Market Squid, *Doryteuthis (Loligo) opalescens*, Fishery Management Plan – Amendment 1

California Department of Fish and Wildlife Marine Region

XXX, 2025

Executive Summary

The Amended Market Squid Fishery Management Plan (MSFMP A-1) is presented in five chapters. Chapter 1 describes the plan's purpose, need, and consistency with the Marine Life Management Act (MLMA). Chapter 2 describes the species and fishery. Chapter 3 provides the framework for management, including control rules, and limits on fishing and the fishery. Chapter 4 includes the scientific basis for management as well as ongoing and planned research to support management. Chapter 5 provides information on anticipated future needs to ensure the fishery remains sustainable.

The market squid (*Doryteuthis (Loligo) opalescens*) fishery is one of the most important in the State of California in terms of total landings and revenue. The fishery generates tens of millions of dollars to the state annually from domestic and foreign sales. In addition to supporting the commercial fishery, the market squid resource is an important forage item for seabirds, marine mammals, and other fish taken for commercial and recreational purposes. Market squid is also used by the recreational fishery as bait.

In 1997, the Legislature approved Senate Bill (SB) 364 (Sher), Chapter 785, Statutes of 1997, which established a moratorium on new vessels entering California's commercial market squid fishery. The initial three-year moratorium placed a cap on the number of vessels in the squid fishery, established a $2,500 permit fee to fund a California Department of Fish and Wildlife (Department) study of the fishery, and provided the Fish and Game Commission (Commission) with interim regulatory authority over the fishery for the duration of the moratorium. As part of SB 364, a Squid Fishery Advisory Committee, made up of resource stakeholders, and a Squid Research Scientific Committee, consisting of many of the world's leading squid fishery scientists, were established to advise the Director of the Department (Director) on recommendations for squid conservation and management and to provide input on the development of research protocols.

In 2001, the Legislature approved SB 209 (Sher), Chapter 318, Statutes of 2001, which established permanent management authority of the market squid fishery to the Commission. The statutes also require the Commission to manage the squid fishery under the guidelines set forth by the MLMA.

The goals of the MSFMP A-1 are to manage the market squid resource to ensure long-term resource conservation and sustainability, and to maintain a framework for management that is responsive to environmental and socioeconomic changes. The MSFMP A-1 establishes the management

program for California's market squid fishery and procedures by which the Commission manages the market squid resource.

Market squid fishery management is based on four management components: 1) fishery control rules, 2) a restricted access program, 3) environmental considerations including a seasonal closure area for seabirds and 4) administrative items. The management components in the original Market Squid Fishery Management Plan (MSFMP), adopted by the Commission in 2004 and implemented in 2005, are amended here, following a review conducted by a Squid Fishery Advisory Committee (SFAC) convened by the Department in 2023 to 2024. These amendments are intended to ensure the continued sustainability of this fishery into the future.

The MSFMP A-1 includes the following management components, implemented through Commission regulations where necessary. Changes to management components from the original MSFMP are shown parenthetically in **bold**:

Fishery Control Rules

- A seasonal catch limitation of 118,000 tons **(unchanged)**;
- Full fishery closures from 0700 Friday to noon Sunday from the U.S.-Mexico border to the California-Oregon border; and from 0700 Friday to midnight Sunday between a line due west from Point Lobos (36° 31.461' North Latitude) and a line due west from Pigeon Point (37 ° 11.000' North Latitude) **(originally noon Friday to noon Sunday statewide)**;
- Squid fishery monitoring programs (biological monitoring and logbooks, **unchanged)**;
- Regulations that require possession of a valid market squid fishery permit to take squid commercially but do not require a squid permit when fishing for live bait **(unchanged)**;
- Squid lighting wattage limits (maximum of 30,000 watts) and shielding regulations that require the lower edges of the lighting shields be parallel to the deck of the vessel **(unchanged)**;
- A requirement that all round haul nets used to take market squid or onboard vessels taking or possessing market squid have a soft (non-metallic) rib line and rope used to purse the net to reduce the potential for bottom contact **(new requirements, not previously included)**.

Restricted Access Program

- A vessel-based capacity goal for the market squid fishery that produces a moderately productive and specialized fleet (55 vessels and 34 light boats, 18 brail vessels, **unchanged)**;
- Annual permit fees starting at (and adjusted annually for inflation, **unchanged)**:
  - Transferable Market Squid Vessel Permit: $2000;
  - Non-transferable Market Squid Vessel Permit: $1000;
  - Transferable Market Squid Brail Permit: $2000;
  - Non-transferable Market Squid Brail Permit: $1000;
  - Transferable Light Boat Permit: $600;
- Full transferability of Market Squid Vessel Permits based on comparable capacity (within 10%); establish transferability of Market Squid Vessel Permits to a vessel of larger capacity under a "2 for 1" permit retirement **(unchanged)**;
- Full transferability of Market Squid Brail Permits based on comparable capacity **(unchanged)**;
- Full transferability of Market Squid Light Boat Permits and establish an upgrade from a Market Squid Light Boat Permit to a Transferable Market Squid Brail Permit on a "1 for 1" permit retirement;
- An initial transfer fee at $500, and an upgrade fee of $1500 **(unchanged)**;

Environmental Considerations

- Seasonal Closures for Seabirds: Squid may not be taken using attracting lights in all waters of the Greater Farallones National Marine Sanctuary at any time **(unchanged)**;
- The expanded fishery closure from 0700 Friday to midnight Sunday between a line due west from Point Lobos (36° 31.461' North Latitude) to a line due west from Pigeon Point (37 ° 11.000' North Latitude) **(originally noon Friday to noon Sunday statewide)**.
- A requirement that all round haul nets used to take market squid or onboard vessels taking or possessing market squid have a soft (non-metallic) rib line and rope used to purse the net to reduce the potential for bottom contact **(new requirements, not previously included)**.

