresher shark	225	0.02
Fantail sole	7,662	0.56		Sixgill shark	204	0.01
Pacific bonito	6,466	0.47		Red rock crab	203	0.01
Spiny dogfish shark	4,736	0.35		Petrale sole	198	0.01
Pacific mackerel	3,272	0.24		Rock sole	141	0.01
Dover sole	2,369	0.17		Cabezon	128	0.01
Unspecified skate	2,248	0.16		Pelagic thresher shark	76	0.01
Spider/sheep crab claws	2,240	0.16		California lizardfish	63	0.00
Great white shark	1,644	0.12		Brown rock crab	48	0.00
Unspecified mackerel	1,381	0.10		California scorpionfish	46	0.00
Swordfish	1,286	0.09		Staghorn sculpin	23	0.00
Shovelnose guitarfish	1,252	0.09		Pacific sardine	20	0.00
Longnose skate	1,064	0.08				

Species Caught and Landed or Discarded – Observer Data

Species	Total Caught	Number Kept	Number Discarded	Number Returned Dead	Number Returned Alive	Number Returned Unknown	Observed Discard Mortality Rate	Rate of Catch in Observed Sets
Mackerel, Pacific	1863	206	1657	1654	3	0	99.8%	21.9%
Halibut, California	775	727	48	28	20	0	58.3%	59.1%
Crab, Rock	749	179	570	437	131	2	76.7%	37.6%
Crab, Spider	558	151	407	250	147	10	61.4%	37.8%
Crab, Pointer	397	16	381	321	60	0	84.3%	18.1%
Skate, California	349	51	298	30	268	0	10.1%	21.7%
Ray, Bat	321	83	238	61	173	4	25.6%	26.0%
Shark, Pacific Angel	257	103	154	18	136	0	11.7%	30.0%
Skate, Longnose	218	65	153	22	126	5	14.4%	16.6%
Whelk	182	72	110	0	110	0	0.0%	5.4%
Crab, Red Rock	160	1	159	148	8	3	93.1%	8.5%
Sea Star	142	0	142	0	141	1	0.0%	10.1%
Ratfish, Spotted	118	0	118	103	15	0	87.3%	7.6%
Shark, Swell	112	9	103	4	98	1	3.9%	9.8%
Guitarfish, Shovelnose	65	49	16	0	16	0	0.0%	7.6%
Skate, Big	63	3	60	0	60	0	0.0%	4.3%
Shark, Brown Smoothhound	62	0	62	25	37	0	40.3%	4.5%
Shark, Leopard	61	27	34	13	20	1	38.2%	10.1%
Crab, Yellow Rock	60	2	58	31	25	2	53.4%	5.4%
Crab, Unidentified	59	0	59	56	3	0	94.9%	2.2%
Shark, Soupfin	52	19	33	20	13	0	60.6%	7.4%
Shark, Spiny Dogfish	47	2	45	10	35	0	22.2%	7.4%
Tunicates, Pelagic	45	0	45	20	0	25	44.4%	1.6%
Scorpionfish, California	41	11	30	2	28	0	6.7%	3.8%
Thornback	41	1	40	3	37	0	7.5%	2.0%
Seabass, White	39	22	17	17	0	0	100.0%	7.2%
Barracuda, California	37	25	12	11	1	0	91.7%	4.7%

Species Caught and Landed or Discarded – Observer Data (cont'd 1)

Species	Total Caught	Number Kept	Number Discarded	Number Returned Dead	Number Returned Alive	Number Returned Unknown	Observed Discard Mortality Rate	Rate of Catch in Observed Sets
Sea Cucumber	36	0	36	5	24	7	13.9%	4.0%
Sea Lion, California	34	0	34	34	0	0	100.0%	5.6%
Crustacean, Unidentified	34	6	28	20	8	0	71.4%	0.9%
Shark, Common Thresher	22	19	3	0	3	0	0.0%	3.4%
Butterfish, Pacific	22	12	10	7	3	0	70.0%	2.5%
Sardine, Pacific	20	0	20	20	0	0	100.0%	2.2%
Lobster, California Spiny	19	0	19	0	19	0	0.0%	2.9%
Bass, Barred Sand	18	0	18	7	11	0	38.9%	3.4%
Hake, Pacific	18	0	18	18	0	0	100.0%	1.8%
Invertebrate, Unidentified	18	9	9	8	1	0	88.9%	1.1%
Sculpin, Cabezon	17	0	17	2	15	0	11.8%	2.7%
Lingcod	17	0	17	11	6	0	64.7%	2.0%
Squid, Jumbo	17	0	17	13	0	4	76.5%	0.7%
Shark, Horn	14	3	11	1	10	0	9.1%	2.7%
Crab, California King	13	10	3	0	3	0	0.0%	1.6%
Rockfish, Bocaccio	12	0	12	5	7	0	41.7%	0.9%
Whitefish, Ocean	12	0	12	2	10	0	16.7%	0.2%
Octopus, Unidentified	11	1	10	0	10	0	0.0%	1.6%
Sole, Fantail	9	1	8	3	5	0	37.5%	1.8%
Rockfish, Vermillion	9	0	9	7	2	0	77.8%	0.9%
Stingray, Round	9	0	9	1	8	0	11.1%	0.5%
Bass, Giant Sea	8	8	0	0	0	0	0.0%	1.8%
Shark, Gray Smoothhound	8	5	3	2	1	0	66.7%	1.3%
Sheephead, California	7	2	5	2	3	0	40.0%	0.9%
Crab, Dungeness	6	0	6	5	1	0	83.3%	1.1%
Ray, California Butterfly	6	0	6	1	5	0	16.7%	0.9%
Shad, American	6	4	2	2	0	0	100.0%	0.9%

Species Caught and Landed or Discarded – Observer Data (cont'd 2)

Species	Total Caught	Number Kept	Number Discarded	Number Returned Dead	Number Returned Alive	Number Returned Unknown	Observed Discard Mortality Rate	Rate of Catch in Observed Sets
Sanddab, Longfin	6	0	6	6	0	0	100.0%	0.5%
Flatfish, Unidentified	5	2	3	0	3	0	0.0%	1.1%
Rockfish, Copper	5	0	5	2	2	1	40.0%	1.1%
Sole, English	5	0	5	1	4	0	20.0%	0.9%
Flounder, Starry	5	5	0	0	0	0	0.0%	0.7%
Sanddab, Pacific	5	0	5	2	3	0	40.0%	0.7%
Bonito, Pacific	5	5	0	0	0	0	0.0%	0.5%
Skate, Starry	5	0	5	1	3	1	20.0%	0.5%
Cormorant, Brandt's	4	0	4	4	0	0	100.0%	0.9%
Ray, Pacific Electric	4	0	4	1	3	0	25.0%	0.9%
Seal, Harbor	4	0	4	4	0	0	100.0%	0.9%
Fish, Unidentified	4	0	4	4	0	0	100.0%	0.7%
Lizardfish, California	4	2	2	2	0	0	100.0%	0.7%
Sea Urchin	4	2	2	1	1	0	50.0%	0.7%
Snail, Unidentified	4	0	4	0	4	0	0.0%	0.7%
Yellowtail	4	2	2	2	0	0	100.0%	0.7%
Croaker, White	4	0	4	3	1	0	75.0%	0.5%
Skate, Unidentified	4	0	4	1	2	1	25.0%	0.5%
Turbot, Curlfin	4	0	4	3	1	0	75.0%	0.5%
Shark, Sevengill	3	0	3	3	0	0	100.0%	0.7%
Sole, Sand	3	1	2	1	1	0	50.0%	0.7%
Anchovy, Northern	3	0	3	3	0	0	100.0%	0.5%
Turbot, Diamond	3	0	3	0	3	0	0.0%	0.2%
Gull, Unidentified	2	0	2	2	0	0	100.0%	0.5%
Mackerel, Jack	2	0	2	1	0	1	50.0%	0.5%
Rockfish, Canary	2	0	2	1	0	1	50.0%	0.5%
Crab, Opossum	2	0	2	2	0	0	100.0%	0.2%

Species Caught and Landed or Discarded – Observer Data (cont'd 3)

Species	Total Caught	Number Kept	Number Discarded	Number Returned Dead	Number Returned Alive	Number Returned Unknown	Observed Discard Mortality Rate	Rate of Catch in Observed Sets
Shark, Unidentified	2	0	2	0	2	0	0.0%	0.2%
Surfperch, Pink	2	0	2	2	0	0	100.0%	0.2%
Bass, Kelp	1	0	1	0	1	0	0.0%	0.2%
Cormorant, Double-crested	1	0	1	1	0	0	100.0%	0.2%
Crab, Marble	1	0	1	0	1	0	0.0%	0.2%
Crab, Northern Kelp	1	0	1	1	0	0	100.0%	0.2%
Croaker, Spotfin	1	0	1	1	0	0	100.0%	0.2%
Dolphin, Short-Beaked Common	1	0	1	1	0	0	100.0%	0.2%
Midshipman, Specklefin	1	0	1	0	1	0	0.0%	0.2%
Octopus, Tuberculate Pelagic	1	0	1	0	1	0	0.0%	0.2%
Pinniped, Unidentified	1	0	1	1	0	0	100.0%	0.2%
Rockfish, Brown	1	0	1	0	1	0	0.0%	0.2%
Rockfish, Rosy	1	0	1	0	0	1	0.0%	0.2%
Rockfish, Unidentified	1	0	1	0	1	0	0.0%	0.2%
Salmon, Other Identified	1	0	1	1	0	0	100.0%	0.2%
Sandab, Unidentified	1	0	1	0	1	0	0.0%	0.2%
Sculpin, Unidentified	1	0	1	0	1	0	0.0%	0.2%
Searobin, Lumptail	1	0	1	0	1	0	0.0%	0.2%
Shark, Sixgill	1	0	1	0	1	0	0.0%	0.2%
Sole, Bigmouth	1	0	1	0	1	0	0.0%	0.2%
Sole, Rex	1	0	1	1	0	0	100.0%	0.2%
Sole, Rock	1	1	0	0	0	0	0.0%	0.2%
Sole, Slender	1	0	1	0	1	0	0.0%	0.2%
Turbot Hornyhead	1	0	1	0	1	0	0.0%	0.2%
Turbot, C-O	1	0	1	1	0	0	100.0%	0.2%

Stakeholder Discussions

- Key industry representatives
- NOAA Fisheries and USFWS staff
- Gear manufacturers
- Oceana and Turtle Island Network

Recommendations

- Potential improvements to data collection and fill information gaps
  - Gear marking
  - Observer coverage
  - Non-transferable permits
  - Electronic technology
  - Soak times
  - Spatial/temporal closures
  - Gear loss reporting

Next Steps

- Open discussion today
- Prioritize potential recommendations
- Continue stakeholder discussions

Thank You

mlmafisheriesmgmt@wildlife.ca.gov

MLMA Master Plan - Bycatch Criteria

CA Marine Species Portal - California Halibut

California Fish and Game Commission
Marine Resources Committee
Comment Letters Received for the July 20, 2023 Meeting Related to Agenda Item 3, Evaluation of Bycatch in the California Halibut Set Gillnet Fishery in Support of the Fishery Management Review

July 18, 2023

Comment #	Commenter Name, Title and Affiliation (if any), Date Received
1.	Email from Dr. Douglas McCauley, Professor, Department of Ecology, Evolution, and Marine Biology, UC Santa Barbara, with letter and associated publication on economic value of giant sea bass, received June 20, 2023
2.	Email from Ciara Ristig, received June 24, 2023
3.	Emailed letter from Dr. Geoff Shester, California Campaign Director and Senior Scientist, and Caitlynn Birch, Pacific Marine Scientist, Oceana, with attached report, received July 7, 2023
4.	Email from Caitlynn Birch, Pacific Marine Scientist, Oceana, transmitting joint letter from 19 scientists, including 12 academic scientists, 1 educator, 3 Ph.D. candidates, and 3 environmental NGO scientists, received July 7, 2023
5.	Email from Ashley Blacow Draeger, Pacific Policy and Communications Manager, Oceana, transmitting a letter signed by 1,427 California residents, received July 7, 2023
6.	Email from Travis York, Executive Assistant, Office of Senator Ben Allen, transmitting joint legislative letter signed by 5 senators and 14 assembly members, received July 7, 2023
7.	Email from Jack Lighton, Chief Executive Officer, SeaLegacy, transmitting letter from Cristina Mittermeier, Co-Founder, SeaLegacy, received July 7, 2023
8.	Letter from Scott Webb, Advocacy & Policy Director, Turtle Island Restoration Network and Chance Cutrano, Director of Programs, Resource Renewal Institute, received July 7, 2023
9.	Letter from 17 non-governmental organizations and school environmental clubs, received July 7, 2023

From: Douglas McCauley <[redacted]>
Sent: Monday, June 26, 2023 4:31 PM
To: FGC <FGC@fgc.ca.gov>
Cc: Ashcraft, Susan@FGC <[redacted]>
Subject: Comment letter on bycatch in CA set gillnet fishery

To whom it may concern,

May I please respectfully request that the attached letter and associated publication on the economic value of giant sea bass be included in the briefing materials for the July MRC meeting under agenda item 3: Evaluation of bycatch in the California halibut set gillnet fishery in support of the fishery management review.

Thank you,

Dr. Douglas McCauley

Mr. Eric Sklar, President
California Fish and Game Commission
P.O. Box 944209
Sacramento, CA 94244-2090

20 June 2023

RE: Bycatch in California set gillnet fishery

Dear President Sklar and Members of the Commission,

I am Professor of Marine Biology at UC Santa Barbara and have studied coastal ecology in California and other Pacific ecosystems for several decades. I wish to share some thoughts in my personal capacity regarding our state's set gillnet fishery.

Effectively assessing and minimizing bycatch is a fundamental cornerstone of all sustainable fishery management and I am grateful to CDFW for their efforts to manage such impacts in many of our state's fisheries. The unintended catch and discarding of marine life is something that I and many colleagues in the research community consider a top negative impact of fisheries, and can also have major economic ramifications on California's coastal communities.

I wanted to take this opportunity to specifically underscore the importance for CDFW of identifying the management needs and minimizing bycatch in the California set gillnet fishery. Non-selective gear types such as set gillnets that are fished in diverse ecosystems, such as the Southern California Bight, have the potential to significantly impact the diversity, function, and resilience of the ecosystem if not properly and thoroughly managed.

While many marine species are affected as bycatch in this gill net fishery, I wanted to call attention to two affected species which have been the subject of study in my lab: the IUCN listed critically endangered giant seabass and the vulnerable white shark. Our group has studied the population dynamics, behavior, and movement of these two species.

Giant seabass, a species that has been prohibited for commercial and recreational take for decades due to severe population decline driven by overfishing, is both discarded and legally landed in this fishery. The average weight landed of giant seabass each year is over 5,500 pounds. Our team has estimated that value of giant seabass alive to the California dive ecotourism industry is more than $2M annually (publication attached) – a value that is diminished significant by this bycatch. It remains that bycatch in the set gill net fishery is the single largest threat to giant seabass populations and has been preventing them from recovering from historic overfishing at a natural and healthy pace.

Over 20 different shark, skate and ray species are both frequently landed and discarded in this fishery, many with no known population assessment or management plan. Globally, approximately a third of such species are now considered headed towards extinction. White

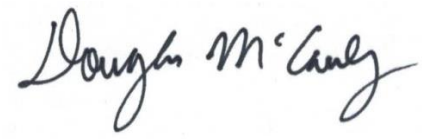
sharks, in particular, have been negatively impacted. Many of the regions in Southern California where the set gill net fishery operates are vital nursery habitat for juvenile white sharks and set gill nets are a top source of mortality for these age classes. And as is the case with giant seabass, white sharks are consequently on a much slower pathway to recovery as a result of this bycatch. This impeded recovery is ecologically consequential as both giant seabass and white sharks are understudied species that by all indications play important roles in California's marine ecosystems.

It is important that the species landed in the set gillnet fishery, including target and incidentally caught species, have management plans and stock assessments that inform catch limits and sustainable harvest. Species with existing federal or state management plans should have the catch associated with this fishery accounted for in the total allowable take, which is not currently occurring for the small number of species managed under fisher management plans.

Ecosystem-based management requires a holistic approach for managing fisheries and marine resources by taking into account the entire ecosystem of the species being managed. The goal of ecosystem-based management is to maintain ecosystems in a healthy, productive, and resilient condition so they can provide the services humans want and need. The Commission should consider this first fishery to be addressed through the scaled management process of the Marine Life Management Act as an opportunity to drive the state towards sustainable, ecosystem based management that both prioritize long-term resilience of fish stocks and healthy marine ecosystems.

Thank you and your colleagues for your past attention issues and leadership when it comes to considering the long-term vibrancy and sustainability of California's fisheries and biodiversity resources and thank you for your attention to this important matter.

Sincerely,



Dr. Douglas McCauley

Department of Ecology, Evolution, Marine Biology

UC Santa Barbara

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WILEY

RESEARCH ARTICLE

The worth of giants: The consumptive and non-consumptive use value of the giant sea bass (*Stereolepis gigas*)

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Abstract

1. Although the economic value of wildlife historically has been attributed to its consumptive use, the global growth of ecotourism has expanded wildlife valuation to include non-consumptive uses. In California, the critically endangered giant sea bass (*Stereolepis gigas*) is paradoxically both a flagship species in the recreational dive industry and regularly sold in California's commercial fisheries when incidentally caught. The differences in the economic value of *S. gigas* to these two key stakeholders – commercial fishers and recreational scuba divers – were explored.
2. The average annual landing value of *S. gigas* was US$12 600, this value was determined using California commercial fishery landing receipt data. In contrast the estimated average value of *S. gigas* to recreational divers was US$2.3 million per year. The non-consumptive use value was calculated by approximating the annual number of recreational charter boat divers and determining divers' willingness-to-pay for a *S. gigas* sighting.
3. Stated landings volumes of *S. gigas* appear to represent a minimum annual extraction of 2% to 19% of the *S. gigas* population. Using self-reported fishery catch location data, *S. gigas* bycatch hotspots were identified and used to inform suggestions for strategic spatial and temporal closures.
4. Overall, these results highlight the value of giant sea bass beyond fisheries and underscore the importance of incorporating non-consumptive values when developing harvest policies and marine management plans.

KEYWORDS

contingent valuation, species management, wildlife economic value, wildlife-viewing

1 | INTRODUCTION

Historically, the primary recognized value of wildlife, from elephants to seahorses, has been the value that can be obtained through their harvest and direct use. Economic forces, such as overexploitation and coastal and land development, are the primary drivers of declining wildlife populations and species extinctions (Barnosky et al., 2011; Jackson et al., 2001; Rosser & Mainka, 2002). However, some species may have substantial economic value that extends beyond traditional use for consumption. Explicitly accounting for these alternative values can, in certain cases, provide a more complete view of a species' worth and lead to more informed species management.

The economic value of an ecosystem or a species can be categorized as either use or non-use values. Non-use value is the intrinsic value of a species' or ecosystem's existence regardless of our interaction with it (Pascual et al., 2010). Use values can be split into at least two categories: consumptive use values, where the goods produced by an ecosystem, or the extraction of a species, can be consumed (e.g. fisheries) and non-consumptive use values, where the species or ecosystem is valued for our desire to interact with it (e.g. whale watching) (Pascual et al., 2010). The consumptive use value of wildlife, particularly marine species, is readily apparent. Globally, wild fish capture in 2014 was 93.40 million tonnes (FAO, 2016) and in the United States alone, the value of the 4.30 million tonnes of wild fish landed that year amounted to US$5.45 billion (National Marine Fisheries Service, 2015). Thus, interest in preserving this valuable resource exerts considerable influence on national and international policy. However, there is increasing awareness of the non-consumptive use values of wildlife to the public and the importance of using these values to better inform management of certain species (Lew, 2015).

Along the coast of California and Baja California, giant sea bass (*Stereolepis gigas*) hold a unique ecological position in the local kelp forest system as the largest teleost carnivore, weighing up to 253 kg (Eschmeyer & Herald, 1983). This slow-growing fish was once a valuable species in California markets. Its commercial fishery began in the late 1800s and peaked in 1932 at over 100 tonnes (Domeier, 2001). Increases in fishing pressure led to depletion in *S. gigas* numbers and the crash of the fishery in the 1970s (Domeier, 2001). The fishery collapse led to a suspension of the *S. gigas* fishery in 1981. However, regulations still allowed the take of two incidentally caught fish per trip in the commercial set gillnet and trammel net fisheries, which principally target white sea bass (*Atractoscion nobilis*) and California halibut (*Paralichthys californicus*) (Domeier, 2001; National Marine Fisheries Service, 2013). In 1988, given the continuing population decline of *S. gigas*, this regulation was amended to allow the take of only one incidentally caught fish per trip (California Fish and Game Code Section 8380, 2016).

Evaluations of the population status of *S. gigas* in 1996 led to it being classified as critically endangered by the IUCN Red List (Cornish, 2004). *Stereolepis gigas* has never, however, been listed as a threatened or endangered species by the State of California (CADFW, 2017). Recent work suggests that southern California *S. gigas* populations may be recovering, likely due to the banning of inshore gillnets in 1994; however, their numbers remain far below pre-exploitation levels (House, Clark, & Allen, 2016; Pondella & Allen, 2008).

Charismatic fauna are incidentally caught in many fisheries, and are either retained owing to some commercial value (e.g. elasmobranchs) or discarded (e.g. seabirds, dolphins) (Croll et al., 2016; Lewison et al., 2014; Lewison, Crowder, Read, & Freeman, 2004). In California, incidentally caught *S. gigas* are legally sold at the landing port and are regularly found in local fish markets, giving this source of bycatch monetary value to fishers. In addition to their value in fisheries, *S. gigas* are also a highly regarded underwater attraction to California's sizeable recreational scuba diving industry (Diving Equipment and Marketing Association (DEMA), 2014). Their bold and curious nature often results in close encounters with divers. These encounters, in conjunction with the their large size, makes them a charismatic and desirable underwater sighting (Figure 1).

FIGURE 1 Giant sea bass (*Stereolepis gigas*) and scuba diver in southern California kelp forest. Photo: J. McClain

Comparisons of the consumptive and non-consumptive values of a subset of other marine megafauna (e.g. reef sharks and manta rays) have provided useful information to species management approaches that maximize value to local communities and stakeholders (Anderson, Adam, Kitchen-Wheeler, & Stevens, 2011; Clua, Buray, Legendre, Mourier, & Planes, 2011; Vianna, Meekan, Pannell, Marsh, & Meeuwig, 2010). Such values have not yet been estimated or compared for *S. gigas*.

Contingent valuation methods provide one mechanism for assigning dollar values to values that do not typically involve market purchases or cash flow by asking respondents for a willingness-to-pay for a specific good (Mitchell & Carson, 1989). Values derived from contingent valuations provide a hypothetical dollar value for a good, not a present or future profit. However, these valuations can provide important information regarding stakeholder preference for the conservation or maintenance of a good or resource (Sanchirico, Lew, Haynie, Kling, & Layton, 2013).

Reducing incidental catch of charismatic species, many of which are valued for recreational viewing (e.g. sharks and cetaceans), is a pressing issue in conservation and fisheries management (Lewison et al., 2004, 2014). Identifying incidental catch hotspots using catch data can inform management strategies for reducing non-target species mortality and preserving recreationally valued species (Cambiè, Sánchez-Carnero, Mingozzi, Muiño, & Freire, 2013; Grantham, Petersen, & Possingham, 2008; Lewison, Soykan, & Franklin, 2009).

Using landing receipt data and contingent valuation surveys, this study provides the first comparison of the consumptive value and estimated non-consumptive use value of the critically endangered *S. gigas* to two important stakeholders, commercial fishers and recreational scuba divers. The results indicate that *S. gigas* are highly valued as a non-consumptive resource, demonstrate the importance of incorporating multiple values when evaluating outcomes of marine management strategies and policy, and provide suggestions for potential management of this important species by using catch location data derived from the landing receipts.

2 | METHODS

2.1 | Value to fishers

California Department of Fish and Wildlife (CADFW) landing receipt data from all commercial fishing trips between 2006 and 2015 were used to determine contemporary average price per whole fish, average size (kg) of fish caught, annual gross value of *S. gigas* to the entire California commercial fleet, and the number of *S. gigas* landed per year. Given that the CADFW regulation during this period only permits fishers to land one incidentally caught *S. gigas* per fishing trip, each landing receipt in the data was assumed to refer to a single landed fish. CADFW landing receipts were also used to determine the average annual value of the target fishery (*A. nobilis* and *P. californicus*) between 2006 and 2015.

Although *S. gigas* are occasionally hooked by recreational fishers, in California recreational take of this species is prohibited. For this reason, an estimate of the consumptive value of *S. gigas* to recreational fishers was not included in the study.

2.2 | Value to divers

2.2.1 | California divers

An estimate of the annual number of charter boat diver days (divers diving from charter dive boats, as opposed to shore diving) who dive south of Point Conception, a core area within the geographic range of *S. gigas* (Domeier, 2001), was generated to calculate the annual non-consumptive value of *S. gigas* to the California scuba diving community. Although California also has a significant private vessel and shore-diving scuba diver demographic, only the value to charter boat divers was considered as this can be most meaningfully and accurately assayed.

A list of all known California dive vessel operators who operate south of Point Conception was compiled using vessel registry lists and key local informant surveys (n = 40) and each boat's maximum stated dive passenger capacity was noted using publicly available vessel listings. All 40 dive vessel operators were contacted, but only a subset (n = 17) were responsive to a survey aimed at obtaining information on their average number of trips per year (t) and average passenger capacity (c) on said trips. Total number of diver days (d) per year for each vessel was calculated as

$$d = t\ (c \times s) \tag{1}$$

where s refers to maximum stated dive passenger capacity for each vessel, and summed these values to provide total number of diver days per year for all surveyed vessels (D_s) (see Table 1 for summary of variables).

Estimates of number of diver days per year for all vessel operators that were not surveyed ('non-surveyed vessels') were generated using values acquired from surveyed vessels. Because the subset of the surveyed vessels was not randomly selected, but rather a result of vessel operator responsiveness, post-stratification sample weighting was used to adjust for missing data from non-surveyed vessels. Post-stratification sample weighting is commonly used to account for non-responses and missing data and reduces potential bias by incomplete representative sampling of a population (Brick & Kalton, 1996; Little & Rubin, 1989) and has previously been used in data regarding surveyed vessels (Lew, Himes-Cornell, & Lee, 2015). Two weighting factors were used in the weighting adjustment: home port location and vessel passenger capacity (see Supplementary material, Appendix A, Table A.1 for details). Once weighted, surveyed vessels were then binned into three groups based on their stated maximum passenger capacities (≤ 6 divers, 7–29 divers, 30–40 divers). Basic economies of scale dictate that per-passenger operational cost should decrease as passenger capacity increases, thus average operating capacity likely differs between groups. Weighted average number of trips per year and average capacity per trip were then averaged across vessels for each of the vessel groups to obtain t_a (weighted average number of trips per year) and c_a (weighted average capacity per trip) for each of the three vessel groups (Table A.2). Using the following formulae:

$$d_a = t_a\ (c_a \times s) \tag{2}$$

$$D_e = d_a \times n \tag{3}$$

where s is maximum stated capacity for each vessel and n is the number of vessels in each vessel group, d_a (average number of diver days per vessel per year) and D_e (estimated number of diver days in a year) were calculated for each vessel group. The sum of the D_s and the D_e values for the three vessel groups provides D_t, the total estimated number of charter boat diver days in southern California per year (Table 1). A supplementary conservative estimate of total diver days per year, D_c, was also generated using the lowest responses for average capacity and average trips per year (Table A.3). A non-weighted estimate was also generated for comparison (Table A.3).

2.2.2 | Non-consumptive use value survey

The target demographic for the non-consumptive value survey was scuba divers who dive off the California coast. After conducting a preliminary survey of 28 scuba divers during observational ride-alongs on dive trips and southern California regional scuba club meetings in 2014, divers were surveyed from August to December 2015. Mailed surveys and face-to-face interviews are the more commonly used surveying techniques; however, recent studies have not found a significant difference in data quality and estimates from contingent valuation surveys between these and on-line surveys (Fleming & Bowden, 2009; Lindhjem & Navrud, 2011; Marta-Pedroso, Freitas, & Domingos, 2007). Thus, an on-line valuation survey was designed in order to maximize reach to scuba divers. The on-line survey was distributed to southern California scuba diving club e-mail lists and posted on regional scuba diving on-line magazine websites.

Respondents were asked to provide general information regarding their scuba diving habits and experience in and outside of California, as

TABLE 1 Variables and definitions for diver day calculations

Variable	Definition
c	Average capacity per trip for each surveyed vessel. Value is expressed as a percentage of maximum stated capacity.
c_a	Average capacity per trip averaged across all vessels for each vessel group. Value is expressed as a percentage of maximum stated capacity.
d	Dive days per year for each surveyed vessel.
d_a	Average diver days per year averaged across all vessels for each vessel group.
n	Number of vessels in each vessel group.
t	Average number of trips per year for each surveyed vessel.
t_a	Average number of trips per year averaged across all vessels for each vessel group.
s	Maximum stated passenger capacity. Value is expressed as a whole number.
D_s	Estimated total number of diver days per year for all surveyed vessels.
D_e	Conservative estimate of total number of diver days per year for all surveyed vessels.

well as their typical diving-related expenses including gear rental, travel distance, and dive boat pricing. In addition, respondents were asked to answer questions pertaining specifically to *S. gigas* including their knowledge of the fish, how they rank the importance of seeing *S. gigas* on a dive (scale of 1 to 5) (see Appendix C, Supplementary material for explanation of rating scale), and past experiences with *S. gigas* on dives. Finally, respondents were asked a series of valuation questions regarding *S. gigas* (see Appendix C for full survey).

The contingent valuation method (CVM), a commonly used method developed for determining the public's stated willingness to pay for non-consumptive public goods (Mitchell & Carson, 1989) and a reliable method for estimating the value of a non-consumptive resource (Carson, Flores, & Meade, 2001), was used to estimate the economic value of *S. gigas* to recreational divers. The payment card (PC) approach to elicit willingness-to-pay (WTP) from respondents (Mitchell & Carson, 1981) was adopted in this study's survey design. With this method, the question is presented in multiple-choice format and respondents are asked to select a WTP value from a set of available predetermined value options. Various valuation methodologies are available for estimating WTP (Mitchell & Carson, 1981), though the effect of questionnaire format may be insignificant when valuing endangered species (Loomis & White, 1996; Richardson & Loomis, 2009). However, the PC elicitation method has been widely used to elicit WTP with regard to wildlife conservation and preservation of natural attractions (Farr, Stoeckl, & Alam Beg, 2014; Jakobsson & Dragun, 2001; Ressurreição et al., 2012; Reynisdottir, Song, & Agrusa, 2008). This method minimizes starting point bias and reduces non-responses (Mitchell & Carson, 1989), and any biases with regard to 'anchoring effects', where a numerical prompt alters a respondent's stated value, can be circumvented by not truncating values available in the payment card (Rowe, Schulze, & Breffle, 1996). In the survey, respondents were asked how much they would be willing to pay, in addition to what they typically pay for a dive charter, for (1) a *potential* sighting of a giant sea bass, and for (2) a *guaranteed* sighting of a giant sea bass. Although it is impossible to guarantee a natural wildlife encounter, a *guaranteed* sighting was used in the WTP elicitation to investigate the value of a *S. gigas* sighting, not of a hypothetical *S. gigas*-viewing industry. Any surveys that were submitted, but were not entirely completed or had skipped questions regarding WTP, were excluded from the analysis.

2.2.3 | WTP statistical analysis

Given high variance in responses, an α-trimmed mean (α =0.05) of the WTP responses for a *S. gigas* sighting, was used. Trimmed means provide a more robust estimate of mean WTP (FAO Economic and Social Development Department, 2000; Mitchell & Carson, 1989). Both conservative and average annual non-consumptive use values of *S. gigas* were calculated by superimposing the WTP distribution from survey responses to D_t, the estimated number of boat divers in a year, and D_c, the conservative estimated number of boat divers in a year. In order to identify the potential for familiarity with *S. gigas* in altering the results, WTP was calculated and non-consumptive use values aggregated for divers who not only dived in California, but also listed California as their primary dive location (Appendix A).

A censored regression (tobit) model was used to determine predictors of diver WTP for a *guaranteed* sighting (*censReg* function, package censReg, R) using the dependent variables of diver experience, behaviour, and knowledge (Table A.4). Censored regressions are preferred when using payment card WTP data as the commonly used ordinary least squares (OLS) regressions for determining WTP can often result in biased estimates (Cameron & Huppert, 1989). All analyses were computed in R (R Core Team, 2015).

2.3 | Spatial and temporal *S. gigas* catch hotspots

The location and month for when *S. gigas* catch-per-unit-effort (CPUE) was highest along the California coast between 2006 and 2015 was determined using the landing receipt data from commercial set gill and trammel net fisheries. CPUE was calculated using catch as biomass of *S. gigas* landed per month and effort calculated as number of gill and trammel net fishing trips in that month. Self-reported catch location information from landing receipts was used to map out average *S. gigas* CPUE per year during this period, and catch date data were used to determine how average *S. gigas* CPUE varied across the months. The values were mapped onto the 547 reporting blocks (approx. 256 km^2) that overlapped with the main portion of *S. gigas* range using QGIS (QGIS Development Team, 2017). For the 15 reporting blocks and month in which average *S. gigas* CPUE was highest, the monetary value of landings from species harvested in the target fishery (i.e. *A. nobilis* and *P. californicus*) was calculated from CADFW landing receipt data and compared the month's value with the overall annual value of the target fishery. For additional details on spatial and temporal hotspot determination using number of individuals caught, total *S. gigas* biomass landed, and bycatch proportion see Appendix B, Supplementary material.

3 | RESULTS

3.1 | Value to fishers

Results from landing receipts indicate that an average of 97 ± 15 individuals $year^{-1}$ (± std. error) were landed between 2006 and 2015, with a mean landing price per pound of US$2.59 ± 1.31 and mean landing price per individual fish of US$143.99 ± 14.37. Average annual landing value of *S. gigas* between 2006 and 2015 in California was US$12 606 ± 1 443. The average annual landing value of the target fishery for this decade was US$1 272 356 ± 113 130, making the landing value of *S. gigas* 0.99% of the value of the target white sea bass and halibut fishery.

3.2 | Value to divers

3.2.1 | California divers

A list of California dive boat operators known to operate south of Point Conception was compiled and operators were surveyed to obtain information on number of trips per year and average scuba diver capacity per trip for each vessel group (Table A.1). Based on the extrapolations from dive charter boat operator survey data, there are an estimated 55 280 charter boat diver days in southern California

in one year (Table A.3). The more conservative estimate, which relies on using lowest number of trips per year and lowest average capacity from interview data for each vessel size group, yielded a lower bound estimate of 37 503 charter boat diver days in one year (Table A.3).

3.2.2 | Scuba diver profiles

In total, 265 divers were surveyed for this analysis. Of those contacted, 331 divers accessed the on-line survey and 279 of these divers submitted a survey; however, 14 of these 279 were excluded from the analysis due to incompleteness. Almost half of the respondents (49.8%) had been scuba diving for more than 10 years and the majority (84%) stated that one of their main reasons for diving was recreation (Table A.5). A third (33.6%) of the divers had obtained a professional level dive certification (Divemaster or Instructor) and the remainder had recreational diving licences (Table A.5).

Of the 265 divers surveyed, 245 (92%) listed California as one of their most frequented dive locations. With regard to diving frequency in California, the mean number of California dives per diver in the past year was 47.65 ± 5.49 (SE) and median of 25 for all diving (shore and boat), and 18.67 ± 2.68 (median = 7) for diving from charter dive boats. The average amount respondents typically paid for a charter boat dive trip in California was US$90.79 ± 3.69 (median = US$115).

Most (99%) of the divers had previously heard of *S. gigas* and 75% had seen one in the wild. When prompted with an open-ended question asking what they knew about *S. gigas*, 30.9% mentioned the fish was rare, endangered, or overfished; 16.2% mentioned the fish was protected from recreational fishing, and 5.7% stated that *S. gigas* population was recovering. The importance of seeing *S. gigas* on a dive was ranked as 4 and 5, on a scale of 1 to 5 where 1 is 'not important at all' and 5 is 'very very important' by most (61%) of the respondents (Figure 2).

3.2.3 | *Stereolepis gigas* WTP

Of the surveyed divers, 86.8% reported a WTP value to see *S. gigas* that was greater than US$0 per dive (Figure 3). The trimmed mean WTP for a guaranteed sighting of *S. gigas* was US$39 with a median of US$30 per dive. Overlaying the average and conservative estimated diver numbers on the WTP distribution, the non-consumptive use value of *S. gigas* equates to US$2.3 million per year. The conservative estimated value, generated using lower-range diver day numbers from survey data, is US$1.5 million per year.

