Evaluation of the California halibut trawl grounds

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FULL RESEARCH ARTICLE

Travis Tanaka[1]*, Kirsten Ramey[2], Shoshana Lescht-Smith[3], Michael Patton[1], Matthew Warren[1], and Paul Reilly[1]

[1] *California Department of Fish and Wildlife, Marine Region, 20 Lower Ragsdale Drive, Suite 100, Monterey, CA 93940, USA* https://orcid.org/0009-0000-9056-2952 (TT)
[2] *California Department of Fish and Wildlife, Marine Region, 619 2nd Street, Eureka, CA 95501, USA* https://orcid.org/0009-0002-5483-5495
[3] *California Department of Fish and Wildlife, Marine Region, 1933 Cliff Drive, Suite 9, Santa Barbara, CA 93109, USA* https://orcid.org/0009-0000-9189-094X

*Corresponding Author: ***Travis.Tanaka@wildlife.ca.gov***

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Abstract

The Marine Life Management Act (MLMA), **California Fish and Game Code, sections 7050–7090**, 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 methods for implementing MLMA goals and objectives and is the California Department of Fish and Wildlife's (CDFW) document for managing state finfish, invertebrate, and algal commercial and recreational fisheries. The California Halibut Trawl Grounds (CHTG), created through legislation (1971), provides trawl fishermen access to a section of state waters off Santa Barbara and Ventura counties to target California halibut (*Paralichthys californicus*). Legislation (Fish & G. Code, § 8495) requires the California Fish and Game Commission (CFGC) to evaluate trawl gear effects on specific Performance Criteria every three years. The CFGC is required to close any area within the CHTG where trawl gear does not meet the required criteria. The last evaluation of the CHTG occurred in 2008, with the CFGC closing one area due to the presence of hard bottom habitat and least fiscal impact to the fishing fleet. From 2022–2023, we re-assessed these Performance Criteria by incorporating recent catch disposition data, West Coast Groundfish Observer Program data, current biogeographical data, and relevant scientific literature. We assessed 2,152 individual organisms, representing 55 species, with 77.9% released live. No species of concern were caught, and minimal bottom contact was evident. We identified management control measures which protect distinct aspects of ecosystem function. Spatial analysis using GIS compared kelp, hard bottom, and biogenic habitats against trawl locations which showed no overlap. Our findings suggest that light touch trawl gear in the CHTG fishery meets the Performance Criteria in Fish and Game Code, section 8495. These findings

suggest that additional closures within the CHTG are not currently warranted.

Key words: bycatch, California Halibut Trawl Grounds (CHTG), habitat, halibut, Master Plan, performance criteria, trawl grounds

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Introduction

California halibut (*Paralichthys californicus),* hereafter referred to as "halibut," are a predatory finfish species important to statewide recreational and commercial fisheries. Halibut's natural range occurs off shallow, soft-bottom habitat from the Quillayute River, Washington, USA (47.916667ºN) to Cabo Falsa (22.833333ºN) in southern Baja California, Mexico (CDFW 2022). Halibut are taken recreationally by diving (spearfishing) and hook-and-line. Commercial halibut are taken by hook-and-line, set gillnet, and trawling. Trawling, an effective, but non-selective method used to take halibut, is allowed only in federal waters and designated trawl ground areas within State waters. State jurisdictional waters are located 0–5.56 km from shore, including bays and estuaries. Regulations governing halibut trawling exist in Fish and Game Code and Title 14, California Code of Regulations. Legislation (Fish & G. Code, §§ 8494–8497) created the California Halibut Trawl Grounds (CHTG) in 1971which were originally described as not less than 1.85 km off the coast of Santa Barbara and Ventura counties. In 2004, Senate Bill 1459 amended Fish and Game Code, section 8495 which modified the scope and dimensions of the CHTG. Additional regulations in California Code of Regulations, Title 14, section 124(b) and Fish and Game Code, section 8496 established the use of light touch trawl gear as the only trawl method allowed in the CHTG. In addition to the management control measures, the fishery is monitored through mandatory logbook and landings reporting and onboard observation, documenting discards and sensitive species by the National Marine Fisheries Service's West Coast Groundfish Observer Program (WCGOP) due to the incidental capture of federally-managed groundfish species.

Fish and Game Code, section 8495(e) established four Performance Criteria and required the California Fish and Game Commission (CFGC) to review every 3 years, beginning 1 January 2008, available monitoring and research related to the CHTG and close any area within the CHTG where trawl gear: 1) does not minimize bycatch; 2) is likely damaging the seafloor; 3) is adversely affecting ecosystem health; or 4) impedes restoration to kelp, coral, or other biogenic habitats. In 2008, the California Department of Fish and Game (CDFG) collected and analyzed data on the four CHTG sub-areas (A–D) (**Fig. 1**), presenting the findings to the CFGC. The review resulted in CFGC establishing a closure of sub-area B

(Fig. 1). This area, based on the best available data at the time, had the highest percentage of hard-bottom substrate and smallest economic benefit (CDFG 2008). The CFGC found that the halibut trawl fishery satisfied the Performance Criteria in the three other sub-areas and no other changes were made. Since the first evaluation by CDFG in 2008, the CHTG have not been reviewed (Fig. 2).

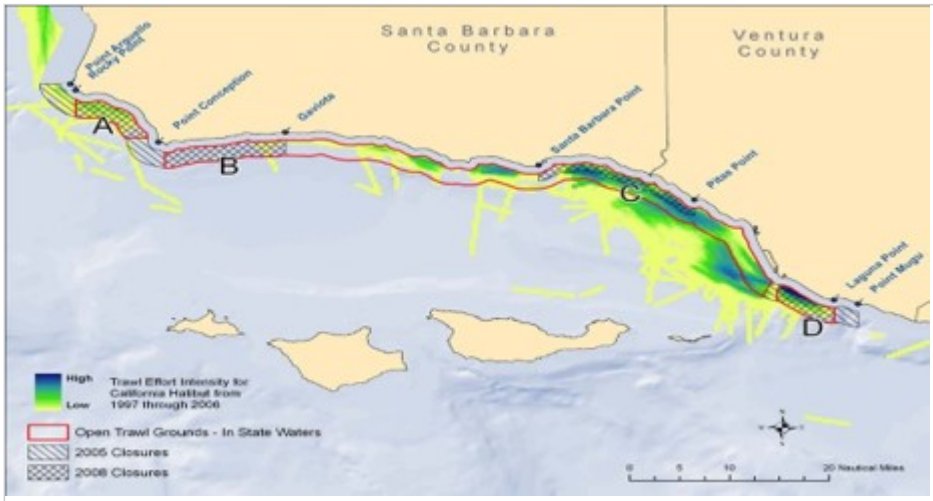

Figure 1. Southern California Halibut Trawl Grounds, including trawl activity based on logbooks, pre-2008. The areas A, B, C, D were evaluated for possible closure by the CFGC if performance criteria were not met (CDFG 2008).