Administrative Items

- The Director may establish an advisory committee for the squid fishery, which may include scientific, environmental, or industry representatives **(unchanged)**.

- The MSFMP A-1 will be reviewed periodically to ensure the fishery remains sustainable and recommend any necessary changes to the management framework or regulations **(unchanged)**.

The MSFMP A-1 utilizes a framework composed of several elements that will allow the Commission to react quickly to changes in the market squid population off California without the need for a full amendment and provides the Commission specific guidelines for making management decisions. Guidelines provided by the MSFMP A-1 will allow for other management strategies, should they become necessary, which would effectively achieve the goals and objectives of the MSFMP A-1 and MLMA. Since market squid is included in the Federal Coastal Pelagic Species Fishery Management Plan (CPS FMP), the MSFMP A-1 framework structure is consistent with management by the Pacific Fishery Management Council outlined in the CPS FMP.

Table of Contents

List of Figures

List of Tables

Acknowledgements

The Department would like to thank the members of the Squid Fishery Advisory Committee who helped with the 2024 review of market squid fishery management, regulations and science.

2024 Squid Fishery Advisory Committee Members:
Allen Akselrud, Caitlin
Ashley, Richie
Augello, Ryan
Barry, John
Bates, Ken*
Cappuccio, Joe
Crabbe, David
Fina, Mark
Galipeau, Russell
Hanson, Corbin
Helms, Greg
McHenry, Porter
Noto, Tom
Susi-Blair, Brian
Towsley, Ken*
Villareal, Joe
Vuoso, Anthony
Weinstein, Anna*
Yoakum, Dan
* These members did not complete the Advisory Committee meeting process.

Contributors to the original 2005 MSFMP process

Squid Research Scientific Committee Members:
Brodziak, Jon, Ph.D.
desClers, Sophie, Ph.D.
Gilly, William, Ph.D.
Hatfield, Emma, Ph.D.
Hamner, William, Ph.D.
Hunter, John, Ph. D
Sydeman, William, Ph.D.
Thomson, Cindy, Ph.D.

Squid Fishery Advisory Committee Members (2005):
Domeier, Michael, Ph.D. (Chair)
Amoroso, Orlando
Borman, John
Brockman, Donald
Crabbe, David
Dewees, Christopher, Ph.D.
Garrison, Karen
Genovese, Eddie
Jerkovich, Nick
Nobusada, Warren
Smith, Allen
Strasser, Paul

MSFMP 2000-2004 Contributors:
The MSFMP was in analysis and design phases beginning in January 2001. The efforts of many Department staff members (note, in 2005 the Department was California Department of Fish and Game [CDFG]), National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries) researchers, University researchers, and fishermen contributed to the 2005 document. The Department acknowledges the concerted work of all individuals who contributed to the development of the MSFMP. For a listing of contributors, please refer to the Draft MSFMP dated 12 April 2004.

MSFMP Lead Authors and Editors:
The 2005 MSFMP was the result of revisions to a preliminary draft, which was released for public review in May 2002. It also went through an extensive peer review process. Based on these reviews, substantial improvements were made to the 2003 and the revised 2004 MSFMP. The core staff of authors and editors committed to these documents included:

Henry, Annette. Survey Coordinator, NOAA Fisheries – Southwest Fisheries Science Center (SWFSC), La Jolla, CA (formerly Biologist, CDFG, La Jolla, CA)
Lazar, Katherine. Scientific Aid. CDFG. La Jolla, CA
Chan, Corey. Scientific Aid. CDFG. La Jolla, CA
McDaniel, Jenny. Fisheries Biologist. NOAA Fisheries - SWFSC. (formerly Scientific Aid. CDFG. La Jolla, CA)
Fluharty, Marilyn. Environmental Scientist. CDFG. San Diego, CA
Rojek, Nora. Fish and Wildlife Biologist, U.S. Fish and Wildlife Service, Fairbanks, AK (formerly Environmental Scientist, CDFG, Monterey, CA)
Johnston, Deborah. Supervisory Biologist, Department of Defense, Tacoma, WA (formerly Environmental Scientist, CDFG, Monterey, CA)
Hill, Kevin, Ph.D. Fisheries Biologist, NOAA Fisheries - SWFSC, La Jolla, CA (formerly Senior Biologist, Specialist. CDFG. La Jolla, CA)

Yaremko, Marci. Senior Biologist, Specialist. CDFG. Santa Barbara, CA
Kong, Corey. Biologist. CDFG. Los Alamitos, CA
Taylor, Valerie. Biologist. CDFG. Los Alamitos, CA
Tanaka, Travis. Biologist. CDFG. Monterey, CA
Read, Robert. Associate Biologist. CDFG. San Diego, CA
Tillman, Terry. Senior Biologist, Specialist. CDFG. Sacramento, CA
Dale Sweetnam. Senior Biologist, Supervisor. CDFG. La Jolla, CA

The Peer Review Panel – Preliminary Draft MSFMP

Peer Review is the process of convening a panel of external experts to review any proposed Fishery Management Plan. The MSFMP Peer Review Panel analyzed the strengths and weaknesses of the FMP and recommended strategies that guided and secured a scientific basis for management. Under the guidance of Drs. William Leet and Christopher Dewees of the University of California, Davis, a Peer Review Panel of scientists was established to review the preliminary draft MSFMP. The Department would like to thank the contributions of the peer reviewers:

Hackett, Steven, Ph.D. School of Business Economics. Humboldt State University. Arcata, CA
Hatfield, Emma, Ph.D. Fisheries Research Services Marine Laboratory, Aberdeen, Scotland
Hochberg, F. G. "Eric", Ph.D. Department of Invertebrate Zoology, Santa Barbara Museum of Natural History. Santa Barbara, CA
Melvin, Ed, Ph.D. School of Fisheries Sciences. University of Washington. Seattle, WA
Pomeroy, Carolyn, Ph.D. Institute of Marine Sciences, University of California at Santa Cruz. Santa Cruz, CA

Chapter 1. Introduction

Market squid (*Doryteuthis (Loligo) opalescens*) is the state's largest fishery by tonnage and often economic value. In addition to supporting the commercial fishery, the market squid resource is important to the recreational fishery as bait and is forage for fishes, marine mammals, birds, and other marine life. In the 1990s, the international market for squid and declining squid production from other parts of the world increased demand for California market squid and resulted in rapid growth in the number of vessels harvesting squid and the volume of squid harvested. To provide for a sustainable fishery and protect against resource damage and ecological effects, the Legislature deemed it necessary to adopt and implement fishery management to sustain the squid population and the marine life dependent on squid.