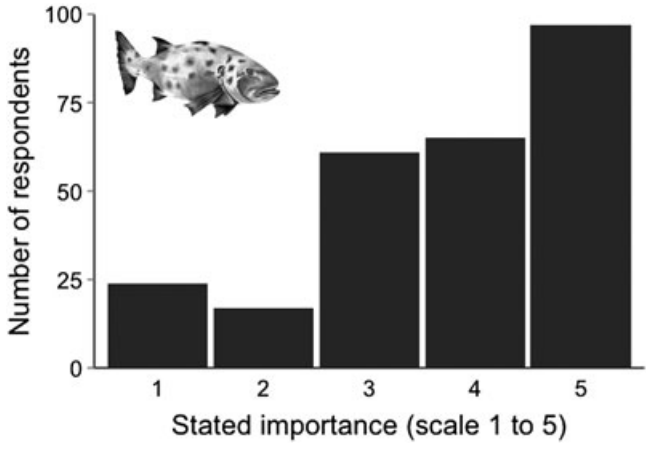

FIGURE 2 Distribution of responses from surveyed divers on the stated importance (on a scale of 1 (low) to 5 (high)) of seeing giant sea bass (*Stereolepis gigas*) while diving

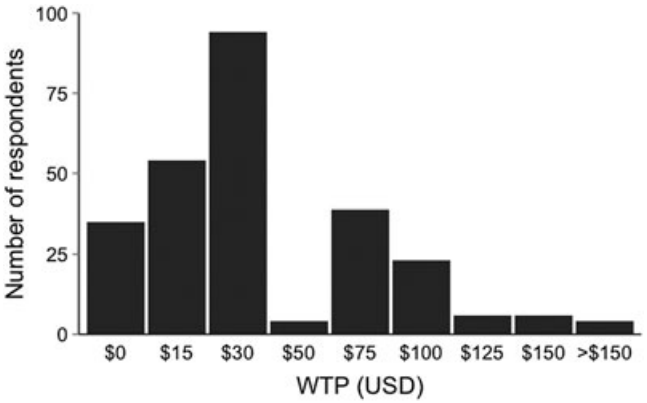

FIGURE 3 Distribution of responses from surveyed divers illustrating their willingness-to-pay (WTP) for a guaranteed sighting of a giant sea bass (*Stereolepis gigas*)

The results from the censored regression suggest only three dependent variables are significant determinants of WTP (Table 2). WTP increased with the maximum amount the respondent would pay for a charter dive and the importance of seeing *S. gigas* on a dive, and decreased for respondents who reported having already seen *S. gigas* underwater (Table 2).

3.3 | Spatial and temporal *S. gigas* catch hotspots

Results from catch location data show that 14 of the 15 blocks with highest *S. gigas* CPUE are south of Point Conception (Figure 4a). Monthly catch data suggest that *S. gigas* CPUE is highest during the month of July (2.23 ± 0.49) (Figure 4b). Eight of the 14 blocks had reported no value attributed to the target fishery between 2006 and 2015 in July. Of the six blocks that did contribute to the target fishery during the month of July between 2006 and 2015, four had an average annual value of US$3 272 (summed across four blocks).

4 | DISCUSSION

This study provides the first economic valuation and comparison of the consumptive and non-consumptive use value of *S. gigas*. The results show that the estimated value of a *S. gigas* sighting to the recreational scuba diving community along the California coast is more than 150 times greater than its ex-vessel value to commercial fishers. These kinds of quantifications of the value of *S. gigas* can and should be meaningfully adopted by management practitioners considering the future of this critically endangered species.

Results from the landing receipt data indicate that the average annual value of incidentally caught *S. gigas* to commercial fishers represents less than 1% of the value of the target white sea bass and halibut fishery. Available independent CADFW reviews on selected California fisheries report the average annual ex-vessel value of the white sea bass fishery (not accounting for the value of landed halibut) to be US

TABLE 2 Results from censored regression for determinants of WTP for a guaranteed *S. gigas* sighting

Dependent variable	Estimated coefficient	Std. error	*t*-value	*P*-value
Dive years	0.193	0.214	0.903	0.366
Dives 5 years	0.009	0.011	0.816	0.415
Certification	−0.359	2.566	−0.14	0.889
Gear	−8.147	8.582	−0.949	0.343
CA diver	−18.576	9.802	−1.895	0.058
CA dives/year	−0.047	0.031	−1.541	0.123
Avg. USD/dive charter	0.01	0.048	0.212	0.832
Max USD/dive charter	0.183	0.061	2.973	0.003*
Heard of GSB	1.154	24.64	0.047	0.962
Seen GSB	−14.875	6.441	−2.309	0.021*
Considered endangered	−1.657	11.458	−0.145	0.885
Considered protected	−4.454	12.329	−0.361	0.718
Considered large	12.775	10.579	1.207	0.227
Knowledge score	2.608	9.223	0.283	0.778
GSB importance	11.885	2.012	5.907	< 0.001*

Estimated regression coefficients for the payment card responses represent marginal impacts on the dollar amount of respondents' willingness-to-pay (WTP).

*Denotes significance.

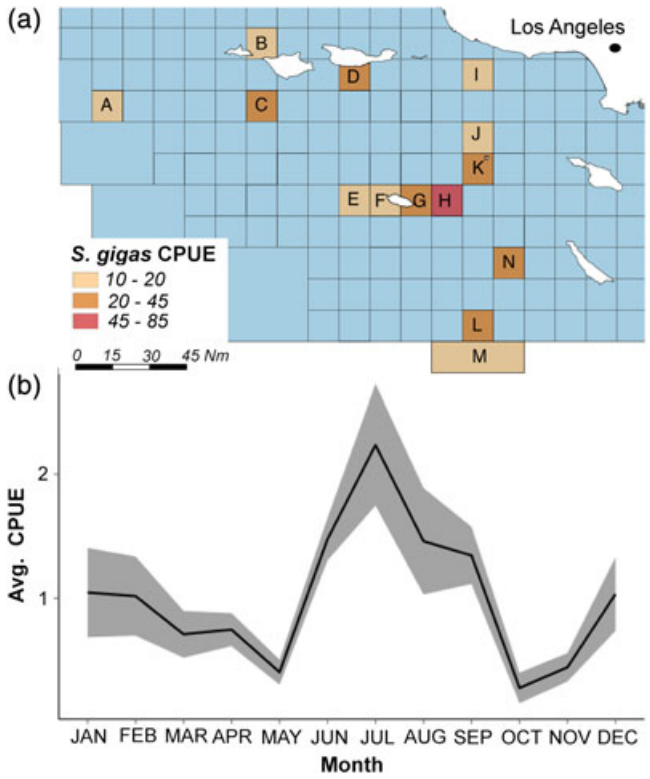

FIGURE 4 (a) 14 blocks in California with the highest average giant sea bass (*Stereolepis gigas*) catch-per-unit-effort (CPUE) for 2006–2015. (B) Average *S. gigas* monthly CPUE (2006–2015). Shaded area denotes inter-annual standard error. CPUE is calculated as sum of kg landed per month/number of commercial fishing trips per month

$1.4 million for the years 2008, 2010 and 2012 (CADFG, 2009, 2011, 2013), slightly higher than the calculated average annual value of the target fishery (US$1.2 million). In addition, the CADFW reports do not take into account the additional 7 years factored into this study's calculation and only report values for landed white sea bass, not halibut (the other target in the gillnet fishery). The incorporation of these two values would likely elevate the ex-vessel value of the target fishery. Thus, it seems likely that this study's calculation of the target fishery value to commercial fishers is an underestimate, which only underscores the marginal value that *S. gigas* landings yield relative to the target fishery.

In contrast, the estimated non-consumptive value of *S. gigas* reveals the high value of this species to the recreational scuba diver industry in California. This calculated value allows for more equitable and direct comparison between different industries and use types. However, it is important to note that the calculated annual non-consumptive value of US$2.3 million does not indicate a potential direct cash flow to the economy, but rather provides a quantitative representation of recreational divers' value of *S. gigas* and represents the potential for a marginal economic value to the diving industry. In addition, although the survey was distributed via Southern California regional lists, this did not exclude all California divers. Thus, the calculation must be considered as including all California divers, not just divers in Southern California. Given the geographical range of *S. gigas*, WTP for a *S. gigas* sighting may be different if the study had been limited to Southern California divers that may encounter them more frequently. Divers who dive from shore or from privately owned vessels, which would likely increase the total non-consumptive use value, were also not included in the calculation. Finally, as the scuba diver survey was distributed electronically through various diving-related e-mail lists, it is important to note that this convenience sample might not be representative of the entire California population. For example, it may bias against divers who maintain less of an electronic presence.

The mean WTP for *S. gigas* of US$42.81 is similar to values previously calculated for other marine megafauna. In the Great Barrier Reef, mean WTP for a guaranteed sighting of elasmobranchs ranged between US$33.82 and US$42.20, between US$42.56 and US

$44.72 for cetaceans, and between US$24.76 and US$32.64 for sea turtles (Farr et al., 2014). In a study conducted across the United States, scuba divers were willing to pay US$29.63 for an increased likelihood of a sea turtle sighting on a dive and US$35.36 for an increased likelihood of a shark sighting (White, 2008). Aggregated across the United States scuba diver population, the annual non-consumptive values of sea turtles and sharks were US$177.8 million and US$212.2 million, respectively (White, 2008). These aggregated annual values are considerably larger than the annual non-consumptive value estimated for *S. gigas* (US$2.3 million); however, this study's values are substantial considering they apply only to the California diver population.

This work indicates the potential for an industry centred on *S. gigas* viewing with profits that might outweigh the current economic value of *S. gigas* as a commercial bycatch product. Shifts from consuming to viewing megafauna have proven to be lucrative to communities of stakeholders both in terrestrial and marine ecosystems. A single elephant has been estimated to draw in US$1.6 million to travel companies, airlines and local economies as a long-lived wildlife-viewing attraction, but only US$21 000 as a single-use consumptive resource in the ivory trade (The David Sheldrick Wildlife Trust, 2014). For the diving industry, reef sharks in Palau were found to be more than 17 times more valuable alive as a non-consumptive use resource over their lifetime than dead as a consumptive resource (Vianna et al., 2010). Globally, the estimated annual economic value of manta ray tourism is US$140 million, which exceeds the annual value of the manta ray gill raker trade of US$5 million by an order of magnitude (O'Malley, Lee-Brooks, & Medd, 2013).

As expected, WTP increased with the maximum amount a respondent would pay for a charter dive, which can be interpreted as the expected positive relationship between income or spending levels and WTP (Carson et al., 2001). As might be predicted, WTP also increased with the stated importance of seeing *S. gigas* on a dive. WTP was also found to decrease for respondents who reported having already seen *S. gigas* underwater. Previous studies show that people tend to value rarity both in economic markets (Lynn, 1991) and wildlife viewing (Booth, Gaston, Evans, & Armsworth, 2011); therefore it is not surprising to see this same effect manifest itself in this system. This may indicate that the total value of *S. gigas* could decrease over time if its population increases. Alternatively, a larger population size of *S. gigas* and increased probability of sighting *S. gigas* could recruit new eco-tourist clientele within and beyond local markets. Other lucrative wildlife encounter industries successfully recruit customers from the global market (Gallagher & Hammerschlag, 2011; O'Connor, Campbell, Knowles, & Cortez, 2009; Topelko & Dearden, 2005).

Based on the calculations in this study, the average annual number of landed incidentally caught *S. gigas* could represent somewhere between 2% and 19% of current local population estimates for this species (Chabot, Hawk, & Allen, 2015). Given uncertainties surrounding the fate of any *S. gigas* that may be lethally captured in gill and trammel nets above the allowable take of one fish per day, it may be prudent to view these as minimum estimates of population-level harvest. Although recent evidence suggests that *S. gigas* populations appear to be increasing (House et al., 2016; Pondella & Allen, 2008), it is unclear if the populations can sustain this present level of bycatch-facilitated harvest. Given the high value documented here of *S. gigas* to recreational divers, more careful investigations of the implications of this catch on *S. gigas* population dynamics is perhaps merited.

Fishing and wildlife viewing are not mutually exclusive activities, and the results from the spatial and temporal hotspot data provide potential suggestions that could serve as seasonal *S. gigas* sanctuaries that may have minimal or no financial impact on target fisheries. For example, Block 'H' (Figure 4a) generates no revenue to gill and trammel net fishers for target species in the month of July, when *S. gigas* CPUE is highest. In addition, blocks B, F, E and M have a July aggregate landing value that is worth only 0.2% of the target fishery's average annual value. Although it could be potentially unnecessary to restrict fishing in entire blocks for one month, areas such as these could provide potential opportunities to strategically identify smaller-scale reefs or patches with particularly high *S. gigas* densities (e.g. aggregation zones for spawning *S. gigas*) where closures might be tenable.

The economic value surrounding *S. gigas* extends beyond scuba divers and fishers, and there are many additional factors to consider when assessing the total economic value of a species. For example, the study did not take into account operational costs for the commercial fishing or scuba diving charter vessels nor how much the recreational diving industry depends on the viewing of *S. gigas*. It also did not incorporate other factors that certainly affect and elevate consumptive use value such as higher market chain prices. Although CADFW state-compiled landing data represents the best and only source of information on *S. gigas* catch, some variability in quality is known from this type of self-reported data (Sampson, 2011; Walsh, Ito, Kawamoto, & McCracken, 2005). Further research is needed to fully understand the potential economic value of *S. gigas* in southern California to other potential coastal stakeholders beyond the two key constituencies that were engaged (commercial fishers and recreational boat divers).

Economic valuations can be used to better inform decision-makers, managers, and policy analysts regarding additional stakeholders and their value of the species in question (Sanchirico et al., 2013). This work provides an initial estimate of the total economic use of *S. gigas* and opens the door to further work further quantifying precise values to the dive industry and the economy at large. In addition, non-consumptive use values can be included in economic-based management (EBM) strategies and future management models for endangered species like *S. gigas* and in long-term marine ecosystem planning. Such approaches would allow consideration of externalities such as benefits to recreational divers, which would help strategically maximize the value of marine resources to coastal communities.

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the supporting information tab for this article.

How to cite this article: Guerra AS, Madigan DJ, Love MS, McCauley DJ. The worth of giants: The consumptive and non-consumptive use value of the giant sea bass (*Stereolepis gigas*). *Aquatic Conserv: Mar Freshw Ecosyst*. 2017;1–9. https://doi.org/10.1002/aqc.2837

Matthews, Kinsey-Contractor@fgc

From: Ciara Ristig <[redacted]>
Sent: Saturday, June 24, 2023 10:09 PM
To: FGC
Subject: Public Comment- July 20 Meeting- Item 3- Gillnet Fishery Bycatch

California Fish and Game Commission, Marine Resources Committee,

Thank you for your time and service.

I'm writing as a concerned citizen and resident of Santa Barbara County about the set gillnet fishery. As an avid diver and friends to several local spear fishermen, I value California's marine environment and hope that it is protected by unnecessary, harmful and outdated fishing equipment. The existing 37 gill net permits are allowing just that, right off of the coast here in Santa Barbara. Recent observer coverage has been minimal, so it is difficult to know the full extent of damage being done.

I am aware of the large amount of bycatch resulting from these nets, including black seabass. It is concerning and hypocritical that an endangered species, which a tremendous amount of federal and state funding has gone into protecting, it also being caught up in these nets. This is far from the only protected species that is being impacted. I think California's ecosystems deserve better.
I will leave it to the experts to determine the best management solutions, but ask that action be taken to resolve this soon and find a fair solution that removes the gillnets absolutely as soon as possible.

Thank you for your time.

Sincerely,
Ciara Ristig

From: Birch, Caitlynn <cbirch@oceana.org>
Sent: Friday, July 7, 2023 3:45 PM
To: FGC <FGC@fgc.ca.gov>; Ashcraft, Susan@FGC <[redacted]>
Cc: Miller-Henson, Melissa@FGC <[redacted]>
Subject: Public Comment for July MRC Agenda Item 3

Hi Susan,

Please include the attached comment letter plus attachment for inclusion in the MRC binder under **Agenda Item 3: Evaluation of bycatch in the California halibut set gillnet fishery in support of the fishery management review**. Apologies for its extreme lengthiness! Appreciate all your work leading up to the MRC and hope you have a great weekend! Stay cool in Sac next week.

Caitlynn

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July 7, 2023

Mr. Eric Sklar, President
California Fish and Game Commission
P.O. Box, 944209
Sacramento, CA 94244-2090

RE: Marine Resources Committee Agenda Item 3: Set Gillnet Bycatch Evaluation

Dear President Sklar and Members of the Commission,

California recently made strong international commitments to be a leader in biodiversity conservation at the United Nations Biodiversity Conference (COP 15).[1] The Marine Life Management Act (MLMA) was intended to be one of the most progressive, ecosystem-based fishery management laws in existence. This Commission, the California legislature, and California voters have all taken decisive action over recent decades to restrict or end the use of destructive, unselective fishing practices off our coast including gillnets, bottom trawls, and pelagic longlines. All around the world, set gillnets are recognized as harmful to marine ecosystems, biodiversity, and vulnerable species. Most recently, Australia[2] and Belize[3] took action to phase out set gillnets from their waters.

Despite the previous bans and current set of regulations, the multi-species California set gillnet fishery continues to have a wide suite of major bycatch concerns that threaten biodiversity, sustainability, other fisheries, and marine ecosystems throughout Southern California. Although there are uncertainties and data gaps, the best available scientific data indicates that new management measures are warranted to ensure the types and amounts of bycatch are reduced to acceptable levels.

Following the Commission's prioritization process that identified the set gillnet fisheries targeting California halibut, white seabass, and Pacific angel shark as 3 of the top 4 highest priorities of all commercial finfish fisheries based on its Ecological Risk Assessment,[4] we appreciate the Department's work on the bycatch analysis and the attention spent by the Marine Resource Committee (MRC) in reviewing set gillnet bycatch over the last two years. However, we are concerned the Department has submitted to the Commission a fundamentally flawed bycatch analysis that downplays serious bycatch concerns and could set a harmful precedent as the first application of the bycatch inquiry in the MLMA Master Plan for Fisheries. Its approach, criteria, and conclusions directly contradict the requirements and precautionary approach of the MLMA. To remedy this problem, we ask the Commission to use the full suite of data before you -- including available data from the federal government as well as analysis provided by other interested parties -- to craft a robust, comprehensive management package to minimize bycatch to acceptable types and amounts.

This letter 1) outlines our concerns with the CDFW Bycatch Evaluation, 2) presents the case for identifying specific types and amounts of bycatch as unacceptable under MLMA criteria, and 3) proposes three alternative suites of management options for reducing bycatch to acceptable levels as required by the MLMA Section 7085.

[1] CNRA 2022. California takes action to protect biodiversity at U.N. negotiations. https://resources.ca.gov/Newsroom/Page-Content/News-List/California-Action-Protect-Biodiversity-UN
[2] https://www.theguardian.com/environment/2023/jun/05/conservationists-welcome-gillnet-fishing-ban-in-great-barrier-reef-world-heritage-area
[3] https://www.pressoffice.gov.bz/statutory-instrument-signed-into-law-to-ban-gill-nets-from-marine-waters/
[4] https://wildlife.ca.gov/Conservation/Marine/MLMA/Master-Plan/Prioritizing-Management-Efforts/Results-of-Fisheries-Prioritization

1. Concerns with CDFW Bycatch Evaluation

The introduction of the report summarizes the MLMA and its innovative features, including "shift[ing] 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."[5] Given the history of set gillnets in California and this legal framework, the presumption under uncertainty must be that set gillnet bycatch is unacceptable unless evidence demonstrates it is not.

Our overarching concerns with the bycatch report are:

- Requiring proof that bycatch is causing harmful impacts rather than placing the burden on demonstrating sustainability as required by the MLMA
- Broadly concluding there is low to moderate impact that is justified in a detailed appendix primarily composed of opinions rather than data or analysis
- Ignoring and failing to use the best available science
- Omitting critical information needed to assess the amounts of bycatch, such as cumulative discard and discard mortality rates from the federal fishery observer data
- Not estimating total fishing effort, catch and discard amounts based on the available data, in direct conflict with the MLMA which requires information and analysis of the type and amount of bycatch (FGC 7085(a) and (b)
- Ignoring whale entanglements in California set gillnets
- Declaring all bycatch issues "low, moderate, or unknown." and setting an impossible threshold for "high" risk
- Failing to consider or recommend management measures that would meaningfully reduce bycatch, such as limits to soak times, hard caps on bycatch, catch limits, or area closures
- Failing to clearly identify target, incidental, and bycatch species as per Step 2 of the MLMA Master Plan's Bycatch Inquiry
- Disregarding the need to address or manage the retained "incidental catch" of dozens of species that are part of this multi-species fishery
- Failing to assess cumulative impacts of bycatch on marine ecosystems
- Analyzing 12 of the 125 species caught in set gillnets, excluding key vulnerable species such as soupfin (tope) shark, which is a depleted species with high discard mortality that is a candidate for federal Endangered Species Act listing
- Ignoring the component of the fishery targeting white seabass, even though it is managed under the same permit
- Failing to provide data or estimates of post-release mortality for all species evaluated, and failing to recognize that mortality rates from the observer data are the minimum mortality rates for each species evaluated

Specific concerns with the bycatch evaluation report:

- The analysis and conclusion of the report take the opposite of a precautionary approach, repeatedly arguing that there is no proof of threats to sustainability. The report concludes that bycatch risks from this fishery are low to moderate, while having no estimates of total fishing effort or total catch, a small sample of observer data, and population status information for only a handful of the over one hundred species caught in this fishery. Example statements from the report:
    - p. 20: "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."

[5] California Marine Life Management Act. https://wildlife.ca.gov/Conservation/Marine/MLMA

- p. A1-40: "No humpback whale has been documented as bycatch in the halibut set gill net fishery in California."
- p. A1-5: For brown smoothhound sharks, the report concludes there is a "Low… probability of mortality exceeding levels that have been scientifically determined to be necessary for the continued viability of the species" with the rationale that "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." Yet the report also states "There is no status estimate or stock assessment", and the observer data indicates brown smoothhound has the highest number dead discards of all sharks, rays, or skates with discard mortality of 47%. A Productivity Susceptibility Analysis ranked brown smoothhound the second most vulnerable state-managed finfish behind Pacific angel shark (Swasey et al. 2016).[6]
- P. A1-2: The report states there are management measures to ensure sustainability for Pacific angel shark and "The Pacific angel shark is largely protected from fishing pressure. Therefore, it is presumed that the population remains relatively stable in California (ESR)." Yet it also states: "Department PSA completed in 2019 indicated angel shark ranked first in vulnerability among 36 fish and invertebrate species analyzed" and CDFW ranked the set gillnet fishery for Pacific angel shark as the number one priority of all state finfish fisheries in the Ecological Risk Assessment prioritization.[7]

- The analysis and conclusions are not supported by quantitative analysis of available data. Instead, the meat of the report is a series of appendices outlining the opinions of agency staff. Quantitative analysis needs to be included in the report to support the conclusions of low to moderate risk, and any conclusions of low to moderate impact require strong data on catch estimates and stock health. The bycatch evaluation is based on ancillary information and professional opinions, without significant acknowledgment or discussion of potential impacts due to the many unknowns. Step 2 of the bycatch inquiry in the MLMA requires the distinguishing of target and bycatch species. Incidental species under the MLMA must be accounted for and managed as either target species under the sustainability standard outlined in Chapter 5 or as bycatch. The Report does not distinguish between which species will be addressed and managed as target or bycatch species, or any plan for managing target species other than California halibut caught in this fishery. Species that are retained at high rates or landed in high frequency with California halibut should be considered for additional management to ensure sustainable harvest.
- The Humpback whale evaluation (Appendix1I. on page A1-40) concludes that no humpback whales have ever been documented as entangled in this fishery, despite the current Marine Mammal Protection Act listing of this fishery as a Category II fishery driven by the take/serious injury of a humpback whale in 2007. There is ample publicly available data in NMFS reports on whale entanglements on the West Coast, which include an unidentified "gillnet" category. An unknown portion of these records are likely to be the Southern California set gillnet fishery, but this data is not presented or discussed as a potential conservation issue. The report denies that California set gillnets entangle humpback whales, contradicting NMFS conclusion in its Marine Mammal Protection Act Category II listing that the fishery entangles humpback whales. The report completely ignores the federally listed endangered humpback whale Central American Distinct Population Segment that feeds primarily in California and Oregon and contradicts the Department's and NMFS's precautionary whale-safe fisheries policy

[6] Swasey et al. 2016. Productivity and Susceptibility Analysis for Selected California Fisheries. https://www.oceansciencetrust.org/wp-content/uploads/2017/07/CDFW-PSA-Report-on-Select-CA-Fisheries_Final-.pdf
[7] https://wildlife.ca.gov/Conservation/Marine/MLMA/Master-Plan/Prioritizing-Management-Efforts/Results-of-Fisheries-Prioritization

for attributing unidentified entanglements. However, in its draft Conservation Plan for the Dungeness Crab Fishery, CDFW recognizes that the Central American DPS feeds primarily in California and Oregon.[8]

- The report attempts to separate sets targeting halibut vs. white seabass in the federal observer data (the observer program tracks the set gillnet fishery as a single fishery, whereas the report analyzes the data in a halibut-centric way), and fails to provide the total number of observed sets when speaking to number of discarded animals/mortality rates in these halibut-targeting sets. While separating these sets may show minor differences in species compositions of bycatch, ultimately the management required to reduce bycatch in either fishery would have to apply to both the white seabass and halibut fishery, as there is only a general gillnet permit issued for both and the main issue with both fisheries is the high rate of bycatch and mortality. Separating these sets ultimately proved to cause further issues and confusion with the limited data, made it impossible to extrapolate observer data into estimates of total catch for the fleet, and minimized the evaluation of the cumulative impacts of the set gillnet fishery on the marine ecosystem throughout this evaluation process.
- The report does not include an evaluation of cumulative impacts, and omits fundamental data for evaluating bycatch such as the cumulative discard rate and discard mortality for the fishery. The report does not present data on the total number and types of species caught and discarded in the fishery. Cumulative impacts are important to evaluate for the ecosystem-based management approach and sustainability standards of the MLMA.
- The management options recommended in the report have promise, however stronger options that directly reduce bycatch and bycatch mortality per the MLMA are not presented. In the list of 3 options proposed, the only measure that would potentially minimize bycatch is the restriction of transferability of the permits to reduce effort over time, which the report suggests could be a short-term option (3-5 years) or a longer-term option that would eventually sunset the permits over time. The short-term option would ultimately not reduce bycatch. The report is equivocal on the question of whether legislation is necessary to implement this option. In the case with non-selective gear-types such as gillnets, reducing fishing effort may be the simplest avenue towards reducing overall bycatch rate.
- The report sets a nearly impossible and inappropriate bar, as few bycatch concerns would ever warrant a “high” risk rating except for an endangered species with a known decreasing population. Extinction is not the standard for high risk. This is the opposite of precautionary.
- The report incorrectly states “there is an FMP for brown smoothhound” (p. A1-5). No such FMP exists.

2. Identification of Unacceptable Types and Amounts of Bycatch in Set Gillnets

In previous submissions to the Commission, we have identified unacceptable types and amounts of bycatch in the set gillnet fishery based on the four MLMA criteria. Attached to this letter, we provide a detailed analysis of available data to provide supporting evidence.

The following table summarizes the types and amounts of bycatch that are unacceptable in the California set gillnet fishery, identifying which MLMA unacceptability criteria each one meets:

[8] CDFW. Draft Conservation Plan for the California Dungeness Crab Fishery. 2021. p. 35 https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=195798&inline “The Central America DPS breeds along the Pacific coasts of Costa Rica, Panama, Guatemala, El Salvador, Honduras, and Nicaragua and feeds almost exclusively off California and Oregon (81 FR 62260).”

Type and/or Amount of Bycatch	Legality	Sustainability	Other Fisheries	Ecosystem
Take of humpback whales	X	X		
Take of gray whales		X		
Cumulative discard rate of 64% and discard mortality rate of 54%		X		X
Minimum of 125 species taken as bycatch		X		X
Discard mortality of sharks, rays, skates, chimeras (spotted ratfish, brown smoothhound shark, bat ray, soupfin shark, leopard shark, California skate, Pacific angel shark, sevengill shark, gray smoothhound shark, Pacific electric ray, white shark)		X		X
Take and discard mortality of minimum of 150 California sea lions per year		X		X
Discard mortality of California halibut (12% discard rate with 40% mortality rate) and white seabass (91% mortality rate)		X	X	
Discard mortality of Rock Crab and Pacific mackerel			X	
Incidental catch of giant sea bass		X	X	
Incidental catch of juvenile white sharks (25 per year)		X		X
Discard mortality of barred sand bass			X	
Take and Discard mortality of cormorants		X		
Discard and discard mortality of lingcod, cabezon, sheephead, boccacio rockfish, barracuda, kelp bass, white croaker, yellowfin croaker, ocean whitefish, king salmon, Humboldt squid, spiny dogfish)			X	
Incidental catch of species without management measures to ensure sustainability (bat ray, spider crab, common thresher shark, California skate, longnose skate, shovelnose guitarfish, soupfin shark)		X		
Catch of federally managed species that is not accounted for in or subject to federal annual catch limits (Pacific mackerel, leopard shark, longnose skate, California scorpionfish, big skate, boccacio rockfish, copper rockfish, cowcod rockfish, king salmon)	X	X		
Discard mortality of crustaceans (rock crab, spider crab, pointer crab, red rock crab, unidentified crabs and crustaceans)		X		
Lost gear (ghost fishing and marine debris)		X		X

3. Management Recommendations

The lack of at-sea monitoring programs in state fisheries to assess bycatch and integrate data into population and stock models seriously impedes the ability to ensure species are being managed to the sustainability requirements of the MLMA. Where evidence for significant or potentially harmful discards exists, a risk-averse and adaptive management approach is required under the MLMA. Fish and Game Code Section 7085(c) states: “In the case of unacceptable amounts or types of bycatch, conservation and management measures that, in the following priority, do the following: (1) Minimize bycatch. (2) Minimize mortality of discards that cannot be avoided.”

We are concerned with approaches that focus only on improved data collection with a plan to revisit the fishery bycatch data at a future date. Our organization has requested additional management measures in the set gillnet fishery since 2012 and have engaged through the Bycatch Work Group, MLMA Master Plan Revision, Fishery Prioritization, Scaled Management Process for California Halibut, and the Bycatch Evaluation. Given the number of fishery priorities requiring attention and resource constraints at the Department and Commission, we have low confidence that such a re-evaluation will occur, or that any meaningful management would result. There is ample evidence before you to act and we strongly urge additional management measures be put in place now to minimize bycatch in this fishery.

To meet the MLMA requirement to minimize bycatch to acceptable types and amounts, we see three alternative pathways forward. The sheer number of species and bycatch concerns in the fishery means that comprehensive and

intensive management is necessary if the fishery is going to continue. Option 1 is to implement a comprehensive suite of management measures to bring the fishery into the 21st century and ensure sustainability as per the MLMA. Option 2 is to initiate a near-term phase out of the fishery, which would be the simplest solution and minimize management costs. Option 3 is a hybrid approach that phases out the fishery in the long-term, while putting in reasonable measures to control bycatch. We request the Commission analyze and consider each of these options. The following table summarizes the elements of each approach, and each element is described below.

	Option 1: Comprehensive management to MLMA sustainability requirements	**Option 2: Near-term phase out and transition program**	**Option 3: Long-term phase-out with bycatch reduction measures**
Active measures to reduce bycatch and/or bycatch mortality	• 24-hour soak time • Bycatch hard caps • Sustainability measures for incidental species • Prohibition on landings of giant seabass and white shark (with an exception for donating dead white sharks for research)	• Permits expire in 5 years	• Permits fully non-transferable • Retire latent permits • 24-hour soak time • Prohibition on landings of giant seabass and white shark (with an exception for donating dead white sharks for research)
Data collection and monitoring	• 100% Bycatch monitoring (observers and/or video) • Gear marking • Electronic logbooks • Electronic vessel tracking • Data-limited assessments for priority species • Assess gear loss rates	• EFPs to identify new low-bycatch methods	• Pilot observer program with partial, random coverage • Gear marking • Electronic logbooks • Assess lost gear rates • EFPs to identify new low-bycatch methods
Legal Requirements	• Secure Incidental Take Permit for ESA-listed humpback whales	• N/A	• Secure Incidental Take Permit for ESA-listed humpback whales

Fishing Effort Reduction through Permit Phase out.

Gillnets, due to their non-selective design and use in areas of high biodiversity, necessitate complex management due to their high rates of bycatch and use in multispecies fisheries. If such management is not practical due to resource constraints, it may be necessary to phase out permits. In 2018, the Commission supported this approach for the drift gillnet swordfish fishery through the passage of Senate Bill 1017 which established a drift gillnet transition program. This program phased out all state permits over a five-year period, established a transition fund, and collected drift gillnets for recycling. In 2022, with support of this Commission, President Biden signed federal legislation to phase out the remaining federal permits for swordfish drift gillnets.

Alternatively, a longer-term phase out of fishing effort over time would reduce bycatch and discard mortality. Retiring latent permits would ensure the fishery does not increase in size. Prohibiting the transfer of permits for the currently active permit holders of the fishery would slowly decrease effort over the long-term, eventually sunsetting the fishery. However, unlike a near-term phase out, a longer-term approach must be accompanied with additional bycatch reduction and measures and monitoring. This would over-time reduce fishing effort and therefore reduce bycatch impacts; and allow for the natural transition to a cleaner gear-type to supply California halibut.

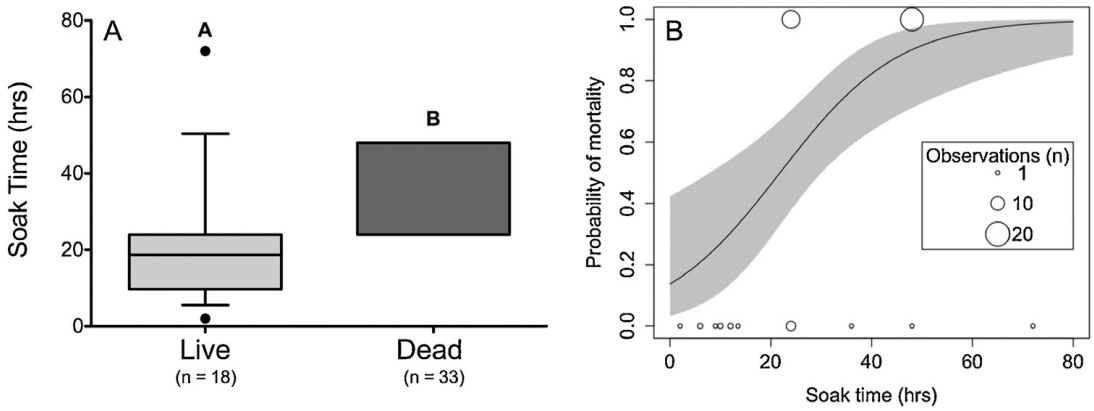
We have heard concerns that phasing out set gillnets would harm fishing communities and result in increased importation of seafood from other countries that may have higher bycatch and/or less regulation. However, there is no evidence to substantiate any of these claims from the experience with the previous bans on set gillnets in state waters in 1994 or off Central California in 2002.

Developing New Methods to Reduce Bycatch

Hook and line gear is already a profitable and viable method for selectively catching California halibut, white seabass, and many other species caught with set gillnets. It has far lower bycatch and lower discard mortality, limiting bycatch to acceptable types and amounts. Many commercial halibut fishermen and all recreational halibut and white seabass fishermen already use hook and line gear. However, we see value in building on this successful method by exploring the potential to scale up the catch rates and volumes of this sustainable gear. For example, in the Pacific halibut fishery in the Pacific northwest, British Columbia, and Alaska, the primary gear type is bottom longlines (trawls and set gillnets are prohibited). In our discussions with current hook and line California halibut fishermen, we have learned that there may be potential to examine this gear type to evaluate whether it can catch California halibut at higher catch rates while minimizing bycatch. The Commission should encourage interested fishermen to develop and test new low-bycatch methods to catch California halibut and white seabass at higher volumes through experimental fishing permits.