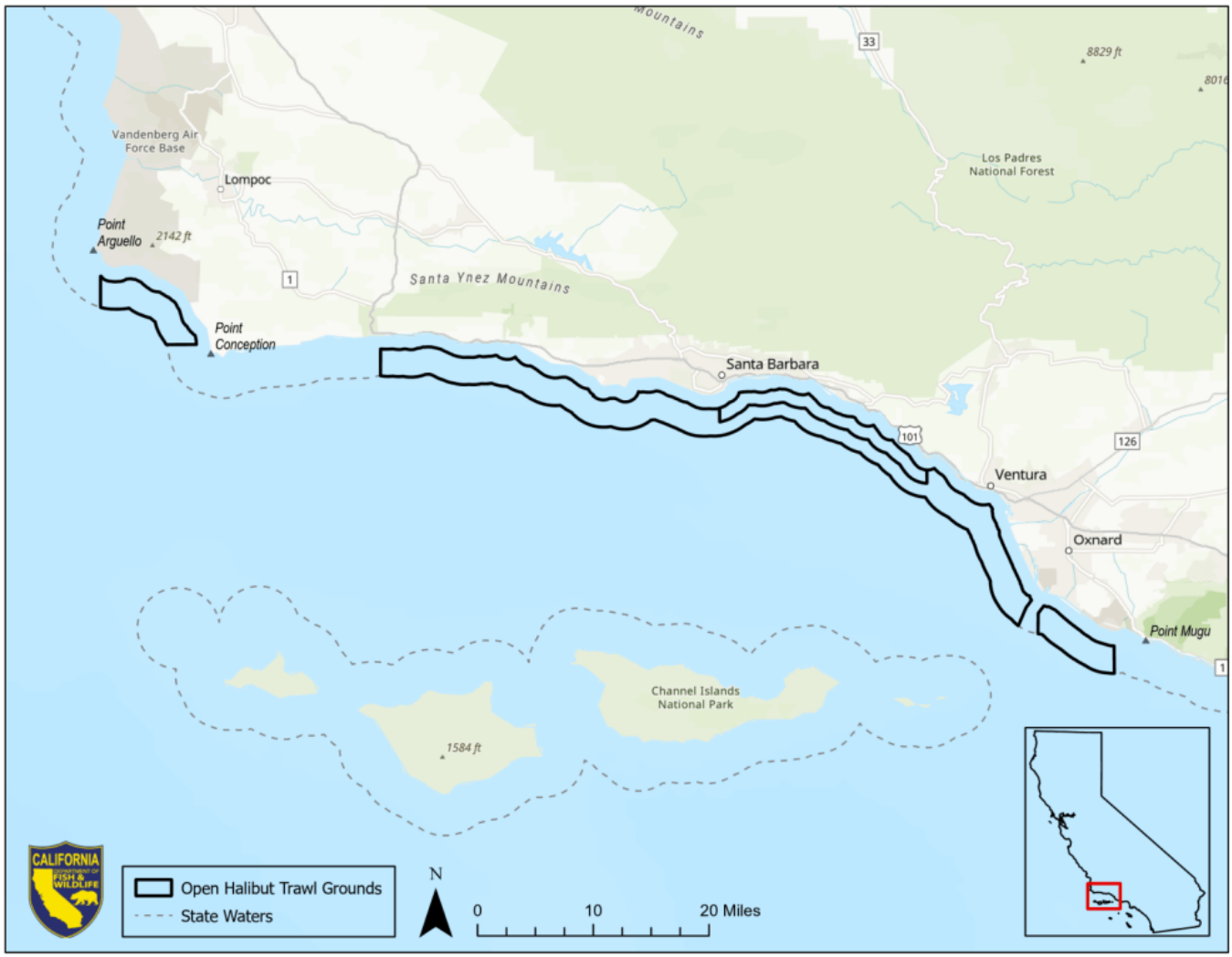

Figure 2. Map of the current California Halibut Trawl Grounds, 2023.

In 2021, the California Department of Fish and Wildlife (CDFW) identified revisiting the required assessment of the CHTG to be a high priority. With the cooperation of CHTG trawl fishermen providing us observation opportunities, we accessed the best available information from WCGOP, CDFW records, and recent habitat information. Using the 2018 Marine Life Management Act (MLMA) Master Plan for Fisheries (Master Plan), these datasets were evaluated against the same four Performance Criteria addressed in 2008 and outlined in Fish and Game Code, section 8495(e) (CDFW 2018). Our findings were presented to the CFGC's Marine Resources Committee at their March 2024 meeting.

Methods

At Sea Observation

We observed trawl trips targeting halibut within the CHTG during the open season of 16 June 2022 to 14 March 2023. With an observation goal of one trip for the entire fleet per month, observations were executed opportunistically pending factors relating to weather, market demand, and vessel availability.

Onboard observations documented normal fishing practices with fishermen selecting their trawl locations and tow duration. To accurately map trawl tow duration, we recorded GPS coordinates and times of each trawl tow at the start, middle (location when trawl was 50% completed), and end trawl locations.

Catch from each tow was brought onboard and separated by species into bins containing fresh seawater. Except for catch retained for sale, we kept discards alive and released prior to the start of the next tow to avoid double counting. We counted all finfish and invertebrates and weighed to the nearest 0.23 kg (if possible) in aggregate by species and disposition. All live sublegal-sized halibut were assessed for spawning maturity and released.

Analysis

Multiple data sources were incorporated in the analysis, including but not limited to WCGOP observation data, CDFW fishery-dependent records (commercial fishermen-reported logbooks and landing receipts), and existing CDFW and National Oceanic and Atmospheric Administration (NOAA) habitat information (**Table 1**).

Table 1. Key datasets and their respective attributes that were incorporated into the analysis of the 2022–2023 California Halibut Trawl Grounds (CHTG) assessment.

Data	Source	Attributes
Onboard observation data, July 2022–March 2023	T. Tanaka, CDFW unpublished data 2023	Observed species (retained and discards) count by disposition, total weight by disposition available for most species
Observer data-fish and invertebrate bycatch, 2018–2022	WCGOP 2023, 2024	Gear type, fishery sector, port, tow position, depth, duration, target strategy, bycatch species, retained weight, discard count and weight. Data contributes to fleet level catch estimates produced NOAA's Fisheries Observation Science Program.
Observer data- marine mammal and marine birds, 2018–2022	WCGOP 2024	Gear type, fishery sector, port, tow position, depth, duration, target strategy, bycatch species, retained weight, discard count and weight
Habitat (kelp, coral, hard bottom, biogenic)	CDFW 2016, 2023a; NOAA 2023	Kelp, coral, hard bottom, biogenic. Location and surface area of each type
Ecosystem Component Species	PFMC 2022a	List of species under the federal Groundfish Management Plan that are not actively managed but monitored to ensure that fishing take is not increasing.
Commercial Trawl Logbooks, 2018–2022	CDFW 2023b	Trawl tow locations for vessels halibut trawling in the CHTG.
Commercial Landing Receipts, 2018–2022	CDFW 2024	Halibut landings data for trawl vessels fishing south of Point Arguello

Data	Source	Attributes
Species biology and ecosystem role, status	Fishbase.org	International finfish database containing species specific data on life history, population status, ecological roles
Monterey Bay light touch trawl study	Wick et al. 2014	Results from a collaborative study assessing the use of light touch trawl gear on soft bottom habitats. Includes species, documentation on amount of soft bottom contact via video
Halibut Enhanced Status Report	CDFW 2022	Life history, fishery descriptions and status, past and present management actions and measures, monitoring and essential fishery information, research needs

We analyzed WCGOP observation data to assess catch trends, including the take of sensitive species within the CHTG. CDFW-observed species were analyzed using the bycatch criteria (Fish & G. Code, § 7085(b)) and acceptability process in the Master Plan as described in Performance Criteria 1 (Fish & G. Code, § 8495(e)).

Performance Criteria 1: Does Not Minimize Bycatch

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” (**Fish & G. Code, § 90.5**). Discarded catch may be returned to the sea alive, dead, or dying, and it is important to assess the mortality rate to evaluate impacts. The Master Plan outlines a four-step process to identify bycatch and assess its potential impacts on sustainability, the ecosystem, and socioeconomics.

In addition to possible threatened, endangered, or species of concern, we selected the top ten most numerous species recorded during onboard observations and documented within the WCGOP data (i.e. greatest number of individuals recorded) and evaluated those species using criteria established in the MLMA (Fish & G. Code, § 7085(b)) and the four-step bycatch evaluation process outlined in the Master Plan. We evaluated each selected species with standardized questions which address the legality of take, current management strategies, threats to sustainability, and impacts to fisheries and ecosystems.

Performance Criteria 2: Likely Damaging the Seafloor

Assessing and measuring long-term seafloor damage is difficult due to the scarcity of quantitative data. Using the best available qualitative information, we used gear observation, at the surface and by video in a related study using light touch trawl gear over soft bottom (Wick et al. 2014). For this assessment, we observed gear retrieval at the conclusion of every tow looking for evidence of bottom contact, indicated by rust removal from where the doors contacted the bottom. Findings from the previous 2008 CHTG assessment and the 2013 collaborative Monterey Bay light touch trawl study (Wick et al. 2014) served as the primary sources of data to examine the impacts of light touch trawl gear on seafloor habitats.

Fleetwide tows from logbooks and observed tows were mapped against known hard bottom and biogenic habitats to examine the extent of potential interaction of trawl gear with these habitats.

Performance Criteria 3: Adversely Affecting Ecosystem Health

Following guidance from the Master Plan, ecosystem impacts were evaluated in this study by:

1. Identification of species that play key roles in the ecosystem.
2. Considering management strategies with multiple control measures.
3. Conducting an ecological risk assessment to understand which relationships are most critical. There are several inquiries and recommendations for this step.

For the selected species, to evaluate each species' ecosystem function, we considered the known life history function of select groundfish species status by referring to NOAA's list of Ecosystem Component species within the Groundfish Fishery Management Plan (FMP) (PFMC 2022a). For species not on the Ecosystem Component species list, we referred to **Fishbase.org** as a source for relevant information. Species characterized as keystone, biogenic, or basal prey species were determined to provide significant ecosystem function.

To address the Master Plan's inquiries to assess ecosystem health, we incorporated the results from the 2019 CDFW Ecological Risk Assessment (ERA) process which identified species which may benefit from additional management action (Samhouri et al. 2019). Results from the statewide (ERA ranked halibut trawl as high risk due to bycatch and potential habitat impacts.

Performance Criteria 4: Impedes Restoration to Kelp, Coral, or Other Biogenic Habitats

To assess the potential impacts of trawl activities on the restoration of kelp, coral, and other biogenic habitats, we carried out the following three step process described by the Master Plan:

1. Describe the habitat utilized by the target species at each life stage.
2. Describe the threats to the habitat utilized.
3. Minimize or mitigate adverse effects fishing activity may have on habitat.

We used available information in the **California Halibut Enhanced Status Report (ESR)** (CDFW 2022) and current GIS data (CDFW 2016, 2023a; NOAA 2023) to address steps 1 and 2. To address step 3, we referred to the results from the 2008 CHTG assessment (CDFG 2008) and the 2013 Monterey Bay light touch trawl study (Wick et al. 2014) to discuss potential impacts of this trawl gear on soft bottom habitats. The trawl gear used today is the same as the gear used in the 2008 assessment and 2013

study. To determine the extent that the CHTG trawl fishery encountered kelp, coral, or hard bottom habitat, we reviewed recent tow activity from logbooks and mapped these tow locations along with the CDFW-observed tows against known biogenic habitat locations (CDFW 2016, 2023a,b; NOAA 2023).