The following sections discuss the purpose and need for management action in the commercial market squid fishery, describe the goals and objectives of the Marine Life Management Act (MLMA) and other relevant law, and identify management objectives specific to the market squid fishery management plan (MSFMP). A description of regulatory authorities and responsibilities that support management objectives completes the chapter.

1.1. Purpose and Need for Action

1.1.1. Problem Statement

Commercial landings of market squid in California increased almost 400% from the 1990-1991 to the 1997-1998 season. The squid fishing season runs from 1 April through 31 March the following year. Concern over the rapid increase in squid harvest and new vessels entering the fishery from other states led to industry sponsored legislation in 1997. Senate Bill (SB) 364 (Sher) was incorporated into Fish and Game Code (FGC) §8420-8429.7 which identified the problem as follows:

(a) The Legislature finds and declares that the fishery for market squid (*Loligo opalescens*) is the state's largest fishery by volume, generating millions of dollars of income to the state annually from domestic and foreign sales. In addition to supporting an important commercial fishery, the market squid resource is important to the recreational fishery and is forage for other fish taken for commercial and recreational purposes, as well as for marine mammals, birds, and other marine life. The growing international market for squid and declining squid production from other parts of the world has resulted

in an increased demand for California market squid, which, in turn, has led to newer, larger, and more efficient vessels entering the fishery and increased processing capacity.

(b) The Legislature finds that the lack of research on market squid and the lack of annual at-sea surveys to determine the status of the resource, combined with the increased demand for, and fishing effort on, market squid could result in overfishing of the resource, damaging the resource, and financially harming those persons engaged in the taking, landing, processing, and sale of market squid.

(c) The Legislature further finds that some individuals, vessels, and processing plants engaged in the market squid fishery have no other viable alternative fisheries available to them and that a decline or a loss of the market squid resource would cause economic devastation to the individuals or corporations engaged in the market squid fishery.

(d) The Legislature declares that to prevent excessive fishing effort in the market squid fishery and to develop a plan for the sustainable harvest of market squid, it is necessary to adopt and implement a fishery management plan for the California market squid fishery that sustains both the squid population and the marine life that depends on squid.

(e) The Legislature finds that a sustainable California market squid fishery can best be ensured through ongoing oversight and management of the fishery by the Commission. With regard to the market squid fishery, the Legislature urges that any limited entry component of a fishery management plan, if necessary, should be adopted for the primary purpose of protecting the resource and not simply for the purpose of diminishing or advancing the economic interests of any particular individual or group.

The legislation further placed a moratorium on the number of vessels in the fishery, established a $2,500 permit for market squid vessels and light boats and initiated a three-year study of the fishery. In addition, the first Squid Fishery Advisory Committee (SFAC) and a Squid Research Scientific Committee (SRSC) were formed to advise the California Department of Fish and Game (Department) on research and interim measures. Further, SB 364 required the Department to submit a report on the status of the market squid fishery with recommendations for a market squid conservation and management plan. In April 2001, the Department submitted the report, which was developed through the cooperative efforts of scientists, fishing industry representatives and other stakeholders. Late in 2001, the Legislature delegated management authority for the squid fishery to the Fish and Game Commission (Commission), including adoption of an MSFMP.

The Legislature recognized that little was known about market squid population dynamics, the size of the resource and other biological

information. In 1998, the Department developed and implemented a large-scale monitoring and biological research program on the market squid fishery and resource. The program continues to provide critical information necessary to long-term management strategies.

During the initial three years of study, contracted independent researchers (in conjunction with Department employees) explored several science-based methods for developing management strategies for the fishery. Research showed that the lifespan of market squid is less than one year, and that market squid availability, and likely their abundance, is highly variable among seasons. The findings indicate that traditional assessment methods used to determine biomass cannot be applied to market squid.

1.1.2. Rationale for MSFMP Review

Between 2014 and 2017, fishing communities from northern California developed a petition that was submitted to the Commission for a community-based squid fishery with its own quota for the ports of Noyo, Eureka, and Crescent City. In August 2021, Monterey area fishermen submitted a petition seeking additional time restrictions for the fishery. The State of Oregon also established commercial squid fishery management measures and regulations requiring the use of purse seine rib lines in 2022. The inquiry for a community quota outside the already established restricted access program, the request for modified time restrictions in Monterey, changes to squid fishery management measures and regulations in Oregon, and the development of the Department's first Enhanced Status Report (ESR) for market squid led to consideration and discussion of potential squid fishery management changes in California. With increasing interest in evaluating existing management and uncertainty involving climate change impacts on sustainable fisheries, the Department identified the need to revisit market squid regulations and initiated the process to form an advisory committee, pursuant to Section 53.02, Title 14, California Code of Regulations (CCR).