24-hour maximum soak time

Reducing the amount of time gear is set underwater can reduce the stress, injury and mortality impacts on more sensitive species. Reducing soak time could also reduce depredation impacts on target and bycatch species, and marine mammal and seabird entanglements from opportunistic predators like sea lions and cormorants. There is direct evidence from the Southern California set gillnet fishery supporting a 24-hour limit on set gillnet soak time to reduce fishing mortality. Lyons et al. 2013 analyzed the effect of several factors on mortality rates of juvenile white sharks in California set gillnets. They concluded soak time was the most important factor determining mortality rates, with statistical significance (See Lyons et al. 2013 Fig. 8). Data provided by the Department on soak times reported in set gillnet fishery logbooks from 2007 to 2022 indicated that 72% of sets are less than 24 hours, while the remaining 28% of sets are greater than 24 hours. Based on these numbers and the significant difference in mortality rates, we estimate that the overall juvenile mortality rate would decrease by approximately 50% if soak times were limited to 24 hours or less (see Table). Arguably this finding would be applicable to other species. For example, other sensitive species with high discard mortality such as the Soupfin shark (64% discard mortality from the Federal observer data)[9] may also benefit from reduced soak durations. Similar to gear tending requirements in other fisheries, there would be an exception during extreme weather events.



Lyons et al. 2013. Fig. 8. The effect of gillnet soak time (all fisheries combined) on juvenile white shark bycatch mortality where (A) average gillnet soak times are compared for gillnet-caught white sharks landed live versus dead and (B) the probability of gillnet-caught white shark mortality relative to gillnet soak times. Panel A: Whiskers represent 10–90th percent quartiles; however, soak times for deceased sharks were only reported as either 24 or 48 h. Letters above bars indicate a significant difference at $p < 0.001$. Panel B: The probability of mortality increased significantly with increases in soak time ($n = 51$; $p = 0.00153$; shaded areas represent 95% confidence intervals).

[9] NMFS. CA Set Gillnet Observer program, observed catch 2007 – 2017. Available :. Accessed June 2023.

	Soak Time	>24 hrs	<24 hrs	Overall mortality rate
Current management	% of sets	2%	72%	40%
	Mortality Rate	90%	20%	
24 hour max soak time	% of sets	0%	100%	20%
	Mortality Rate	90%	20%	

Table. Example calculations based on Lyons et al. 2013[10] white shark mortality rates by soak time and CDFW soak time data from fishery logbooks for California set gillnets targeting California and white seabass 2007-2022.[11] Mortality estimates are approximate. Columns refer to cumulative soak times greater than or less than 24 hours.

Bycatch monitoring by fishery observers and electronic video monitoring

To address the data collection needs for managing this fishery, some version of bycatch monitoring is needed. Bycatch monitoring could be accomplished through a pilot state-run observer program that would document catch and discards of marine animals, as well as information on mesh size, panel length, soak duration, and number of observed sets. Alternatively, the state could work with the existing NMFS West Coast Gillnet Observer Program to increase federal observer coverage and improve data collection protocols. Electronic video monitoring could eventually also be used to collect this data, or a combination of both EM and state observers could be used. 100% observer coverage is necessary to detect and obtain accurate estimates of rare event bycatch of species such as leatherback sea turtles, loggerhead sea turtles, and white sharks.[12]

Bycatch Hard Caps

In the absence of a permit phase-out, hard caps on the bycatch of priority and sensitive species are an essential tool ensure that bycatch in the fishery does not exceed specified levels to ensure sustainability and acceptable types and amounts of bycatch. Hard caps can be set at the fleetwide or vessel level and require 100% bycatch monitoring using human observers and/or electronic video monitoring. There is strong precedent for this approach in fisheries with bycatch concerns. The federal west coast groundfish bottom fishery requires 100% observer coverage or electronic video monitoring to enforce individual quotas ("catch shares") by species for each vessel. The Hawaii shallow-set pelagic longline fishery requires 100% observer coverage to enforce hard caps on endangered leatherback and loggerhead sea turtle interactions. Species for which hard caps should apply in the set gillnet fishery include humpback whales, gray whales, white sharks, sea lions, giant seabass, tope sharks, seabirds, sea turtles, dolphins, and others.

Gear marking

We support the Department report recommendation to require set gillnet gear marking to allow for identification of gillnets involved in wildlife entanglements. The set gillnet fishery operates in Biologically Important Areas for several whale species that migrate and feed on the West Coast, and NMFS has designated the fishery a Category II fishery under

[10] Lyons, K., et al., The degree and result of gillnet fishery interactions with juvenile white sharks in southern California assessed by fishery-independent and -dependent methods. Fish. Res. (2013) http://dx.doi.org/10.1016/j.fishres.2013.07.009
[11] CDFW data request, 2023. Soak Duration in the CA Set Gillnet Fishery, 2007-2022.
[12] Carretta and Curtis paper.

the Marine Mammal Protection Act due to interactions with ESA listed humpback whales.[13] It is currently unlikely to identify gillnet whale entanglements to the California set gillnet fishery due to inadequate gear-marking of the current fisheries and the difficulty of the disentanglement operations to get clear photos of the gear. In addition to current gear-marking requirements, a unique mesh-netting should be selected for the California set gillnet fishery that would distinguish the nets from other gillnet fisheries (such as Mexico's CA halibut set gillnet fishery). A standardized mesh net color, in addition to unique identification numbers or patterns along cork lines and buoys, may help address concerns related to unidentified set gillnets in marine mammal entanglements. Gear-marking improvements should be reviewed by NMFS's entanglement response team to ensure the changes meet their identification needs during whale entanglement operations.

Additional Logbook data requirements

Additional logbook requirements that would support management of the fishery should be implemented. In addition to ensuring current logbook requirements are enforced, logbook reporting should also include the net length, mesh size, and soak duration for each set, as well as the number of sets that occurred during each fishing trip. This data would inform total fleetwide fishing effort estimates, and total catch and bycatch estimates.

Data-limited assessments for priority species

One of the primary focal points of the MLMA Master Plan Revisions was to develop new data-limited tools to assess species sustainability. Priority species should be identified for data-limited assessments, with particular attention on species that are incidentally landed and/or discarded at high rates.

Lost Gear

Set gillnets are collected in the California Lost Fishing Gear Recovery Project. Lost set gillnets, sometimes referred to as "ghost gear" are marine debris that are documented off California to entangle fish, crabs, lobster, and birds.[14] This represents additional bycatch mortality that is not included in fishery observer data estimates of bycatch. The Department needs to monitor gear tags which are required to be placed on each set gillnet and must be returned to CDFW at the end of each 1-2 fishing seasons. Unreturned tags would indicate lost gear.

Incidental Take Permit for ESA-Listed Humpback Whales

The legality of bycatch is one of the four criteria in determining bycatch acceptability under the MLMA. The federal Endangered Species Act prohibits the take of an endangered species without an incidental take permit (ITP). The set gillnet fishery takes humpback whales in California, which include the endangered Central American DPS and the threatened Mexico DPS. Recently, the lack of an ITP for the California Dungeness crab fishery to entangle endangered whales and sea turtles resulted in litigation and a subsequent court settlement. As a result, the Department is currently applying for an ITP and submitting a Conservation Plan to NMFS for that fishery. The Department must also initiate a similar process for the California set gillnet fishery and other fisheries that entangle endangered whales and sea turtles.

[13] NMFS. CA Halibut, White Seabass and Other Species Set Gillnet (>3.5 in mesh) - MMPA List of Fisheries. Available: https://www.fisheries.noaa.gov/national/marine-mammal-protection/ca-halibut-white-seabass-and-other-species-set-gillnet-35-mesh Accessed: June 2023.
[14] UC Davis Lost Gear Retrieval. 2022. Accessed Feb 2023. https://www.ucdavis.edu/climate/news/tons-lost-fishing-gear-recovered-southern-california-coast

Conclusion

A precautionary approach is required under the MLMA where evidence is lacking to demonstrate sustainability. It is clear there need to be management changes to reduce bycatch in the California set gillnet fishery. We remain committed to working through this process with the Department, the Commission, fishery participants, and other stakeholders to find a path forward that minimizes bycatch while promoting robust fishing communities and opportunities. Together, we can build on all the work to date to ensure California remains a leader in biodiversity protection and ecosystem-based fishery management under the MLMA.

Sincerely,

Geoffrey Shester, Ph.D.
California Campaign Director & Senior Scientist

Caitlynn Birch
Pacific Marine Scientist

Attachment: Oceana Bycatch Data Analysis of the California Set Gillnet Fishery by Caitlynn Birch and Geoff Shester

Oceana Bycatch Data Analysis of The California Set Gillnet Fishery

By Caitlynn Birch and Geoffrey Shester, Ph.D.

July 7, 2023

Background

All around the world, set gillnets are recognized as harmful to marine ecosystems, biodiversity, and vulnerable species. [1] Compared to other gear-types, bottom set gillnets continue to pose some of the most complex management and conservation challenges.[2]

Through the state's scaled management process as outlined in the Marine Life Management Act's (MLMA) Master Plan for Fisheries, the California set gillnet fishery rose to the top of the priority list of fisheries in need of updated management due to potential ecosystem risk.

The commercial California set gillnet fishery is a single permit fishery (General Gill/Trammel Net Permit issued by CDFW) that targets and lands multiple species. Under this permit, fishermen may fish with 6.5 inch mesh to target white seabass or 8.5 inch mesh to target California halibut. However, multiple species are retained with both mesh sizes and the fishery is considered a multi-species target fishery. Nets may be up to 6,000 feet long and are anchored to the seafloor at each end. After nearshore and depth restriction closures in Southern and Central California in 1994 and 2002, the current fishery operates in Southern California federal waters (3-200 nautical miles [nm]) south of Point Arguello and in state waters outside of 1nm from the Channel Islands. In 2022, there were 100 set gillnet permit holders, and of these there are 32 active vessels in the set gillnet fishery that have recently landed halibut. This fishery is under jurisdiction of and managed by the state of California through the California Fish and Game Commission (CFGC) and California Department of Fish and Wildlife (CDFW).

This document is intended to support a holistic view of the publicly available information on bycatch and catch compositions in the California set gillnet fishery, and to support the MLMA Master Plan's bycatch inquiry[3] to help inform bycatch acceptability under the MLMA criteria (MLMA Section 7085) as part of the state's ecosystem-based management objectives.

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[3] Marine Life Management Act, Master Plan for Fisheries, Chapter 6. Ecosystem Based Objectives: limiting bycatch to acceptable types and amounts. https://mlmamasterplan.com/6-ecosystem-based-objectives/#limiting

Available Data

Publicly Available Federal Observer Data

We analyzed publicly available federal observer data collected by National Marine Fisheries Service (NMFS), which placed trained independent fishery observers on the commercial California halibut and white seabass set gillnet fishery from 2007 to 2017 for set gillnet vessels operating in southern California.[4] Observer data is available back to 1990, however, the 2007-2017 period reflects the fishery under current regulations. Over this 11-year period, the observer program was active in 6 years: 2007, 2009-2013, and 2017. This data is reported by number of animals caught, kept, and returned. Observers evaluate the mortality of all individual animals returned (discarded) (returned dead, returned alive, returned unknown). The bycatch and catch are not recorded by weight. NMFS observers are placed on vessels for the primary purpose of estimating marine mammal interactions, under the authority of the Marine Mammal Protection Act. However, all species caught are recorded and documented. California halibut and white seabass are targeted via different mesh sizes, however, the observer program aggregates all data from both mesh sizes. NMFS considers the set gillnet fishery a single fishery under their Marine Mammal Protection Act List of Fisheries. The observer program measures fishing effort in number of sets. A set is a single deployment and retrieval of a set gillnet. One or more sets may occur on each fishing trip. Observed sets are aggregated by year, and do not provide spatial information, soak duration (duration net is left underwater to fish), or panel length. In addition, the observer program records the number of sets observed during each year, and estimates the total number of fleetwide sets in 3 of the 6 observed years, but did not estimate fleetwide sets for the last 3 years (2012, 2013, 2017).

Year	Number Sets Observed	Estimated Total Sets	Percentage Observed
2007	248	1,387	17.8%
2010	216	1,724	12.5%
2011	171	2,123	8.1%
2012	250	Not estimated	Unknown
2013	169	Not estimated	Unknown
2017	204	Not estimated	Unknown

Table 1. National Marine Fisheries Service (NMFS) Set Gillnet Observer program 2007 – 2017; number of sets observed each year during that period, and the NMFS estimated total number of fleetwide sets for 2007, 2010, and 2011. NMFS was unable to estimate total number of fleetwide sets for the years 2012, 2013, and 2017. Total sets observed over the 6 years observed are 1,258 sets.

Total Landings Days Data

Total landings days, or trips, were provided by the California Department of Fish and Wildlife for the set gillnet fishery for the period of 2007 – 2021 (Table 2).[5] This data was summarized by year and by mesh size. Since multiple sets may occur on each trip, the number of sets these trips represent is unknown. For 2007 - 2016 the large-mesh and small-mesh set gillnet trips were combined due to logbook reporting at the time. Logbook reporting requirements changed after 2016 and were then separated by mesh-size, although some trips were still reported as combined small and large mesh in the subsequent years after the reporting change. Large mesh (>8in) set gillnet trips are considered California halibut

[4] National Marine Fisheries Service. Accessed 2022. California Set Gillnet Observer Program, Observed Catch 2007-01-01 to 2017-12-31. Available: https://media.fisheries.noaa.gov/2022- 01/setnet-catch-summaries-2007-2010-2013-2017.pdf *observer data is recorded by number of animals
[5] CDFW data request. Total Landing days/trips annually in the CA set gillnet fishery. 2022.

targeting trips and small-mesh (6-7.9in) trips considered white seabass and yellowtail targeting trips. As the publicly available federal observer data does not distinguish between halibut and white seabass targeting trips, both large-mesh and small-mesh trips were combined to produce an estimate of total effort in number of total fleetwide trips per year for the set gillnet fishery.

Year	Set* (small & large)	Large-mesh Set	Small-mesh Set	Total Set Net Trips
2007	1,945			1,945
2008	1,936			1,936
2009	2,131			2,131
2010	1,587			1,587
2011	2,096			2,096
2012	1,752			1,752
2013	1,720			1,720
2014	1,243			1,243
2015	1,076			1,076
2016	1,136	214	115	1,465
2017	112	859	379	1,350
2018	91	1,178	387	1,656
2019		1,395	299	1,694
2020		1,312	284	1,596
2021		1,356	196	1,552

Table 2. Total landing days or trips annually in the California set gillnet fishery. Data were summarized as count of unique date/captain/vessel/gear combinations by year, each indicating one day of landing (i.e. one trip) by a single individual. Provided by CDFW, 2022.

Protected Species Data

In addition to protected species counts and species documented in the federal observer data, we sourced expanded estimates of marine mammal, seabird and white shark take, and whale entanglement records (not expanded) from federal reports.

Marine mammals

We sourced expanded estimates of marine mammal take associated with the set gillnet fishery based on observed interactions from the most recent Stock Assessment Reports for the four marine mammal species in the federal observer data: CA sea lion[6], harbor seal[7], long beaked common dolphin[8], short beaked common dolphin[9].

Whale entanglement records were sourced from the Marine Mammal Protection Act List of Fisheries[10] as well as NOAA Fisheries Whale Entanglement Records on the U.S. West Coast.[11]

[6] NMFS. 2019. Marine Mammal Stock Assessment Reports by Species/Stock: CALIFORNIA SEA LION (Zalophus californianus): U.S. Stock. NOAA Fisheries. https://media.fisheries.noaa.gov/dam-migration/ca_sea_lion_final_2018_sar.pdf. Accessed November 2022. *estimates by fishery located in Table 1.
[7] NMFS. 2014. Marine Mammal Stock Assessment Reports by Species/Stock: HABOR SEAL: California Stock. NOAA Fisheries. https://media.fisheries.noaa.gov/dam-migration/po2014sehr-ca_508.pdf
[8] NMFS. 2021. Marine Mammal Stock Assessment Reports by Species/Stock: LONG-BEAKED COMMON DOLPHIN (Delphinus delphis bairdii): California Stock. https://media.fisheries.noaa.gov/2022-08/2021-LONG-BEAKED%20COMMON%20DOLPHIN-California%20Stock.pdf Accessed 2023
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[11] NMFS. 2021. Large whale entanglements off the U.S. West Coast, from 1982-2017. Saez, L., D. Lawson, and M. DeAngelis. NOAA Tech. Memo. NMFS-OPR-63A, 50 p. Updated through 2022 by NMFS. 2023. NOAA Fisheries Whale Entanglement Response Program. Official Report. L. Saez,. Jan 2023.

Seabirds

In addition to observed seabirds in the federal observer data, we sourced expanded seabird estimates from the National Bycatch Report database, though expanded estimates are only available for two of the six years observed (2011, 2012).[12]

White shark

We sourced expanded estimates of white shark catch from the Status Review of the Northeastern Pacific Population of White Sharks (Carcharodon Carcharias) under the Endangered Species Act, which estimated total juvenile white shark catch from fishery logbooks.[13] Data from this report was sourced from Table 4.3, and expanded estimates are only available through 2011. We requested updated data from CDFW, however, data since 2011 were not released due to asserted confidentially concerns.

Methods

Catch Compositions

To calculate catch compositions from the federal fishery observer data we analyzed the species groups present in the catch, examined the composition of catch that is kept versus discarded, and evaluated discard mortality across species and species groups.

Species Groups

We categorized the observer data into several species groups for different purposes: taxonomic or ecological similarities and management considerations. Taxonomic groups included marine mammals, seabirds, bony fish, Chondrichthyes (sharks, skates, rays, chimeras), and invertebrates. Management consideration categories differed depending on the purpose of analysis. Under the MLMA, incidentally caught species must be managed as either bycatch or as target species. For this purpose we identified incidentally caught and landed species that should be considered for management as "target species" due to their high catch volume and retainment rate. For catch composition analyses, incidentally caught and retained individuals were separated from incidentally caught and discarded individuals.

Composition of Catch Kept vs. Discarded

The observer data was used to determine the composition of the catch that is kept by the fishers versus the portion that is discarded. Kept catch refers to the species that are retained for sale or consumption, while discarded catch includes species that are discarded at sea due to various reasons, such as regulatory requirements, market preferences, damaged individuals, or undersized individuals. To understand the portion of retained catch that is considered "target" species catch versus "incidental" species catch, we also separated the retained catch by target and non-target species in some cases.

Discard Rate and Mortality Rate

We calculated discard rate by species, by species group, and in aggregate as the number of individuals discarded divided by the total number of individuals caught.

Discard mortality rate is available for all species in the federal observer dataset, defined as the number of individuals discarded dead divided by the total number of individuals discarded. Discard mortality rate can be achieved through observer programs which document the mortality of the animal as it is discarded. Post-release mortality is additional mortality that occurs after the species is released alive, caused by injury, stress or predation. Post-release mortality is

[12] NMFS. National Bycatch Report Database, Seabird Bycatch by Fishery 2011, 2012, Update 2. https://appsst.fisheries.noaa.gov/stapex/f?p=243:101:29602220642274: Accessed August 2022

[13] Dewar et al. 2013. Status Review of the Northeastern Pacific Population of White Sharks (Carcharodon Carcharias) under the Endangered Species Act, 2013. https://repository.library.noaa.gov/view/noaa/17705. Table 4.3 Average estimated catches from U.S. west coast set nets 2001-2011.

generally not known and requires species and fishing-gear specific studies conducted in labs, with tracking devices, or tanks on vessels. However, post-release discard mortality can be a significant source of additional mortality. In the absence of post-release mortality information, the discard mortality rate must be understood as the minimum mortality rate for the species discarded.

We calculated discard mortality rate for the total observer dataset across all species combined, across species groups, and for individual species.

Catch Composition Across Species

Calculating catch composition across different species involves analyzing the observer data to determine the relative proportions of each species within the overall catch. By aggregating the data annually or across total observed years, we generated catch composition estimates for different species. These estimates can be expressed as proportions or percentages of the total catch, providing insights into the species' relative contribution to the overall catch.

By analyzing catch compositions across species groups, the composition of catch kept versus discarded, and across different species, valuable information is obtained for fisheries management, conservation, and scientific assessments. These simple calculations aid in understanding the species interactions, identifying bycatch concerns, evaluating the impact of fishing practices, and can inform effective management strategies.

Spatial and Soak Time Data

We requested data on soak durations of the CA set gillnet fishery from CDFW which was provided as a range of soak times and frequency reported in logbooks for sets occurring in the California set gillnet fishery (CA halibut and white seabass) from 2007 to 2022.[14] This was analyzed to understand the proportion of sets with soak times under 25 hours already occurring in the set gillnet fishery.

Spatial extent of the fishery was estimated using GIS from known depth restrictions for the gear, and current regulations. CDFW also provided a map of fishing effort by block and halibut landings for comparison.[15]

Total Effort and Total Catch Estimates

A management challenge with the California set gillnet fishery and the available data is estimating total fishing effort in consistent metrics with observed effort. The Bycatch Inquiry of the MLMA states that the "types and amounts" of bycatch must be evaluated to determine the acceptability of the bycatch. To achieve accurate "amounts" of bycatch the available observer data must be extrapolated to estimate total fleetwide catch and discarded catch using estimates of total effort.

Estimating total fishing effort can be done in several different approaches depending on the gear type and availability of data. For gillnets for which net length and soak duration are variable for each set, the best estimate of standardized fishing effort is net soak hours and net length per unit set, which could be extrapolated to the total fleetwide sets deployed during a given period.

The publicly available observer data collected from 2007 – 2017 is recorded by number of sets observed, and does not include soak duration or net length. Additionally, the observer program only estimated total number of fishing sets per year for 3 of the 6 years observed, and both CDFW and NMFS analysts have indicated those estimates of total sets are highly uncertain.

[14] CDFW data request, 2023. Soak Duration in the CA Set Gillnet Fishery, 2007-2022.

[15] CDFW, pers. comms. 2023. Set gillnet fishing effort associated with CA halibut landings 2007 – 2017.

Further complicating total effort estimates, The California Department of Fish and Wildlife (CDFW) has been tracking total effort of the fishery in number of trips, or number of times a vessel lands catch. In 1 trip, multiple sets may be occurring depending on where the fisher is fishing, how many times the nets were deployed and retrieved, weather conditions and success of fishing effort.

Due to data gaps in fishing effort, accurate catch per unit effort (CPUE), a standard metric in fishery management used to achieve both target and non-target total catch in a given fishery, is difficult to achieve for the set gillnet fishery.

Based on the limits in available data, one approach is to use the CDFW annual trip counts to develop a minimum, lower-bound estimate of total effort that can be used to generate minimum, lower-bound estimates of total catch and discards. Following this approach, we assumed that 1 trip is equivalent to 1 set, and used the CDFW provided total number of fishing trips per year as an estimate of total fishing sets per year. From this, we calculated the annual mean number of sets that occurred over that period. We multiplied the annual mean effort by the previously calculated CPUE based upon observer data, and were able to estimate total annual fleetwide catch. These estimates should be considered minimum estimates with the understanding that one trip can represent multiple sets. This method for developing minimum total catch estimates based on assuming 1 trip = 1 set was recommended as a viable approach in consultations with Department and Commission data analysts and a NMFS bycatch data analysist. They should not be viewed as central or absolute estimates.

In the future management of this fishery, fishery managers should consider better data collection efforts to estimate total fleetwide fishing effort. Total fishing effort is a standard tool of fishery management to assess impacts on both target species and bycatch species, as well as inform better stock assessments and more informed management decisions.

Spatial Extent of Fishing Effort

The California set gillnet fishery operates in Southern California federal waters (3-200nm offshore) and outside of 1nm of the Channel Islands. Depths deeper than 60 fathoms are typically too deep to fish using set gillnets.

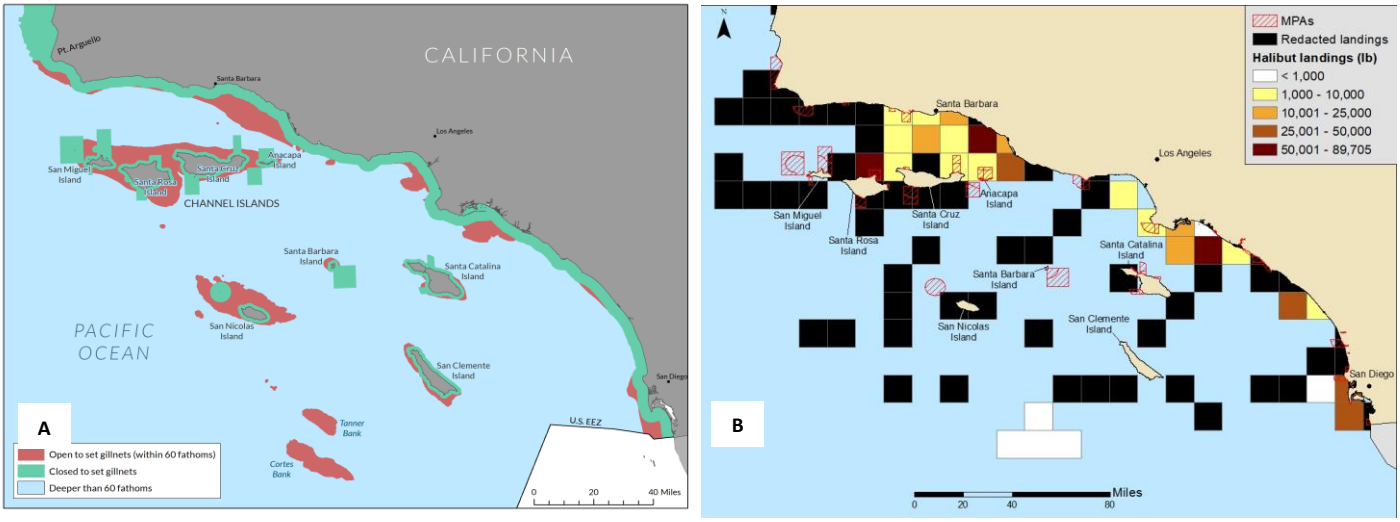

Figure 1. Map (A) produced by Oceana depicts a spatial approximates of areas of potential set gillnet fishing (for both CA halibut and white seabass) in Southern California based on depths (shallower than 60 fathoms) and current regulations. Areas in red are areas open to set gillnet fishing and shallower than 60 fathoms. Map (B) produced by the California Department of Fish and Wildlife shows fishing effort in California halibut landings by spatial block for the CA halibut set gillnet fishery (CDFW, 2023).[16] Black blocks indicate areas where set gillnet effort occurred, but do not show landings for confidentiality purposes.

[16] CDFW, pers. comms. 2023. Set gillnet fishing effort associated with CA halibut landings 2007 – 2017.

Results and Discussion

Soak Time

The duration that nets are set and left underwater can have an impact on mortality of the catch. From available soak time data, approximately 73% of sets occurring in the fishery are less than 25 hours in length, 26% of sets are between 26-50 hours in length, and 6% of sets are left to soak for more than 50 hours.

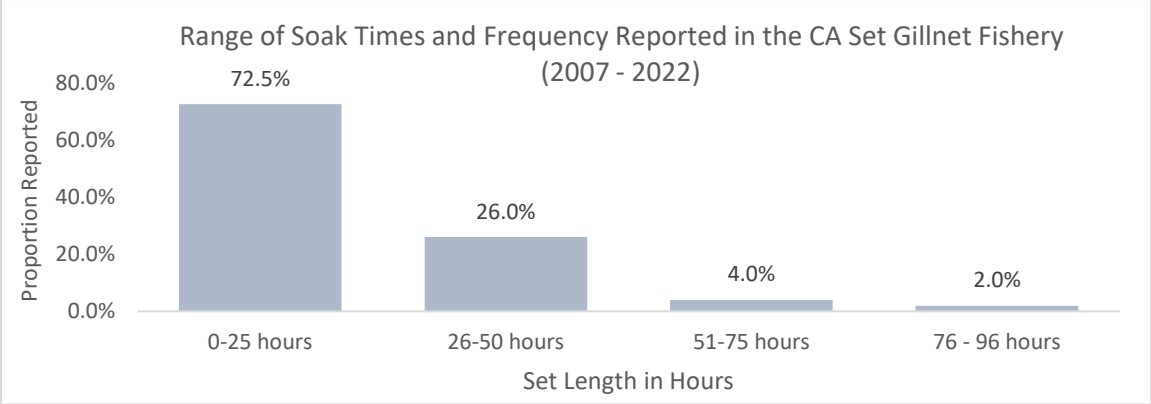

Figure 2. Range of soak times and frequency reported for sets occurring in the California set gillnet fishery (CA halibut and white seabass) from 2007 to 2022 (CDFW, 2023)[17]. Reported soak times may be subject to inaccuracies as they are based on self-reported data from gillnet logbooks. In cases where data were provided as <1%, we assumed 0.5%.

Catch and Bycatch Compositions from Raw Observer data

Federal observer data was used to understand general catch and bycatch compositions, discard mortality, and trends in which species are generally kept or discarded.

Over the 6 years of available data, 1,258 sets were observed in the CA set gillnet fishery, or an average of 210 sets per year observed. Over these 1,258 sets, 18,255 animals were caught, 6,530 were retained, and 11,725 were discarded. Of the 11,725 animals discarded, 6,359 were discarded dead, 5,127 were alive at the time of discard, and 239 had an unknown mortality status upon discarding (Table 9, Appendix).

Discard rate, or the proportion of total catch that is not retained, is generally used as a measure of waste or ecological impact, allowing for comparisons across fisheries.[18] From federal observer data of the set gillnet fishery, the aggregate discard rate across all species ranges from 51% to 72% over the 6 years observed, and retention rates range from 28% to 49% (Table 3).

Year	% Discarded	% Retained	% Discard mortality
2007	65	35	50
2010	70	30	71
2011	51	49	57
2012	63	37	36
2013	72	28	43
2017	61	39	56
Total across all years	**64**	**36**	**54**

Table 3. Annual discard rate and percent discard mortality rate aggregated for all catch for each year observed based on federal observer data of the CA set gillnet fishery.

[17] CDFW data request, 2023. Soak Duration in the CA Set Gillnet Fishery, 2007-2022.
[18] U.S. National Bycatch Report. Corporate Author(s): U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service; Published Date: 2011; Series: NOAA technical memorandum NMFS-F/ SPO; 117E.

Aggregated over the 6 years, 64% of all catch has been discarded and 36% retained. Of the total percent retained for all years, 21% is made up of California halibut and white seabass, the primary target species, and 15% consists of other incidentally retained species (Figure 3.)

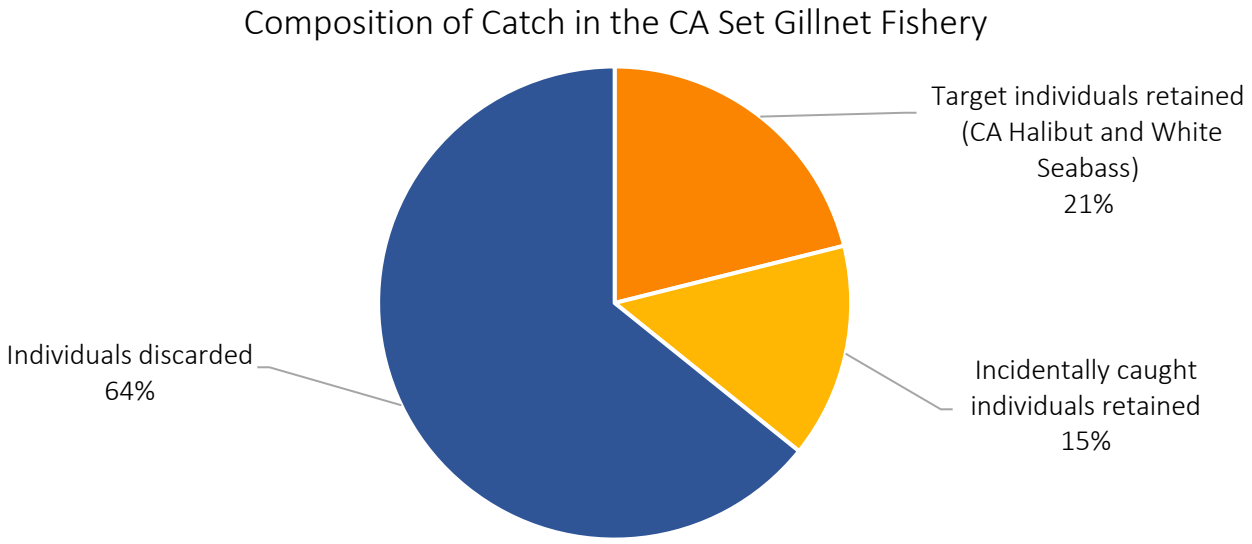

Figure 3. Catch composition of observed catch by number of animals, separated into three categories: retained CA halibut and white seabass, retained incidental individuals, and discarded individuals. Based upon 6 years of federal observer data 2007 – 2017.[19]

Of the total discarded catch by number of animals, the majority (41%) is made up of invertebrate species, followed by cartilaginous fish (Chondrichthyes) species (29%) and bony fish species (29%). Marine mammal and seabirds, from the observer data, make up 1% of total discarded catch by number of animals (Figure 4).

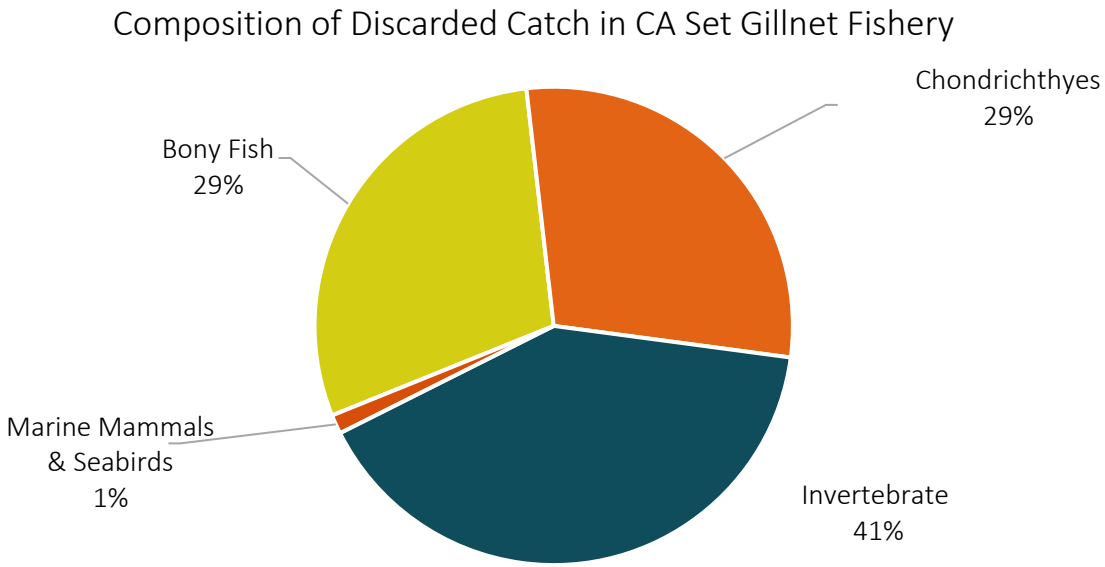

Figure 4. Composition of discarded catch in the CA set gillnet fishery based upon federal observer data 2007 – 2017.[15] *Categories of catch include bony fish, marine mammals and seabirds, Chondrichthyes, and invertebrates.*

[19] National Marine Fisheries Service. Accessed 2022. California Set Gillnet Observer Program, Observed Catch 2007-01-01 to 2017-12-31. Available: https://media.fisheries.noaa.gov/2022- 01/setnet-catch-summaries-2007-2010-2013-2017.pdf *observer data is recorded by number of animals

Of the top most frequently discarded species in the observer data, 9 are Chondrichthyes species (sharks, skates, rays and chimeras), 8 are invertebrate species (crab, squid, sea stars, and sea snails), and 3 are bony fish species (P. mackerel, Scorpionfish, and California halibut).

Top Discarded Species	Observed Discarded (over 1,258 sets)	Discard Mortality Rate
1. Pacific Mackerel	2126	98.7%
2. Rock Crab	1280	56.4%
3. Jumbo (Humboldt) Squid	847	88.9%
4. Spider Crab	845	49.8%
5. Swell Shark	731	2.1%
6. Pointer Crab	646	81.4%
7. California Skate	391	8.7%
8. Sea Star	382	0.3%
9. Bat Ray	376	20.5%
10. Spiny Dogfish	336	35.7%
11. Longnose Skate	307	23.1%
12. Brown Smoothhound Shark	284	47.2%
13. Whelk	240	2.1%
14. Pacific Angel Shark	216	13.9%
15. Spotted Ratfish	199	67.3%
16. Red Rock Crab	179	92.2%
17. Yellow Crab	137	58.4%
18. California Halibut	121	39.7%
19. California Scorpionfish	119	41.2%
20. Leopard Shark	108	45.4%

Table 4. Top 20 discarded species ranked by number of animals discarded in the federal observer data.[20]

Discard Mortality

For this fishery based on observer data, total discard mortality rate across all six years for all species discarded is 54.2%, meaning that of all sets observed, over half of the animals thrown back were considered dead by the observer upon discarding. These do not include any estimates or assumptions of post-release mortality. The discard mortality rate varies across years however, and ranges from as low as 36% and up to 71% in certain years. The overall discard mortality rate can be driven by certain species that are caught and discarded in high numbers and have high mortality rates.