Results

We observed eight trawl trips, totaling 25 tows in sub-area C of the CHTG during the period July 2022 through March 2023. One observation trip occurred in federal waters totaling 4 tows, as the fisherman chose to target areas outside the CHTG that day (Fig. 3). We attempted to conduct an observation trip within the CHTG every month of the open fishing season except June 2022, and January and February 2023. Based on the number of landings by the fleet during the open season of the CHTG, we observed approximately 4.9% of available landings for the period. No observation trips were conducted during June 2022 due to staffing shortage and February 2023 due to poor weather. One trip was taken in January 2023, but fishing activity occurred outside of the CHTG due to storm debris found within the normal CHTG fishing grounds.

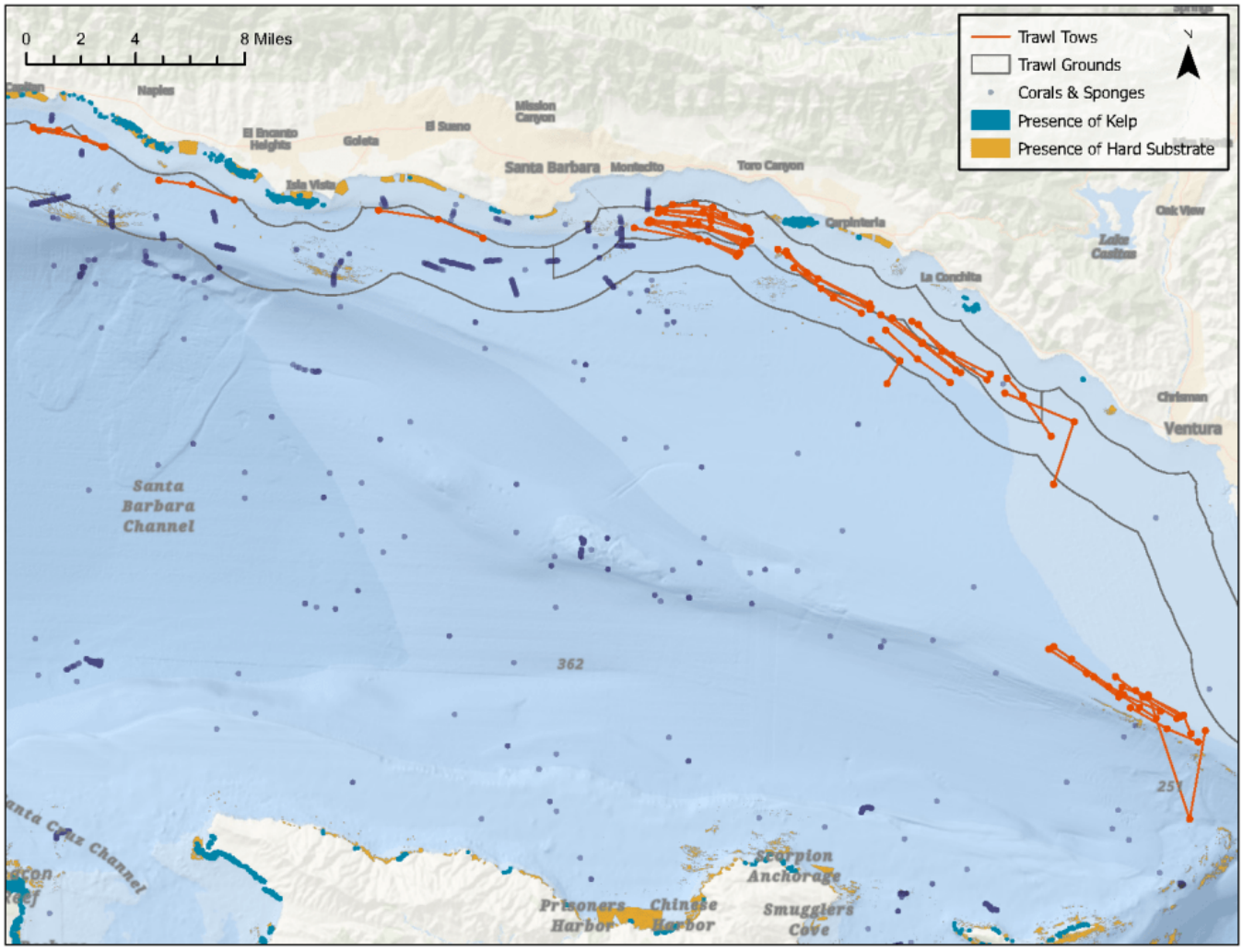

Figure 3. Biogenic habitat, kelp, and hard bottom locations relative to CDFW observed tow locations (CDFW 2016, 2023a; NOAA 2023).

Performance Criteria 1: Does Not Minimize Bycatch

A total of 21 invertebrate species and 34 finfish species were counted and assessed during the onboard observations (**Table 2**). No finfish or invertebrate species of special concern, marine mammals, or birds were taken or injured. California sea lions (*Zalophus californianus*) were observed following the vessel and preying on fish from the cod-end of the trawl gear. Of the 2,152 total organisms counted, 77.9% were assessed as live and released, 12.9% released dead and 9.2% of species caught were retained. Across all observed trips, fantail sole (*Xystreurys liolepis*); legal-sized (males—101.6 cm (40 in), females—106.7 cm) (42 in) Pacific angel sharks (Squatina californica); and legal-sized (55.9 cm) (22 in) halibut were the only species retained for sale. Marketable species such as mantis shrimp (*Hemisquilla ensigera californiensis*); starry flounder (*Platichthys stellatus*); and sand sole (*Psettichthys melanostictus*), were not retained due to the low number caught. Additionally, marketable federally managed groundfish species were not retained due to lack of market demand and the low number caught. Sea pens were encountered on the foot rope of the first tow during the first observation trip. While noted, they were not counted. No other biogenic species were encountered for the remainder of the study.

Table 2. Observed catch and disposition from the net cod-end. * = killed by sea lions ** = includes four killed by sea lions. Total weight in kg. Catch sorted in descending order based on the number observed "Total Count."

Common Name	Count (kept)	Count (released live)	Count (released dead)	Total Count	Total Wt.	Total Count %	Total Wt. %	% Mortality by species
California skate	—	640	2	642	333.8	29.8	17.1	0.3
longspine combfish	—	99	120	219	4.3	10.2	0.2	54.8
halibut-legal	153	—	4*	157	542.2	7.3	27.8	—
halibut-sublegal	—	119	24**	143	157.2	6.6	8.1	16.8
Pacific angel shark	19	90	—	109	585.7	5.1	30	—
slender crab	—	100	5	105	14.9	4.9	0.8	4.8
hornyhead turbot	—	86	2	88	19.4	4.1	1.0	2.3
yellow rock crab	—	79	—	79	24.8	3.7	1.3	—
sheep crab	—	75	2	77	89.8	3.6	4.6	2.6
pink seaperch	—	7	59	66	1.2	3.1	—	89.4
octopus	—	35	1	36	—	1.7	—	2.8
English sole	—	32	3	35	7.9	1.6	0.4	8.6

Common Name	Count (kept)	Count (released live)	Count (released dead)	Total Count	Total Wt.	Total Count %	Total Wt. %	% Mortality by species
fantail sole	27	3	—	30	16.7	1.4	0.9	—
Kellets whelk	—	24	—	24	2.9	1.1	0.1	—
California scorpionfish	—	22	—	22	7.2	1.0	0.4	—
white croaker	—	14	8	22	2.2	1.0	0.1	36.4
red rock crab	—	19	—	19	5.7	0.9	0.3	—
sea star	—	19	—	19	0.2	0.9	—	—
spiny dogfish	—	13	6	19	34.8	0.9	1.8	31.6
Pacific sanddab	—	6	12	18	0.4	0.8	—	66.7
Pacific electric ray	—	17	—	17	17.9	0.8	0.9	—
Nudibranch	—	16	—	16	—	0.7	—	—
salp	—	15	—	15	—	0.7	—	—
armed box crab	—	14	—	14	1.5	0.7	—	—
barred sand bass	—	9	5	14	12.9	0.7	0.7	35.7
brittle star	—	12	—	12	—	0.6	—	—
plainfin midshipmen	—	10	1	11	2.4	0.5	0.1	9.1
skate eggs	—	11	—	11	—	0.5	—	—
halfbanded rockfish	—	3	7	10	0.4	0.5	—	70
hermit crab	—	10	—	10	2.7	0.5	0.1	—
sea hare	—	8	1	9	0.1	0.4	—	11.1
bat ray	—	8	—	8	26.2	0.4	1.3	—
specklefin midshipman	—	8	—	8	1.7	0.4	—	—
curlfin turbot	—	4	3	7	1.6	0.3	—	42.9
swell shark	—	7	—	7	3.6	0.3	0.2	—
California lizardfish	—	4	2	6	1.0	0.3	—	33.3