In 2023, the Department, with support from the California Ocean Protection Council and Resources Legacy Fund, initiated a review process for the market squid fishery and MSFMP A-1. The Department convened a new SFAC charged with reviewing the fishery and advising the Department on potential changes to California market squid fishery management. The goals of the SFAC process were to:

- Review changes in fishery dynamics
- Respond to past stakeholder input and management change petitions

- Consider potential new management measures as guided by the MSFMP A-1, ESR, and MLMA
- Work with a postdoctoral scholar (post-doc) to forecast future landings and catch per unit effort (CPUE) and evaluate harvest control measures in the context of climate change using Empirical Dynamic Modelling (EDM)
- Explore opportunities for small-scale fisheries and the ability for coastal communities and local economies to adapt to climate change
- Modernize data collection and fishery monitoring efforts, including the use of electronic reporting

1.1.3. Location and General Characteristics of the Project Area

The marine environment is composed of numerous microhabitats, each of which supports a distinct assemblage of species uniquely adapted to their environment. The harvest of market squid is proposed statewide, in all areas defined as ocean waters in CCR Title 14 §27.00, except where prohibited or restricted, as specified, in state marine protected areas (MPAs), and as regulated by provision of this MSFMP A-1. Generally, market squid are harvested nearshore on sandy bottom habitats. Seasonal shifts in resource availability and timing of peak market squid spawning results in vessel participation typically concentrated in two distinct fishing areas, central California in the summer and Southern California Bight (SCB) in the late fall and early winter.

In the late fall and early winter, colder temperatures and winter storms generate more mixing of the water column, coinciding with increased landings in the SCB from the northern Channel Islands southward to the U.S. / Mexico International border. During the summer, fishing effort in central California is focused around Monterey Bay and tends to occur between April and September, coinciding with the upwelling season. Prior to the 1980s, the majority of commercial catch came from the Monterey Bay area. However, since the 1985-1986 season, the majority of the catch has come from the SCB. Landings spiked dramatically in the Monterey Bay area in 2010 and continued through 2014. An in-depth description of habitat associations and life history characteristics of market squid is found in Chapter 2.

1.2. The Marine Life Management Act

The MLMA of 1998 created policies, goals, and objectives to govern the conservation, sustainable use and restoration of California's living marine resources. The MLMA opened a new chapter in the conservation and management of California's marine wildlife and fisheries (Weber and

Heneman 2000) and gave the Commission and Department specific authorities, goals, objectives, and mandates for managing marine resources.

Goal I: Ensure Long-Term Resource Conservation and Sustainability

The MLMA's overriding goal is to ensure the conservation, sustainable use, and restoration of California's marine living resources [FGC §7050(b)]. The goal includes the conservation of healthy and diverse marine ecosystems and marine living resources [FGC §7050(b)(1)], as well as for allowing and encouraging only those activities and uses that are sustainable [FGC §7050(b)(2)]. Sustainability is the overriding principle of the MLMA.

Within this overall policy on marine living resources, the MLMA sets the State's policy for marine fisheries [FGC §7055; §7056]. Objectives include:

1. Conserve the health and diversity of marine ecosystems and marine living resources [FGC §7050(b)(1)].
2. Allow and encourage only those activities and uses of marine living resources that are sustainable [FGC §7050 (b)(2)].
3. Maintain the health of marine fishery habitat, and to the extent feasible, restore or enhance that habitat where appropriate [FGC §7056(b) and §7084].

Goal II: Employ Science-based Decision-making

The MLMA includes, as a general objective, promotion of marine ecosystem research that will enable better management decisions [FGC §7050(b)(5)]. The MLMA also calls for basing decisions on the best available scientific information as well as other information that the Department and the Commission possess [FGC §7050(b)(6)]. While the MLMA emphasizes scientific information in making decisions regarding the conservation and sustainable use of California's marine living resources, it also recognizes the value and importance of relying upon other sources of information such as local knowledge [FGC §7056(h)].

Objectives include:

1. Encourage fishery management decisions that are adaptive and based on the best available information and that do not substantially delay the management process [FGC §7056(g) and FGC § 7072(b)].
2. Create cooperative and collaborative partnerships with fishery participants, public and private entities, and research institutions to acquire Essential Fishery Information (EFI) and to design and conduct research and monitoring [FGC §7056(k)].

3. Periodically review the management system for effectiveness in achieving sustainability goals and for fairness and reasonableness in its interaction with people affected by management [FGC §7056(m)].

Goal III: Increase Constituent Involvement in Management

The MLMA focuses special attention on constituent involvement in marine fisheries management – not only in the development of management plans but in other key activities such as research and implementation of management decisions. The MLMA calls for involving "all interested parties" in making decisions regarding marine living resources [§7050(b)(7)] and for disseminating accurate information on the status of marine life and its management §7050(b)(8)]. Objectives include:

1. Develop an open decision-making process and seek the advice and assistance of interested parties so as to consider relevant information including local knowledge [FGC §7056(h)].
2. Allow fishery participants to propose methods to prevent or reduce excess effort in market squid fishery [FGC §7056(e)].
3. Involve constituents in preparing Fishery Management Plans (FMPs) [FGC §7076(a)].
4. Involve interested people in designing research protocols for individual FMPs [FGC §7074(b)].

Goal IV: Balance and Enhance Socio-economic Benefits

California's fisheries are a public trust resource. As such they are to be protected, conserved and managed for the public benefit, which may include food production, commerce and trade, subsistence, cultural values, recreational opportunities, maintenance of viable ecosystems, and scientific research. None of these purposes need be mutually exclusive and, ideally, should be encouraged to the degree possible, consistent with resource conservation. The MLMA requires recognition of important aesthetic, educational, scientific, and recreational uses that do not require taking marine wildlife, as well as the economic and cultural importance of sustainable sport and commercial fisheries [FGC §7050(b)(3)(4)]. Objectives include:

1. Recognize the importance of non-consumptive uses of California's marine resources [FGC §7050(b)(3)].
2. Observe the long-term interests of people dependent on fishing for food, livelihood, or recreation, and minimize the adverse impacts of fishery management on small scale fisheries, coastal communities, and local economies [FGC §7056(i)(j)].