Discard mortality rate varies greatly across species groups and for individual species (Figure 5 & Table 5). Marine mammals and seabirds had the highest observed discard morality rate at 97%. Bony fish species across the 1,258 sets observed had a 78% discard mortality rate; invertebrate species had a discard mortality rate of 62%, and Chondrichthyes had a discard mortality rate of 22%.

[20] National Marine Fisheries Service. Accessed 2022. California Set Gillnet Observer Program, Observed Catch 2007-01-01 to 2017-12-31. Available: https://media.fisheries.noaa.gov/2022- 01/setnet-catch-summaries-2007-2010-2013-2017.pdf *observer data is recorded by number of animals

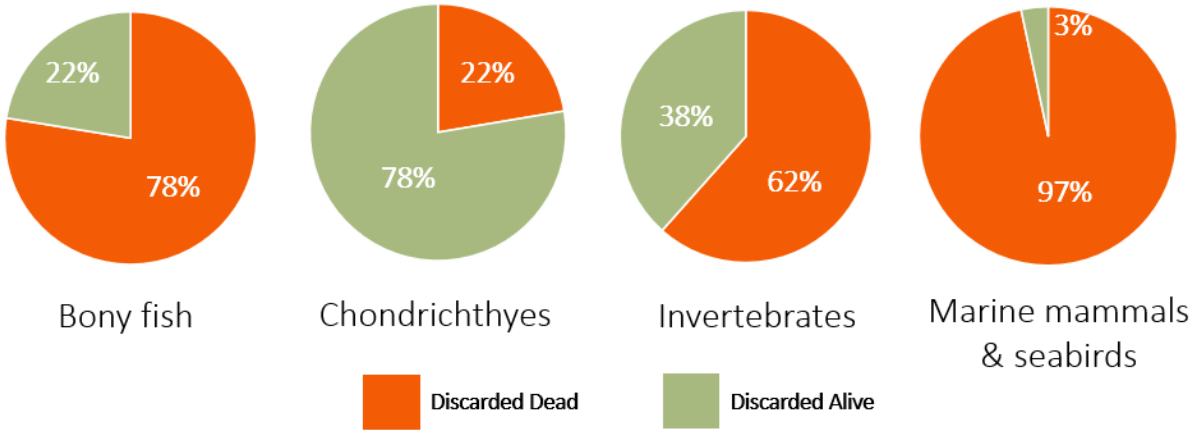

Figure 5. Discard mortality rate based on federal observer data across species groups: Bony fish, Chondrichthyes, Invertebrates, and Marine Mammals and Seabirds.[21]

The high discard mortality rate among the observed bony fish is likely being driven by Pacific mackerel, which have a high discard mortality rate (98.7%) and are caught in high numbers in some observed years. Conversely, the low discard mortality rate across all Chondrichthyes species caught is likely being driven by the high rate of survival of the most caught and discarded sharks species, the swell shark, which has a discard mortality rate of 2%. Other shark and ray species have much higher discard mortality rates, such as the Soupfin shark (64% discard mortality rate) and the Leopard shark (45% discard mortality rate), but are caught less frequently. Lyons et al. 2013 found that the discard mortality rate of juvenile white sharks is significantly related to soak time, with higher discard mortality rates in longer soaks.[22]

Example Species	Higher Discard Mortality Rate	Example Species	Lower Discard Mortality Rate
Pacific Mackerel	98%	Thornback Ray	3%
Rock Crab	56%	Whelk	2%
CA Halibut	40%	Swell Shark	2%
Giant seabass	50%	Spiny Lobster	4%
Brown Smoothhound Shark	47%	Cabezon	11%
Leopard Shark	45%	Pacific Angel Shark	14%
Spotted Ratfish	67%	Sea Cucumber	7%
Soupfin Shark	64%	California Skate	9%

Table 5. Example species with high discard mortality rates and lower discard mortality rates from the federal observer data. Discard mortality rates are aggregated across all years of available data.[17]

A chart of all observed species and their discard mortality rate can be found in the Appendix (Table 9).

Post-release Mortality

Few studies exist on post-release mortality for species caught in the CA set gillnet fishery. There is a post-release mortality study examining spiny dogfish (S. acanthias) mortality in gillnets, a species also caught in the CA set gillnets. Rulifson (2007) caught S. acanthias by commercial otter trawl and gillnet, with sampled fish left on deck for 10–15 min (to simulate fishing processes) before being categorized as live or dead. Sub-samples (n=480 for each gear type) were then placed in sea pens that were anchored for 48 hours.[23] The direct capture mortality was 0% for trawl (0.5–1.5 h tow

[21] National Marine Fisheries Service. Accessed 2022. California Set Gillnet Observer Program, Observed Catch 2007-01-01 to 2017-12-31. Available: https://media.fisheries.noaa.gov/2022- 01/setnet-catch-summaries-2007-2010-2013-2017.pdf *observer data is recorded by number of animals
[22] Lyons, K., et al., The degree and result of gillnet fishery interactions with juvenile white sharks in southern California assessed by fishery-independent and -dependent methods. Fish. Res. (2013), http://dx.doi.org/10.1016/j.fishres.2013.07.009
[23] Rulifson, R. A. (2007). Spiny dogfish mortality induced by gill-net and trawl capture and tag and release. North American Journal of Fisheries Management 27, 279–285.

duration) and 17.5% for gillnet (19.5–23.5 h soak time). After 48 hours in the sea pens, there was no further mortality of trawl-caught S. acanthias, whereas there was a further 33% mortality for those caught by gillnet.

A study estimating post-release mortality of a shark species (M. antarcticus) in the same family (Triakidae) as many of the shark species caught in the set gillnet fishery may give an approximate indication of additional mortality in the fishery for closely related species. Lyle et al. (2014) conducted a study in the Tasmanian gillnet fisheries, where post-release survival for the M. antarcticus shark was estimated to be 58.7%, indicating an additional post-release morality of 41.3%.[24] Species in the California set gillnet fishery most closely related to M. antarcticus are the smoothhound shark species, such as the brown smoothhound and gray smoothhound. Other shark species that are in the same Triakidae family are the leopard shark and soupfin (tope) shark. Several studies indicate variable survival of this family in fisheries, and note post-release mortality is an important source of overall mortality associated with fishing.[20,25,26]

Hyatt et al. (2012) looked at the blood chemistry of carcharhiniform sharks caught in experimental gillnets and longlines, with higher lactate concentrations and a greater pH in gillnet-caught sharks, underlining the greater physiological effect of capture in gillnets.[27]

While a proportion of fish can survive capture and release from gillnets, some individuals escaping from this gear may retain monofilament netting around parts of the body,[28,29] but it is uncertain as to how frequent this is and the subsequent effects of these events.

Studies conducted on post-release mortality in gillnet fisheries suggest potential bycatch mitigation measures to reduce overall mortality in gillnet fisheries could include spatial and temporal restrictions, restrictions on net lengths, limiting soak times, changes to mesh size, hanging ratio and height of the net and modifications to the thickness and color of the netting.[30,31]

Incidentally Retained Species

The CA set gillnet fishery is considered a multi-species fishery and many species that are legal and marketable are retained in addition to the primary target species CA halibut and white seabass. There are several species from the observer data that appear to be clear secondary targets -- caught in high numbers relative to other species and high rates of retainment. These species are yellowtail, CA barracuda, and common thresher shark. These three species are retained over 75% of the time and make up a significant proportion of non-target species retained.

There are many species in the observer data frequently caught and retained, but a significant proportion of the catch of these species is also discarded. This may be due to differing fisher preferences or availability of markets for certain species. Many of these species are Chondrichthyes, and include the bat ray (44% retained), pacific angel shark (37% retained), and California skate (22% retained) among others. Many species in the dataset are caught and discarded more often than they are retained, with a small number of individuals retained over the 6 years of data. A full table of the top retained species (ranked by observed number retained) can be found in Table 6. From observer data, incidentally retained catch (excluding California halibut and white seabass) comprises 15% of the total catch of the set gillnet fishery

[24] Lyle, J. M., Bell, J. D., Chuwen, B. M., Barrett, N., Tracey, S. R. & Buxton, C. D. (2014). Assessing the impacts of gillnetting in Tasmania: implications for by-catch and biodiversity. Institute for Marine and Antarctic Studies, University of Tasmania. Fisheries Research and Development Corporation (FRDC) Project No. 2010/016. Available at http://dpipwe.tas.gov.au/Documents/Gillnetting_Impacts_Tas_Bycatch_Biodiversity_ FRDC2010.pdf/

[25] Frick, L. H., Reina, R. D. & Walker, T. I. (2010a). Stress related changes and post-release survival of Port Jackson sharks (Heterodontus portusjacksoni) and gummy sharks (Mustelus antarcticus) following gill-net and longline capture in captivity. Journal of Experimental Marine Biology and Ecology 385, 29–37.

[26] Frick, L. H., Walker, T. I. & Reina, R. D. (2012). Immediate and delayed effects of gill-net capture on acid–base balance and intramuscular lactate concentration of gummy sharks, Mustelus antarcticus. Comparative Biochemistry and Physiology A 162, 88–93.

[27] Hyatt, M. W., Anderson, P. A., O'Donnell, P. M. & Berzins, I. K. (2012). Assessment of acid–base derangements among bonnethead (Sphyrna tiburo), bull (Carcharhinus leucas) and lemon (Negaprion brevirostris) sharks from gillnet and longline capture and handling methods. Comparative Biochemistry and Physiology A 162, 113–120.

[28] Schwartz, F. J. (1984). A blacknose shark from North Carolina deformed by encircling monofilament line. Florida Scientist 47, 62–64

[29] Seitz, J. C. & Poulakis, G. R. (2006). Anthropogenic effects on the smalltooth sawfish (Pristis pectinata) in the United States. Marine Pollution Bulletin 52, 1533–1540.

[30] Thorpe, T. & Frierson, D. (2009). Bycatch mitigation assessment for sharks caught in coastal anchored gillnets. Fisheries Research 98, 102–112

[31] Baeta, F., Batista, M., Maia, A., Costa, M. J. & Cabral, H. (2010). Elasmobranch by-catch in a trammel net fishery in the Portuguese west coast. Fisheries Research 102, 123–129.

and contributes 41.6% of the total retained catch for the fishery. For each top retained species, we evaluated whether there are management measures in the set gillnet fishery to ensure sustainability, such as size limits, catch limits, or closed seasons. Some species managed under federal Fishery Management Plans (FMP) have annual catch limits when targeted in federal fisheries, but those limits do not apply to the set gillnet fishery and set gillnet catch is not applied to those federal limits. Those species include Pacific mackerel, leopard shark, longnose skate and California scorpionfish.

Species	FMP	Assessed	Management measures for sustainability	ESR	Observed Retained	Observed Discarded	Discard Mortality Rate	Percent Retained
Seabass, White (target)	Yes (State FMP)	Yes (2016)	Size limit	Yes	2975	74	91%	98%
Halibut, California (target)	No	Yes (2011)	Size limit	Yes	878	121	40%	88%
Crab, Spider	No	No	None	No	321	845	50%	28%
Ray, Bat	No	No	None	No	296	376	20%	44%
Mackerel, Pacific	Yes (CPS FMP)	Yes (2021)	None *	No	228	2126	99%	10%
Crab, Rock	No	No	None	Yes	221	1280	56%	15%
Yellowtail	No	No	Size limit	Yes	192	4	100%	98%
Whelk	No	No	None	No	137	240	2%	36%
Barracuda, California	No	No	Size limit	Yes	134	43	98%	76%
Shark, Common Thresher	Yes (HMS FMP)	Yes	None	No	130	14	29%	90%
Shark, Pacific Angel	No	No	Size limit	Yes	125	216	14%	37%
Skate, California	No	No	None	No	110	391	9%	22%
Shark, Leopard	Yes (G FMP)	No	None*	No	106	108	45%	50%
Skate, Longnose	Yes (G FMP)	Yes	None*	No	78	307	23%	20%
Guitarfish, Shovelnose	No	No	None	No	68	28	4%	71%
Shark, Brown Smoothhound	No	No	Size limit	Yes	55	284	47%	16%
Scorpionfish, California	Yes (G FMP)	Yes (2017)	Size limit	No	55	119	41%	32%
Crab, Pointer	No	No	None	No	54	646	81%	8%
Shark, Swell	No	No	None	No	52	731	2%	7%
Shark, Soupfin	Ecosystem Component Species GFMP	No	None	No	40	86	64%	32%
Squid, Jumbo (Humboldt)	No	No	None	No	27	847	89%	3%
Bass, Giant Sea	No	No	1 per trip in set nets (closed fishery)	No	26	8	50%	76%

*Table 6. Top incidentally retained species, ranked by number of observed animals retained.[32] Percent retained and discard mortality rate is included to better understand total mortality of each species, along with relevant management information for each species. * Species has a federal Annual Catch Limit, but set gillnet catch is not counted toward or subject to such limit.*

Many species caught in this fishery as bycatch or as incidentally landed species (that are not target species) do not have stock assessments or other indicators of stock status, or basic management for sustainability in place under guidelines of the MLMA. The CA set gillnet fishery is considered a multi-species fishery, which can be difficult in terms of management under the Marine Life Management Act, which manages species in fisheries as either "targets" or "bycatch". The MLMA states this in terms of incidental fisheries catch:

> "Incidental catch is defined as fish caught incidentally during the pursuit of the primary target species, but legal and desirable to be sold or kept for consumption. Some may define these species as secondary targets or retained bycatch. For purposes of FMP development these species should be accounted for and must be managed either as target species under the sustainability standards outlined in Chapter 5, or as bycatch under the bycatch standard described below." (MLMA Master Plan for Fisheries, Chapter 6)[33]

[32] National Marine Fisheries Service. Accessed 2022. California Set Gillnet Observer Program, Observed Catch 2007-01-01 to 2017-12-31. Available: https://media.fisheries.noaa.gov/2022- 01/setnet-catch-summaries-2007-2010-2013-2017.pdf *observer data is recorded by number of animals

[33] Marine Life Management Act Master Plan for Fisheries, Chapter 6: Ecosystem-based Objectives. https://mlmamasterplan.com/6-ecosystem-based-objectives/

Many species retained incidentally are also discarded, making their total mortality (retained + discard mortality) potentially significant, and should be considered for additional management to ensure sustainable harvest.

Target species

California halibut and white seabass are considered the primary targets of this multispecies gillnet fishery, and combined, both target species landed out of the total catch of the fishery comprise 21% of the total catch. California halibut caught makes up 5.5% of the total catch by number of animals in the observer data. Retained CA halibut comprises 4.8% of the total catch of the fishery, and comprises 13.4% of total retained catch. California halibut has a discard rate of 12%, and a discard mortality of 39.7%. White seabass comprises 16.7% of the total catch by number of animals in the observer data. Retained white seabass comprises 16.3% of total animals caught, and makes up 45.6% of total retained catch of the fishery. White seabass has a discard rate of 2.4% and discard mortality rate of 90.5%.

California halibut does not have a current stock assessment (last assessment in 2011), and is not yet managed under a Fishery Management Plan (FMP) with catch quotas, though the state is currently working on a state FMP and updated stock assessment. The California halibut stock in Southern California is depleted, and efforts in all fishing sectors should be explored to reduce bycatch impacts on such a commercially important species in California. From observer data, 12% of halibut caught are discarded, which have a discard mortality rate of 39.7%. Discard mortality does not consider depredation that may be occurring of this resource while the nets are soaking by sea lions and other natural predators, nor does it consider post-release mortality.

White seabass is managed under a state FMP and has a 2016 stock assessment. The most recent stock assessment for white seabass estimates the stock is at 27% of its unfished biomass, indicating depletion, though not “overfished” as defined by the Pacific Fishery Management Council as below 25% of a stock’s unfished biomass.

Protected Species

Marine Mammals

This fishery is a Category II fishery under the Marine Mammal Protection Act (MMPA) for its interactions with protected marine mammals. The primary rational for the Category II listing is the take of ESA-listed humpback whales.[34] The observer program that monitors this fishery has authority under the MMPA.

Marine mammals this fishery has interacted with historically include the southern sea otter, northern elephant seal, and harbor porpoise. In the current observer data (2007 – 2017) there are 4 identified species of marine mammals the fishery has interacted with during this period: CA sea lion (n= 90), harbor seal (n = 9), long-beaked common dolphin (n = 2), and the short-beaked common dolphin (n = 2). From observer data, all marine mammals caught are discarded and have a near 100 percent discard mortality rate (99%). These numbers are observed marine mammal interactions and are not expanded. An unknown number of marine mammals breakaway with portions of netting still entangled around their body, and additional mortality and injury of these marine mammal stocks should be considered.

NMFS provides expanded estimates of marine mammal fishery related death and injury in their Stock Assessment Reports for marine mammals.[35] From these reports an estimated 150 CA sea lions are killed each year in the CA set gillnet fishery, out of a total 197 estimated fishery related mortalities from observed fisheries.[36] An estimated 23 harbor seals are killed annually in the CA set gillnet fishery, though the California Harbor seal stock has not been evaluated since

[34] NOAA Fisheries. MMPA List of Fisheries: CA Halibut, White Seabass and Other Species Set Gillnet (>3.5in mesh). Available: https://www.fisheries.noaa.gov/national/marine-mammalprotection/ca-halibut-white-seabass-and-other-species-setgillnet-35-mesh. Accessed 2023

[35] NMFS. Marine Mammal Stock Assessment Reports by Species/ Stock. https://www.fisheries.noaa.gov/national/marinemammal-protection/marine-mammal-stock-assessmentreports-species-stock

[36] NMFS. 2019. Marine Mammal Stock Assessment Reports by Species/Stock: CALIFORNIA SEA LION (Zalophus californianus): U.S. Stock. NOAA Fisheries. https://media.fisheries.noaa. gov/dammigration/ca_sea_lion_final_2018_sar.pdf. Accessed November 2022. *estimates “by fishery” located in Table 1.

2013. An estimated ≥1.6 Long beaked common dolphins, and ≥ 3 short beaked common dolphins are killed annually in the fishery.

The NMFS West Coast Entanglement program has identified the take of a humpback whale in 2007, and a gray whale in 2020, to the Southern California set gillnet fishery.[37] Large whale entanglements are an ongoing problem on the U.S. West Coast and have become more common over the last decade, but due to a lack of unique gear marking requirements for the CA set gillnet fishery and other fisheries, most whale entanglements remain unidentified to the fishery-level. Efforts to implement better gear-marking and identification protocols in many fishing sectors in California and other states are ongoing. From known records of whale entanglements on the West Coast 2001 – 2022, 22 gray whales, 12 humpbacks, and 1 unidentified whale have been entangled in unidentified gillnets.[38] Unidentified gillnets are commercial gillnets that could not be identified down to the fishery level, and could be set gillnet entanglements from the Southern California fishery, among a number of other gillnet fisheries on the West Coast and Mexico. In this analysis, any identified drift gillnet or Tribal gillnet is excluded.

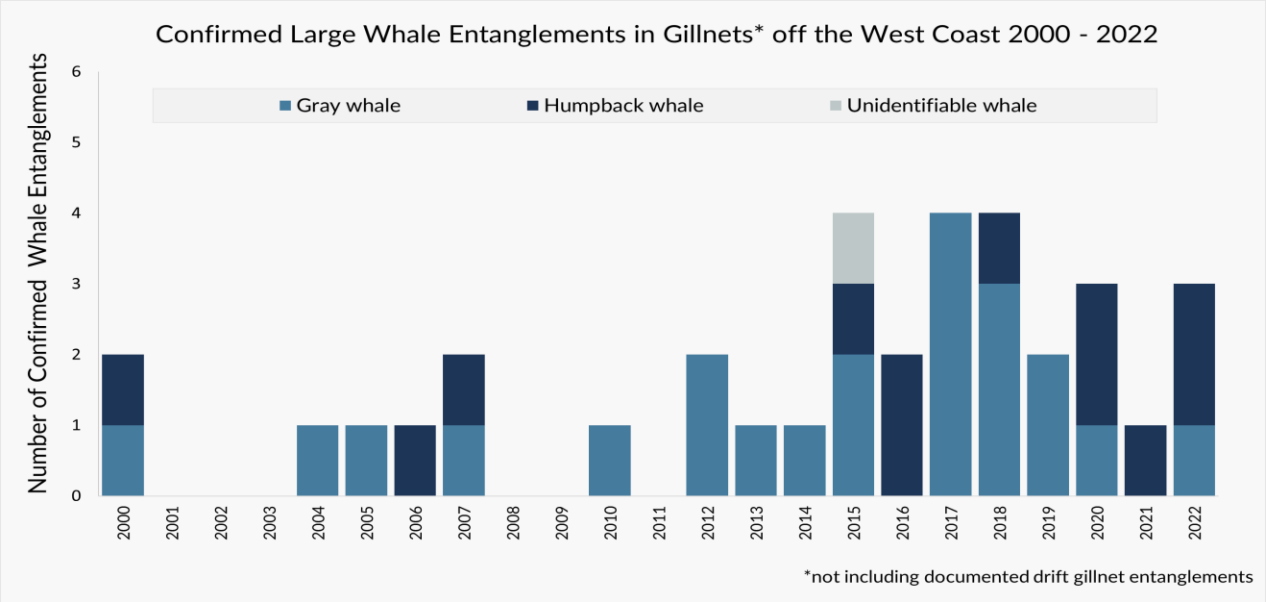

Figure 6. Confirmed Large Whale Entanglements in Gillnets off the West Coast 2000 – 2022. Entanglement records were only included if the entanglement could reasonably be attributed to the California set gillnet (CA halibut and white seabass) fishery. We have included all the "Gillnet" records, excluding any that are drift gillnet, tribal gillnet, or where the "Gear set location code" is OR, WA, Central California and Northern California. Gear-set location filters are set only to "unknown", "California unknown" or "Southern California".

[37] NOAA Fisheries. MMPA List of Fisheries: CA Halibut, White Seabass and Other Species Set Gillnet (>3.5in mesh). Available: https://www.fisheries.noaa.gov/national/marine-mammalprotection/ca-halibut-white-seabass-and-other-species-setgillnet-35-mesh. Accessed 2023

[38] NMFS. 2021. Large whale entanglements off the U.S. West Coast, from 1982-2017. Saez, L., D. Lawson, and M. DeAngelis. NOAA Tech. Memo. NMFS-OPR-63A, 50 p. Updated through 2022 by NMFS. 2023. NOAA Fisheries Whale Entanglement Response Program. Official Report. L. Saez, Personal communication. Jan 2023.

Seabirds

From observer data, there are 4 identified seabird species caught by the fishery and 3 unidentified seabird species. These include the Brandt's Cormorant (n=11), the Common Murre (n=3), the Double-crested Cormorant (n= 1) and the Pelagic Cormorant (n= 1). Unidentified species in the observer data are the unidentified Gull (n=2), unidentified Cormorant (n = 23) and unidentified seabird (n =3). Total seabirds caught from the observer data 2007 - 2017 are 44 birds.

The National Bycatch Report Update 2 database[39] provides expanded estimates for seabirds catch in the set gillnet fishery for 2011 and 2012. In 2011, an estimated 247 seabirds were caught in the set gillnet fishery (49 Brandt's Cormorants and 198 unidentified seabirds); a total of 458 estimated seabirds were caught in 2011 in all observed West Coast fisheries (7 fisheries), indicating set gillnets caught 54% of the estimated seabird catch in 2011 (Table 7). However, the Coefficient of Variance (CV) for the estimates in the set gillnet fishery are high, indicating uncertainty in the extrapolations. In 2012, an estimated 72 seabirds were caught in the set gillnet fishery (18 Pelagic Cormorants and 54 unidentified seabirds); a total of 439 estimated seabirds were caught in 2012 in all observed West Coast fisheries (7 fisheries), indicating set gillnets caught 16% of the estimated seabird catch in 2012 (Table 8). Again, the Coefficient of Variance (CV) for estimates in the set gillnet fishery is high, indicating uncertainty in the extrapolations.

California Halibut/White Seabass and Other Species Set Gillnet (>3.5 in Mesh):						
Common Name	Scientific Name	Year	Bycatch	Unit	CV	Footnote(s)
Brandt's cormorant	Phalacrocorax penicillatus	2011	49.00	INDIVIDUAL	0.61	
Seabirds (unidentified)	Laridae	2011	198.00	INDIVIDUAL	1.03	
Fishery total			**247.00**			

Table 7. National Bycatch Report Update 2: 2011, expanded estimates of seabird bycatch by fishery; estimated seabird bycatch for the CA halibut/white seabass and other species set gillnet fishery for 2011.

California Halibut/White Seabass and Other Species Set Gillnet (>3.5 in Mesh):						
Common Name	Scientific Name	Year	Bycatch	Unit	CV	Footnote(s)
Pelagic cormorant - Pacific	Phalacrocorax pelagicus	2012	18.00	INDIVIDUAL	0.98	
Seabirds (unidentified)	Laridae	2012	54.00	INDIVIDUAL	0.72	
Fishery total			**72.00**			

Table 8. National Bycatch Report Update 2: 2012, expanded estimates of seabird bycatch by fishery; estimated seabird bycatch for the CA halibut/white seabass and other species set gillnet fishery for 2012.

White Sharks

The NMFS status report of the Northeastern white shark population estimates an average of 25 white sharks were caught annually in the CA set gillnet fishery from 2001 – 2011, representing the most recent estimate of annual white shark catch. [40] Most white sharks reported in logbooks over the data period (1982 – 2012) were young of year. White shark mortality increases with soak duration of the nets.[41] This take of white sharks represents 93% of all white shark catch estimated in observed West Coast fisheries.

[39] NMFS. National Bycatch Report Database, Seabird Bycatch by Fishery 2011, 2012, Update 2. https://appsst.fisheries.noaa.gov/stapex/f?p=243:101:29602220642274:::::. Accessed July 2023

[40] Dewar et al. 2013. Status Review of the Northeastern Pacific Population of White Sharks (Carcharodon Carcharias) under the Endangered Species Act, 2013. https://repository.library.noaa.gov/view/noaa/17705. Table 4.3 Average estimated catches from U.S. west coast set nets 2001-2011.

[41] Lyons, K., et al., The degree and result of gillnet fishery interactions with juvenile white sharks in southern California assessed by fishery-independent and -dependent methods. Fish. Res. (2013), http://dx.doi.org/10.1016/j.fishres.2013.07.009

Data and Management Gaps

The lack of comprehensive monitoring programs in state fisheries to assess bycatch and integrate data into population and stock models seriously impedes a full understanding of bycatch consequences and impacts on target and incidentally retained species. However, where evidence for significant bycatch exists, a risk-averse and adaptive management approach is clearly warranted.

In addition to identified sustainability concerns and ecosystem risk, this analysis highlights several key areas of uncertainty that warrant improved data collection. These include:

- Gear marking to enable positive and negative attribution of gillnet wildlife entanglements to the California set gillnet fishery.
- Consistent and regular observer coverage and/or electronic video monitoring to increase sample sizes.
- Collection of data on the number and duration of sets, the set location, and length of each net for each set to enable total effort calculations and accurate estimates of total catch and discards.
- Stock assessments or data-limited assessments for incidentally caught and retained species as well as discards.
- Differentiating observer coverage based on set gillnet mesh sizes to compare catch compositions in halibut-targeting vs. white seabass-targeting sets.
- Evaluating the effects of soak time on discard mortality.

Despite these uncertainties and data gaps, the publicly available data on bycatch in the California set gillnet fishery indicates a wide suite of conservation concerns across the MLMA Criteria for determining acceptable levels of bycatch. The high number of species caught in the fishery suggests that significant management improvements are necessary to ensure sustainability and keep bycatch to acceptable types and amounts under the MLMA.

Appendix

Table 9. NMFS Set Gillnet Observer Data;[42] totals have been compiled over the 6 years of available data 2007 – 2017 over 1,258 sets observed. Included in the table is the Discard Mortality Rate based on observer data, Percent Retained based on observer data, and total extrapolated estimates for 2007 – 2021 based upon the 1set:1trip ratio explained in the *total effort methods* section above. Total extrapolated estimates of catch, discard, and discard mortality are based upon an estimated 24,699 sets from 2007 – 2021. Average annual estimated sets over this period are 1,653.

Species	Total Observed Catch (2007 - 2017)	Observed Retained	Observed Discarded	Observed Returned Dead	Observed Returned Alive	Observed Returned Unknown	Discard Rate (Total discarded/total caught)	Discard Mortality Rate (total discarded dead/ total discarded)	Rate Retained (total retained/ total caught)	Min Catch Estimate (2007 - 2021)	Min Discard Estimate (2007 - 2021)	Min Discard Mortality Estimate (2007 - 2021)
Seabass, White	3049	2975	74	67	6	1	2.4%	90.5%	97.6%	60,105	1,459	1,321
Mackerel, Pacific	2354	228	2126	2098	28	0	90.3%	98.7%	9.7%	46,404	41,910	41,358
Crab, Rock	1501	221	1280	722	546	12	85.3%	56.4%	14.7%	29,589	25,233	14,233
Crab, Spider	1166	321	845	421	409	15	72.5%	49.8%	27.5%	22,985	16,658	8,299
Halibut, California	999	878	121	48	73	0	12.1%	39.7%	87.9%	19,693	2,385	946
Squid, Jumbo (Humboldt)	874	27	847	753	32	62	96.9%	88.9%	3.1%	17,229	16,697	14,844
Shark, Swell	783	52	731	15	713	3	93.4%	2.1%	6.6%	15,435	14,410	296
Crab, Pointer	700	54	646	526	120	0	92.3%	81.4%	7.7%	13,799	12,735	10,369
Ray, Bat	672	296	376	77	295	4	56.0%	20.5%	44.0%	13,247	7,412	1,518
Skate, California	501	110	391	34	357	0	78.0%	8.7%	22.0%	9,876	7,708	670
Skate, Longnose	385	78	307	71	231	5	79.7%	23.1%	20.3%	7,590	6,052	1,400
Sea Star	382	0	382	1	376	5	100.0%	0.3%	0.0%	7,530	7,530	20
Whelk	377	137	240	5	223	12	63.7%	2.1%	36.3%	7,432	4,731	99
Dogfish, Spiny	357	21	336	120	210	6	94.1%	35.7%	5.9%	7,038	6,624	2,366
Shark, Pacific Angel	341	125	216	30	186	0	63.3%	13.9%	36.7%	6,722	4,258	591
Shark, Brown Smoothhound	339	55	284	134	150	0	83.8%	47.2%	16.2%	6,683	5,599	2,642
Shark, Leopard	214	106	108	49	57	2	50.5%	45.4%	49.5%	4,219	2,129	966
Ratfish, Spotted	201	2	199	134	65	0	99.0%	67.3%	1.0%	3,962	3,923	2,642
Yellowtail	196	192	4	4	0	0	2.0%	100.0%	98.0%	3,864	79	79
Crab, Red Rock	180	1	179	165	11	3	99.4%	92.2%	0.6%	3,548	3,529	3,253
Barracuda, California	177	134	43	42	1	0	24.3%	97.7%	75.7%	3,489	848	828
Scorpionfish, California	174	55	119	49	69	1	68.4%	41.2%	31.6%	3,430	2,346	966
Shark, Common Thresher	144	130	14	4	8	2	9.7%	28.6%	90.3%	2,839	276	79
Crab, Yellow	139	2	137	80	55	2	98.6%	58.4%	1.4%	2,740	2,701	1,577
Shark, Soupfin	126	40	86	55	31	0	68.3%	64.0%	31.7%	2,484	1,695	1,084
Crab, Unidentified	107	0	107	95	12	0	100.0%	88.8%	0.0%	2,109	2,109	1,873
Lobster, California Spiny	103	2	101	4	97	0	98.1%	4.0%	1.9%	2,030	1,991	79
Bass, Barred Sand	101	3	98	36	62	0	97.0%	36.7%	3.0%	1,991	1,932	710
Thornback	99	1	98	3	95	0	99.0%	3.1%	1.0%	1,952	1,932	59

[42] National Marine Fisheries Service. Accessed 2022. California Set Gillnet Observer Program, Observed Catch 2007-01-01 to 2017-12-31. Available: https://media.fisheries.noaa.gov/2022- 01/setnet-catch-summaries-2007-2010-2013-2017.pdf *observer data is recorded by number of animals

Guitarfish, Shovelnose	96	68	28	1	27	0	29.2%	3.6%	70.8%	1,892	552	20
California Sea Lion	90	0	90	89	1	0	100.0%	98.9%	0.0%	1,774	1,774	1,754
Sea Cucumber	88	16	72	5	29	38	81.8%	6.9%	18.2%	1,735	1,419	99
Cabezon	77	14	63	7	55	1	81.8%	11.1%	18.2%	1,518	1,242	138
Lingcod	68	5	63	30	33	0	92.6%	47.6%	7.4%	1,340	1,242	591
Skate, Big	65	3	62	0	62	0	95.4%	0.0%	4.6%	1,281	1,222	0
Invertebrate, Unid.	47	9	38	8	4	26	80.9%	21.1%	19.1%	927	749	158
Tunicates, Pelagic	45	0	45	20	0	25	100.0%	44.4%	0.0%	887	887	394
Crustacean, Unidentified	43	6	37	25	12	0	86.0%	67.6%	14.0%	848	729	493
Bass, Giant Sea	34	26	8	4	4	0	23.5%	50.0%	76.5%	670	158	79
Rockfish, Bocaccio	31	0	31	18	10	3	100.0%	58.1%	0.0%	611	611	355
Sheephead, California	28	9	19	7	12	0	67.9%	36.8%	32.1%	552	375	138
Hake, Pacific	27	0	27	27	0	0	100.0%	100.0%	0.0%	532	532	532
Sardine, Pacific	27	0	27	27	0	0	100.0%	100.0%	0.0%	532	532	532
Shark, Horn	26	4	22	1	21	0	84.6%	4.5%	15.4%	513	434	20
Sea Urchin	26	2	24	3	19	2	92.3%	12.5%	7.7%	513	473	59
Butterfish, Pacific	25	12	13	8	5	0	52.0%	61.5%	48.0%	493	256	158
Sole, English	25	2	23	3	20	0	92.0%	13.0%	8.0%	493	453	59
Sole, Fantail	21	6	15	3	12	0	71.4%	20.0%	28.6%	414	296	59
Sanddab, Pacific	21	1	20	7	13	0	95.2%	35.0%	4.8%	414	394	138
Shark, Gray Smoothhound	20	8	12	3	9	0	60.0%	25.0%	40.0%	394	237	59
Cormorant, Unidentified	20	0	20	16	4	0	100.0%	80.0%	0.0%	394	394	315
Sole, Slender	19	2	17	8	9	0	89.5%	47.1%	10.5%	375	335	158
Whitefish, Ocean	19	2	17	4	13	0	89.5%	23.5%	10.5%	375	335	79
Octopus, Unidentified	19	1	18	1	17	0	94.7%	5.6%	5.3%	375	355	20
Crab, Marble	19	0	19	17	2	0	100.0%	89.5%	0.0%	375	375	335
Skate, Starry	19	0	19	2	16	1	100.0%	10.5%	0.0%	375	375	39
Shark, Shortfin Mako	17	17	0	0	0	0	0.0%	retained	100.0%	335	0	0
Stingray, Round	17	3	14	1	13	0	82.4%	7.1%	17.6%	335	276	20
Sculpin, Unidentified	17	1	16	3	13	0	94.1%	18.8%	5.9%	335	315	59
Crab, Dungeness	16	0	16	8	8	0	100.0%	50.0%	0.0%	315	315	158
Crab, California King	14	11	3	0	3	0	21.4%	0.0%	78.6%	276	59	0
Rockfish, Vermilion	14	1	13	9	4	0	92.9%	69.2%	7.1%	276	256	177
Croaker, White	14	0	14	11	3	0	100.0%	78.6%	0.0%	276	276	217
Flatfish, Unidentified	13	3	10	2	8	0	76.9%	20.0%	23.1%	256	197	39
Turbot, Hornyhead	12	4	8	3	5	0	66.7%	37.5%	33.3%	237	158	59
Bass, Kelp	12	0	12	2	9	1	100.0%	16.7%	0.0%	237	237	39
Rockfish, Copper	12	0	12	8	3	1	100.0%	66.7%	0.0%	237	237	158
Bonito, Pacific	11	10	1	1	0	0	9.1%	100.0%	90.9%	217	20	20
Cormorant, Brandt's	11	0	11	11	0	0	100.0%	100.0%	0.0%	217	217	217
Croaker, Yellowfin	9	3	6	1	5	0	66.7%	16.7%	33.3%	177	118	20