Common Name	Count (kept)	Count (released live)	Count (released dead)	Total Count	Total Wt.	Total Count %	Total Wt. %	% Mortality by species
Pacific staghorn sculpin	—	6	—	6	—	0.3	—	—
queenfish	—	1	5	6	0.2	0.3	—	83.3
California spiny lobster	—	4	—	4	1.7	0.2	—	—
California tonguefish	—	2	2	4	—	0.2	—	50
shovelnose guitarfish	—	4	—	4	9.8	0.2	0.5	—
market squid	—	3	—	3	—	0.1	—	—
striped nudibranch	—	3	—	3	—	0.1	—	—
horn shark	—	2	—	2	1.6	—	—	—
mantis shrimp	—	2	—	2	0.1	—	—	—
ridgeback prawn	—	2	—	2	—	—	—	—
sand sole	—	1	1	2	0.8	—	—	50
big skate	—	1	—	1	10	—	0.5	—
blenny	—	1	—	1	—	—	—	—
brown rock crab	—	1	—	1	0.1	—	—	—
brown rockfish	—	1	—	1	2.0	—	0.1	—
California corbina	—	—	1	1	1.0	—	—	100
kelp crab	—	1	—	1	—	—	—	100
orange peel doris	—	1	—	1	—	—	—	—
southern spearpoint poacher	—	—	1	1	—	—	—	100
spotfin croaker	—	1	—	1	0.1	—	—	—
starry flounder	—	1	—	1	0.2	—	—	—
Grand Total	**199**	**1,676**	**277**	**2,152**	**1,951.5**	**—**	**—**	**—**

To assess the impacts of bycatch, we evaluated the top ten most numerous bycatch species encountered (Appendices 1a–1j) using the Master Plan bycatch criteria. The top ten species (seven finfish, three invertebrates) (**Table 2**) included: California skate *(Raja inornate);* slender crab *(Metacarcinus gracilis)*; longspine combfish *(Zaniolepis latipinnis);* halibut (sublegal); Pacific angel shark; hornyhead turbot (*Pleuronichthys verticalis)*; yellow rock crab (*Metacarcinus anthonyi)*; sheep crab *(Loxorhynchus grandis)*; pink seaperch *(Zalembius rosaceus);* and English sole *(Parophrys vetulus)*. Of the seven finfish, California skate was the top species encountered at 29.8% of the count with an instantaneous mortality of 0.3%. By contrast, longspine combfish was 10.2% of the count, but with an instantaneous mortality of 54.8%. Pink seaperch had the highest instantaneous mortality at 89.4%, but only 3.1% of the count.

Total instantaneous mortality for all species combined, including species preyed upon by sea lions was 12.9%. Finfish instantaneous mortality was 15.8% when including those that were killed by sea lions. Sea lions were the only marine mammal species observed around the vessel or gear. Sea lion induced instantaneous mortality confirmation is based on observation of direct take by the marine mammal or presence of mutilated fish parts or having claw/teeth marks. Without sea lion induced mortality, finfish mortality was 15.3%. Invertebrate instantaneous mortality was 2.0%. Of those species released dead during the assessment, the majority (64.6%) consisted of longspine combfish and pink seaperch.

For the period of 2002–2022, WCGOP observed the statewide open access (trawlers without a federal groundfish permit) halibut trawl fleet at a median of 15%, with a 2022 observation median of 17% (Somers et al. 2023). Based on the last five years (2018–2022) of confidential observer data specific to the CHTG, WCGOP observers documented 148 finfish and invertebrate species including species groups (**Appendix 1a and 1b**) (WCGOP 2023, 2024). Documented species of concern included five giant sea bass (*Stereolepis gigas)* and one soupfin shark *(Galeorhinus galeus)*. This dataset does not indicate disposition upon discard. WCGOP observers document take and interaction of marine mammals, seabirds, and sensitive species with trawl gear. WCGOP data show that during the period of 2018–22, there were four California sea lions and eight Brandt's cormorants *(Phalacrocorax penicillatus)* observed entangled or killed by open access trawl gear while fishing within the CHTG (WCGOP 2024).

Kelp pieces, broken kelp holdfasts, plastic trash, abandoned crab traps, and other debris were present during five of seven observation trips. All observed holdfasts and drift kelp parts were already senesced before captured by the gear. Encountered holdfasts and kelp were not taken from the bottom by the observed trawl gear since fishing occurs outside of known kelp forest locations and fishing depth is greater than where kelp grow. Holdfasts were broken and in decomposed condition. Drift kelp was decomposed and were entangled in the net webbing and the cod-end. While noted, these items were not counted or weighed.

Performance Criteria 2: Likely Damaging the Seafloor

Inspection of trawl gear at the conclusion of every tow revealed consistent, but limited signs of direct bottom contact where rust was removed from hanging chains on the foot rope and the bottom, leading edge of the trawl doors as seen previously in the 2013 (Wick et al. 2014) light touch trawl study. The other indication of bottom contact was the presence of sea pens on the foot rope during the first observation trip.

Performance Criteria 3: Adversely Affecting Ecosystem Health

An ecosystem-based approach to managing fisheries requires that ecosystem dynamics, such as interactions with other species, and ecosystem impacts be considered broadly. The Master Plan provides guidance on how to apply the principles of ecosystem-based fisheries management when making management decisions and identifies a three-step practical approach to managing for ecosystem health:

Step 1. Identification of species that play key roles in the ecosystem.

Ecosystem roles as described in the Master Plan include keystone species, foundational or biogenic species, basal prey species, and apex predators. There are many finfish and invertebrate species that utilize the soft bottom habitat of the CHTG. The species we observed either utilize soft bottom or are epipelagic and transiting through the area (**Table 2**). WCGOP observers documented a similar suite of species (**Appendix 2a and 2b**).

We did not document any biogenic species other than sea pens within the CHTG during our assessment tows. During WCGOP observed trips, observers documented sea pens (56), and a small number of horny gorgonian *(Holaxonia* spp*)* (5).

Most finfish species encountered during our observations are predators or apex predators that feed on other fishes and invertebrates. Noted apex predators included Pacific angel shark and spiny dogfish *(Squalus suckleyi).* Additionally, WCGOP observer data (**Appendix 2a**) documented the catch of apex species such as common thresher shark *(Alopias vulpinus)*, sevengill shark *(Notorynchus cepedianus),* and giant sea bass.

Several crustaceans were documented during our observations and similarly by WCGOP observers (**Appendix 2b**). Crustaceans are generally scavengers and predators of demersal invertebrates. WCGOP observers also noted basal prey species such as market squid *(Doryteuthis opalescens);* octopus, and smaller finfish such as unidentified midshipman *(Batrachoididae);* unidentified croaker, *(Sciaenidae)*; queenfish *(Seriphus politus);* unidentified combfish *(Zaniolepis);* and pink seaperch. We noted the same basal prey species, Longspine combfish and pink seaperch, act as predators of benthic invertebrates and a basal prey species to larger fish (**Table 2**).

Step 2. Consider management strategies with multiple control measures.

To promote ecosystem health, a suite of management measures is in place and applicable to the trawl grounds. These multiple combinations of management measures, such as gear controls, effort restrictions, and size and quota limits, were evaluated on their effectiveness in conserving ecosystem health. The ecosystem benefits of each management measure are described in **Table 3**.

Table 3. Management control measures currently applied to the California Halibut Trawl Grounds (CHTG), description of the measure, and benefits to conservation.

Management Control Measures and Authority	Description	Benefits
Gear requirements (Fish & G. Code, § 8496; Cal Code Regs., tit. 14, § 124.b)	Light-touch trawl gear onlyDoor weight maximum of 226.8 kg (500 lb)19.1 cm (7.5 in) cod-end meshNet constructed of twine 7 mm or lessMaximum headrope length of 27.4 m (90 ft)No rollers or bobbins	Light touch trawl gear shown to minimize bottom contact, limits bycatch and habitat impact, helps preserve halibut age structure
Effort restriction (Fish & G. Code, § 8494)	Restricted access permit required to trawl in the CHTG (41 permits issued for the 2022–2023 license year)	Limits fishing activity, minimize mortality on overfished and non-target species
Temporal restriction (Fish & G. Code, § 8496)	CHTG open to trawling 15 Mar–15 June	Protects halibut within the CHTG during the spawn season
Spatial restriction (Fish & G. Code, § 8495)	Defined area between 1.85 km (1 nm) and 5.56 km (3 nm) from shore	Control fishing activities
Quota and size limits (Fish & G. Code, §§ 8392, 8496)	Halibut minimum length of 55.9 cm (22 in).Trawl fishermen without a federal groundfish permit are allowed to take minimal quantities of open-access groundfish quota.	The halibut minimum length preserves population spawning and age structure.Incidental groundfish take is factored into the overall federal management allocation of groundfish per fishery sector.
Other measures or monitoring (federal observer coverage, logbooks, fish tickets) (Fish & G. Code, §§ 7923, 8026; Cal Code Regs., tit. 14, § 147)	Observers document at-sea discardsMandatory logbooks Electronic fish tickets	Discard data contributes to fleetwide bycatch estimates (NFSC 2023)Fishery reported data on retained catch, tow position, and total time of tow (CDFW 2023b).Species and weight reported to CDFW.

Step 3. Conduct ecological risk assessments (ERA) to understand which ecological relationships are most critical.

CDFW identified and scored ERA attributes on multiple fisheries, including halibut trawl. Using these attributes, Samhouri et al. (2018) evaluated the fisheries ecosystem risk based on target species, bycatch groups, and habitat groups. This analysis used exposure and sensitivity indices to calculate relative risk.