3. Develop mechanisms to resolve disputes about issues such as, but not limited to, access, allocation, and gear conflicts [FGC §7056(k); FGC §7059(b)(2)].

Goal V: Identify Implementation Costs and Sources of Funding

The Department's management of commercial and recreational fisheries has been supported by general funds appropriated by the Legislature, by federal funds for commercial and recreational fishing, and by user fees in the form of permits, licenses, and other fees (FGC §710.5). In FGC §711(c), the Legislature stipulated that revenues for recreational hunting and fishing programs not be used for other purposes, including commercial fishing. In 1993, the Legislature reiterated its intent to ensure adequate funding from appropriate sources (FGC §711).

Objectives:

1. Help ensure that fees more accurately reflect all costs of the Department's management [FGC §710.5].
2. Identify the resources and time necessary to acquire essential fishery information [FGC §7081(b)].
3. Cooperate with the Legislature, the commercial fishing industry, recreational fishermen, the environmental community, and other interested people to identify alternative sources of funding for "the department's necessary marine resource management and protection responsibilities" [FGC §710.7(c)].

1.2.1. MLMA Master Plan

The MLMA Master Plan (Master Plan) is a roadmap designed by the Department to achieve the objectives and goals described in the MLMA. As many fisheries are under state jurisdiction, and given the limited resources of the Department, prioritizing management efforts is essential. First adopted in 2001, the Master Plan provides guidance on prioritization, as well as tools and resources to aid the management process. It advises on the development of FMPs to manage priority species, including market squid, based on the results of a productivity and susceptibility analysis. A second revised Master Plan was adopted in 2018 that enhanced the implementation of the MLMA through new tools, insights, and priorities that have emerged since 2001. The Master Plan also presents an overview on performing stock assessments and utilizing population modeling techniques for data limited fisheries such as market squid.

The exploration of EDM is an example of how new tools and insights have informed the management of market squid since the implementation of the

original MSFMP. Other guidance topics in the Master Plan include prioritization of management efforts, meeting stock sustainability objectives, meeting ecosystem objectives, integrating MPAs into fisheries management, adapting to climate change, advancing socioeconomic and community objectives, making management adaptive, using the best available science, enhancing and scaling MLMA based management, ensuring the Master Plan is an effective resource and guide, and engaging stakeholders and collaborating with partners. Master Plan goals and objectives were a primary focus during the 2023-2024 SFAC process. The Master Plan can be found online at https://wildlife.ca.gov/Conservation/Marine/MLMA/Master-Plan.

1.2.2. Enhanced Status Reports

In addition to the Master Plan, ESRs are key documents to implementing the goals of the MLMA. ESRs are publicly available and provide an overview of a specific fishery. Information described in ESRs include annual landings, species biology and history, current management activities, monitoring activities, and assessment efforts. The Master Plan envisions the use of ESRs in lieu of full FMPs for species with low levels of management need. Since enactment of the original Master Plan in 2001, 36 ESRs have been developed, covering 45 of the State's most significant commercial and recreational fisheries, including market squid. Unlike other species, where ESRs are used in the absence of a full FMP, the market squid ESR supplements the FMP. It summarizes all available and the latest EFI, ensuring the transparency and accessibility goals outlined by the MLMA are achieved. Unlike an FMP, the market squid ESR is updated annually with key fishery and scientific information. The ESR is available on the Department's Marine Species Portal at https://marinespecies.wildlife.ca.gov/market-squid/.

1.3. Specific Goals and Objectives of the Market Squid Fishery Management Plan

1.3.1. Goals:

- To manage the market squid resource to ensure long-term resource conservation and sustainability;
- To develop a framework for management that will be responsive to environmental and socioeconomic changes.

1.3.2. Objectives:

- Provide for the sustainable use of the market squid resource by commercial and recreational fisheries for the optimum long-term benefits of present and future generations;

- Maintain an adequate forage reserve for marine mammals, fish and seabirds;
- Use adaptive management to provide for necessary changes and modifications of management measures in a timely and efficient manner;
- Ensure proper utilization, the avoidance of bycatch in the market squid fishery, and the avoidance of wastage of market squid in other fisheries;
- Support and promote increased understanding of market squid natural history, population dynamics, and its ecosystem's role to improve management;
- Ensure effective monitoring of the market squid population and its fisheries;
- Ensure enforcement of regulations;
- Identify, protect, and restore critical market squid habitat;
- Minimize the adverse impacts of management on small-scale fisheries, coastal communities, and local economies.

1.4. Constituent Involvement

The MLMA calls for meaningful constituent involvement in the development of each FMP and requires the Department to develop a process to involve interested parties in the development or review of an FMP. In addition, the California Environmental Quality Act (CEQA) requires public consultation during lead agency review of all proposed projects subject to a certified regulatory program [See generally Public Resources Code (PRC) §21080.5(d)(2); see also CCR Title 14 §781.5]. The MSFMP A-1 and its associated implementing regulations is, of course, such a project under CEQA.

1.4.1. Involvement in the Original 2005 FMP Development

In 1998, two advisory committees were formed to examine the market squid fishery: the SFAC and the SRSC. The SFAC included fishery participants, environmentalists, and scientists and advised the Department on proposed management strategies and changes to the fishery. The SRSC comprised national and international university, agency, and private industry scientists and made recommendations on squid research protocols and methods as well as management strategies. The two committees met from 1998 through 2000 and played a major role in the interim management of the fishery.

The Department prepared and filed a Notice of Preparation (NOP) with the State Clearinghouse in December 2001 for distribution to appropriate responsible and trustee agencies for their input and comments. Further, the

notice was provided to individuals and organizations that had expressed prior interest in regulatory actions regarding market squid. Comments received in response to the NOP and a preliminary draft MSFMP are addressed in Section 4 of the 2005 MSFMP.