Sanddab, Longfin	9	3	6	6	0	0	66.7%	100.0%	33.3%	177	118	118
Crab, Decorator	9	0	9	4	5	0	100.0%	44.4%	0.0%	177	177	79
Salmon, King	9	0	9	8	1	0	100.0%	88.9%	0.0%	177	177	158
Turbot, Diamond	9	0	9	0	9	0	100.0%	0.0%	0.0%	177	177	0
Harbor Seal	9	0	9	9	0	0	100.0%	100.0%	0.0%	177	177	177
Octopus	8	0	8	0	8	0	100.0%	0.0%	0.0%	158	158	0
Ray, California Butterfly	8	0	8	1	7	0	100.0%	12.5%	0.0%	158	158	20
Shark, Prickly	8	0	8	0	8	0	100.0%	0.0%	0.0%	158	158	0
Snail, Unidentified	8	0	8	0	8	0	100.0%	0.0%	0.0%	158	158	0
Sole, Rock	7	6	1	0	1	0	14.3%	0.0%	85.7%	138	20	0
Lizardfish, California	7	2	5	4	1	0	71.4%	80.0%	28.6%	138	99	79
Skate, Unidentified	7	0	7	1	5	1	100.0%	14.3%	0.0%	138	138	20
Flounder, Starry	6	5	1	1	0	0	16.7%	100.0%	83.3%	118	20	20
Shad, American	6	4	2	2	0	0	33.3%	100.0%	66.7%	118	39	39
Crab, Opossum	6	1	5	2	3	0	83.3%	40.0%	16.7%	118	99	39
Shark, Sevengill	6	1	5	3	2	0	83.3%	60.0%	16.7%	118	99	59
Turbot, Curlfin	6	0	6	3	3	0	100.0%	50.0%	0.0%	118	118	59
Sole, Sand	5	1	4	2	2	0	80.0%	50.0%	20.0%	99	79	39
Fish, Unidentified	5	0	5	5	0	0	100.0%	100.0%	0.0%	99	99	99
Mackerel, Bullet	5	0	5	5	0	0	100.0%	100.0%	0.0%	99	99	99
Ray, Pacific Electric	5	0	5	2	3	0	100.0%	40.0%	0.0%	99	99	39
Rockfish, Canary	5	0	5	1	3	1	100.0%	20.0%	0.0%	99	99	20
Sole, Petrale	4	3	1	1	0	0	25.0%	100.0%	75.0%	79	20	20
Anchovy, Northern	4	0	4	4	0	0	100.0%	100.0%	0.0%	79	79	79
Crab, Sand	4	0	4	2	2	0	100.0%	50.0%	0.0%	79	79	39
Mackerel, Jack	4	0	4	2	1	1	100.0%	50.0%	0.0%	79	79	39
Midshipman, Specklefin	4	0	4	0	4	0	100.0%	0.0%	0.0%	79	79	0
Rockfish, Cowcod	4	0	4	0	4	0	100.0%	0.0%	0.0%	79	79	0
Rockfish, Unidentified	4	0	4	3	1	0	100.0%	75.0%	0.0%	79	79	59
Shark, Unidentified	4	0	4	2	2	0	100.0%	50.0%	0.0%	79	79	39
Sole, Bigmouth	4	0	4	1	3	0	100.0%	25.0%	0.0%	79	79	20
Turbot, C-O	4	0	4	1	3	0	100.0%	25.0%	0.0%	79	79	20
Tuna, Yellowfin	3	3	0	0	0	0	0.0%	retained	100.0%	59	0	0
Fish, Other Identified	3	2	1	0	1	0	33.3%	0.0%	66.7%	59	20	0
Turbot, Spotted	3	1	2	0	2	0	66.7%	0.0%	33.3%	59	39	0
Bird, Unidentified	3	0	3	3	0	0	100.0%	100.0%	0.0%	59	59	59
Crab, Hermit	3	0	3	0	3	0	100.0%	0.0%	0.0%	59	59	0
Crab, Northern Kelp	3	0	3	2	1	0	100.0%	66.7%	0.0%	59	59	39
Mollusk, Unidentified	3	0	3	0	3	0	100.0%	0.0%	0.0%	59	59	0
Murre, Common	3	0	3	3	0	0	100.0%	100.0%	0.0%	59	59	59
Rockfish, Gopher	3	0	3	2	1	0	100.0%	66.7%	0.0%	59	59	39

Rockfish, Treefish	3	0	3	1	2	0	100.0%	33.3%	0.0%	59	59	20
Shark, Blue	3	0	3	0	3	0	100.0%	0.0%	0.0%	59	59	0
Skate, Other Identified	3	0	3	0	3	0	100.0%	0.0%	0.0%	59	59	0
Unidentified Cormorant	3	0	3	3	0	0	100.0%	100.0%	0.0%	59	59	59
Rockfish, Grass	2	2	0	0	0	0	0.0%	retained	100.0%	39	0	0
Halfmoon	2	0	2	2	0	0	100.0%	100.0%	0.0%	39	39	39
Mola, Common	2	0	2	0	2	0	100.0%	0.0%	0.0%	39	39	0
Needlefish, California	2	0	2	0	2	0	100.0%	0.0%	0.0%	39	39	0
Rockfish, Bank	2	0	2	0	1	1	100.0%	0.0%	0.0%	39	39	0
Rockfish, Brown	2	0	2	0	2	0	100.0%	0.0%	0.0%	39	39	0
Sablefish	2	0	2	1	1	0	100.0%	50.0%	0.0%	39	39	20
Short Beak Common Dolphin	2	0	2	2	0	0	100.0%	100.0%	0.0%	39	39	39
Surfperch, Other Ident.	2	0	2	2	0	0	100.0%	100.0%	0.0%	39	39	39
Surfperch, Pink	2	0	2	2	0	0	100.0%	100.0%	0.0%	39	39	39
Surfperch, Rubberlip	2	0	2	2	0	0	100.0%	100.0%	0.0%	39	39	39
Long Beak Common Dolphin	2	0	2	2	0	0	100.0%	100.0%	0.0%	39	39	39
Shark, White	1	1	0	0	0	0	0.0%	retained	100.0%	20	0	0
Cormorant, Double-crested	1	0	1	1	0	0	100.0%	100.0%	0.0%	20	20	20
Croaker, Spotfin	1	0	1	1	0	0	100.0%	100.0%	0.0%	20	20	20
Echinoderm, Unidentified	1	0	1	0	1	0	100.0%	0.0%	0.0%	20	20	0
Fringehead, Sarcastic	1	0	1	0	1	0	100.0%	0.0%	0.0%	20	20	0
Garibaldi	1	0	1	0	1	0	100.0%	0.0%	0.0%	20	20	0
Guitarfish, Banded	1	0	1	0	1	0	100.0%	0.0%	0.0%	20	20	0
Gull, Unidentified	1	0	1	1	0	0	100.0%	100.0%	0.0%	20	20	20
Hagfish, Pacific	1	0	1	1	0	0	100.0%	100.0%	0.0%	20	20	20
Pelagic Cormorant	1	0	1	1	0	0	100.0%	100.0%	0.0%	20	20	20
Pinniped, Unidentified	1	0	1	1	0	0	100.0%	100.0%	0.0%	20	20	20
Pipefish, Bay	1	0	1	0	1	0	100.0%	0.0%	0.0%	20	20	0
Rockfish, Bronzespotted	1	0	1	0	0	1	100.0%	0.0%	0.0%	20	20	0
Rockfish, Kelp	1	0	1	1	0	0	100.0%	100.0%	0.0%	20	20	20
Rockfish, Rosy	1	0	1	0	0	1	100.0%	0.0%	0.0%	20	20	0
Salmon, Other Identified	1	0	1	1	0	0	100.0%	100.0%	0.0%	20	20	20
Sanddab, Speckled	1	0	1	0	1	0	100.0%	0.0%	0.0%	20	20	0
Sanddab, Unidentified	1	0	1	0	1	0	100.0%	0.0%	0.0%	20	20	0
Searobin, Lumptail	1	0	1	0	1	0	100.0%	0.0%	0.0%	20	20	0
Shark, Sixgill	1	0	1	0	1	0	100.0%	0.0%	0.0%	20	20	0
Sole, Rex	1	0	1	1	0	0	100.0%	100.0%	0.0%	20	20	20
Triggerfish, Finescale	1	0	1	0	1	0	100.0%	0.0%	0.0%	20	20	0
Unidentified Gull	1	0	1	1	0	0	100.0%	100.0%	0.0%	20	20	20
Total	**18254**	**6530**	**11724**	**6358**	**5127**	**239**	**64.2%**	**54.2%**	**35.8%**	**359,842**	**231,116**	**125,335**

Table 10. Chondrichthyes species recorded in the observer data including any current management, stock assessments, and general information from the observer data.

Chondrichthyes Species	Enhanced status report	PSA Vulnerability Score (Degrees of vulnerability, as follows: lowest, V < 1.8; medium, 1.8 < V < 2.0; high, 2.0 < V < 2.2; and highest, V > 2.2)	Fishery Management Plan (FMP)	Stock Assessment (in the last 10 years)	Stock Status	Discard Mortality Rate	Observed Discarded Dead	Observed Retained	Observed total catch
Spotted Ratfish	No		Ecosystem Component Species GFMP	No	None	67%	134	2	201
Brown Smoothhound Shark	Enhanced Status Report	1.77	No FMP	No	None	47%	134	55	339
Spiny Dogfish	No		"In the fishery" of the GFMP	Spiny Dogfish Stock Assessment	42% of unexploited levels	36%	120	21	357
Bat Ray	No		No FMP	No	None	21%	77	296	672
Longnose Skate	No		"In the fishery" of the GFMP	Longnose Skate (CA, OR, WA) Stock Status	57% unexploited levels	24%	71	78	385
Soupfin Shark	No		Ecosystem Component Species GFMP	No	None	64%	55	40	126
Leopard Shark	No		"In the fishery" of the GFMP	No	None	46%	49	106	214
California Skate	No		Ecosystem Component Species GFMP	No	None	9%	34	110	501
Pacific Angel Shark	Enhanced Status Report	2.02	No FMP	No	None	14%	30	125	341
Swell Shark	No		No FMP	No	None	2%	15	52	783
Common Thresher Shark	No		"In the fishery" of the HMS FMP	Common Thresher Stock Assessment	Not overfished or subject to overfishing	33%	4	130	144
Sevengill shark	No		No FMP	No	None	60%	3	1	6
Gray Smoothhound Shark	No		No FMP	No	None	25%	3	8	20
Thornback	No		No FMP	No	None	3%	3	1	99
Pacific Electric Ray	No		No FMP	No	None	40%	2	0	5
Starry Skate	No		No FMP	No	None	11%	2	0	19
California Butterfly Ray	No		No FMP	No	None	13%	1	0	8
Round Stingray	No		No FMP	No	None	7%	1	3	17
Horn Shark	No		No FMP	No	None	5%	1	4	26
Shovelnose Guitarfish	No		No FMP	No	None	4%	1	68	96
Banded Guitarfish	No		No FMP	No	None	NA	0	0	1

Prickly Shark	No		No FMP	No	None	NA	0	0	8
Sixgill Shark	No		No FMP	No	None	NA	0	0	1
White Shark	No		No FMP	Central Coast Abundance estimates	286 adults/subadults	NA	0	1	1
Shortfin Mako	No		"In the fishery" of the HMS FMP	Shortfin Mako North Pacific Stock Assessment through 2016	# of mature females 36% higher # of mature females at MSY	0%	0	17	17
Blue Shark	No		"In the fishery" of the HMS FMP	Blue Shark Stock Assessment NPO	Not in an overfished state	0%	0	0	3
Big Skate	No		"In the fishery" of the GFMP	Stock status of big skate US Pacific Coast	79.2% of Unfished spawning biomass	0%	0	3	65

Table 11. Example species and information pertinent to the MLML Bycatch Inquiry for assessing sustainability and acceptability of bycatch.

Bycatch Inquiry Factor	**Soupfin (Tope) Shark**	**Brown Smoothhound**	**Bat Ray**
Ecosystem Importance	Sharks are apex predators, maintaining healthy and balanced ecosystems through predator top-down control. Depletion of shark populations is known to limit ecosystem function and resilience.	Sharks are apex predators, maintaining healthy and balanced ecosystems through predator top-down control. Depletion of shark populations is known to limit ecosystem function and resilience.	As predatory species, skates play pivotal roles in the regulation of lower trophic level organisms and, therefore, of marine ecosystems, especially after the decline of the largest top predators such as large pelagic sharks (Shepherd and Myers, 2005, Myers et al., 2007, Baum and Worm, 2009)
Population Status	No population assessment ESA candidate species IUCN Critically Endangered Population crashed in 1940s (Vitamin A fishery) Remains depleted	No population assessment.	No population assessment. Status of California rays and skates highly uncertain
Inherent Vulnerability	Triennial reproductive cycle (reproduces once every 3 years) Southern California nursery grounds (females and juveniles caught in SoCal) Late sexual maturity Fishbase: Very high vulnerability (76 of 100)	A Productivity Susceptibility Analysis ranked brown smoothhound the second most vulnerable state-managed finfish behind Pacific angel shark (Swasey et al. 2016). Fishbase: High Vulnerability (58 of 100)	Late onset maturity, low fecundity, and slow growth. Fishbase: Very high vulnerability (75 of 100)
Impacts from Set Gillnet Fishery	Minimum estimate of 1,695 sharks discarded from 2007 – 2021 (based on 1 set to 1 trip extrapolation) High discard mortality rate (64%) Historic regional depletions in Southern CA due to set net impacts	47% discard mortality Most discarded dead of all Chondrichthyes by number of animals	21% discard mortality Minimum of ~7,400 discarded 2007 – 2021 (based on 1 set to 1 trip extrapolation) Caught and landed at high rates with no catch limits (present in ~13% of set gillnet sets targeting CA halibut; not including white seabass targeting sets) (Chris Free Bycatch Report 2022)

From: Birch, Caitlynn <cbirch@oceana.org>
Sent: Friday, July 7, 2023 03:51 PM
To: FGC <FGC@fgc.ca.gov>; Ashcraft, Susan@FGC <[redacted]>
Subject: RE: Public Comment for July MRC Agenda Item 3

Please also include the attached sign-on letter for inclusion in the MRC binder under Agenda Item 3: Set gillnet bycatch evaluation. Thanks!!

Caitlynn

From: Birch, Caitlynn
Sent: Friday, July 7, 2023 3:45 PM
To: FGC <fgc@fgc.ca.gov>; Ashcraft, Susan@FGC <[redacted]>
Cc: Miller-Henson, Melissa@FGC <[redacted]>
Subject: Public Comment for July MRC Agenda Item 3

Hi Susan,

Please include the attached comment letter plus attachment for inclusion in the MRC binder under **Agenda Item 3: Evaluation of bycatch in the California halibut set gillnet fishery in support of the fishery management review**. Apologies for its extreme lengthiness! Appreciate all your work leading up to the MRC and hope you have a great weekend! Stay cool in Sac next week.

Caitlynn

Caitlynn Birch | Pacific Marine Scientist

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July 7, 2023
Mr. Eric Sklar, President
California Fish and Game Commission
P.O. Box 944209
Sacramento, CA 94244-2090

RE: Marine Resource Committee Agenda Item 3: Set Gillnet Bycatch Evaluation

Dear President Sklar and Members of the Commission,

We the undersigned scientists see a strong need to address and minimize bycatch in state managed fisheries. Effectively assessing and minimizing bycatch is a fundamental cornerstone of sustainable, ecosystem-based fishery management (Pew Oceans Commission). The unintended catch and discarding of marine life – known as bycatch – is widely considered among the top ecological impacts of fisheries (Hall et al. 2000, Davies et al. 2009, Donaldson et al. 2011). Fisheries bycatch can have ecosystem-level effects by changing the abundance of non-target species, alter biodiversity by removing predator and prey species at unsustainable levels, and becomes a particularly visible conservation concern when it involves threatened groups (e.g. sharks, seabirds, marine mammals) (Hall et al. 2000, Cook 2001, Gilman et al. 2008). Biodiversity is a key component in stable ecosystems which are facing unprecedented stressors from warming ocean temperatures, habitat loss, and other anthropogenic impacts (Worm et al. 2006, Heip et al 2009).

Bycatch in gillnets has long been recognized as a global conservation concern. The low selectivity and high mortality rates of bycatch in gillnets has been implicated in regional and population level declines of many vulnerable species in marine ecosystems globally (Forney et al. 2001, Read 2006, Pondella and Allen 2008, Zyldelis et al. 2009, Rodríguez-Quiroz et al. 2012, Regular et al. 2013, Reeves et al. 2013, Wallace et al. 2013, Lewison et al. 2014, Herrera et al. 2017). Relative to other fisheries, bottom set gillnets continue to pose some of the greatest management and conservation challenges, particularly when mortality and species impacts are not monitored (Berrow 1994, Alverson et al. 1994, Cook 2003, Forney et al. 2001, Dunn et al. 2009, Shester and Micheli 2011, Micheli et al. 2014).

Non-selective gear types such as bottom gillnets that are fished in diverse ecosystems like the Southern California Bight have the potential to significantly impact the diversity, function, and resilience of the ecosystem if not thoughtfully managed. The California set gillnet fishery has high rates of bycatch and discard mortality, and impacts over 125 species including marine mammals, sharks, rays, skates, and other fish, many of which have unassessed populations and vulnerable life histories that make them susceptible to depletion. A key principle of ecosystem-based fisheries management is the need to protect ecosystems and populations by applying the precautionary principle (Dayton 1998, Chuenpagdee et al. 2003). California fisheries must forge the path towards ecosystem-based and sustainable management of fish and wildlife stocks, target and non-target species. A growing body of scientific research shows us the fragile nature of the oceans, and the defaunation processes that currently threaten marine ecosystems (Pauly et al. 2002, Myers et al. 2007, McCauley et al. 2015). In this context, it is imperative to consider the ecological impacts of fisheries that have disproportionate impacts on wildlife and fish stocks. There is a strong need to consider all ecosystem stressors and impacts when considering fisheries management in the 21st century. Precautionary and adaptive management approaches are warranted. We urge to California Fish and Game Commission to

thoughtfully consider the impacts of this fishery in the context of an ecosystem-based approach, and take further management actions to minimize harmful bycatch.

Sincerely,

Fiorenza Micheli, Ph.D., Professor, Hopkins Marine Station of Stanford University

Neil Hammerschlag, Ph.D., Founder, Atlantic Shark Expeditions

Judith Weis, Ph.D., Professor Emerita, Rutgers University

Douglas McCauley, Ph.D., Professor, University of California Santa Barbara

Katie Lubarsky, Staff Researcher, Scripps Institution of Oceanography

Joseph J. Cech, Jr., Ph.D., Professor Emeritus of Fisheries Biology, University of California Davis

Kathryn Matthews, Ph.D., Chief Scientist, Oceana

Francine Kershaw, Ph.D., Senior Scientist, Natural Resource Defense Council

Kimberly Bolyard, Ph.D., Assoc. Professor of Biology and Environmental Science, Bridgewater College

Gretchen C. Daily, Ph.D., Bing Professor of Environmental Science, Sanford University

Ken Caldeira, Ph.D., Senior Scientist (Emeritus), Carnegie Institution for Science

Mario Mota, Ph.D., Associate Professor, National University

Joy Kumagai, PhD Candidate, Hopkins Marine Station of Stanford University

David Costalago, Ph.D., Marine Scientist, Oceana

Andrea Schreier, Ph.D., Adjunct Associate Professor, University of California Davis

Giulio De Leo, Ph.D., Professor, Hopkins Marine Station of Stanford University

Natalie Arnoldi, PhD candidate, Biology, Hopkins Marine Station of Stanford University

Melissa Palmisciano, PhD Candidate, Stanford University

Maurice Goodman, PhD Student, Stanford University

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Matthews, Kinsey-Contractor@fgc

From: Blacow, Ashley <ablacow@oceana.org>
Sent: Friday, July 7, 2023 10:06 AM
To: FGC
Subject: public comment letter: Agenda Item 3: Evaluation of bycatch in the California halibut set gillnet fishery
Attachments: public comment letter_Agenda Item 3 Evaluation of bycatch in the California halibut set gillnet fishery.pdf

Dear President Sklar and Commissioners,

Please find attached a letter signed by 1,427 California residents in support of reducing bycatch in California's set gillnet fishery. This is in accordance with *Agenda Item 3: Evaluation of bycatch in the California halibut set gillnet fishery in support of the fishery management review* for the July 20 MRC meeting.

Best,
Ashley Draeger

Ashley Blacow-Draeger | Pacific Policy and Communications Manager

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July 6, 2023

California Fish and Game Commission
715 P Street, 16th Floor
Sacramento, CA 95814

Dear President Sklar and Commissioners:

We write urging you to address the unacceptable bycatch in California's set gillnet fishery. Set gillnets are responsible for injuring and killing more than 125 species of ocean animals — most of which are tossed overboard as waste, many already dead or dying. I am concerned that set gillnet fishing gear is compromising the health and biodiversity of the unique ocean ecosystem off Southern California.

Set gillnets are a threat to whales — including humpback and gray whales — and kill more sea lions than all other observed West Coast fisheries combined. Nearly three out of every four sharks, rays, and skates caught are tossed overboard — vulnerable and ecologically important species which grow slowly and reproduce few young. The population status for most of these species has not been assessed.

In many respects, California is a world leader when it comes to addressing ocean health and protecting marine biodiversity. However, one of the most harmful and indiscriminate fishing methods in the country is still being allowed in ocean waters off Southern California including the Channel Islands — a globally important haven for biodiversity often referred to as "the Galapagos of North America."

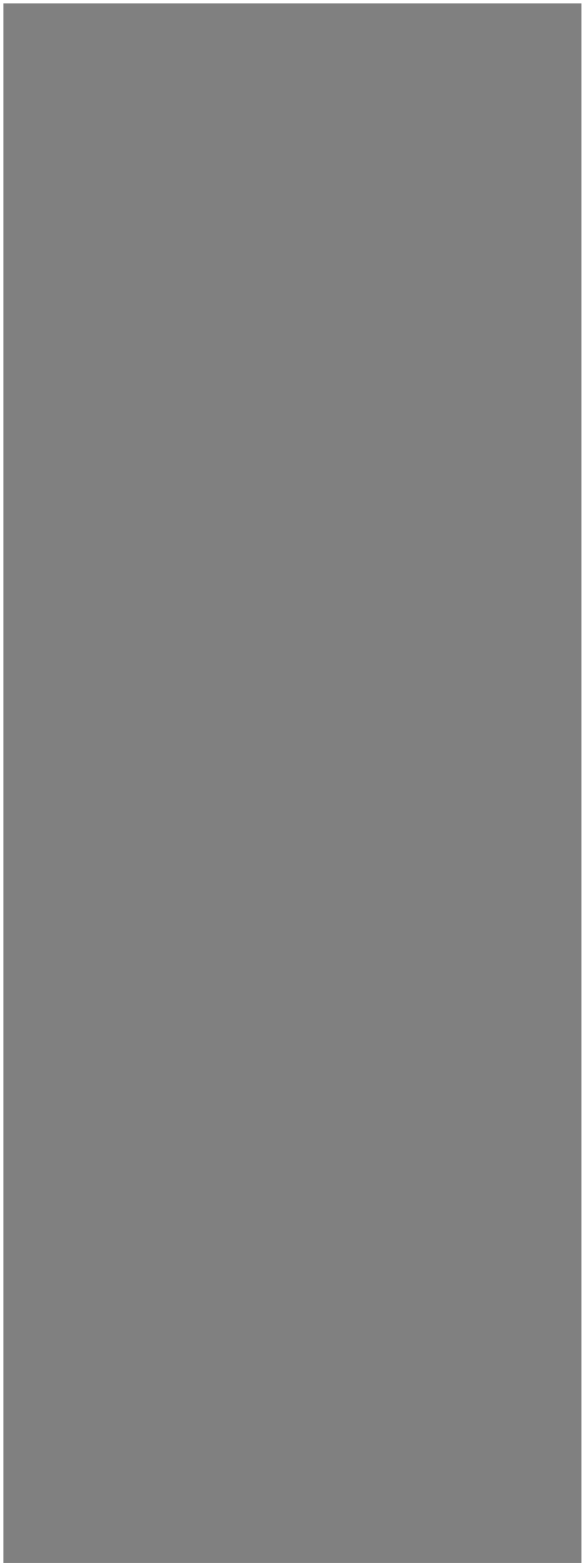
We appreciate the Commission's past actions to address bycatch in this fishery by prohibiting these nets in central coast waters and your current prioritization to evaluate ongoing bycatch in the set gillnet fishery off Southern California. We urge you to formally determine that the bycatch with this fishing method is unacceptable under the criteria in the Marine Life Management Act and take action to reduce bycatch and ensure that the unique ocean ecosystem off California can continue to thrive into the future.

Sincerely,

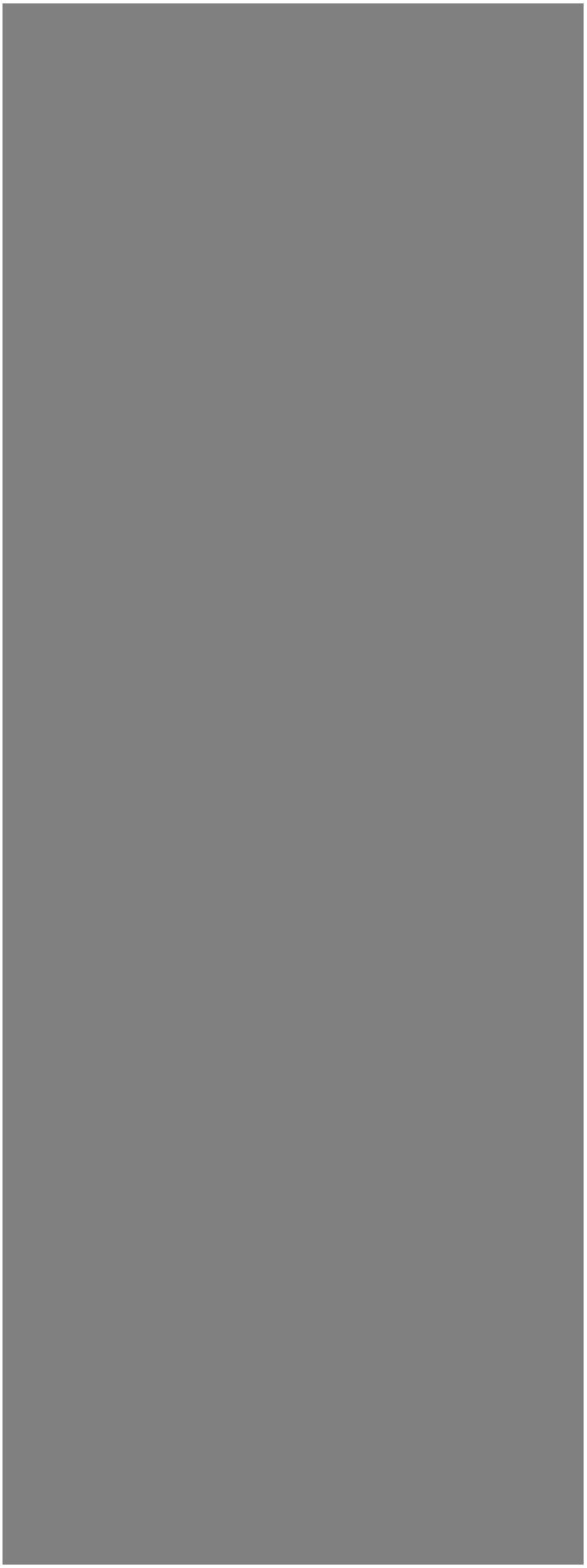
1,427 California residents

First Name	Last Name	City	State	Postal Code
Sara	Abbott			
Rachel	Abdel			
Jennifer	Abernathy			
Alberto	Acosta			
James	Adams			
Elizabeth	Adan			
Steven	Aderhold			
Carolina	Adler			
Natalie	Aharonian			
Kim	Akeman			
Elena	Albanese			
Linda	Albarran			
Susan	Albrecht			
Zubair	Ali			
Julie	Alicea			
Jennifer	Allenprather			
Paul	Almond			
Gregory	Alper			
Mitch	Altieri			
Linda	Alvarado			
Maria	Aminger			
Liz	Amsden			
Jon	Anderholm			
Janis	Andersen			
Barbara	Anderson			
Benjamin	Anderson			
Lorien	Anderson			
Sandra	Anderson			
Sharyl	Andreatta			
S	Andregg			
Tina	Ann			
G.S.	Anson			
Miguel	Apodaca			
Patricia	Appel			
Catherine	Archbold			
Susan	Ardigo			
Gene	Arias			
Laura	Arias			
Elisabeth	Armendarez			
Erika	Armin			
Alisa	Arnold			
Tina	Arnold			
Alejandro	Artigas			
Candi	Ausman			
Joshua	Auth			
Phyllis	Avilla			

Luke	Baade
Jennifer	Baak
Paul	Babbini
Christina	Babst
Kimberly	Bach
Ahna	Backstrom
Lois	Bacon
Ellen	Baer
Jennifer	Bair
Gwyn	Baker
Steven	Bal
Disa	Balderama
Patricia	Baldwin
Barbara	Ballenger
Michele	Banks
Giulia	Barbarito
Liz	Barillas
Allie	Barkalow
Joanne	Barnes
Michael	Barnes
Candice	Barnett
Judith	Barnett
Cara	Barnhill
Melia	Barnum
Nina	Barrios
Elizabeth	Barris
Sandra	Barros
Tim	Bartell
Regina	Basurto
Lori	Bates
Ayse	Batova
Jacqueline	Baudouin
Valerie	Baugher
Gary	Baxel
Jo	Baxter
Heidi	Bean
Jackie	Bear
Deanna	Beck
Carol	Becker
Suzanne	Becket
Victoria	Behar
Rawhi	Beituni
Richard	Bejarano
Mary	Bell
Cassandra	Bellantoni
Michael	Belli
Daniel	Benador

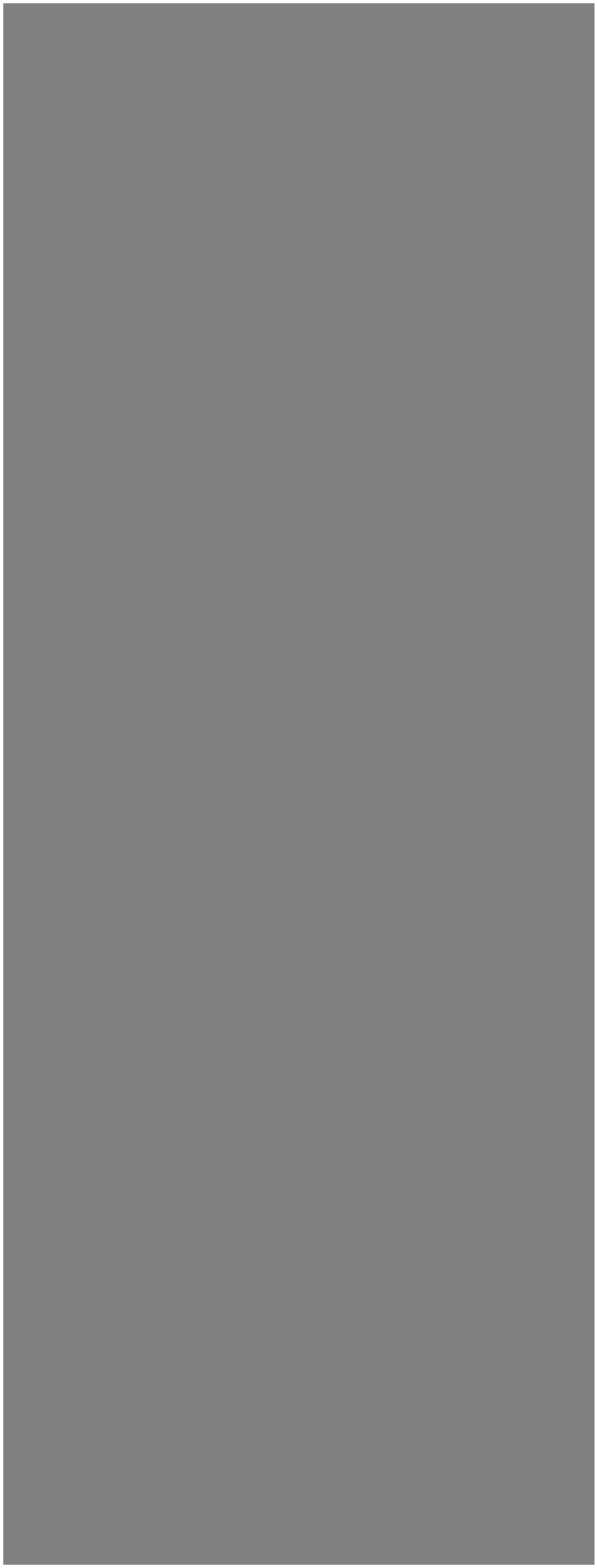


Jan	Bender
Kathryn	Bender
Barb	Benedict
Jeff	Bennett
Annette	Benton
Myra	Berario
Cheryl	Berg
Miriam	Berg
Juliann	Berman
Leah	Berman
Guillermo	Bermudez
June	Bernal
Adam	Bernstein
Kelly	Berry
Yolanda	Berumen
Mark	Beseda
Donald	Betts
Vicky	Bhej
Benjamin	Billhardt
Barbara	Bills
Janet	Bindas
Jennifer	Bindel
Elissa	Binsky
Meredith	Birkhead
Monica	Bishop
Ian	Bixby
Richard	Blain
D	Bleecher
Patricia	Blevins
Kirk	Bloomgarden
Laurel	Blossom
Jessamy	Boas
Trina	Bodine
Kathryn	Boeddiker
Kathy	Boettcher
Robert	Bogart
Susan	Bogdanovich
Casey	Bohrisch
Richard	Bold
Debbie	Bolsky
Michael	Bordenave
Marty	Bostic
Vic	Bostock
William	Boucher
Rob	Boughton
Michael	Bowersox
Ted	Boyce



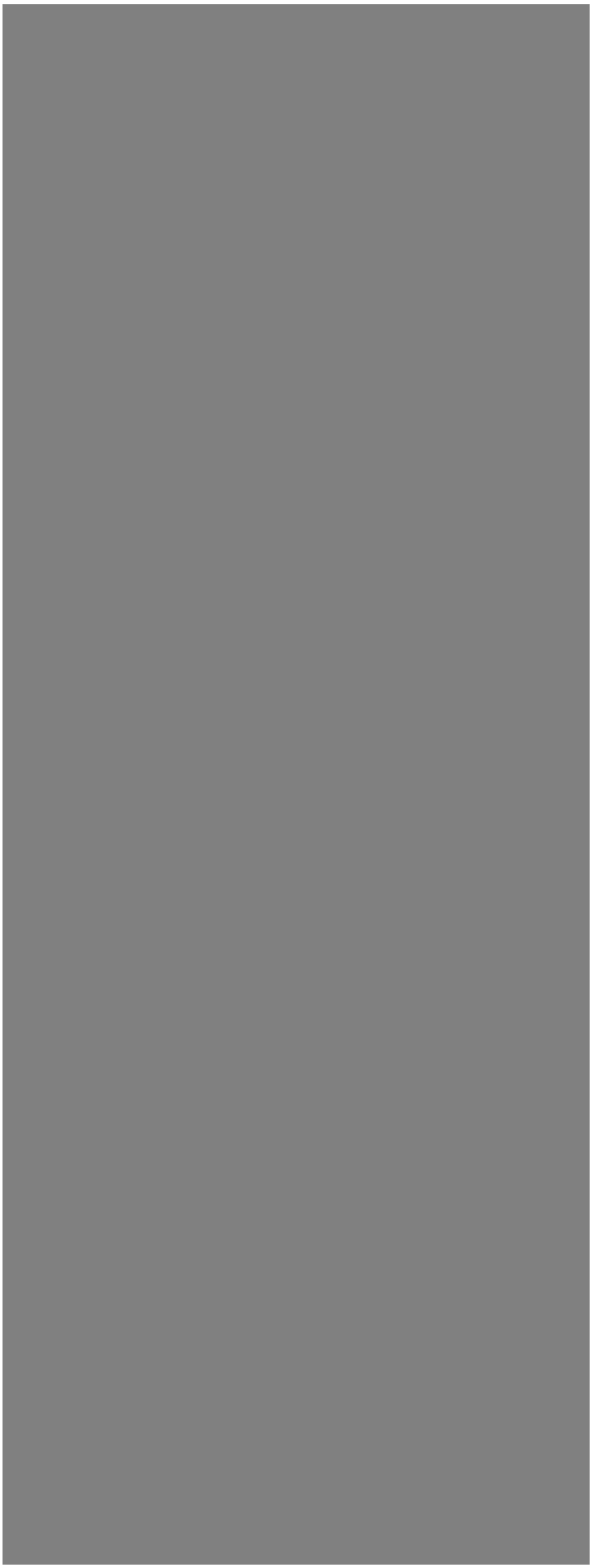
Carol	Boyd
Ellen	Boyd
Jeannie	Boyd
Richard	Boyer
Jill	Boyle
Taryn	Braband
Victoria	Brandon
Kelly	Brannigan
Karen	Brant
Michael	Braude
Rosa	Bravo
Colleena	Brazen
Joan	Breiding
Nathan	Brenner
Tina	Brenza
Michael	Brewer
William	Briggs
Susan	Brisby
Mary	Brooks
Jennifer	Broughel
Elizabeth	Brown
Emma	Brown
Meg	Brown
Bruce	Bryan
Melissa	Bryan
Leo	Buckley
Nancy	Bukowski
Mike	Bullock
Tammy	Bullock
Clinton	Burdette
Deborah	Burge
Russell	Burke
Ruth	Burman
Terrence	Butler
Tim	Butler
Anne	Byers
Linda	Calbreath
Kyle	Calcagno
Charles	Calhoun
Katie	Cali
John	Cameron
Sharon	Camhi
Candace	Campbell
Norma	Campbell
Cheryl	Caplow
Karen	Carl
Shelley	Carlisle