For halibut trawl, the risk to species was considered high, mostly due to high scores for the bycatch and habitat attributes. Samhouri et al. (2018) found that bycatch risk for this fishery was higher compared to other fisheries evaluated due to the amount of bycatch and perceived relative mortality. Similarly, risk to habitat was considered high for halibut trawl due to impacts to soft bottom and structure forming

invertebrates (Samhouri et al. 2018).

The Master Plan offers the following six inquiries and recommended actions to help identify potential impacts to ecological function:

1. Has the ecological role of the target species been identified? Does the target species play a key ecosystem role as defined above?

The California Halibut Enhanced Status Report (ESR) describes halibut's ecological role as a predator of finfish and benthic invertebrates with food size preference depending on halibut size. Juvenile halibut prefer smaller finfish and benthic invertebrates, switching to larger fish later in life. (CDFW 2022). Halibut are not known to have a special ecological role; however, juvenile halibut may be preyed upon by sharks, rays, marine birds, and mammals (CDFW 2022).

2. Is the target species a basal prey species?

No, halibut is not a basal prey species.

3. Has an ERA been conducted for the target species?

An ERA was completed for each of the four halibut sectors- trawl, gillnet, commercial hook-and-line, and recreational hook-and-line. For halibut trawl, the ecological threats identified for the statewide fishery are bycatch and habitat (soft bottom and habitat forming invertebrates).

4. Have the major areas of uncertainty in ecosystem dynamics been identified?

Major areas of uncertainty in ecosystem dynamics for the CHTG have not been identified. However, the ESR has identified research needs which could reduce this uncertainty (CDFW 2022).

5. Are multiple control measures in place that may help to achieve EBFM objectives?

There are several management control measures in place for the CHTG trawl fishery that provide protection to different aspects of ecosystem function (**Table 3**). Similar control measures were identified in CDFW's previous CHTG assessment (CDFG 2008) with staff finding that "current management measures in place may collectively foster a sustainable bottom trawl fishery inside and outside of the CHTG and indirectly promote a healthy ecosystem by reducing potential fishery impacts on the system."

6. Has there been an assessment of how the target stock is likely to be impacted by changing environmental or ecological conditions?

There is no formal ecosystem model to determine the effect of changing environmental/ ecological conditions on the halibut stock. However, halibut respond positively to warm water conditions with improved larval recruitment and reduced recruitment success during cold water conditions (CDFW 2022). Within the ESR (CDFW 2022), CDFW has recognized the importance of understanding the impact of weather and climate trends on population recruitment.

Performance Criteria 4: Impedes Restoration to Kelp, Coral, or Other Biogenic Habitats

The Master Plan provides three steps to address potential impacts to achieve the goal of protecting habitats:

Step 1. Describe the habitat utilized by the target species at each life stage.

Halibut, except for the egg and larval stages, are benthic animals for their entire life. Young halibut prefer sheltered bays and estuaries before moving offshore. For their adult life, halibut prefer soft bottom habitat of varying depths, depending on their spawn cycle (CDFW 2022). Soft bottom accounts for 98.9% of the available habitat within the CHTG (CDFW 2023a).

Step 2. Describe the threats to the habitat utilized.

We identified the following threats which could include nearshore dredging, beach nourishment, infrastructure, oil industry operations, shoreline hardening, and bottom disturbing fishing gear (NCDEQ 2023). Of these threats to the CHTG bottom habitat, only bottom disturbing fishing gear falls under CFGC and CDFW regulatory authority. According to the Master Plan, bottom trawl gear (doors, foot rope, net) has potential interactions with bottom habitat resulting in severe damage to biogenic habitat and death to burrowing organisms. The CHTG halibut trawl fishery requires light touch trawl gear which has been shown to limit bottom contact (Wick et al. 2014). When comparing habitat against long-term records from the fishery, fishery practice in the CHTG indicate that fishermen avoid vulnerable habitats as shown by position data from trawl tows observed during this evaluation against known habitat (**Fig. 3**) and trawl logbooks (**Fig. 4**). These habitats also pose a risk to fishermen by snagging or damaging their gear. Biogenic habitats are a small percentage of the overall area of the CHTG. According to current CDFW Biogeographic Information and Observation System data (CDFW 2016, 2023a; NOAA 2023), the CHTG contains 0.0015% biogenic habitat with 0.7% hard bottom habitat (Figs 5–8). There is no kelp habitat within the CHTG. At 98.9%, soft bottom is the predominant CHTG habitat.

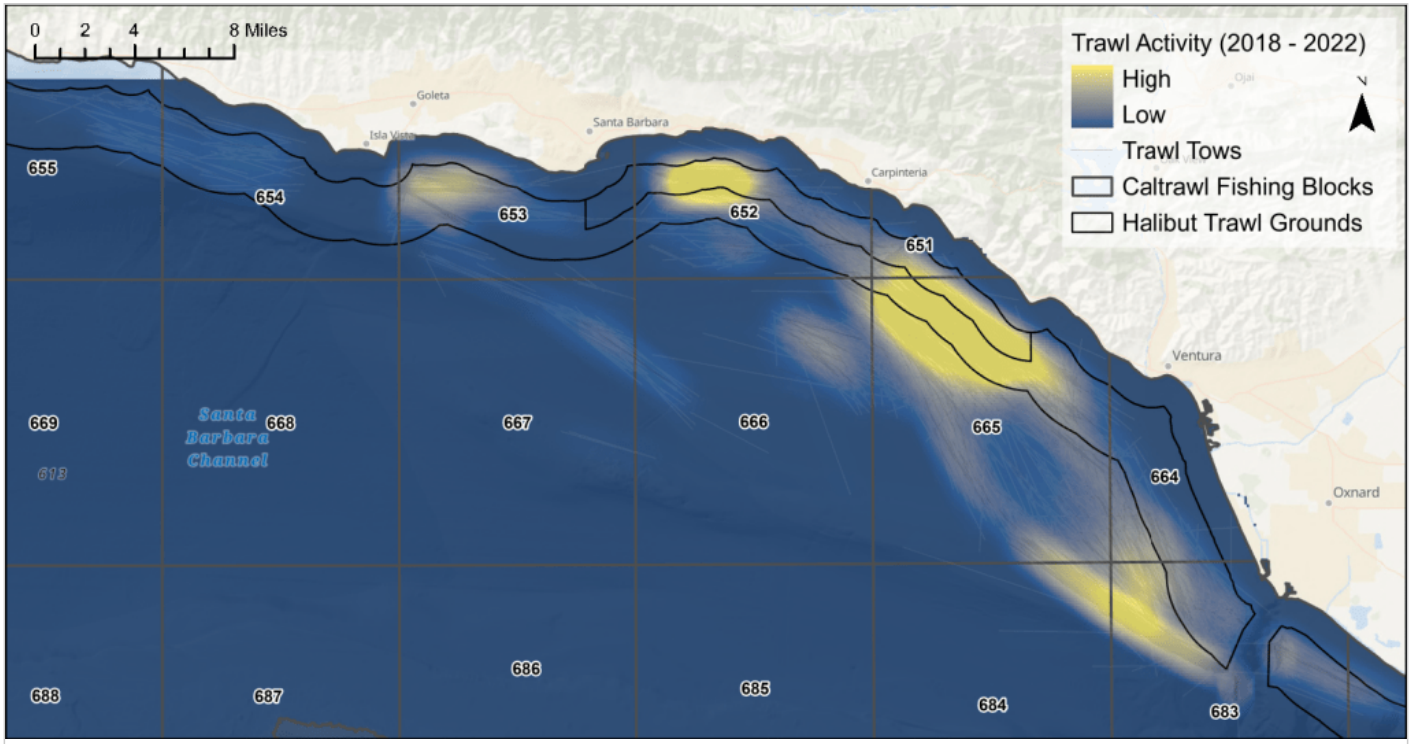

Figure 4. Trawl location frequency, inside and outside, the Trawl Grounds based on logbook data, 2018–2022 (CDFW 2023b).