The Department also conducted two public meetings to present options for management of the market squid fishery. The first meeting was held on 26 January 2001 in Port Hueneme and the second was in Monterey on 27 January 2001. The proposed project for management of the market squid fishery was developed through the two venues.

The Department released the Preliminary Draft MSFMP for public review and comment on 15 May 2002. The Preliminary Draft MSFMP was sent to interested parties and was also posted on the Department's web site for public review. The Department accepted all written comments regarding the Preliminary Draft MSFMP that were received before 8 February 2003. Responses to comments regarding the Preliminary Draft MSFMP are addressed in Section 4.

The Department submitted to the Commission the Draft MSFMP on 7 July 2003. The MSFMP was the result of revisions to the Preliminary Draft MSFMP, which was released for nearly a year of public review in 2002. It also went through an extensive scientific peer review process. As a result, substantial improvements were incorporated into the 2003 Draft MSFMP, and it was completely reorganized into four sections and streamlined for clarity and content. Public testimony on the Draft MSFMP was taken at the 1 August 2003 and 5 December 2003 Commission meetings.

At the 3 December 2003 meeting, the Commission asked the Department to incorporate additional alternatives and analysis into the Draft MSFMP. A revised Draft MSFMP was released for public review and comment on 12 April 2004. Public testimony on the revised Draft MSFMP was taken by the Commission at the 4 May 2004, 27 August 2004, and 3 December 2004 meetings. In addition, the Commission held special hearings in Monterey (23 July 2004) and San Pedro (13 August 2004) to take public testimony directly from fishermen in the ports where the majority of squid fishing activity occurs.

The Commission adopted the MSFMP at its 27 August 2004 and 3 December 2004 meetings. The Department has addressed all written comments regarding the Draft MSFMP received through 3 December 2004 in Section 4 of the original MSFMP.

1.4.2. Involvement in the FMP Review

In spring 2022, one-on-one interviews with interested stakeholders were conducted by the professional facilitation team, Concur Inc., to capture the broad range of perspectives on potential changes for squid fishery management and to test the willingness of interviewees to engage in a deliberative advisory process. In fall 2022, a call for nominations was released by the Department to squid fishery stakeholders, California Native American Tribes, and the public. SFAC members were selected to participate as representatives for specific stakeholder groups, and an SFAC listserv was developed to keep the public and interested Tribes informed of the SFAC's progress. Concur assisted in developing a biography portfolio that included each of the SFAC members, meeting ground rules, and a committee charge to help the SFAC prepare for a series of meetings. The SFAC consisted of a broad group of stakeholders, including representatives from the fishing industry, non-governmental organizations, government scientists, and the public.

The SFAC met 10 times between July 2023 and May 2024. Input was compiled by the Department, reviewed with SFAC members, and eventually used to develop final Department recommendations. The recommendations were presented to the SFAC over the course of a two-day final meeting to gauge agreement, receive recommended changes, and finalize the Departments recommendations.

In July and November 2023, the Department provided written updates on the SFAC process to the Fish and Game Commission's Marine Resources Committee (MRC). In July 2024, the MRC received and discussed the Department's submitted SFAC report, which detailed the Department's proposed recommendations after concluding the SFAC process. At the November 2024 MRC meeting, the MRC recommended moving forward with the Department's recommendations regarding changes in monitoring, further exploration in fishing dynamics and EDM, fishing effort and temporal closures, small scale fishery access, gear, and lighting and seabird habitat.

1.5. The Structure of the Market Squid Fishery Management Process under the Marine Life Management Act

The MLMA recognizes the need to adapt to changing circumstances and embraces the principle of adaptive management. The MLMA defines adaptive management as a scientific policy that seeks to improve management "by viewing program actions as tools for learning" (FGC §90.1). Management measures must be designed to provide useful

information whether they succeed or fail. Monitoring and evaluation of fisheries are needed to detect the effect of the measures.

The MLMA explicitly calls for ensuring that managers can respond to changing environmental and socio-economic conditions [FGC §7056(l)], and requires that FMPs establish a procedure for regular review and amendment, if that is appropriate [FGC §7087(a)]. Because the review and amendment of an FMP is generally a lengthy process, the MLMA allows greater flexibility in responding to changes in a fishery by allowing an FMP to specify the kinds of regulations that may be changed without amending the FMP itself [FGC §7087(b)]. Federal regulatory processes are similar, where annual quotas or in-seasons adjustments in management measures may generally be made without resorting to the lengthy process of amending the FMP itself.

To meet the standards of the MLMA for adaptive management, the MSFMP A-1 establishes a hierarchical framework within which adjustments to the management of the market squid fishery can be made in a responsible and timely manner. Depending upon the scale and significance of needed changes in management, the FMP itself may need to be amended or an in-season decision by the Commission or Department may be appropriate. The former action requires much greater analysis and public review than does the latter. Standards for determining the appropriate level of action are described below.

1.5.1. Process of Plan Review

The MLMA requires public and peer review for all FMPs (FGC §7075-7078). For public review, the Department solicits input and/or assistance from the various user groups who may be affected by the FMP or other interested parties prior to and during development of an FMP. The Department can also approach the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries), Sea Grant, the Pacific Fishery Management Council (PFMC), or advisory committees established by the Department for advice. Once the FMP or amendment is developed, the plan must be submitted to the Commission and available to the public for review and comment. The Commission must hold at least two public hearings on the FMP. Any comments or proposals made to the Commission relative to the FMP may be considered by the Commission and forwarded to the Department for inclusion into the FMP.

For peer review, the Department set up a formalized procedure as required by FGC §7062 for examining the science that is used as the basis for any management recommendation. The peer review panel was given all pertinent comments received by the Department from fishery participants or

other interested parties. Any suggestions made through peer review can be used in whole or part; however, if the Department disagrees with the findings and chooses not to use the recommendations, an explanation of why the peer review recommendations were not used must accompany the FMP or amendment. Comments received from the peer review committee and Department responses were presented in Section 4 of the Draft MSFMP dated 12 April 2004. As the overall management framework was not changed in this amendment, additional external peer review was not conducted. Changes presented are supported by the same scientific basis and consistent with the framework established in the original 2005 MSFMP.