Sharon	Carlson
Jim	Carnal
Gina	Carollo
Lulu	Carpenter
Monica	Carrero
John	Carroll
Suellen	Carroll
Angela	Carter
Grace	Carter
Lynn	Carter
Loretta	Caruana
Edward	Cassidy
James	Castaldi
Ana	Castanos
Margaret	Cechettini
Alex	Cecola
Jayne	Cerny
Ivana	Cerovecki
Nicole	Cervantes
Katherine	Cha
Carina	Chadwick
Claire	Chambers
Christine	Chapman
Elaine	Charkowski
Stacie	Charlebois
Anik	Charron
Ranga	Chary
Allan	Chen
Justin	Chernow
Debi Y	Chew
Antonia	Chianis
Deborah	Chill
Patricia	Ching
Karen	Chinn
Bob	Chirpin
Beng	Chiu
Joseph	Chlubna
AJ	Cho
Andrew	Choubelden
James	Christian
Steven	Christianson
Sandra	Christopher
Natalie	Chronister
Jonathan	Chu
Elaine	Chung
Christina	Ciesla
Raquel	Cito

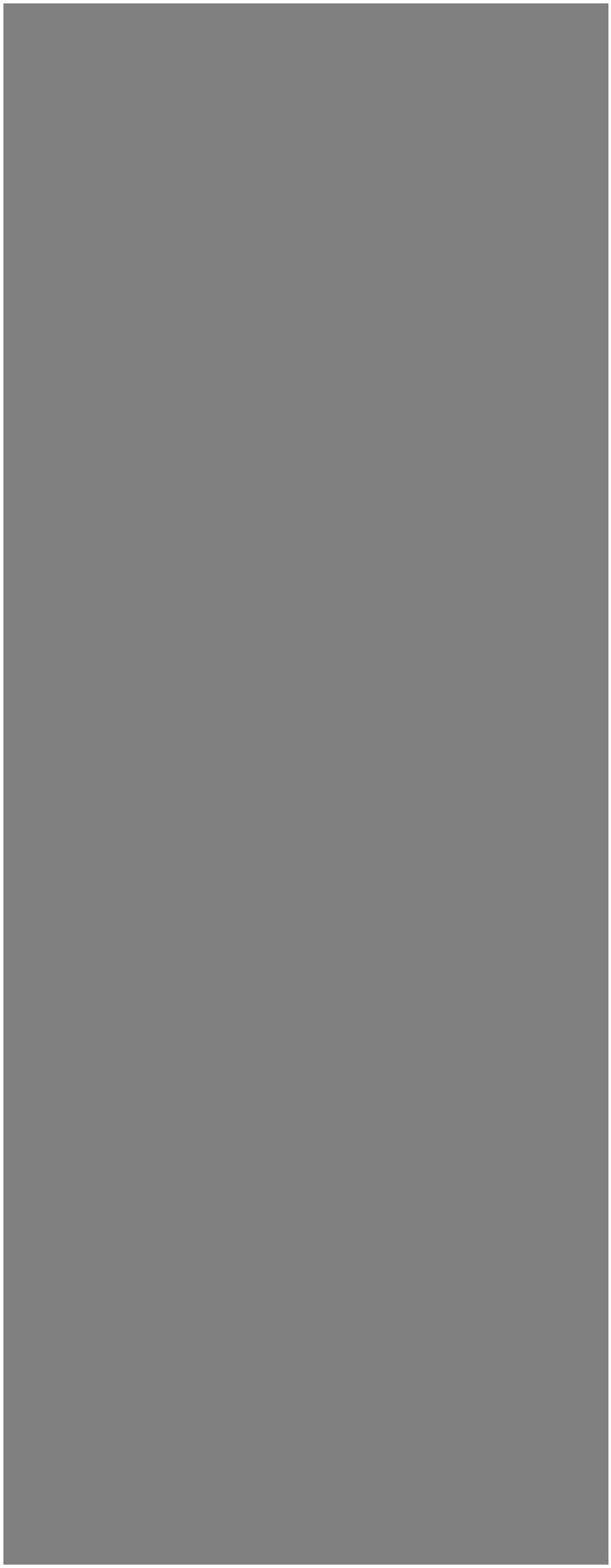


Rebecca	Clark
Beth	Clary
Angela	Clayton
Kathy	Clements
Ruth	Clifford
Luz	Cobarrubias
Charlotte	Cohen
Joanne	Cohen
Tina	Colafranceschi
Cayla	Coleman
Laura	Collins
Deborah	Collodel
Gina	Comin
Gary	Connaught
Thomas	Conroy
Rhianna	Contreras
Elaine	Cook
Jenny	Cook
Thea	Cook
Enoe	Corado
Cecly	Corbett
Natalie	Corkhill
Stacy	Cornelius
Stephanie	Corona
Theresa	Corrigan
Debbie	Corsiglia
Erlinda	Cortez
Francisco	Cortez
Deborah	Cosentino
Bruce	Coston
Michelle	Coulter
Linda	Cowgill
Lorena	Cox
Peter	Cox
A	Craig
Ashley	Craig
Cecelia	Crane
Donna	Crane
Marty	Crane
Jen	Cranne
Rebecca	Crea
Phillip	Cripps
Sonianoemi	Cross
Jean	Crossley
Kurt	Cruger
Sherrell	Cuneo
Grace	Cunningham

Chris	Curtis
Michael	Curtis
Silvio	Curtis
Romona	CzichosSlaughter
Brittney	Dales
Jennifer	Dalton
Emerson	Damiano
Krista	Dana
Elizabeth	Daniels
Marianne	Daranskykanter
Aimee	Darrow
Robyn	Davidoff
Amy	Davis
Carla	Davis
Daniel	Davis
Patti	Davis
Phallon	Davis
Patricia	Day
Joanne	Deanfreemire
Glen	Deardorff
Michael	Dearth
Yves	Decargouet
Pam	Decharo
Ester	Deel
Nan	Dejarlais
Roxanne	Delgado
Rocio	Delira
Rachael	Denny
Richard	Desantis
Elisse	Desio
Linda	Detels
Viola	Deters
Alli	Detwiler
Jean	Devito
Paul	Dewolf
Alison	Dice
Martha	Dickinson
Jeff	Dickson
Lawrence	Dillard
Terry	Dillard
Sanja	Dimitrijevic
Larry	Dinger
Sheila	Dixon
Mary	Doane
Irene	Dobrzanski
Carolyn	Dolen
Renate	Dolin



Alexander	Donofero
Shel	Doonan
Dawna	Dorcas-Werner
Denise	Dorey
Victoria	Douglass
Paulette	Doulatshahi
Stephen	Dousman
Gordon	Dow
Robert	Downer
Sharon	Downs
Ramona	Draeger
Harry	Drandell
Laura	Dufel
Glenda	Dugan
Neville	Dunn
Arnaud	Dunoyer
Nicolas	Duonn
Cindy	Dupray
Brent	Durand
Kira	Durbin
Samuel	Durkin
Claude	Duss
R.C.	Dutra
Laura	Dutton
Ruth	Duvalle
Scott	Eckels
Elaine	Edell
Rick	Edmondson
Johnna	Edmunds
Rich	Elam
Evan	Elias
Evelyn	Ellis
Tracy	Ely
Scott	Emsley
Helen	Engledow
Ruth	Ereza
Kelle	Erwin
Vanessa	Escamilla
Emily	Ettinger
John	Everett
Richard	Falzalorw
Valerie	Fannin
Aisha	Farhoud
Gail	Farina
Linda	Farnell
Wendy	Fears
Samantha	Fedycki



Jami	Feldman
Joan	Fellers
Cindy	Ferguson
Judith	Ferm
Gabriela	Fernandez
Lisa	Ferreira
Mariateresa	Ferrero
Asano	Fertig
Malia	Fesler
Cheryl	Figueroa
Chris	Figueroa
Jason	Fish
Aaron	Fisher
Melanie	Fisher
Ted	Fishman
Stan	Fitzgerald
Tyler	Fitzgerald
Robert	Flagg
Michele	Fletcher
Jessica	Flores
Brooke	Florian
Katie	Flynn
Nancy	Fomenko
Teri	Forester
Erin	Foret
Shasta	Fortin
Nicole	Fountain
Margaret	Fowler
Joy	Fox
Michelle	Fox
Darren	Frale
Mary	Franceschini
Imara	Francioni
Rita	Franco
Peter	Frank
Jessica	Franklin
Katie	Franklin
William	Franklin
Lynn	Franks
Mary	Franz
Mark	Frappier
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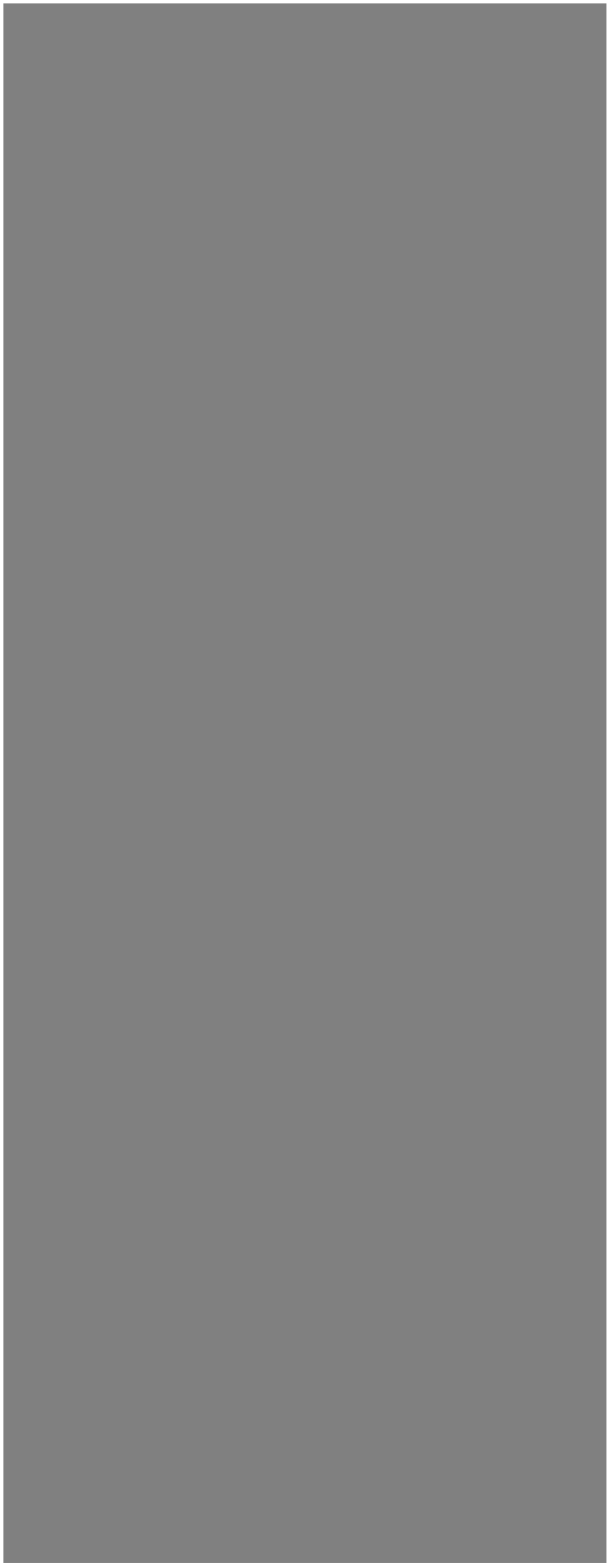
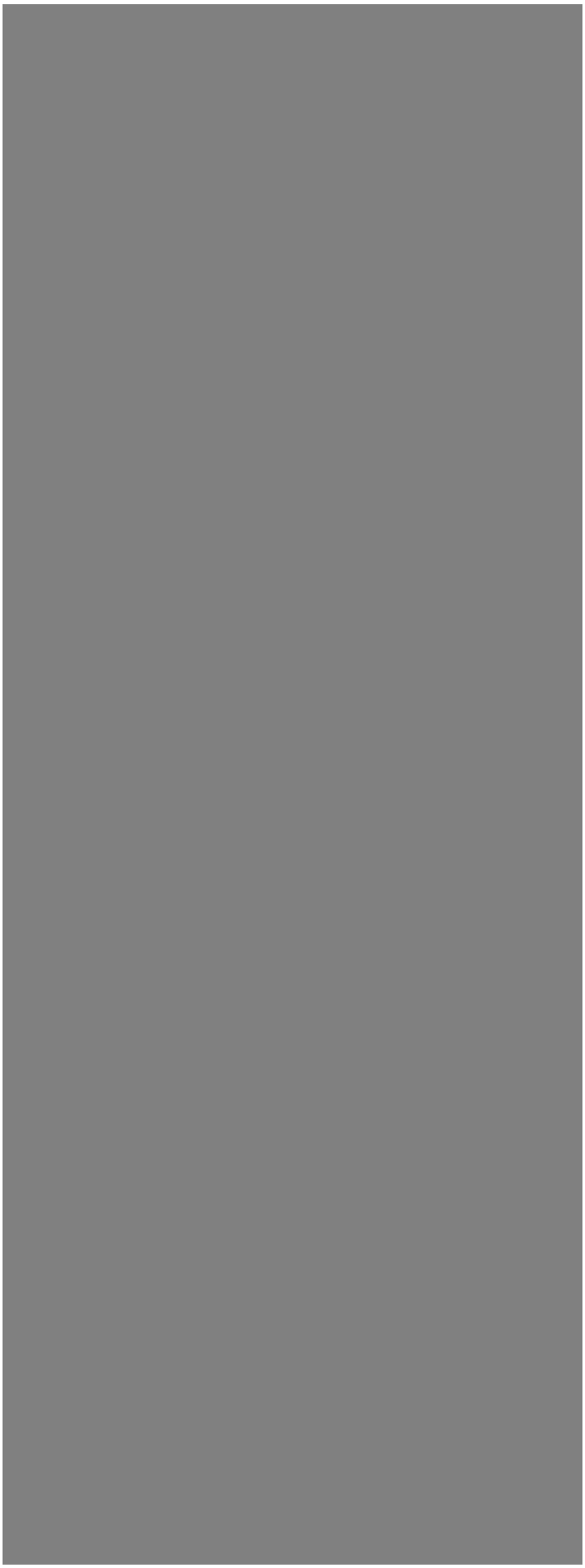
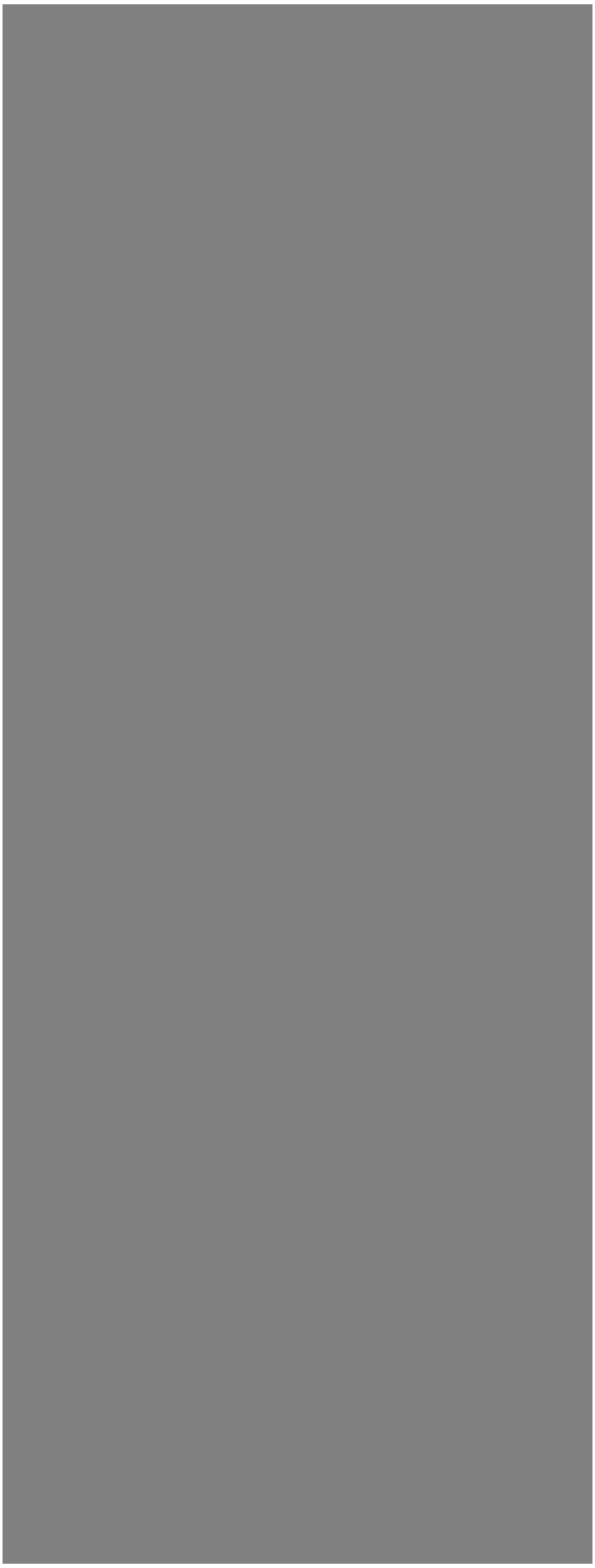
Barbara	Frazer
Rea	Freedom
Linda	Freeman
Elaine	Frey
Jan	Friel



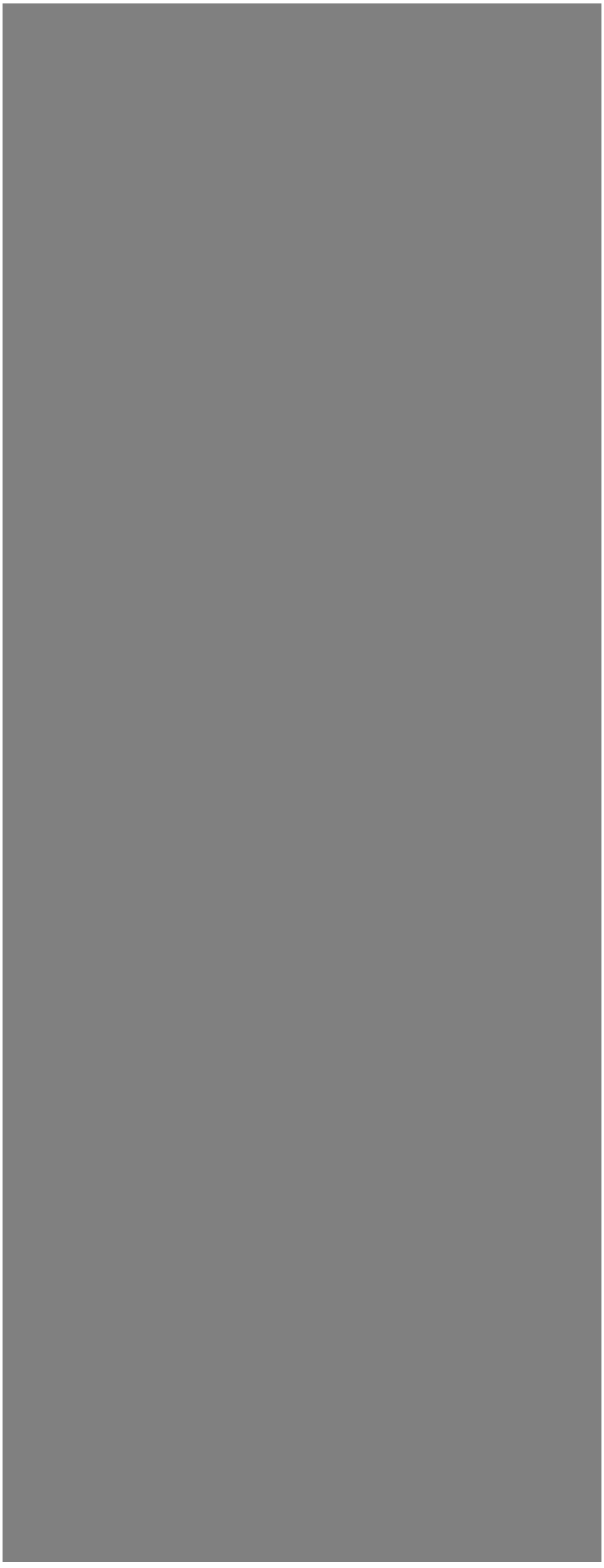
Friend	Friend
Danielle	Fritch
Dianne	Fritsche
Jeff	Fromberg
Lisa	Frost
Monica	Fruedman
Kathy	Fujimoto
Kristina	Fukuda
Judy	Fukunaga
Marilyn	Fuller
Karen	Furniss
Sherrill	Futrell
Joyce	Galantai
Daryl	Gale
Justin	Ganz
Marcia	Garceau
Dawn	Garcia
Espana	Garcia
Jeffery	Garcia
Ramiro	Garcia
Ked	Garden
David	Gardner
Michael	Garitty
Ann	Garside
Kris	Gata
Jessie	Gates
Celina	Gentry
Michael	Gertz
Mike	Getz
Lisa	Gherardi
Annette	Ghezzi
Pamela	Gibberman
Christina	Gill
Nancy	Gillis
Valerie	Girard
Paula	Glaser
Stephanie	Glatt
Luann	Glatzmaier
Ned	Gleason
Robert	Glover
Wyatt	Glynn
Gary	Goetz
Geoff	Goins
Kathleen	Goldman
Paula	Goldsmid
Scott	Goldstein
Kim	Golis



Christopher	Golson
Hanh	Gonh
Linda	Gonzales
Tara	Gonzales
Nerin	Gonzalez
Shauna	Gonzalez
Denise	Goodman
Cynthia	Goodwin
Mark	Gotvald
Nancy	Gowani
Kathlyn	Grabenstein
Katarina	Grabowsky
Fred	Granlund
Gia	Granucci
Nath	Gras
Erin	Grasse
Gabriel	Graubner
Randy	Gray
Jamie	Green
June	Green
Pamela	Green
Corinne	Greenberg
Stephen	Greenberg
Tara	Grenier
Michelle	Grimes
David	Grimshaw
Kathy	Grissom
Maria	Gritsch
Malcolm	Groome
Sandy	Gross
Lorna	Groundwater
Ann	Grow
Joseph	Gualtieri
Geralyn	Gulseth
Riya	Gupta
David	Gutierrez
Alexa	Guzman
Perry	Gx
Ian	Haddow
Janine	Haefer
Sean	Hagstrom
Brenda	Haig
Jim	Haley
Christopher	Hall
Diana	Hall
Holly	Hall
Sue	Hall



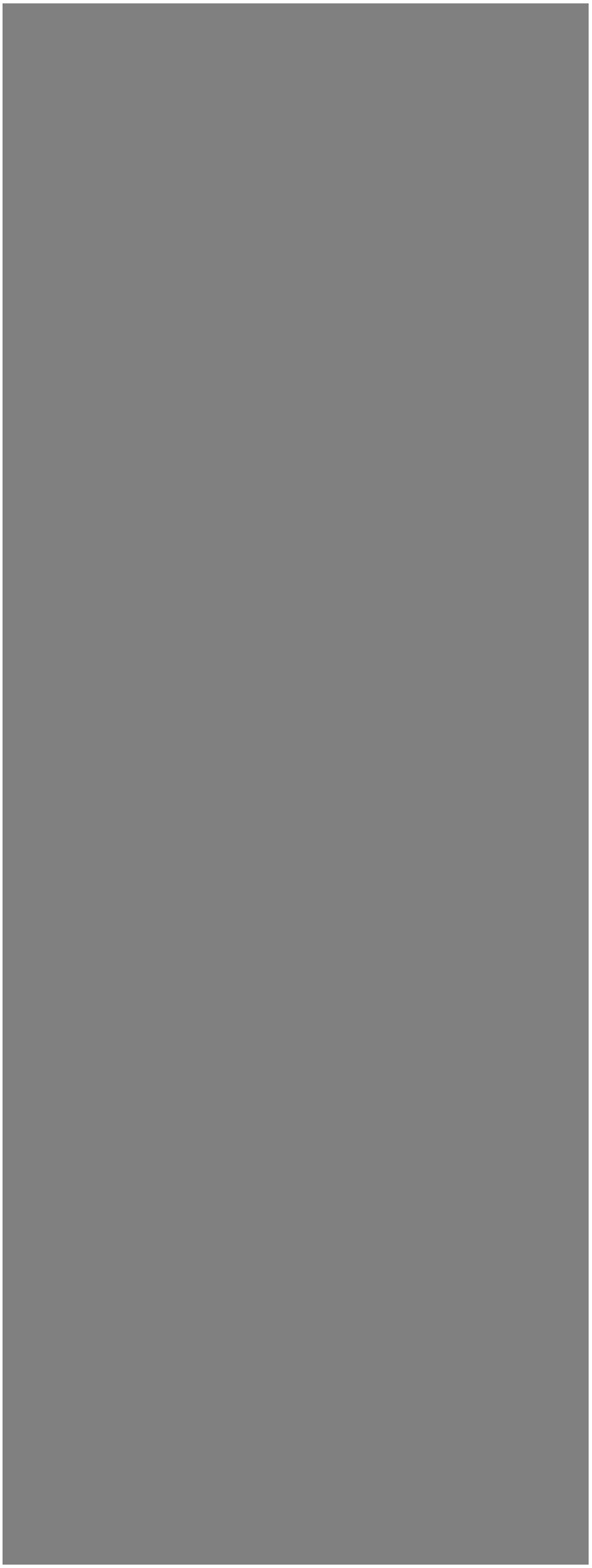
Therese	Hall
Margie	Halladin
Nowlin	Haltom
Gary	Hamel
Frederick	Hamilton
Jeremy	Hamilton
Robin	Hamlin
Sharon	Handa
Khai	Hang
Susan	Hanger
Rebecca	Hanna
Sally	Hanson
Joe	Hardin
Natasha	Harding
Jana	Harker
Rey	Harmon
Omar	Haro
Barbara	Harper
Silva	Harr
Brooke	Harris
John	Harris
Laurel	Harris
Randall	Hartman
Erfin	Hartojo
Pratiksha	Hasji
Nadine	Hatcher
Artineh	Havan
John	Hawkins
Sharon	Hawkinson
Shannon	Healey
Patt	Healy
Ross	Heckmann
Sharon	Hefke
Naomi	Heiman
Christine	Hein
Janet	Heinle
Bridgett	Heinly
Rebecca	Helems
Lesle	Helgason
Jude	Hellewell
Miranda	Helly
Carol	Hemingway
Karla	Henderson
Kelly	Henderson
Nancy	Henderson
Anne	Henkes
Debbie	Hennessey



Teresa	Hensley
Janet	Herbruck
David	Hermanns
Nathalia	Hernandez
Laura	Herndon
Diane	Hestich
Eleanor	High
Jerri	Hildebrand
Debra	Hill
Eloise	Hill
Pat	Hill
Terry	Hill
Dana	Hinkle
Coni	Hintergardt
Ah	Ho
Linh	Hoang
Alex	Hobbs
Suzanne	Hodges
John	Hoffman
Michael	Hogan
Howard	Holko
Roger	Hollander
Sterling	Hollins
Candace	Hollisfranklyn
Stephen	Holman
Lukas	Holsen
Mike	Honda
Celeste	Hong
Malina	Hong
Wendy	Horvath
Cyndi	Houck
Janet	Howe
Linda	Howie
Li	Huang
Ronnie	Huber
Troy	Huff
Lucy	Hughes
Vicki	Hughes
Adrian	Hurley
Gill	Hurley
Mark	Hurst
Jacob	Huskey
Frank	Huttinger
Jinx	Hydeman
Caridad	Ignarra
Neil	Illiano
Pec	Indman

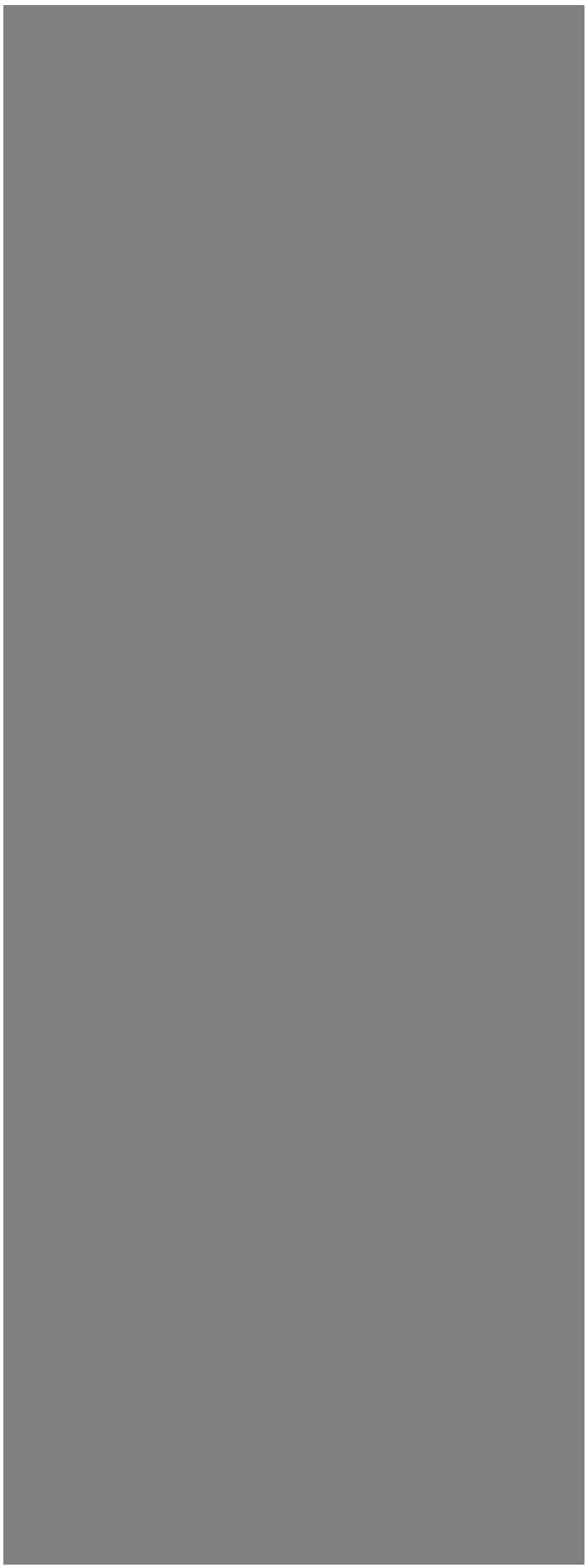
Marian	Isaac
Julia	Ivanova
Gregory	Jackson
Kari	Jackson
Trudy	Jacobs
Laura	Jacobson
Gina	Jager
Ramsey	Jammal
Cathy	Janacua
Hillie	Janssen
Richard	Jaramillo
Robert	Jardine
Julien	Jegou
S	Jensen
Dorothy	Jimenez
Lexi	Jimenez
Laurie	Jiobu
Claire	Joaquin
Indeera	Johnn
Deanna	Johnson
Elizabeth	Johnson
Evelyn	Johnson
Joel	Johnson
Reid	Johnson
Shawn	Johnson
Linda	Johnston
Michael	Johnston
Miles	Johnstone
Diana	Jones
Amie	Jordan
Stacey	Joslin
Dave	Juergens
Kathie	Jung
Lindsey	Kalfsbeek
Sharon	Kantanen
Eliot	Kaplan
Chad	Kapusta
Marianna	Karamanli
Lise	Kastigar
Paula	Katz
Andrea	Kaufman
Michael	Kaufman
Michael	Kavanaugh
Robert	Keats
Gloria	Keller
April	Kelley
Lisa	Kellman

Lisa	Kelly
Teri	Kelly
Shannon	Kemena
Erik	Kemper
John	Kerby
Catherine	Kermer
James	Kerr
Carol	Kerridge
Kelly	Kessl
Laren	Kessler
Lynda	Key
N	Khalsa
Caroline	Kim
Elli	Kimbauer
Sonia	King
Sue	King
Timothy	Kinkead
Carol	Kinser
Jeff	Kinsey
Saran	Kirschbaum
Karen	Kirschling
Betty	Kissilove
Margaret	Kitts
Julie	Klabin
Leslie	Klein
Renee	Klein
Diana	Kliche
Lily	Kloepfer
Deanna	Knickerbocker
Lindsay	Knights
Tatyana	Kobzak
Valeria	Kobzak
Cindy	Koch
Ina	Komins
Kathy	Kosinski
Dennis	Kostyk
Rick	Koury
Michael	Krikorian
MJ	Kubala
Mark	Kupke
Jerine	Kurashige
Laszlo	Kurucz
Sheri	Kuticka
Laakea	Laano
Tim	Lachman
Sally	Lacy
Rochelle	Lafrinere

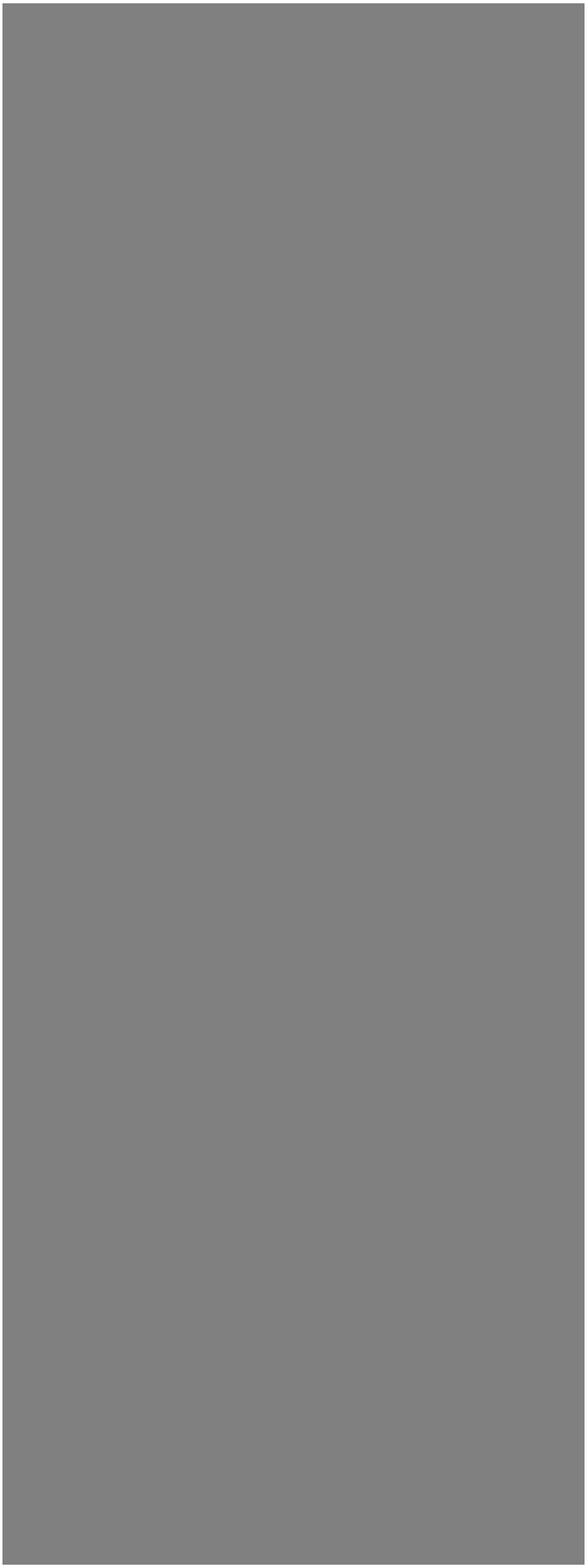


Frances	Lam
Jessica	Lam
Alexandra	Lamb
Diane	Lamont
Alissa	Lancebyrne
Dennis	Landi
Lizz	Lang
Jeri	Langham
Joann	Lapolla
Robert	Lappo
Stephanie	Larro
Linda	Larsen
Nadine	Larsen
Natacha	Lascano
Lisa	Lashaway
Lynne	Latham
Kristin	Laughtindunker
Jennifer	Lawson
Robert	Lea
Harlan	Lebo
Brenda	Lee
Peter	Lee
Kim	Leigh
Miriam	Leiseroff
Allison	Lenoil
Lauren	Leonarduzzi
Bob	Leppo
Linda	Leruth
Jim	Leske
Virginia	Leslie
Carol	Leuenberger
Jeff	Levicke
Lisa	Lewis
Patricia	Lewis
Sherman	Lewis
John	Liddy
Louise	Lieb
Andrea	Lieberman
Amy	Liebman
Jessica	Likens
Darrick	Lin
Stephanie	Linam
James	Lindgren
Carrie	Lindh
Robyn	Little
Bruce	Littleton
David	Liu