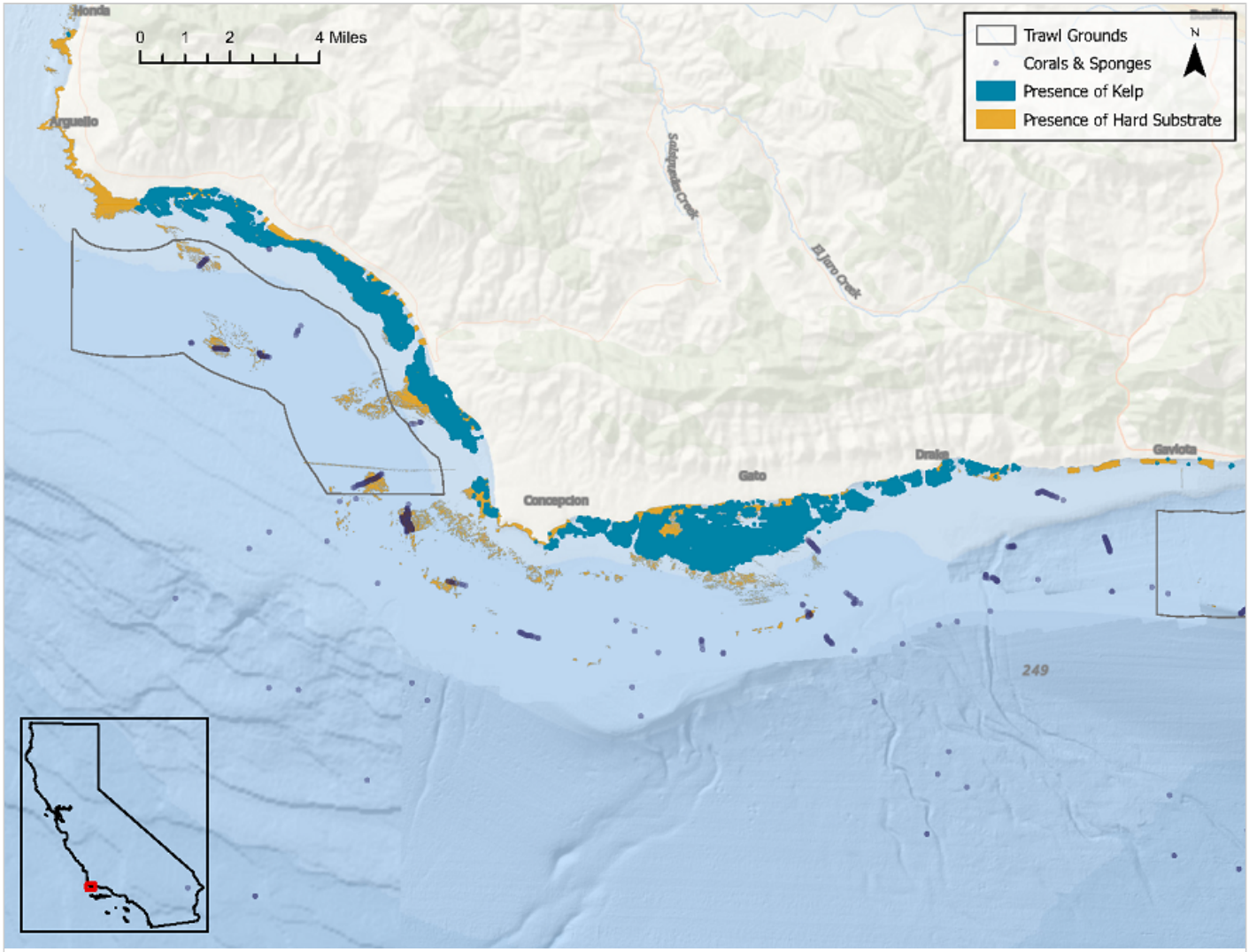

Figure 5. Biogenic habitat from Point Arguello to Point Conception (CDFW 2016, 2023a; NOAA 2023).

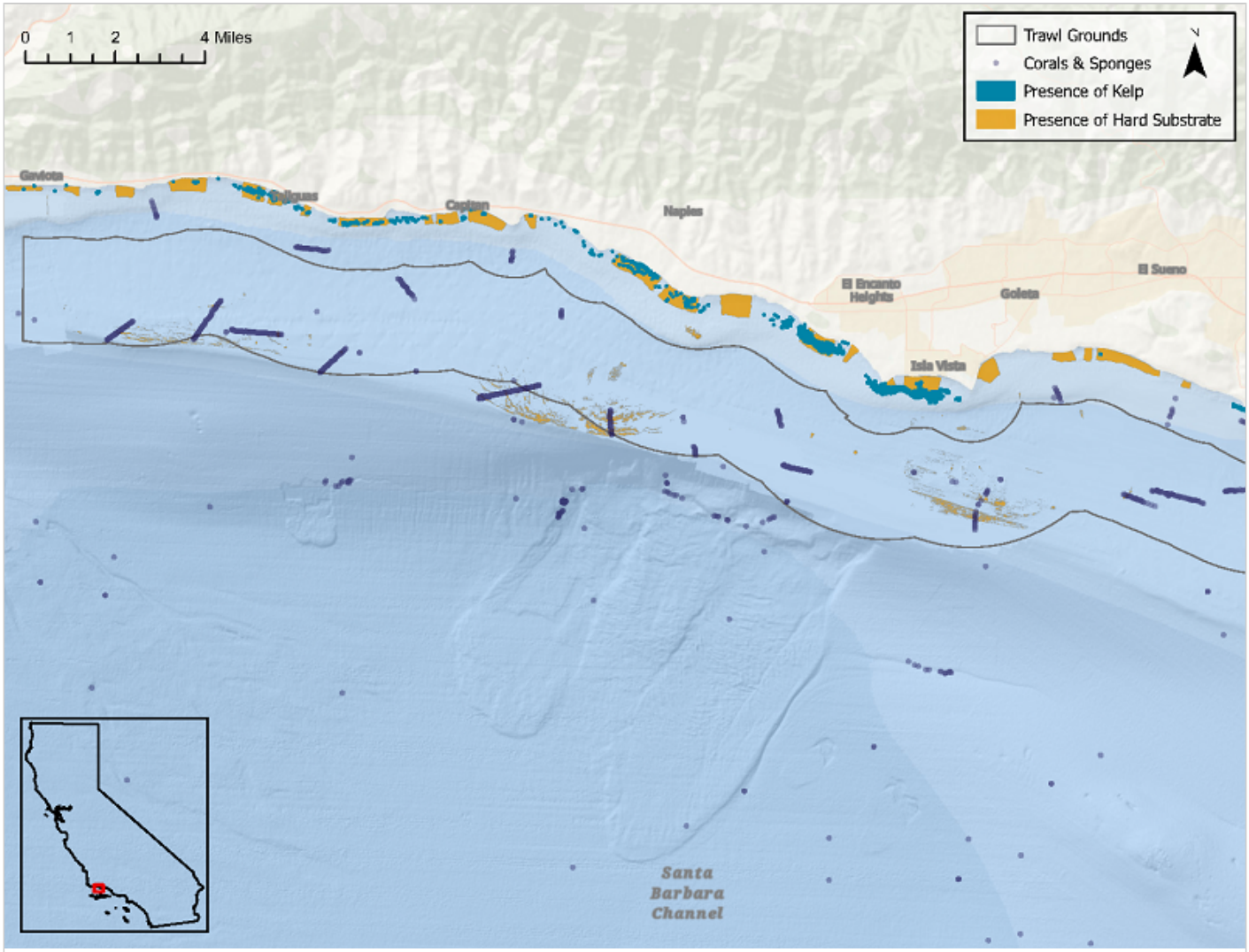

Figure 6. Biogenic habitat from Gaviota to Santa Barbara (CDFW 2016, 2023a; NOAA 2023).

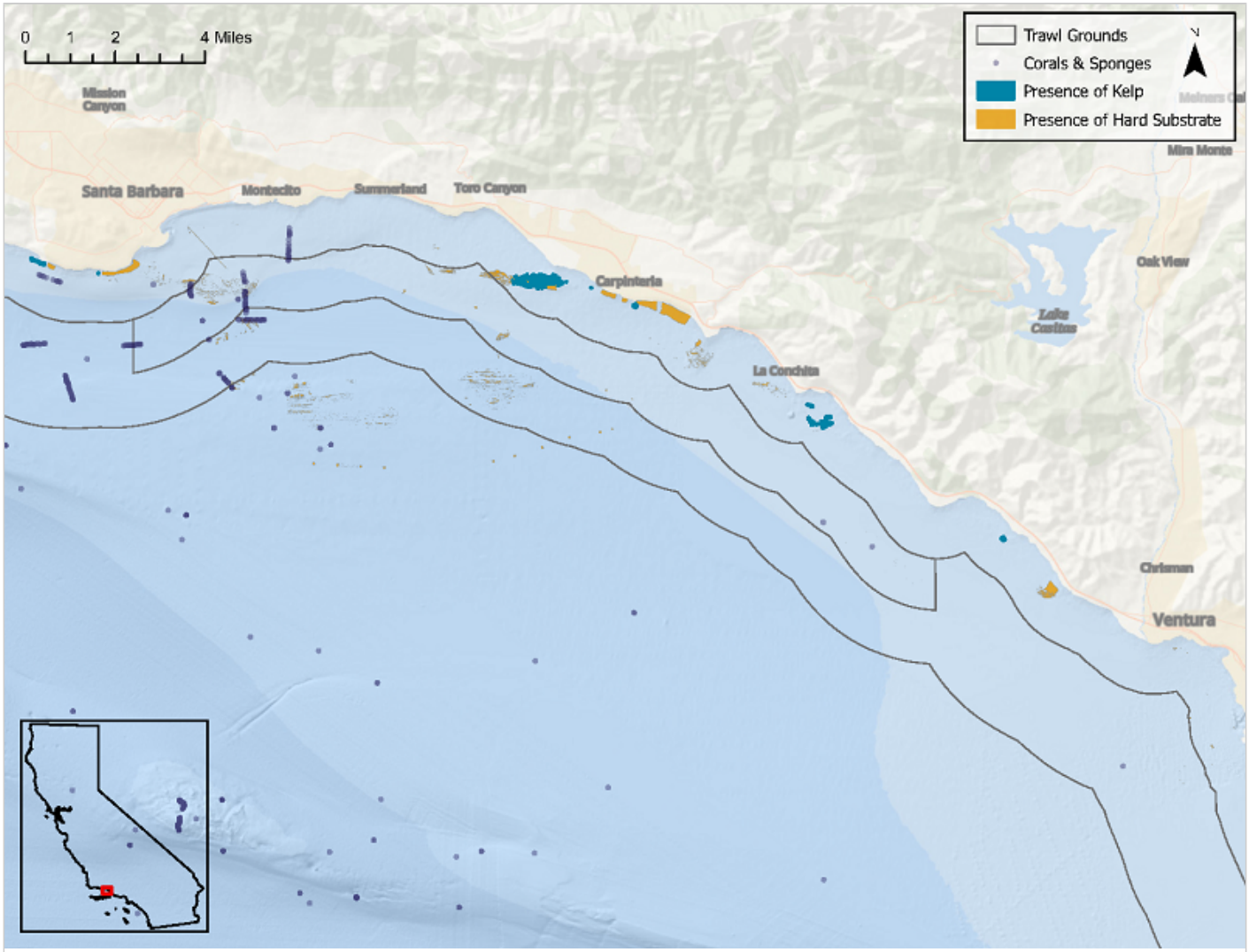

Figure 7. Biogenic and hard bottom habitat Santa Barbara to Ventura (CDFW 2016, 2023a; NOAA 2023).