Following adoption of the MSFMP A-1, the Department recommends periodic review to evaluate fishery performance as a result of new requirements and to determine if additional amendments or regulatory changes are needed. The ESR is the primary document to find up-to-date information on California market squid fishery and fishery management.

1.5.1.1. Types of Framework Actions

The Commission may take four general types of actions within the framework of the MSFMP A-1: 1) FMP amendment, 2) full rulemaking, 3) notice action, and 4) prescribed action. Each type of action reflects a different degree of change in management - from changing a basic feature of the MSFMP A-1 itself to implementing a routine administrative matter, such as closing the fishery when seasonal catch limit (SCL) is reached. Brief descriptions of each action type and the conditions for their use follow.

FMP Amendment

FMP framework management is designed to be flexible and adaptable to a wide range of future conditions and intended to function without the need for frequent amendment. However, unforeseen biological, environmental, social or economic developments may create a situation under which the MSFMP A-1 does not adequately provide effective management of the market squid fishery. Under such circumstances, the Commission could amend the MSFMP A-1.

The MSFMP A-1 must be amended if the change in management is a major or controversial action outside the scope of the MSFMP A-1. Examples of such actions include:

- changes to management objectives;
- a change in the "overfished" or "overfishing" definitions;
- amendments to any procedures required by the FMP;
- revisions to any management measures that are fixed in the FMP.

Besides obtaining the views of advisory bodies, holding public hearings, and soliciting public comments, preparation and adoption of an amendment to the MSFMP A-1 may require environmental analysis of proposed changes under CEQA.

Full Rulemaking Actions

If changes to management measures will have a long-term effect, allow discretion in their application, or have impacts that may not have been analyzed previously, a full rulemaking process is required. This process, which must follow standard Administrative Procedures Act procedures, normally requires at least three Commission meetings. full rulemaking may also be used to declare a management measure "routine." In the full rulemaking process, the Commission reviews the issues at a first meeting and authorizes its staff to publish notice of its intent to adopt regulations at a later meeting. This notice, which begins a minimum 45-day period for public comment, includes specific documentation including an Informative Digest that summarizes existing law and the effect of the proposed action, the deadline for public comments, the time and place of any public hearings, and contact information for obtaining additional information. The notice is sent to persons on the Commission's and Department's active mailing lists and published in the California Regulatory Notice Register.

At its second meeting, the Commission reviews the proposed measures and alternatives in detail and receives public comment. At the third meeting, the Commission hears public comment and adopts the final rules. Commission staff then submits the final rules to the Office of Administrative Law for procedural review prior to publication.

The Commission or the Department may refer an issue to a standing committee or appoint an ad-hoc advisory committee to conduct further analyses and/or develop recommendations. The composition of such committees will include the Department, other agencies with statutory responsibility for the issue, representatives from affected groups, and any other persons chosen by the Commission.

This process does not diminish the authority of the Director or the Commission to take emergency regulatory action under FGC §7710, California Government Code (CGC) §11346.1, or FGC §240.

Notice Actions

Once a measure (such as establishing annual catch quotas) has been classified as routine through the full rulemaking Action process, it may be

modified after a single meeting of the Commission if both of the following conditions are met:

- the modification is proposed for the same purpose as the original measure;
- impacts of the modification are within the scope of the impacts analyzed when the measure was originally classified as routine.

Before acting on such a proposal, the Commission will send a written notice describing the proposed action to people on the Commission's and Department's active mailing list and will provide a 15-day period for comment.

Prescribed Actions

When an action is non-discretionary and the impacts have already been analyzed through full rulemaking, the Department may take the action without prior public notice, opportunity to comment, or a Commission meeting. An example of such a Prescribed Action is the closure of a fishery when a quota has been reached. The full rulemaking process that authorized the Prescribed Action must specify methods for notifying the public.

1.5.1.2. Review of Management Measures

The MLMA requires periodic review of management measures because environmental, social, and economic changes during the year may lead to consideration of regulatory changes under the framework described above. The MSFMP A-1 proposes that the Department conduct a periodic review to determine the effectiveness of market squid regulations in accomplishing the goals and objectives of the MSFMP A-1. Periodic review will determine whether any resource, conservation, social, or economic issues exist that require a management response.

Examples of biological issues that might trigger further review and possible regulatory action are:

- catch that is projected to exceed the allowable catch limits;
- increased interaction with non-target species;
- any adverse or significant change in the biological characteristics of harvested market squid stock (e.g., age composition);
- existing or imminent overfishing;
- development of a stock assessment for market squid that significantly changes the estimates of impacts from current management;

Examples of social or economic issues that may be addressed in the periodic review are:

- gear conflicts, or conflicts between competing user groups;
- extension of fishing and marketing opportunities as long as practicable;
- improvements to product volume and flow to the consumer or user;
- to increase economic yield;
- to maintain or improve the safety of fishing operations;
- to increase or decrease fishing efficiency;
- to maintain or improve product quality;
- to maintain or improve data collection, including means for verification;
- to maintain or improve monitoring and enforcement;
- to address any other measurable benefit to the fishery.

If the Department determines that current management of the market squid fishery is not meeting the goals of the MSFMP A-1, the Department may present such information to an advisory committee(s) established under the MSFMP A-1 to seek their views and recommendations. The Department will then present its recommendations and views of the advisory committee(s) to the Commission regarding the need for changes in management of the market squid fishery. The Department will present the rationale, data and analyses in support of its recommendations for regulatory changes. The advisory committee(s) may also make management recommendations to the Department. The Commission will then determine whether to consider an amendment to the MSFMP A-1 or a full rulemaking action for the regulations implementing it.