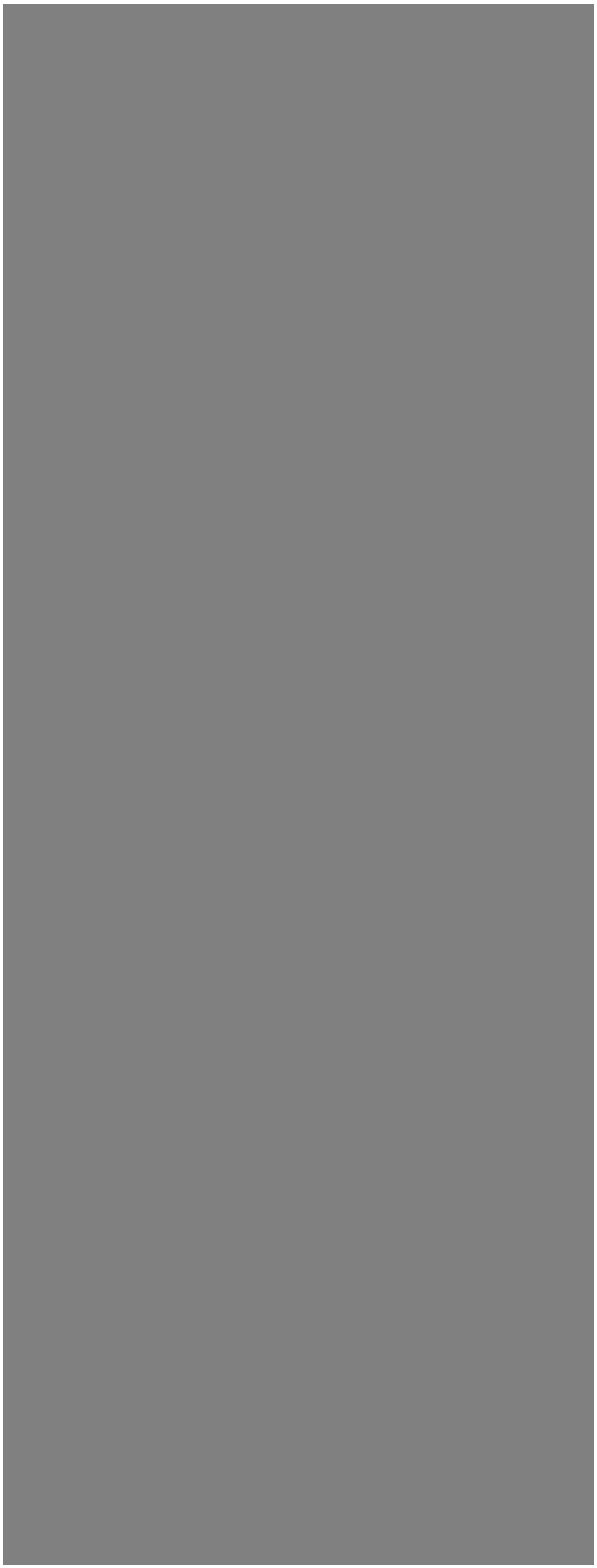
Marilyn	Livote
Colleen	Lobel
Rosemary	Lojo
Margaret	Lomba
Lynne	Long
Adela	Lopez
Giselle	Lopez
Frank	Lorch
Judith	Lotz
Rachel	Loui
Kathleen	Love
Lanelle	Lovelace
Shalomar	Loving
Marsha	Lowry
Gina	Lozano
Diana	Lubin
Penny	Luce
George	Ludwig
Carl	Luhring
Judy	Lukasiewicz
David	Luna
Bill	Lundeen
Alexandria	Luostari
Andy	Lupenko
Steve	Lustgarden
Lynn	Luther
Michal	Lynch
Rosann	Lynch
Edward	Macan
Nina	Macdonald
Jocelyn	Macho
Sherry	Macias
Brian	Mackerer
Kristy	Madden
Sally	Madigan
Linda	Maggy
Mario	Magpale
Mary	Maher
Victor	Maisano
Glenn	Majeski
Janet	Maker
Martin	Male
Ginabella	Mallari
Karen	Mallis
Wila	Mannella
Robert	Mantia
Wendi	Marchesi



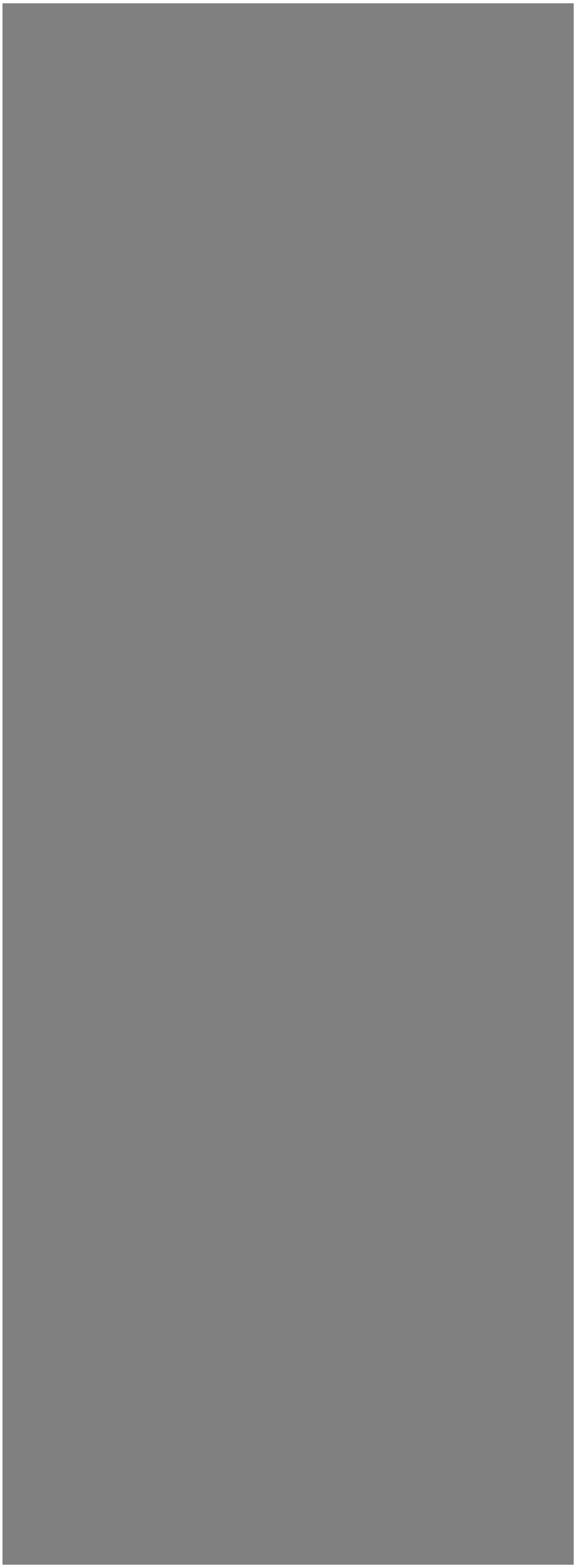
Abbey	Markham
Tina	Markowe
Autumn	Marr
Sherry	Marsh
Dorrine	Marshall
Brittany	Martinez
Mario	Martinez
Scott	Mason
Lee	Mastro
Mary	McAuliffe
Carole	McCarthy
Karen	McCaw
Bob	McCleary
Barney	McComas
Douglas	McCormick
Maria	McCready
Abbi	McCue
Evan	McDermit
Robert	McDonnell
Kelley	McDowell
Molly	McEnerney
Nicola	McGillicuddy
Kerri	McGoldrick
Michael	McGowan
Bithiah	McGriff
Michele	Mcguckin
Cynthia	McHugh
Heather	McHugh
Lisa	McJenkin
Caephren	McKenna
Bruce	McKinley
Laurie	McLaughlin
Jonathan	McLeod
Alexa	McMahan
Michael	McMahan
Sparrow	McMorran
Philip	McMorrow
Heidi	McRae
Gard	Meddaugh
Kathleen	Medina
Don	Meehan
Ken	Meersand
Randi	Mello
Beth	Merrill
George	Meyer
Tanya	Meyer
Veronica	Michael



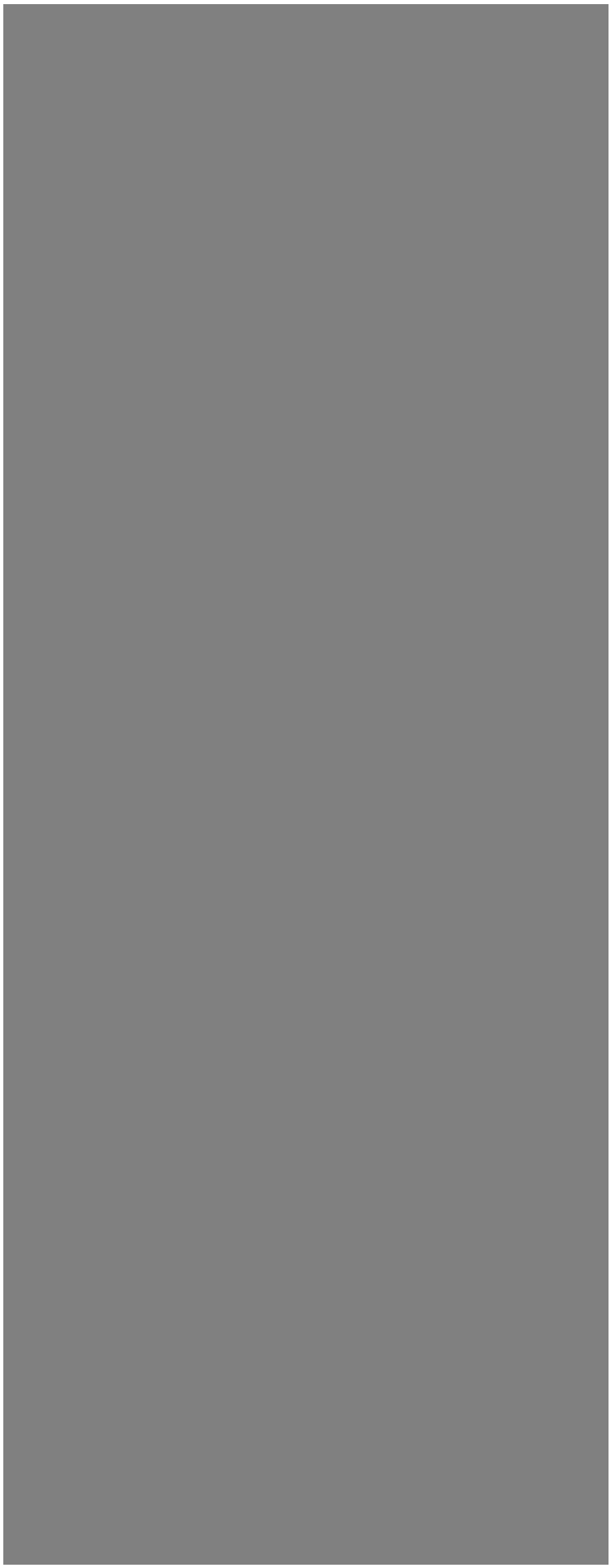
Patti	Mickelsen
Nicole	Mikals
Heidi	Miller
Kellie	Miller
Rhianna	Miller
Erin	Millikin
Randy	Mills
Christine	Minnich
Nina	Minsky
Evangeline	Miranda
Laura	Mire
Margaret	Mischner
Bonnie	Mitchell
Desiree	Mitchell
Jessica	MitchellShihabi
Cody	Mitcheltree
April	Modesti
Allison	Moffett
Angela	Moini
Bianca	Molgora
Nelson	Molina
Carol	Mone
Dana	Monroe
James	Monroe
Michelle	Montano
Elaine	Monteton
Jill	Montillano
Stephanie	Moore
Kathy	Mora
Mario	Mora
John	Moreau
Liza	Morell
Yvonne	Moreno
Sandra	Morey
Christine	Morgan
Linda	Morgan
Melvis	Morris
Sharon	Morris
Sam	Morrison
Leeann	Morrissey
Bonita	Mugnani
Sharon	Mullane
Glenn	Mullins
Annette	Murch
Lauren	Murdock
Cassie	Murphy
Dana	Murphy



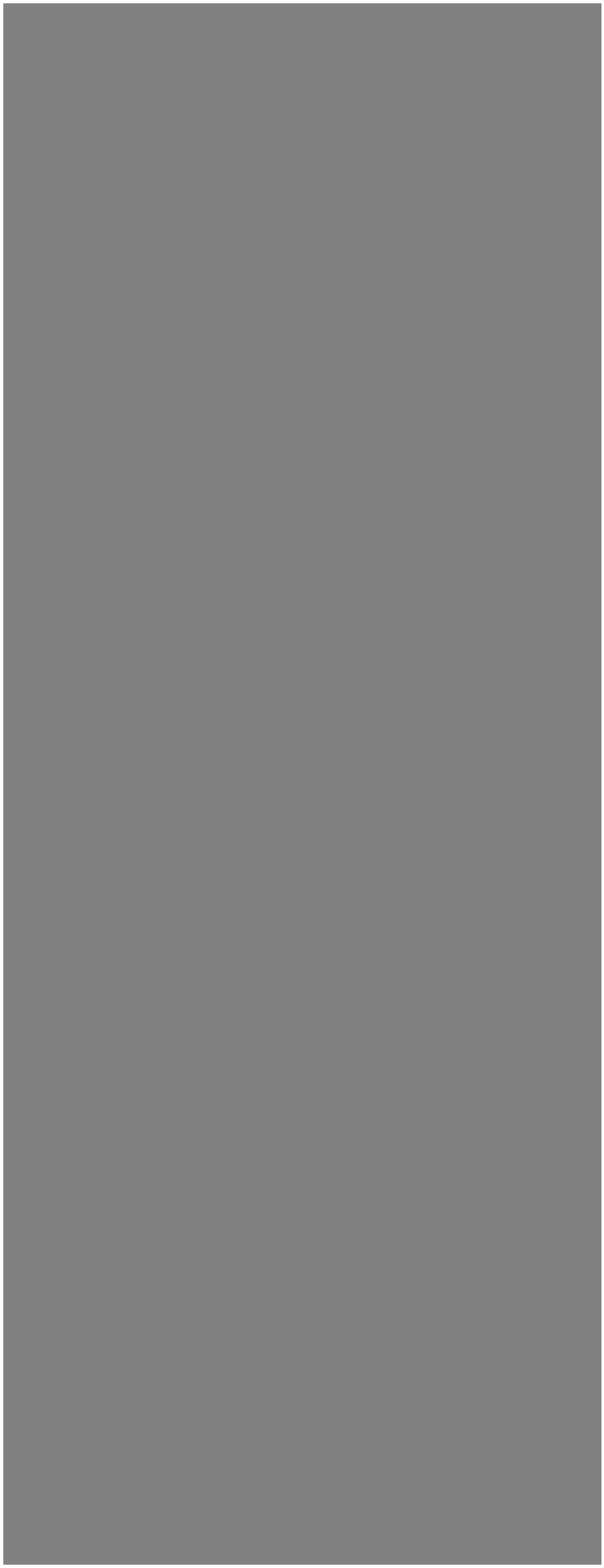
Melissa	Murphy
Barbara	Murray
Charla	Murry
Ann	Myers
Deborah	Myers
Mecky	Myers
Sue	Nadell
Ella	Naidoo
Midori	Nakayama
Laura	Nardozza
Raquel	Narvios
Biz	Nasharr
Jeanette	Navarro
Deborah	Nelson
Dency	Nelson
Pamela	Nelson
Scott	Nelson
Gina	Ness
Alice	Neuhauser
Sharon	Nicodemus
Nancy	Nilssen
Pamela	Nitsos
Sheree	Noeth
Katherine	Nolan
Kristin	Norby
Valerie	Nordeman
Claire	Nordvik
Maria	Nowicki
Thomas	Nulty
Adriana	Nunez
Carlos	Nunez
Marci	Nunez
Stephanie	Nunez
Max	Nupen
Joan	Nygaard
Abraham	Oboruemuh
Kathy	O'Brien
David	Ohrberg
Anne	Oklan
Alyssa	Olivas
Frances	Oliver
Krister	Olsson
Chris	O'Malley
Polly	O'Malley
Gerald	Orcholski
Henry	Ortiz
Mariby	Ortiz



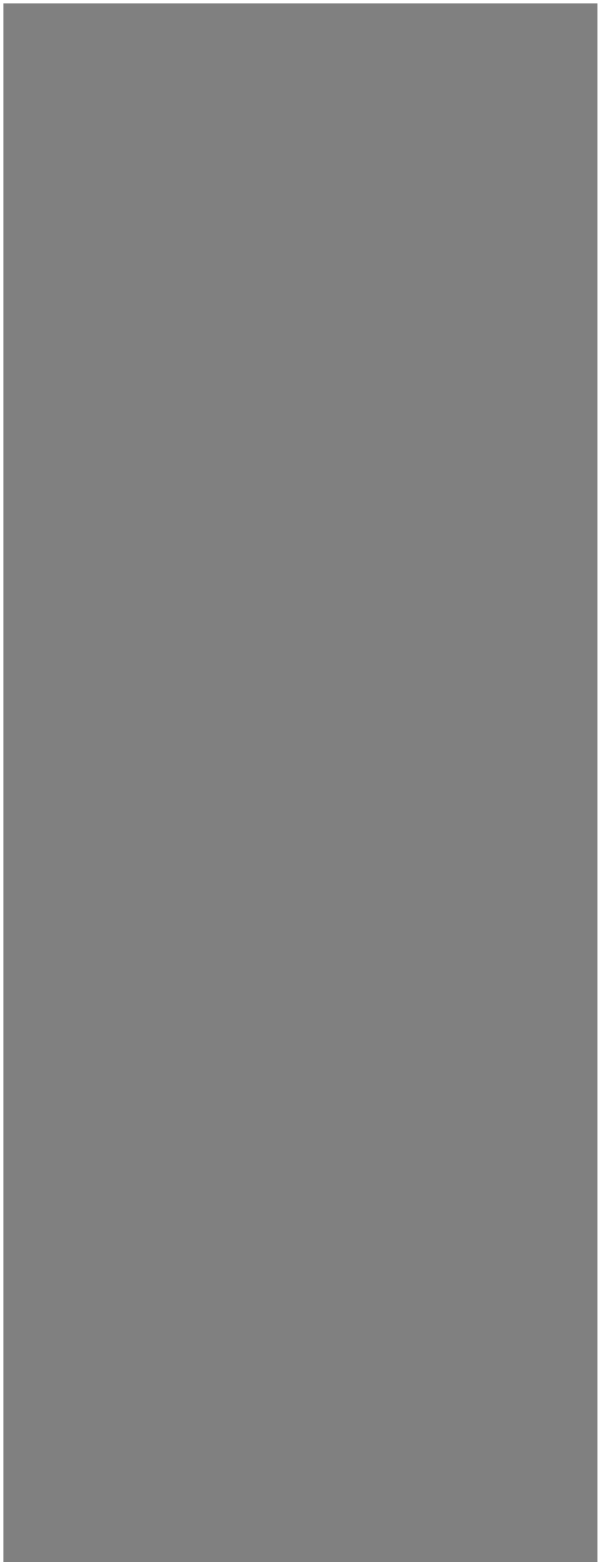
Hillary	Ostrow
Donna	Owens
Cinzia	Paganuzzi
Georgette	Paine
Ashley	Palacios
John	Paladin
Aeryn	Palmer
Heidi	Palmer
Sharon	Paltin
Tony	Paredes
Benjamin	Park
Elaine	Parker
Leotien	Parlevliet
Elodie	Patarias
Lynne	Pateman
James	Patton
Lisa	Patton
Brandon	Paul
Deborah	Paul
Kathy	Paul
Caryl	Pearson
Sarah	Peck
Greg	Pennington
Linda	Penrose
Sandra	Peregrina
Paula	Pereira
Jenny	Perez
Nadia	Perez
Marilyn	Perona
Kevin	Perry
Barbara	Peters
Kim	Peterson
Matthew	Peterson
Damir	Pevec
Jamie	Pfister
Scott	Pham
Tami	Phelps
Jennifer	Philips
Annie	Phillips
Ivor	Phillips
Rochelle	Phillips
Brian	Pierson
Lynn	Pique
Polly	Pitsker
Joseph	Pluta
Barbara	Poland
Kathy	Popoff



Tania	Popov
Chris	Popp
Kristy	Porteous
Erika	Porter
Melissa	Porter
Penny	Potter
Doreen	Poulson
Antonia	Powell
Kathleen	Powell
Matt	Powell
Judith	Poxon
Wendy	Pratt
Michael	Price
Rosalie	Prieto
Menkit	Prince
Noelle	Prince
Micaela	Pronio
Annette	Punimata
Sharon	Quan
Valerie	Quan
Debra	Quandt
Robert	Quarrick
Jennifer	Quednau
Marilyn	Quindo
Audrey	Quintero
Paul	Rabjohns
Alex	Rader
Mary	Ragsdale
Sandra	Rakestraw
Chezi	Ram
Andy	Ramirez
Graciela	Ramirez
Sue	Ramirez
Paul	Ramos
Sigrid	Ramos
Elizabeth	Ramsey
Walter	Ramsey
Carolyn	Rand
Dee	Randolph
Denise	Ranidae
Wallace	Ransom
Jenise	Rauser
Edward	Redig
Penny	Redman
Lauren	Rednour
Kaylynn	Reeb
Kathryn	Reichard



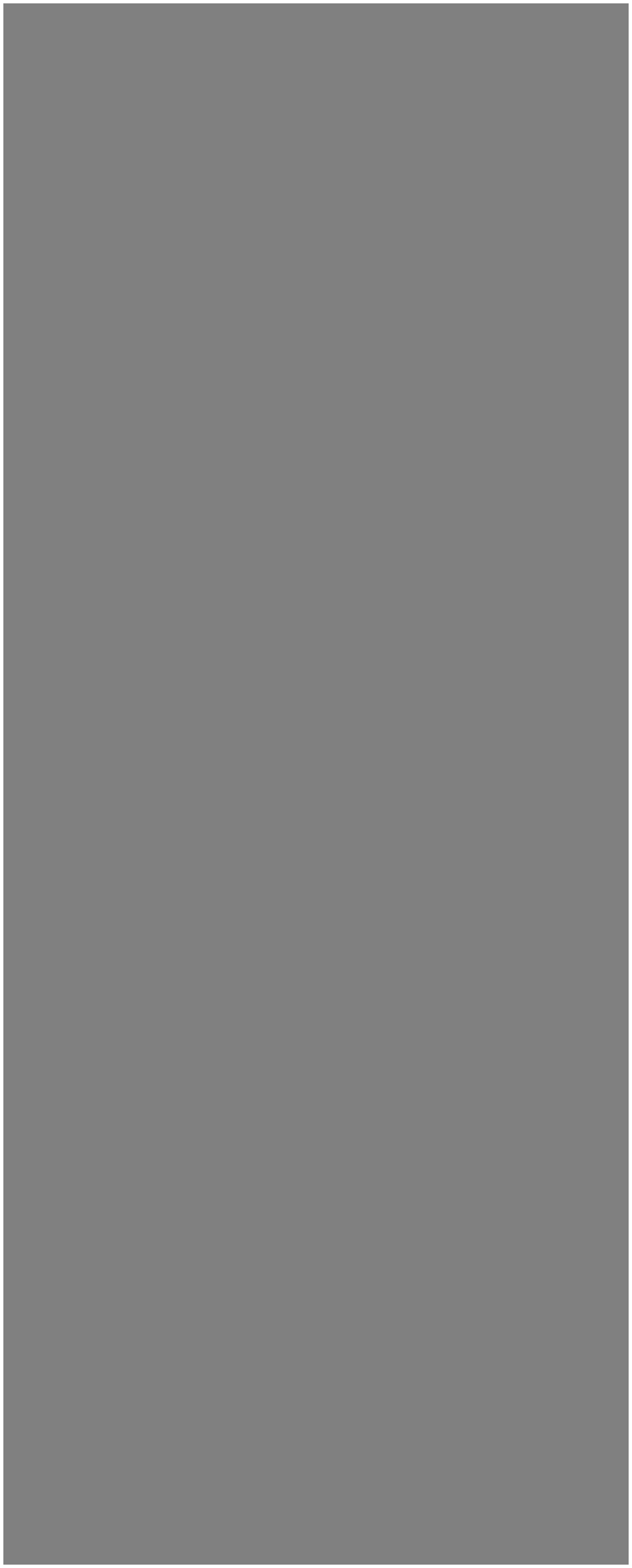
Peter	Reimer
Kurt	Renfro
Carlene	Reuscher
Christian	Reyes
Mike	Reyes
Javier	Reza
Jill	Rhiannon
Janet	Rhodes
Genevieve	Riber
Jennifer	Ricchiazzi
Mark	Ricci
Robert	Ricewasser
Kim	Richmeier
Jean	Riehl
Carol	Rigrod
Cyndi	Ringoot
Marianna	Riser
Michaele	Risolia
Jessenia	Rivas
Lori	Rivas
Jacquelyn	Roberts
Jennifer	Roberts
Joyce	Roberts
Francis	Robertson
Kirstin	Robertson
Laura	Robichek
Nancy	Robinson
Lisa	Robles
Candace	Rocha
Silvia	Rocha
Sophie	Rocheleau
Phil	Rockey
Cheryl	Rockwell
Marykay	Rodarte
Karen	Roegner
Pamela	Rogers
Shanna	Rojas
Mary	Rojeski
Jack	Rollens
Michele	Roma
Sonia	Romero
Valerie	Romero
Veronica	Romero
Greg	Rosas
Robert	Rosenblum
Olivia	Rosestone
Amani	Ross



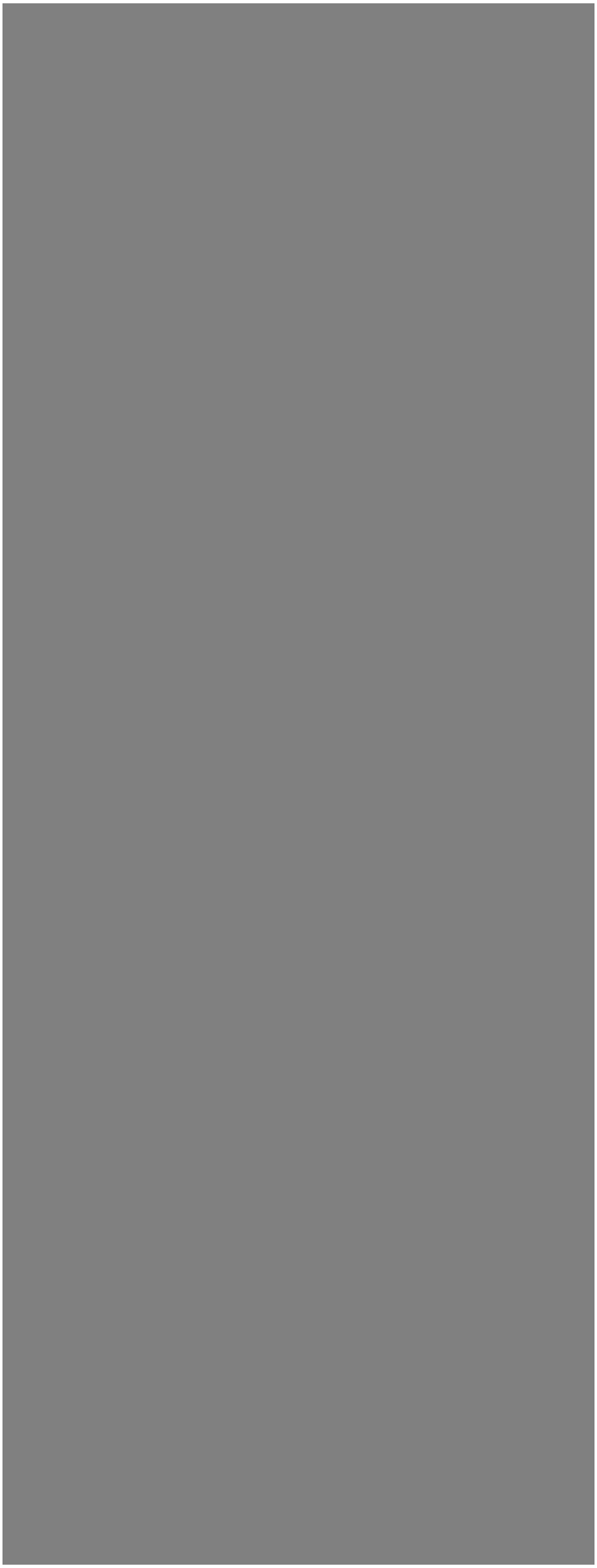
Melanie	Ross
Jodi	Rowe
Zach	Rowlands
Yuliya	Rudnik
Mox	Ruge
Sylvia	Ruiz
William	Ruppert
Cathy	Russell
Denise	Russo
Brian	Rutkin
Therese	Ryan
Anoushka	Sahai
Rajinder	Saini
Lisa	Salazar
Mimi	Salili
Jackie	Samallo
Brooke	Sampson
Jonathan	Sampson
Kimberly	Sanchez
Sylvia	Sanchez
Tom	Sanchez
Pam	Sandberg
Michele	Sanderson
Danni	Sangston
Michelle	Santy
Emily	Sapp
Natasha	Saravanja
Vicki	Sarnecki
Rondi	Saslow
Angelina	Saucedo
Pamela	Saulter
Irene	Saurwein
Linda	Savitz
Carol	Schaffer
Susan	Schairer
Andrea	Schauer
Christy	Schauf
Ginger	Schedler
Myra	Schegloff
Barbara	Scheinman
Mary	Scheller
Nancy	Schelling
Janice	Schenfisch
Jonathan	Scher
Lauren	Schiffman
Bob	Schildgen
Christy	Schilling

Paulette	Schindele
Heather	Schlichter
Jennifer	Schmidt
Michael	Schnabel
William	Schoene
Laura	Schuman
Ron	Schutte
Emma	Schuyler
Amanda	Schwartz
Katherine	Schwartz
Louise	Schwartz
Sherry	Sclafani
Anneke	Scott
Bruce	Scott
Ellen	Segal
Harold	Segelstad
Lisa	Segnitz
Casey	Sell
Lynn	Sentenn
Elliott	Sernel
Linda	Shadle
Mariam	Shahrais
Eileen	Shahzada
Kaelan	Shannon
Madeline	Shapiro
Lindsay	Sharp
Peggy	Sharp
Diane	Shaw
Donna	Shaw
Al	Shayne
Gabriel	Sheets
Margaret	Shekell
Marilyn	Shepherd
Margo	Sherbainbridge
Lisa	Sherman
Erika	Shershun
Geoff	Shester
Saahil	Sheth
Shireen	Shipman
Summer	Shippy
Jennifer	Shontz
Marguerite	Shuster
Lauren	Siadek
Nancy	Sidebotham
Martha	Siegel
Jeff	Sierra
DG	Sifuentes

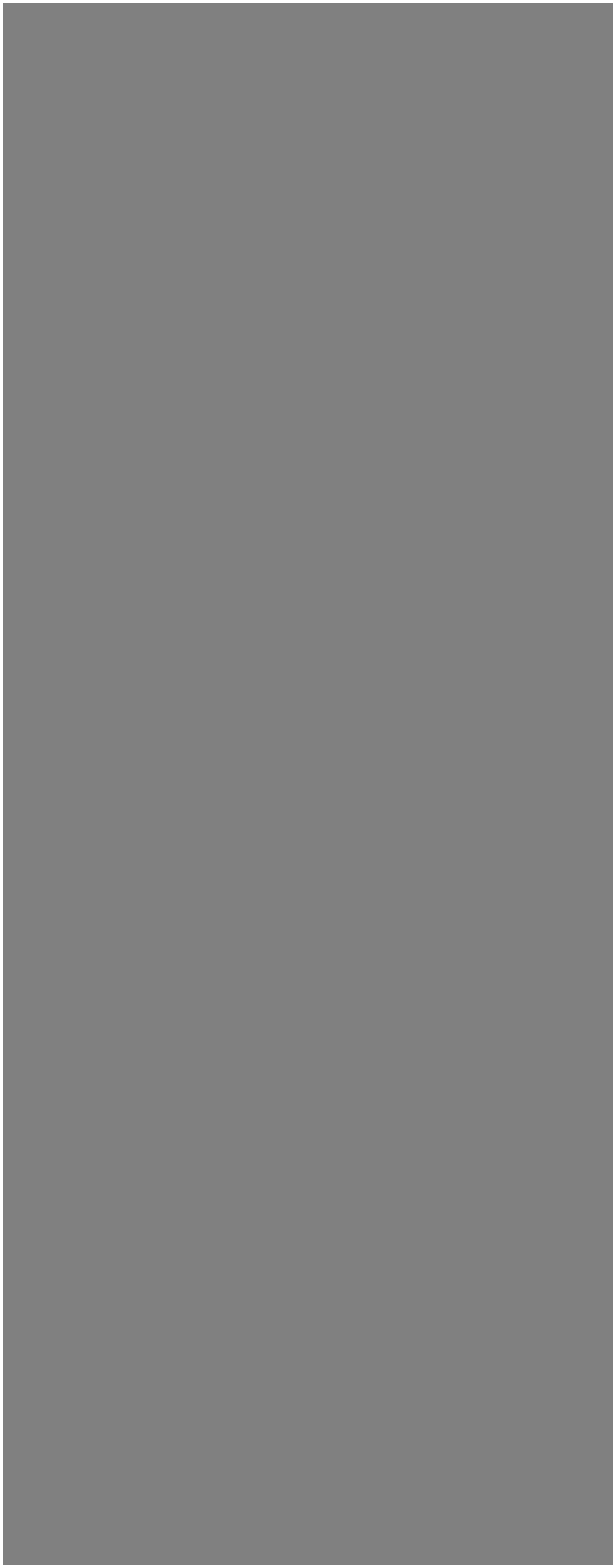
Sheila	Silan
Stephan	Silen
Dan	Silver
Julian	Siminski
Ari	Simke
Joyce	Simonds
Nan	Singhbowman
Randle	Sink
Christine	Sirias
Holly	Sletteland
Susan	Sloan
Skye	Smirnov
Belinda	Smith
Cynthia	Smith
Grace	Smith
Kathleen	Smith
Margaret	Smith
Michele	Smith
Scott	Smith
Stephani	Smith
Megan	Snipes
Renee	Snyder
Todd	Snyder
Magda	Socorro
Amanda	Solomon
Karen	Sommer
Cyndi	Sood
John	Sorenson
Jeffrey	Spangler
Rick	Sparks
Michelle	Sparksgillis
Terry	Spellman
Barbara	Spencer
Darla	Spencer
Jane	Spini
Leslie	Spoon
Catheryn	Sproull
Kathryn	St John
Danuta	Stachowiak
Ken	Stack
Carol	Stafford
Paul	Stanley
Cathy	Stansell
Wayne	Steffes
Sallye	Steiner
Gabriel	Steinfeld
Judith	Steinhart



Peter	Steinhart
Therese	Steinlauf
Shelley	Sterrett
Bob	Stevens
Jasmine	Stewart
Margaret	Stewart
Michael	Stewart
Peggy	Stewart
Tai	Stillwater
Helen	Stone
Russell	Stone
Brenda	Street
Mark	Strickland
Aaron	Stroh
Bruce	Stubbs
Robin	Sturmthal
Tad	Sullivan
Olivia	Summers
Stacie	Surabian
Rachel	Swan
Virginia	Swan
Patricia	Sweet
Brittany	Sweeting
Calder	Swiderski
Richard	Swift
Barbara	Tacker
Carol	Taggart
Robert	Taggart
Trina	Takahashi
Michael	Talbot
Susan	Tamura
Carol	Tao
Karla	Tapia
Ted	Tarnowski
Fred	Tashima
Thomas	Tataranowicz
Leslie	Tate
Tammy	Taunt
Sasha	Taus
Alison	Taylor
Melinda	Taylor
Melvin	Taylor
John	Teevan
James	Tejani
Mark	Temkin
Rick	Teneyck
Warren	Tenhouten