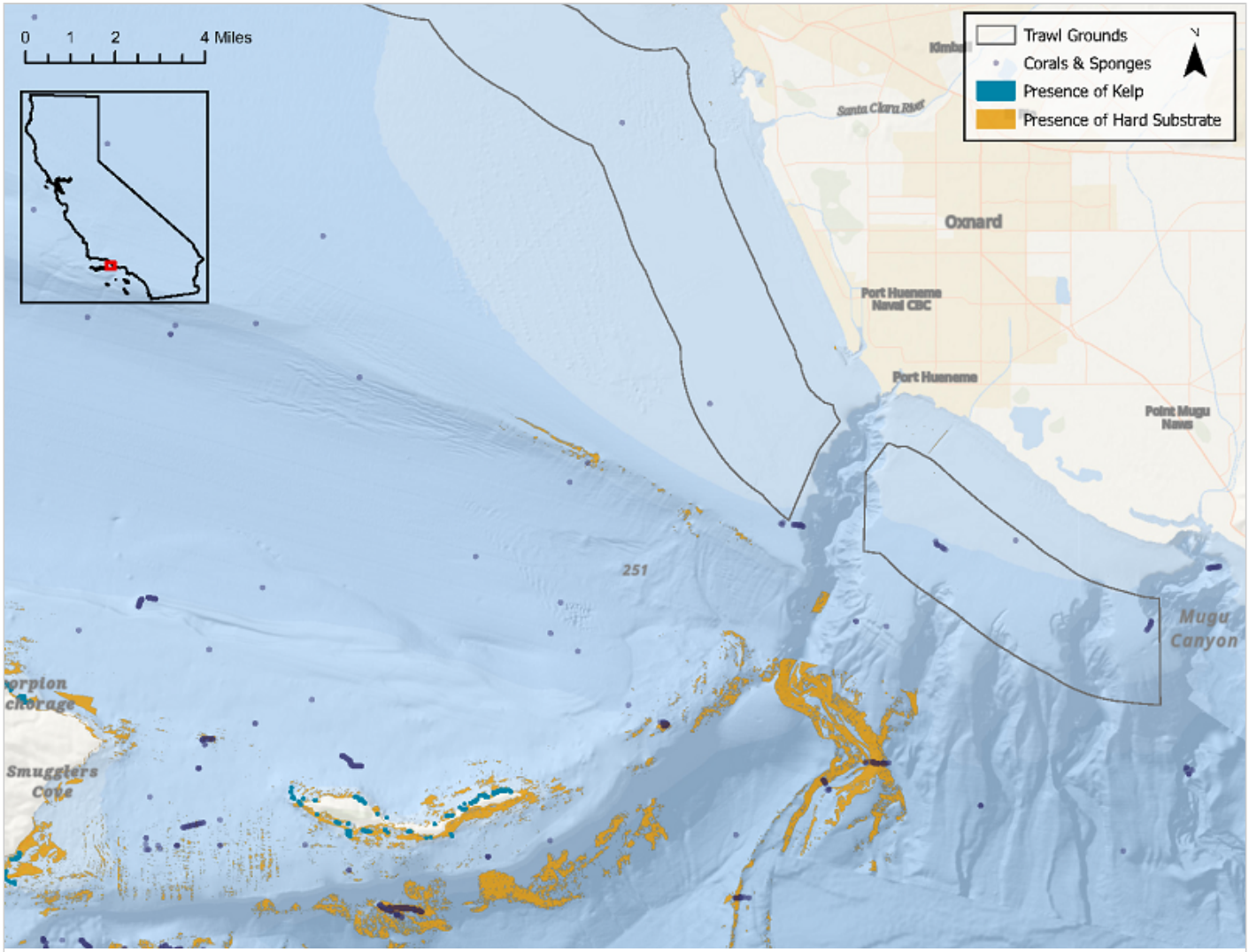

Figure 8. Biogenic and hard bottom habitat off Oxnard and Point Mugu (CDFW 2016, 2023a; NOAA 2023).

Step 3. Minimize or mitigate adverse effects fishing activity may have on habitat.

There are many strategies available to protect habitats, and many of these strategies have already been implemented to protect the State's most sensitive marine habitats. The most common strategies include MPAs and management control measures (**Table 3**). The trawl fishery in the CHTG has gear restrictions (light touch trawl gear required) that are known to minimize bottom impact. The trawl fishery is limited in space to the boundaries of the CHTG and there is also a restricted access system that limits the number of vessels that may participate in the overall fishery.

Discussion

As directed by the Master Plan, CDFW began a process to prioritize our state-managed species based on their productivity and susceptibility to environmental and fishing pressures. In December 2019, CDFW presented the prioritization of 17 state-managed commercial fisheries and 14 state-managed recreational fisheries to the CFGC (**Fish and Game Commission 2019**). Through this process, halibut

was identified as a **high priority species for management attention**, due to the potential risk to the species from fishing induced sub-legal mortality, and bycatch.

The Master Plan calls for a applying the appropriate level of management intensity based on a fishery's needs. This **scaled management approach** to fisheries management includes a suite of management alternatives, ranging from the completion of ESRs to rule-makings to more comprehensive Fishery Management Plans. In 2020, CDFW began the initial stages of considering the best **scale of management** for the halibut fishery and partnered with stakeholders to identify areas of concerns.

Learning from the knowledge gained during a **stakeholder process** and information gathering effort, CDFW 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 **CHTG assessment**; 5) expansion of a halibut management strategy evaluation; and 6) performing a bycatch evaluation on the gillnet and trawl gear types.

Under the direction of the Master Plan and utilizing CDFW and WCGOP observer data, related trawl studies that utilize light touch trawl gear, and the latest habitat information for the CHTG, we completed our assessment of the CHTG. At one trip per month, our observation rate was 4.9% of available trips for the CHTG fleet. Historically, median WCGOP coverage (rate at which participants within the fishery are observed) for the statewide open access (trawlers without a federal groundfish permit) halibut trawl fleet is 15%, with coverage of 17% in 2022 (Somers et al. 2023). Limited entry (trawlers with a groundfish permit) coverage is 100%, but none of these vessels have targeted halibut since 2013 (Somers et al. 2023). Based on the Performance Criteria outlined in Fish and Game Code, section 8495 and the information compiled, we provided the CFGC with the best available information about the halibut trawl fishery operating within the CHTG.

Performance Criteria 1: Bycatch

Results of this assessment have documented considerable amounts of discarded bycatch with low instantaneous discard mortality (12.9%) for all species within the CHTG fishery. This mortality rate was influenced by the presence of organic and inorganic debris captured by the net. This debris had the effect of plugging the cod-end mesh, increasing the mortality of smaller fish such as pink seaperch and longspine combfish. Despite being a non-selective gear, specifications required for light touch trawl gear (**Table 3**) contribute to the lower mortality and minimal habitat impacts within the CHTG fishery. By comparison, federal groundfish bottom trawl gear (11.4 cm [4.5 in] and 20.3 cm [8 in] footrope [PFMC 2022a]) are designed for greater bottom contact resulting in more effective herding and capture of fish (Lomeli et al. 2019). While not a requirement, CHTG trawlers are encouraged to use polypropylene constructed nets to reduce weight, minimizing bottom contact (CDFG 2008). Comparatively, in the 2013 Monterey Bay light touch trawl study, observed instantaneous mortality was 14.1% for all finfish combined, mostly due to the catch of longspine combfish, juvenile shortbelly rockfish, *(Sebastes jordani)*, and juvenile chilipepper rockfish, *(Sebastes goodie)*. Invertebrate mortality was lower than finfish mortality at 2.7% (Wick et al. 2014). The Master Plan stipulates that determining fishing induced mortality is key to assessing impact to a bycatch species. A key dataset, WCGOP observers documented discarded species by counts and weights and retained species by weight (WCGOP 2023, 2024); however,

WCGOP assigns a default 100% mortality to all observed species except for four groundfish species, which limits our ability to use this data source to determine true mortality estimates. The four species that have mortality estimates for halibut trawl are big skate *(Beringraja binoculata)* (50%), ling cod *(Ophiodon elongatus)* (50%), longnose skate *(Caliraja rhina)* (50%), and sablefish *(Anoplopoma fimbria)* (50%); however, only one big skate was observed as bycatch during the course of our CDFW observations.