Tamara	Thebert
Rita	Thio
Anita	Thomason
Brenda	Thompson
Doug	Thompson
Geraldine	Thompson
Melanie	Thompson
Sandra	Thompson
Nancy	Thomsen
Alastair	Thorburn
Cathy	Thornburn
Cortney	Thornton
Loretta	Tiefen
Erhyen	To
Jan	Todd
April	Toller
Margaret	Tollner
Andy	Tomsky
Eileen	Tonzi
Ava	Torrebueno
Susie	Tortell
Carla	Tourville
Cheryl	Townsend
Carol	Toye
Kate	Transchel
Diane	Trautman
Charles	Tribbey
Jeremy	Trimm
Tia	Triplett
Liana	Trock
Nira	Trock
Yael	Trock
Gina	Truex
Michael	Tullius
Anthony	Tupasi
Danielle	Turner
Virginia	Turner
Wendell	Turner
Susan	Turney
Sabina	Ubell
Janice	Uehlein
Georja	Umano
Stacie	Umetsu
Robert	Underwood
Chanda	Unmack
Marcie	Usselman
Monique	Ussini



Sylvia	Vairo
Alexia	Valdora
Cara	Vallot
Anne	Vanalstyne
Berington	Vancampen
Gabrielle	Vandenbosch
Sara	Vandusen
Janet	Vankanegan
Steve	Vankanegan
Shana	Vanmeter
Kris	Vanstralen
Teresa	Vanzeller
Melissa	Vasconcellos
Sherry	Vatter
Rosewind	Veilove
Vianney	Ventura
Cynthia	Villegas
Carlene	Visperas
Herbert	Vogler
Deepak	Vohra
Pablo	Voitzuk
Melanie	Vollbrecht
Janice	Vonitter
Carol	Vonsederholm
Jennifer	Wagner
Alex	Wagonfeld
Kaitlin	Walker
Mitch	Walker
Suzi	Walker
Duane	Wall
Lauren	Wallace
Patrice	Wallace
Ernie	Walters
Jennifer	Walters
Judy	Wang
Maria	Wanless
Penelope	Ward
Christopher	Ware
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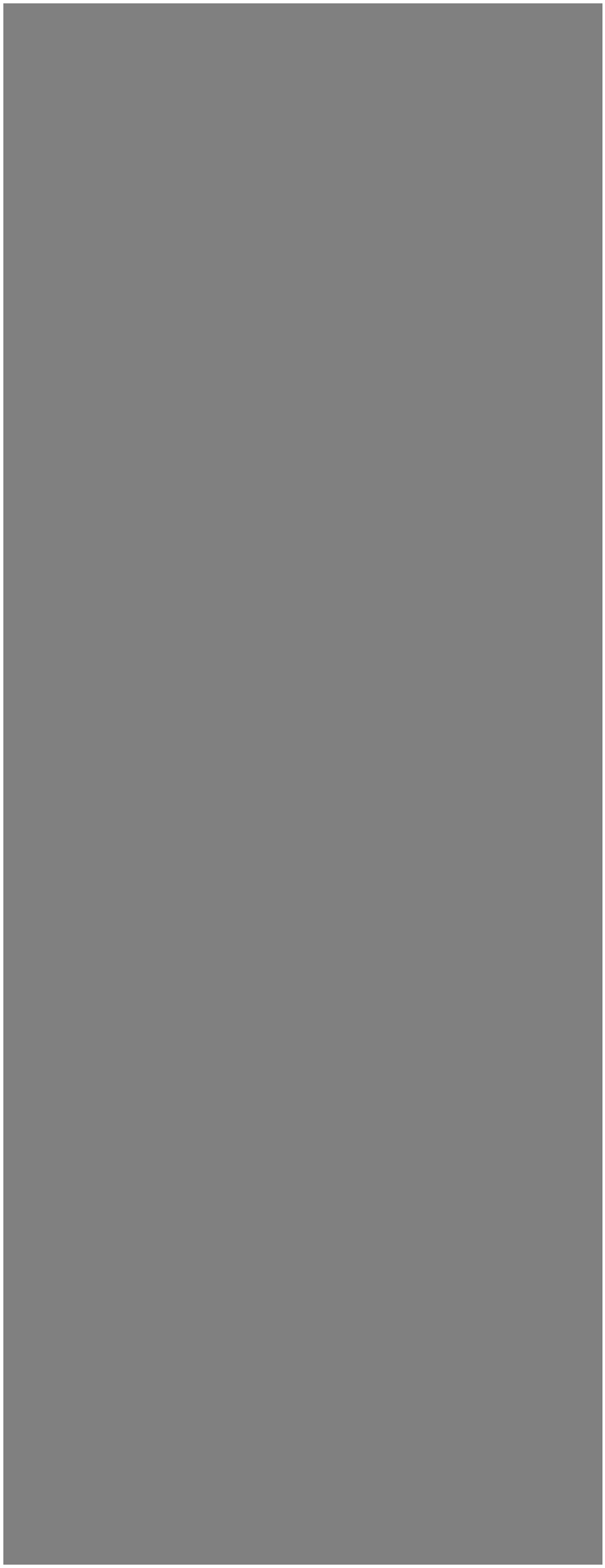
Anita	Watkins
Michael	Watson
Richard	Watson
Max	Weasner
Kelly	Weaver
Donald	Webb
Linda	Webb



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Merris	Weber
Stephanie	Weber
Kevin	Weibezahl
Russell	Weisz
Suzanne	Wells
Heath	West
Julie	West
Signe	Wetteland
Janet	Wheeler
Michelle	Wheeler
Heidi	Whelchel
Gail	Whitacre
Lisette	Whitaker
Beki	White
Tina	White
Frances	Whiteside
Barbara	Whyman
Carol	Wiley
Dorothy	Wilkinson
Beth	Willer
Gerry	Williams
Robin	Williams
Nancy	Williamson
Norm	Wilmes
Jim	Wilson
Maria	Wilson
Karsten	Windt
Joshua	Wines
Lisa	Winningham
Meagan	Winters
Greg	Winton
Anita	Wisch
Dan	Wizner
Patrice	Woeppel
Liza	Wolf
Rachel	Wolf
Amy	Wolfberg
Pat	Wolff
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Elaine	Woodriff
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Don	Wright
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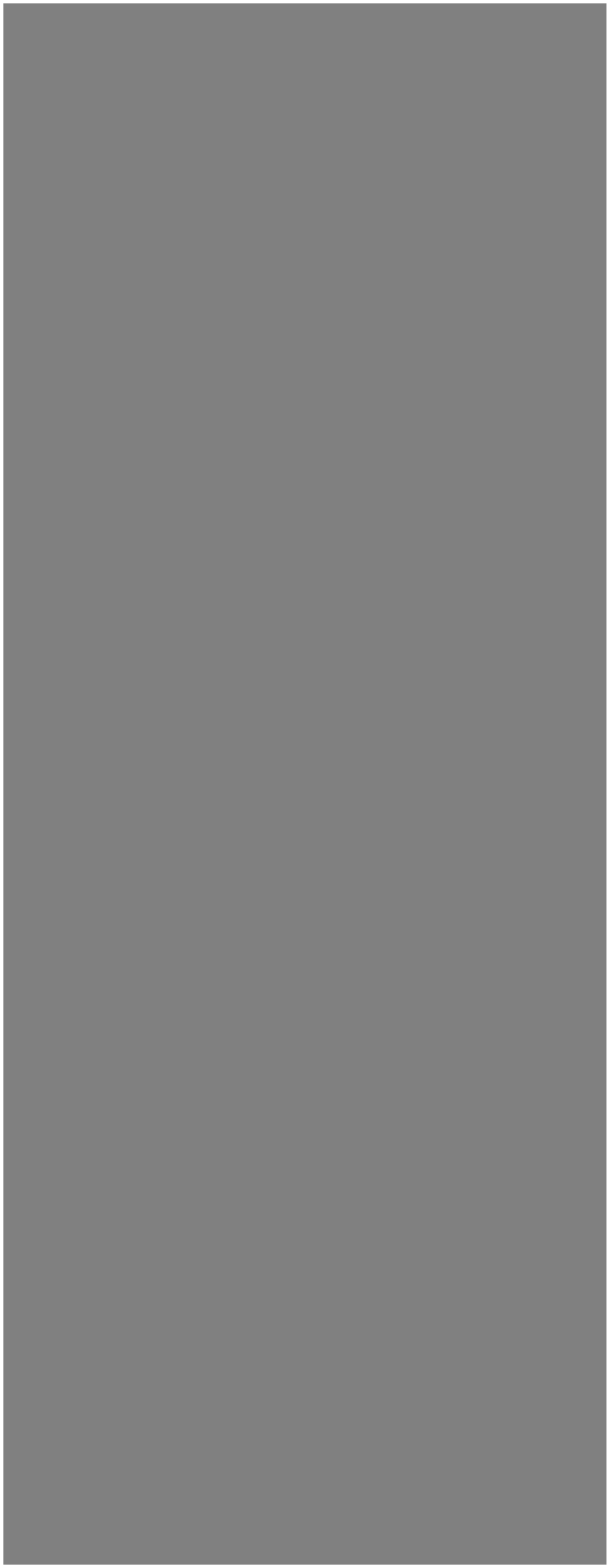
Marjorie	Xavier



Kyle	Yaskin
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Brittney	Yore
Bing	York
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Katie	Yu
Barry	Zakar
Eric	Zakin
Rena	Zaman-Zade
Connie	Zarate
Sandy	Zelasko
Helen	Zeller
Robyn	Zelmanovitz
Esther	Zepeda
Amanda	Zicari
Marianna	Zimmerman
Kristina	Zweig
Maxine	Zylberberg

Matthews, Kinsey-Contractor@fgc

From: York, Travis <Travis.York@sen.ca.gov>
Sent: Friday, July 7, 2023 12:33 PM
To: FGC
Subject: Legislative Sign-on Letter - Set Gillnets
Attachments: FINAL Biodiversity Threats from Set Gillnets Sign-on Letter.pdf

Good afternoon,

Attached is a Legislative sign-on letter signed by members of the Senate and the Assembly expressing concern regarding the impacts of set gillnets on biodiversity. Please let me know if you have any questions.

Travis York
Executive Assistant
Senator Ben Allen, 24th District
916-651-4024

CALIFORNIA LEGISLATURE

STATE CAPITOL
SACRAMENTO, CALIFORNIA
95814

July 6, 2023

Charlton H. Bonham, Director
California Department of Fish and Wildlife
715 P Street
Sacramento, CA 95814

Eric Sklar, President
California Fish and Game Commission
715 P Street, 16th Floor
Sacramento, CA 95814

Dear Director Bonham and President Sklar,

As California lawmakers who are invested in the sustainability of California's ocean health and climate-ready fisheries, we write to express our concerns regarding the types and rates of bycatch in the California set gillnet fishery targeting California halibut and white seabass. We urge the California Fish and Game Commission and the California Department of Fish and Wildlife to uphold the state's commitment to protecting marine biodiversity by following the approach and criteria laid out in the federal Marine Life Management Act to promulgate comprehensive management measures to reduce bycatch in the California halibut and white seabass set gillnet fishery to acceptable levels. Doing so will support vibrant and sustainable fishing communities while protecting wildlife.

The condition of oceans is overwhelmingly important to Californians, both for quality of life and the economy. California's robust marine economy generated $51.6 billion in Gross Domestic Product in 2019 – the second highest GDP of all 30 coastal states. California has a long history of regulating the set gillnet fishery to reduce bycatch and prevent negative impacts on the marine environment and protected species. Set gillnets were first banned off northern California as early as 1915. Due to bycatch concerns, California voters banned this gear type within southern California inshore waters via a 1990 state ballot proposition, and set gillnets were banned off central California by the California Fish and Game Commission in 2002. Nevertheless, this small fishery currently operates with little oversight in the biologically diverse ocean waters off southern California. Addressing this fishery's impacts on biodiversity is timely on the heels of action by a California delegation to protect biodiversity at the December 2022 United Nations negotiations.

Federal observer data from NOAA Fisheries indicates the California set gillnet fishery discards 64 percent of the fish and other animals caught in the nets — among the highest discard rates in the nation. More than half of these discards are already dead, which is not only wasteful but

raises sustainability concerns for a number of vulnerable species. More than 125 species of ocean animals are caught, including ecologically important sharks, rays, sea lions, dolphins, whales, and seabirds. These high rates of bycatch reflect poorly on California's fishing communities and its reputation as a provider of sustainable seafood.

Due to the documented take of large whales (including humpback and gray whales), NOAA Fisheries lists California set gillnet fishery as a Category II fishery under the federal Marine Mammal Protection Act. California has taken strong action to prevent whale entanglements in other fisheries, such as drift gillnets and Dungeness crab.

We are committed to supporting and strengthening sustainable California fishing communities. Notably, set gillnets disproportionately affect marine species relative to hook-and-line gear – a more selective, lower-impact method to commercially and recreationally catch halibut and white seabass. Only 39 estimated active set gillnet permits exist, and 87 percent of California halibut commercial fishers already use hook-and-line gear. Additionally, set gillnets catch undersized halibut, which are discarded dead with impacts to commercial and recreational anglers who target halibut with cleaner gear types.

As stewards of healthy oceans, we are grateful to the Commission and the Department for prioritizing the management of set gillnets off the California coast. If legislative changes or funding is needed, we stand by, ready to help.

Sincerely,

BEN ALLEN
Senator, 24th District

LAURA FRIEDMAN
Assemblymember, 44th District

STEVE BENNETT
Assemblymember, 38th District

MARC BERMAN
Assemblymember, 23rd District

CATHERINE BLAKESPEAR
Senator, 38th District

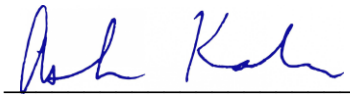
TASHA BOERNER
Assemblymember, 77th District

DAMON CONNOLLY
Assemblymember, 12th District

DIANE DIXON
Assemblymember, 72nd District

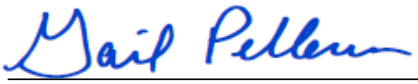
LENA GONZALEZ
Senator, 33rd District

COREY JACKSON
Assemblymember, 60th District



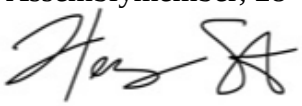
ASH KALRA
Assemblymember, 25th District

JOSH LOWENTHAL
Assemblymember, 69th District



GAIL PELLERIN
Assemblymember, 28th District

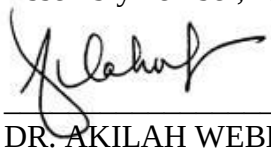
ANTHONY RENDON
Assemblymember, 62nd District



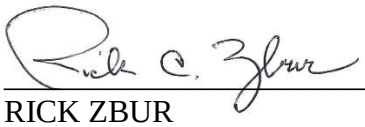
HENRY STERN
Senator, 27th District

PHIL TING
Assemblymember, 19th District

TOM UMBERG
Senator, 34th District



DR. AKILAH WEBER
Assemblymember, 79th District



RICK ZBUR
Assemblymember, 51st District

Matthews, Kinsey-Contractor@fgc

From: Jack Lighton <jack@sealegacy.org>
Sent: Friday, July 7, 2023 3:50 PM
To: FGC
Cc: Cristina Mittermeier
Subject: Evaluation of bycatch in the California halibut set gillnet fishery - letter for submission
Attachments: California Fish and Game Commission_SetGillnet_SeaLegacy_070723.pdf

Dear President Sklar and Members of the California Fish and Game Commission,

Please see the attached letter written by Cristina Mittermeier, co-founder of SeaLegacy, an international ocean conservation organization.

We ask that this letter be included in the July 20th, 2023 MRC materials under **Agenda Item 3: Evaluation of bycatch in the California halibut set gillnet fishery in support of the fishery management review**.

We are grateful for all that you do to preserve our natural resources.

Warm Regards,
Jack

--

Jack E. Lighton
Chief Executive Officer, SeaLegacy

sealegacy.org | jack@sealegacy.org

Watch SeaLegacy's Brand Anthem

July 7, 2023

Mr. Eric Sklar, President
California Fish and Game Commission
P.O. Box, 944209
Sacramento, CA 94244-2090
Via email: fgc@fgc.ca.gov

Dear President Sklar and Members of the California Fish and Game Commission,

SeaLegacy is an international nonprofit organization using strategic communications at the intersection of art, science, and conservation to protect and rewild the ocean within our lifetimes. We have conducted over 45 expeditions, studied over 765 species, and documented over seven million images of ocean life that call our water plant home.

We commend the California Fish and Game Commission for its commitment to the conservation of our precious marine resources. Today, we humbly implore you to take swift action in the best interest of our marine ecosystems and ban the use of set gillnets.

Set gillnets have proven to be a detrimental fishing method that poses significant threats to the health and survival of numerous marine species. In addition to the target catch these nets are meant to catch, they also ensnare and kill countless non-target species — including critically endangered marine mammals, sharks, fish, and seabirds. The excessive waste caused by set gillnets is unacceptable, and urgent measures are needed to address this issue.

The use of set gillnets has long been associated with unsustainable fishing practices and has led to severe declines in several important marine populations. It is disheartening to witness the loss of such unique and irreplaceable marine life, and it is our collective responsibility to prevent further harm.

Moreover, set gillnets not only endanger marine species but also disrupt the delicate balance of marine ecosystems. The indiscriminate nature of these nets disrupts food chains, impacting the abundance and diversity of marine life. The loss of key species can trigger a cascade of ecological effects, leading to imbalances that reverberate throughout the ecosystem. By banning set gillnets, California can take a crucial step toward preserving the integrity and resilience of its marine habitats.

We acknowledge that responsible fisheries management is a complex task, and we commend the efforts made thus far to regulate fishing activities. However, it is imperative to recognize that the use of set gillnets is incompatible with sustainable fishing practices and ecosystem-based management.

Alternative fishing methods, such as hook-and-line and other selective fishing gears, can provide viable alternatives without causing the same level of harm to non-target species. Several regions around the U.S. and various international jurisdictions have already taken action to ban or severely restrict the use of set gillnets. By joining these progressive efforts, California can lead by example and become a global advocate for sustainable fisheries management.

SeaLegacy urges the California Fish and Game Commission to prioritize the protection of our marine ecosystems by banning the use of set gillnets off California entirely. By taking this critical step, California can contribute significantly to the preservation of marine biodiversity and ensure the sustainable future of its fisheries. We stand ready to support you in this important endeavor and look forward to witnessing California continue its leadership in ocean conservation.

Thank you for your attention to this urgent matter. We trust in your commitment to the well-being of our oceans for this and future generations and remain hopeful that you will act decisively to ban set gillnets.

Sincerely,

Cristina Mittermeier
Co-Founder, SeaLegacy
www.sealegacy.org

SeaLegacy
6671 W Indiantown Rd Suite 50-170
Jupiter, Florida 33458
www.sealegacy.org

July 7, 2023,

Mr. Eric Sklar, President
California Fish and Game Commission
P.O. Box, 944209
Sacramento, CA 94244-2090

RE: Marine Resource Committee Agenda Item 3: Set Gillnet Bycatch Evaluation

Dear President Sklar and Members of the Commission,

I would like to express my appreciation to Kirsten Ramey, Craig Schuman, and their staff at the California Department of Fish & Wildlife (CDFW) as well as Susan Ashcraft, and her staff, and both Commissioner Murray and yourself representing the Marine Resource Committee (MRC) for the amount of work that has been dedicated to addressing the concerns arising from California Set Gillnets. Between understanding data complexities, listening to stakeholder concerns, and undertaking California's first bycatch acceptability determination, I am grateful to both CDFW and the MRC for following through on the Marine Life Management Act (MLMA) master plan prioritization[1] of the management of Set Gillnets.

California is perceived as a world lighthouse for developing ambitious policies that protect our precious marine ecosystem while supporting robust, local, sustainable fisheries. As new challenges continue to manifest, driven by climate change and in conjunction biodiversity crisis, it is imperative we don't stray from the mandates laid out in the MLMA. Setting a strong precedent while undertaking the first acceptability determination for the fishery with some of the most significant ecosystem concerns is critical to enshrine the MLMA's ability to act as a tool in protecting California's marine biodiversity.

Although we appreciate the department's work, some aspects of the CDFW's bycatch analysis stray from cornerstones of the Marine Life Manage,ment Act and thus lead to weaker management than required to get bycatch to acceptable levels.

With the intention of having a constructive dialogue at the upcoming MRC meeting, we aim to highlight our concerns with the CDFW's framing of the analysis concerning the MLMA and put forward potential recommendations that aim to bring the types and amounts of bycatch in the Set Gillnet fishery to acceptable levels.

[1] https://wildlife.ca.gov/Conservation/Marine/MLMA

The analysis must be based on the Precautionary Principle.

Shifting 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, is a key component of what makes the MLMA work;"[2] The Department's analysis is framed in the opposite light, and does not assume unknowns in the data or data limitations in this historically problematic fishery to be a stronger indicator of unacceptability. If the precautionary principle were utilized, the "significant data limitations and knowledge gaps to determine amounts and types of bycatch and potential risks to sustainability, fisheries, and ecosystems" would provide a framework for the analysis that this fishery does not have adequate data to prove its sustainability. The burden of proof not being placed on the has negative trickle-down effects throughout the report.

Not Utilizing Best Available Science in Determining Types & Amounts of Bycatch

The Department extensively relies on landing and logbook data to comprehend the composition of the catch. Although this information holds value, treating self-reported data sets and fishery-dependent data as equally significant is an inherently flawed approach to gauging fishery bycatch. Reporting discards in logbooks is not mandatory, occurs relatively infrequently, and is susceptible to inaccuracies due to its reliance on self-reporting by fishermen.

The Department and Chirss Free's Halibut bycatch report mentions, "the observer data offers the best insights into bycatch in the California halibut fishery. Maintaining support for the observer program is thus important for characterizing bycatch, understanding its ecological and economic impacts, and designing strategies for minimizing bycatch in the fishery. " Federal Observer Data is the only indicator that gives an independent and holistic snapshot of what species are kept relative to discard, as well as the pre-release mortality for this gear type.

Despite the observer data being the best available science for determining discards and thus bycatch in this gear type, the Department calls into question the relevancy of the federal observer data because they cannot extrapolate just the Halibut Fleet when assessing bycatch[3]. The omission of this data results in the department's analysis not including estimates on efforts for total effort, catch, and discards.

Bycatch acceptability is determined by analyzing the types and amounts of bycatch as established in the MLMA. The MLMA also requires the department to use the best available science and involve stakeholders in a comprehensive and transparent process. By disregarding the best available science in determining total estimates of types and amounts of bycatch, Step 3 in the bycatch inquiry, which considers the impacts of the relative level of bycatch within the fishery on the biological health of the particular bycatch species[4], would be hard to discern.

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[2] "California Department of Fish and Wildlife. 2023. Evaluating Bycatch in the California Halibut Set Gill Net Fishery.")

[3] Free, Christopher, "Assessment of associated landed species and bycatch discards in the California halibut gill net and trawl fisheries", UC Santa Barbara

[4] https://wildlife.ca.gov/Conservation/Marine/MLMA

However, there is already a precedent of the Department having the ability to calculate type and magnitudes for Set Gillnets. Several critical attributes in the department's 2018 Master Plan Ecological Risk Assessment process related to the type and magnitude of bycatch in the directed fisheries and became driving factors in the Department's streamlined approach to prioritization.[5]

Not Managing all Caught Species for Sustainability

Viewing this analysis from a solely Halibut perspective appears to shift throughout the report. Step 2 of the MLMA bycatch criteria requires the Department to determine which species are the target of the fishery, which are incidental catch species, and which are bycatch species[6]. These classifications guide how management needs will be approached for the species caught in a particular species:

"Incidental catch is defined as fish caught incidentally during the pursuit of the primary target species, but legal and desirable to be sold or kept for consumption. Some may define these species as secondary targets or retained bycatch. For purposes of FMP development, these species should be accounted for and managed as target species under the sustainability standards outlined in Chapter 5 or as bycatch under the bycatch standard described below.[7]"

The MLMA is designed so that species that are "incidentally" caught do not fall through the cracks of management. These species must be managed either as a target or in accordance with the Chapter 5 Stock Sustainability Objectives in the MLMA.

Previously the Department cited the inability to isolate targeted Halibut targeted trips in the federal observer data as a rationale for not calculating total catch and discard estimates. In this instance, the Department also forgoes completing this step in the bycatch inquiry but instead cites that Set Gillnets are multispecies fishery, and the definition of bycatch or incidental catch may be considered fluid. While I agree with the Department that this is a multispecies fishery, I don't agree that is sufficient reasoning to disregard a "neccessary"[8] requirement of MLMA bycatch acceptability determination. Also, if the Department believed this to be a multi-species fishery, they would have been able to extrapolate total estimates of catch and discard from the Federal Observer Data.

By moving the target between a multispecies fishery and a Halibut-centric approach, the Department's report did not address multiple integral components of the bycatch acceptability determination. Not explicitly stating what is defined as Target, Incidental, and Bycatch has large implications for managing this fishery's vast and diverse amount of discard. Set Gillnets boast some of the highest bycatch

Set Gillnets are responsible for catching a plethora of species, making many susceptible to not being adequately managed. Out of 97 finfish, shark, ray, and skate species caught in the fishery, 68 have no population assessment and have unknown population levels. Furthermore, 56 of these species are not managed in state or federal Fishery Management Plans, standard management tools used to manage for sustainability and prevent overfishing and species depletion[9].

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[5] California Department of Fish and Wildlife. 2023. Evaluating Bycatch in the California Halibut Set Gill Net Fishery."
[6] https://wildlife.ca.gov/Conservation/Marine/MLMA
[7] https://wildlife.ca.gov/Conservation/Marine/MLMA
[8] California Department of Fish and Wildlife. 2023. Evaluating Bycatch in the California Halibut Set Gill Net Fishery.")
[9] NMFS Observer Data

For this fishery to be consistent with the MLMA, Set Gillnets either need to be defined as a multi-species, multi-target fishery and prioritize the identification of incidentally caught species or be treated as a targetted fishery and broaden the scope as to what is considered bycatch.

Criteria for Effective Management to Occur

If the Set Gillnet Fishery is to continue, the following gaps must first be filled for this fishery to have a chance at having acceptable levels of bycatch.

Data and Enforceability Constraints: Set Gill Net Observer Program

As directed by the MLMA, the sufficient lack of critical data coupled with this gear type historical concerns being banned in various iterations in California, the United States, and abroad raises multiple red flags. To escape scrutiny through the lens of the precautionary principle, more data that is not driven by self-reporting sources are prone to bias and error.

There currently are no enforceable regulations to monitor the discard of species in the Set Gillnet Fishery. The state must mandate some form of data collection, including a pilot state-run observer program, consistent electronic monitoring, and/or work with the National Marine Fishery Service West Coast Gillnet Observer Program to increase federal observer coverage. Considering the magnitude of species caught, the minimal monitoring over the last 15 years, and the innate sustainability concerns with Set Gillnets, 100% observer coverage should be required. It is impossible to achieve acceptable levels of bycatch when there are no independent scientific-based methods to monitor it.

These observer programs should also measure the soak time of each set length of each set, how many set net panels are cast, the mesh size for each set, and where effort is located. This information will provide the Department and stakeholders with adequate data to understand total effort calculations and accurately estimate total catch and discards.

Vulnerable Species Protection: Enforceable Hardcaps

In conjunction with 100% observer coverage, the Department should adopt hardcaps to enforce individual quotas upon catching a vulnerable or endangered species. This also will give the Department the tools to monitor and enforce existing regulations that pertain to the Set Gillnet Fishery. For example, it is illegal to catch halibut with less than 8.5-inch mesh. Yet given the current enforcement structure, it would be impossible to discern if Halibut was caught in the small mesh net, given various mesh set panels are cast alongside each other on a Set Gillnet trip. Hardcaps coupled with 100% observer coverage would be consistent with the federal west coast groundfish bottom fishery, which also requires a form of 100% observer coverage to enforce catch quotas in the fishery.

Adopt Sustainability Standards or Bycatch Criteria for Target, Incidental, and Bycatch Species

Identifying the top five landed species is insufficient in categorizing the different types of catch in the Set Gillnet fishery. The Department and the MRC must complete step 2 and begin a management review process for all observed caught species in the Set Gillnet fishery. There are no exceptions or exemptions in the MLMA that give Set Gillnets a pass in regulating its catch. As a multispecies fishery with such a high discard and mortality rate, it is vital to ensure that all species incidentally caught are held to a sustainability standard promulgated in Chapter 5 of the MLMA. Not doing so contradicts the MLMA's regulatory framework.

Unilateral Apply management to all General Gillnet Permits

Operating under the assumption that the Department believes Set Gillnets to be a multispecies fishery management measures should apply to all General Gillnet Permits since:

1. There is only one General Gillnet Permit, not a Halibut or White Sea Bass Gillnet permit.
2. California has over a hundred-year history of regulating Set Gillnets as a gear type.
3. The White Sea Bass FMP has not been updated since 2002. Given its high ranking on the 2018 ESR, unilaterally applying the same regulations would help modernize the White Sea Bass fishery.
4. This could lead to better data collection between Department and the federal observer program if methods of observing bycatch were similar.
5. As noted, the Federal Observer data is the best and only non-self-reporting method of understanding discards. Separating the sets did show some variability in catch; however, operating under the precautionary principle was insufficient in proving bycatch levels to be acceptable. Concerns regarding Halibut came from the same data source as White Sea Bass; thus, homogenously applying the same management would save both stakeholders and regulatory staff time to apply to better manage this fishery.

Non-Transferability of Permits and Potential Phase Out

To effectively bring Set Gillnets into compliance with the precautionary principle of the MLMA, novel management measures must be adopted. With 13 just vessels contributing to 90% of the catch[10], ending the transfer of these permits will allow the Department to contain the myriad of bycatch concerns from this gear type. If management measures deem ineffective or the anglers are not interested in participating in the 21st-century managed fishery, then it may be time to discuss facilitating the phase-out of the permits altogether and begin a collective dialogue on how to support the anglers in that transition.

[10] California Department of Fish and Wildlife. 2023. Evaluating Bycatch in the California Halibut Set Gill Net Fishery.")

These approaches represent a suite of potential management options that could be applied to the California halibut and white seabass set gillnet fishery. We ask that at the upcoming MRC meeting, we can have a science-based dialogue that utilizes the precautionary principle as promulgated in the MLMA.

Sincerely,

Scott Webb
Advocacy & Policy Director
Turtle Island Restoration Network

Chance Cutrano
Director of Programs
Resource Renewal Institute


NRDC
DEFENDERS OF WILDLIFE
CENTER for BIOLOGICAL DIVERSITY
Because life is good.
EARTHJUSTICE
AMERICAN CETACEAN SOCIETY
San Diego Chapter
AMERICAN CETACEAN SOCIETY
PASADENA AUDUBON SOCIETY
ODA
OCEAN DEFENDERS ALLIANCE
Working for a debris free sea
Ocean Conservancy
Ric O'Barry's DOLPHIN PROJECT
OCEANA
SURFRIDER FOUNDATION
SHARK STEWARDS
Project O
SAN DIEGO AUDUBON SOCIETY
west marin environmental action committee
POMONA VALLEY AUDUBON SOCIETY
Sea and Sage Audubon Society
Resource Renewal Institute
Innovations for a Sustainable Future.
THE INTERNATIONAL GAME FISH ASSOCIATION
MARINE CONSERVATION NETWORK
MCN
SHARK ALLIES
SAVE OUR SHORES
Heal the Bay
LOS ANGELES WATERKEEPER
OPS: OCEANIC PRESERVATION SOCIETY
PALOMAR AUDUBON SOCIETY
SWIA
EHL
ECO San Diego
Environmental Center of San Diego
WILDCOAST COSTASALVAJE
WILDAID
TURTLE ISLAND RESTORATION NETWORK
FIGHTING FOR A BLUE-GREEN PLANET
The SeaChange Agency
PACIFIC BEACH COALITION
Palos Verdes/South Bay Audubon Society
Azul
THE PEW CHARITABLE TRUSTS
PACIFIC MAMMAL CENTER
VOW
VOICES of Wildlife in NH
CETACEAN SOCIETY INTERNATIONAL
epic
Predator Defense
Fighting for wildlife since 1990
KLAMATH FOREST ALLIANCE
NY4WHALES
New York Whale and Dolphin Action League
NY4WHALES.ORG
Animal Welfare Institute
BUFFALO FIELD CAMPAIGN
Protecting Wild Bison Since 1997
INTERNATIONAL MARINE MAMMAL PROJECT
A PROJECT OF EARTH ISLAND INSTITUTE
WWW.WHALE.ORG
OCEAN ALLIANCE
AMERICAN BIRD CONSERVANCY
HUMANE ACTION Pittsburgh
THE HUMANE SOCIETY OF THE UNITED STATES
bleu WORLD
LICK-WILMERDING HIGH SCHOOL
MAYBECK HIGH SCHOOL
BAY AREA YOUTH CLIMATE SUMMIT
MARIN ACADEMY
THE NUEVA SCHOOL
hanken GREEN TEAM
SUSTAINABILITY CLUB
University of San Diego
Be Blue Go Green

July 7, 2023,

Mr. Eric Sklar, President
California Fish and Game Commission
P.O. Box, 944209
Sacramento, CA 94244-2090

RE: Marine Resource Committee Agenda Item 3: Set Gillnet Bycatch Evaluation

Dear President Sklar and Members of the Commission,

The undersigned organizations are concerned about the high levels of bycatch in set gillnets. The unintended catch and discarding of dead or injured marine life is widely considered among the top ecological impacts of fisheries – contributing to population impacts and a reduction in marine biodiversity. To combat this, the California Department of Fish and Wildlife (CDFW) identified set gillnets as a top management priority due to their ecological risks due to bycatch, habitat impacts, and target species vulnerability, with the gear type ranking #1, #3, and #4 in CDFW's ecological risk assessment[1].

California's set gillnets have among the highest discard rates—by the number of animals—of any fishery in the country. According to federal fishery observers, 64 percent of all animals caught are discarded, and over 50 percent are discarded as dead. Over the last 15 years, conservative estimates indicate more than 230,000 animals in total have been discarded in the set gillnet fishery; however, using commercial fish landings data to estimate total catch, the number of discarded animals could be as high as 2 million. More than 125 species are caught, including ecologically important sharks and rays, sea lions, dolphins, and seabirds [2, 3, 4]. This fishery has been documented to catch endangered leatherback sea turtles [5] and has been involved in large whale entanglements off California [6, 7]. Furthermore, 70 percent of the discarded fish and shark species do not have population assessments. In halibut-targeting set gillnet trips, California halibut accounts for just 10.6 percent of all animals caught [8].

Because of the bycatch concerns, this gear type was banned within state waters by a 1990 California ballot proposition and banned off Central California by the California Fish & Game Commission in 2002. However, set gillnets still operate relatively unchecked in federal waters off Southern California but are still under the jurisdiction of the California Fish & Game Commission.

Set gillnets have a disproportionate impact on marine species relative to hook-and-line gear that targets halibut, and 87 percent of California halibut commercial fishers already use hook and line gear [9]. Discarding dead, undersized halibut in set gillnets impacts commercial and recreational anglers who target halibut with cleaner gear types.

We rely upon fishery managers and policymakers to ensure that all seafood is responsibly harvested in ways that support recreation, other fisheries, and the unique marine biodiversity along California's coastline. The Marine Life Management Act (MLMA) includes bycatch acceptability criteria that are fleshed out in a detailed bycatch inquiry in the MLMA Master Plan for Fisheries, giving resource managers the tools to identify bycatch concerns and implement measures to minimize bycatch. In the

context of these criteria and based on publicly accessible federal observer data and other bycatch information, we request the Commission to formally determine that the types and amounts of bycatch in set gillnets are unacceptable. The term "unacceptable" is not intended as a value judgment on the fishery or participants; instead, it represents a legal threshold, as written in the Marine Life Management Act (MLMA) (Fish and Game Code Section 7085), that is intended to initiate management action.

We Urge the California Fish and Game Commission and the California Department of Fish and Wildlife to uphold the state's commitment to protecting marine biodiversity and promulgate comprehensive management measures to reduce bycatch in the California halibut and white seabass set gillnet fishery to acceptable levels. Doing so will support vibrant and sustainable fishing communities while protecting wildlife.

Sincerely,

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