Based on our observations, the catch of organic and inorganic debris in the CHTG fishery could be a driver in increased catch and mortality of small fish species, some of which serve an ecosystem role as basal prey to larger fishes. Future work with WCGOP data as part of CDFW's statewide trawl bycatch analysis will further explore the relationships between organic and inorganic debris on bycatch rate. Based on the findings of the statewide bycatch analysis, there may be opportunities to work with the fleet to minimize the impact of debris, such as the development of best fishing practices. These practices could include avoiding debris laden areas, especially following a storm event which has the effect of increasing debris carrying runoff. There are fishermen in the fleet that currently do this as general practice and there is an opportunity to learn from their experience and expertise. Additionally, CDFW and trawl fishery representatives are partnering to investigate net modifications leading to a reduction in catch of undesirable species and potential to catch cod-end plugging debris.

Prior to 2010, the CHTG fishery's primary market was the high value live halibut product (CDFG 2008). This trend continued until 2010 when market demand shifted to a fresh, dead product. (CDFW 2022). CHTG taken halibut continue to supply local fish markets and fish wholesalers with a high quality, fresh product. For the period of 2018–22, the CHTG contributed to 77% of all southern (south of Pt Arguello) halibut trawl catches and 19% of all southern commercial halibut landings (CDFW 2024). Trawlers also land incidental catch taken during halibut trawls. The amount of retained incidental catch fluctuates depending on market order and whether species caught meet management standards such as minimum length or federal groundfish monitoring requirements, thus affecting potential discard rate. A related study performed by industry found that while 90% of species caught were marketable, approximately 39% were retained due to demand (Sunada et al. 2008).

Performance Criteria 2: Seafloor Damage

Determining the extent of seafloor damage in the CHTG is difficult with the lack of quantitative data. Despite this, we used the best available qualitative information, including direct observations to assess seafloor damage. In the Wick et al. (2014) study, light touch trawl gear was shown to have minimal contact with the seafloor. NOAA researchers utilized GoPro cameras mounted on the head rope and trawl doors, oriented down, to video the extent of bottom contact. Overall, the videos showed that the dropped chain loops and leading edge of the trawl doors contacted the bottom. Video analysis showed the footrope skimmed the bottom without disruptive contact. The footrope was seen going over the top of several flatfish and crab.

Lomeli et al. (2019) tested small footrope (<20.5 cm) federal trawl gear sweeps (footrope) against footrope configurations which were designed to fish at different elevations off the bottom. Similarly light touch trawl which has an elevated footrope due to the lack of rollers or bobbins, Lomeli et al. (2019) found that the modified footrope which was elevated off the bottom showed potential benefit to minimizing catch of demersal organisms and habitat impact and suggested that "light touch ground gear

could be effective at further reducing trawl gear interactions with the seafloor and associated non-target organisms."

Light touch trawl doors were also shown to have minimal seafloor contact depending on the contour of the soft bottom. Video footage documented that the trawl door edge left periodic 1-inch furrows within the sediment. Inspection after the tows confirmed that the leading edge of the door contacted the bottom as evidenced by the rust on the door being scoured off where contact was made.

Prior to becoming a legal requirement (Cal. Code Regs., tit. 14, § 124(b) and Fish & G. Code, § 8496) and being proactive, the Southern California Trawlers Association recommended CHTG trawlers to use light touch trawl gear to minimize seafloor impact (CDFG 2008).

Performance Criteria 3: Ecosystem Health

We identified possible habitat threats which could include nearshore dredging, beach nourishment, infrastructure, oil industry operations, and bottom disturbing fishing gear (NCDEQ 2023). Beach nourishment and dredging could have the negative effect of increasing turbidity and sedimentation. Turbidity and sedimentation also occur from storm runoff deposited by Santa Barbara and Ventura County River basin, particularly during the winter months (CDFG 2008). Of these threats to the CHTG bottom habitat, only bottom disturbing fishing gear falls under CFGC and CDFW regulatory authority. While fishing gear is a possible threat, the mobile substrate of shallow, soft bottom habitat may have a short recovery period from bottom contact gear (Lindholm et al. 2004). The general practice of having short tows and use of light touch trawl gear may also facilitate this faster recovery.

The CHTG fishery achieves the management goal in Criteria 3 through an integrated management strategy which relies on combinations of several management control measures (**Table 3**), such as quotas, size limits, gear controls, and effort restrictions. Having a combination of management control measures is intended to provide protection to different aspects and relationships of ecosystem function. The Master plan notes that understanding these relationships, can assist with decision making that supports ecosystem interactions. A precautionary management approach accounts for the drivers and uncertainties in the ecosystem and recognizes which management approach to consider or the requirement for more information (Master Plan 2018). To address and balance policy, stakeholder, and ecological needs, researchers and CDFW staff scientists and managers developed the **Ecological Risk Assessment (ERA)** process to identify species which may require additional management action (Samhouri et al. 2019). Statewide, halibut trawl was ranked as high risk due to bycatch and potential habitat impacts. However, this ERA did not consider the control measures required in the CHTG and was a general assessment applied to the statewide trawl fishery. Samhouri et al. (2018) suggests that regional ERAs would improve accuracy and are better to address local issues. Samhouri et al. (2018) further noted that while risk by the statewide trawl fishery to soft bottom and habitat forming invertebrates "neither was expected to be particularly sensitive."

Performance Criteria 4: Impedes Kelp, Coral, or Biogenic

Habitat

Biogenic habitats, made by living organisms, provide structure for other species and contribute significant ecological functions (Loh et al. 2019). The most common biogenic habitats of southern California include kelp, coral, seagrasses, and other structure-forming invertebrates. Seagrasses are restricted to shallower depths in nearshore waters and are not directly influenced by trawling activity within the CHTG. A variety of kelp, coral and other biogenic habitats do occur in waters within or adjacent to the CHTG; however, the CHTG's primary habitat is soft bottom (sand/mud) with isolated areas of hard bottom habitat. In this study, sea pens were encountered on one of the 25 observed tows; however, the absence of biogenic species documented during a majority of observations suggest the need to develop additional methods for assessing potential habitat impacts when biogenic species are not captured by the trawl.

There are minimal or no impacts to kelp, coral, or biogenic habitat from the light touch trawl gear. Observed tows from this assessment and those previously reported by the fleet showed that fishing activities avoided biogenic habitat and known kelp locations. While the occurrence of these habitats is minimal in the CHTG, fishermen prefer not to fish in these areas to avoid snagging their gear.

Recommendation and Future Needs

Despite the potential of the CHTG trawl fishery to have a high discard rate, most species are released in a live condition (~78%), and with no observed impacts to the seafloor, ecosystem health, or biogenic habitats. Given these factors, along with the management measures governing CHTG trawling, despite 86% of onboard observations occurring in only sub-area C, we concluded that the light-touch trawl gear fishery in the CHTG meets the Performance Criteria as evaluated using the standards established in the Master Plan and thus does not recommend any closures within the CHTG. The other two areas were not assessed due to fishermen preference to fish closer to port or to avoid areas with excess storm debris. Analysis of available data showed that additional efforts to collect data from sub-areas A and D were not needed for this study. Sub-area A was occasionally fished by Santa Barbara trawlers, but in recent years has had little trawling activity due to the price of fuel and distance from the harbor. Based on trawl logbook data, sub-area D has also shown little recent activity. Both sub-areas A and D have no kelp habitat. Bathymetric data (CDFW 2016, 2023a; NOAA 2023) shows some hard bottom (3.3%) and little coral habitat (<0.1%) in sub-area A (**Fig. 5**) and coral habitat (1%), but no hard substrate in sub-area D (**Fig. 8**). Additional future attention could be warranted for these sub-areas should local trawl efforts expand to these areas.

Under existing law, the CFGC is charged with evaluating the CHTG every three years using the Performance Criteria, with the last assessment completed in 2008. We accomplished the current CHTG assessment with the cooperation of the fleet who provided onboard opportunity. Additionally, critical observation data was available to us via WCGOP. Future assessments could face challenges in having the latest and best available information, limiting the ability to perform an assessment every three years. Due to attrition, there are fewer vessels participating in the trawl fishery which could limit the number of vessels available to provide onboard opportunities. Due to amendments concerning NOAA's fishery-management authority, effective 1 January 2025, WCGOP has ceased to provide onboard observations of the halibut open access trawl fishery. Despite these issues, there are potential data alternatives that would provide the information required to assess each Performance Criteria. CDFW should work closely

with trawl participants to collect information on catch, including bycatch mortality, and to encourage further exploration of opportunities for minimizing bycatch. This effort could include encouraging fishermen to test electronic reporting and monitoring technology as an option to document catch, bycatch, trawl tow times, and associated fishing locations. The data stream provided by fishermen through the paper commercial logbook could be improved by becoming digital and working with fishermen to document their bycatch along with recording retained catch. Habitat impact analysis could be improved through partnering with outside entities to use remote operating vehicles or camera studies to document trawled locations over time. These research resources could help to overcome potential gaps and to improve future CHTG assessments, as well as inform broader statewide conservation efforts aimed at evaluating and addressing trawl bycatch. With possible data alternatives, CDFW could approach the CFGC to discuss the timescales for alternatives to the triennial CHTG evaluation.

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