1.6. Authority and Responsibility

As per the California Constitution, the State Legislature, through statute, may provide for the seasons and the conditions under which different species of fish may be taken. California law consists of 29 codes including the FGC. Laws in the FGC consist of statutes and propositions passed by the voters of the state. Statutes, such as MLMA, are chaptered bills that have passed through both houses of the Legislature and ultimately signed by the Governor and recorded by the Secretary of State. The FGC is administered and enforced through regulations. The rulemaking powers of the Commission, a body created by the Constitution and appointed by the Governor, are delegated to it by the Legislature.

The Department is the state agency charged with carrying out certain policies adopted by the State Legislature and the Commission. The

Department enforces statutes and regulations governing recreational and commercial fishing activities, conducts biological research, monitors fisheries, and collects fishery statistics necessary to protect, conserve, and manage the living marine resources of California.

Other state agencies have functions and responsibilities that directly or indirectly affect the management of ocean and coastal resources. In addition, marine resources are also managed by federal laws governing the take of seabirds, marine mammals, fish, and shellfish (Weber and Heneman 2000).

1.6.1. California Environmental Quality Act

The Legislature enacted CEQA in 1970 to serve primarily as a means to require public agency decision makers to document and consider the environmental implications of their actions. In so doing, CEQA is premised on a number of Legislative findings and declarations, including a finding that it is "necessary to provide a high-quality environment that at all times is healthful and pleasing to the senses and intellect of man." [PRC §21000(b)] CEQA also codifies State policy to, among other things, "Prevent the elimination of fish or wildlife species due to man's activities, insure that fish and wildlife populations do not drop below self-perpetuating levels, and preserve for future generations representations of all plant and animal communities and examples of the major periods of California history" [Id., PRC §21001(c)]. A similar provision in the FGC also declares: "It is hereby declared to be the policy of the State to encourage the conservation, maintenance, and utilization of the living resources of the ocean and other waters under the jurisdiction and influence of the State for the benefit of all the citizens of the State and to promote the development of local fisheries and distant-water fisheries based in California in harmony with international law respecting fishing and the conservation of the living resources of the oceans and other waters under the jurisdiction and influence of the State." (FGC §7055) CEQA applies to all "governmental agencies at all levels" in California, including "state agencies, boards, and commissions" [PRC §21000(g), 21001(f)(g)]. Public agencies, in turn, must comply with CEQA whenever they propose to approve or carry out a discretionary project that may have a significant effect on the environment (see generally Id., PRC §21080). For purposes of CEQA, a project includes "an activity which may cause either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment," that is, like the proposed project, "directly undertaken by any public agency" [Id., PRC §21065(a)]. Moreover, as mandated by the Legislature, "it is the policy of the state that projects to be carried out by public agencies be subject to the same level of review

and consideration under [CEQA] as that of project required to be approved by public agencies" (Id., PRC §21001.1).

Unlike its "procedural" federal counterpart, the National Environmental Policy Act (42 USC §4321 et seq.), CEQA contains a "substantive mandate" that public agencies refrain from approving projects with significant environmental effects if there are feasible mitigation measures or alternatives that can substantially lessen or avoid those effects (Mountain Lion Foundation, supra, 16 Cal.4th at p. 134; PRC §21002). CEQA, as a result, "compels government first to identify the [significant] environmental effects of projects, and then to mitigate those adverse effects through the imposition of feasible mitigation measures or through the selection of feasible alternatives" [Sierra Club v. State Board of Forestry (1994) 7 Cal.4th 1215, 1233; see also Sierra Club v. Gilroy City Council (1990) 222 Cal. App.3d 30, 41.]. Public agencies fulfill CEQA's mandate through required consultation with other interested public agencies and the public; preparation of Environmental Impact Reports (EIRs), functional equivalent documents (see section 1.3.1.1), or other appropriate CEQA analysis; subjecting their environmental analyses to public review and comment, and preparing responses to public comments concerning the environmental impacts associated with their proposed projects; and ultimately adopting findings detailing compliance with CEQA's substantive mandate. In this respect, the CEQA process "protects not only the environment but also informed self-government" [Citizens of Goleta Valley v. Board of Supervisors (1990) 52 Cal.3d 553, 564 (internal quotation marks deleted)]. Indeed, as underscored by the California Supreme Court, compliance with these requirements, even in the context of a certified regulatory program, "ensures that members of the [governmental decision-making body] will fully consider the information necessary to render decisions that intelligently take into account the environmental consequences. It also promotes the policy of citizen input underlying CEQA [Mountain Lion Foundation, supra, 16 Cal.4th at p. 133 (internal citations omitted)].

1.6.2. Functional Equivalent

There is an alternative to the CEQA EIR/Negative Declaration (ND) requirement that exists for State agencies with activities that include protection of the environment as part of their regulatory program. Under this alternative, an agency may request certification of their program from the Resources Agency Secretary (PRC §21080.4 of CEQA). With certification, an agency may prepare functional equivalent environmental documents (ED) in lieu of EIRs or NDs (PRC §15252 CEQA Guidelines). The regulatory program of the Commission has been certified by the Resources Agency Secretary; thus, the Commission is eligible to submit an ED in lieu of an EIR. However, the

exception for the certified state regulatory program is not a blanket exemption from CEQA because the agency must still comply with CEQA policies, evaluation criteria, and standards.

1.6.3. MSFMP Environmental Document

The ED found in Section 2 of the 2004 original FMP describes the proposed project options, status quo options (no project alternative), and a range of alternative project options evaluated in the original draft MSFMP. It discusses the potential effects of the proposed project, reasonable alternatives to the proposed action and cumulative effects related to the proposed project and its alternatives. The discussion of alternatives focuses on the alternatives to the project that are capable of avoiding or substantially lessening the significant effects of the project, even if the alternatives would impede to some degree the attainment of the project objectives or would be more costly. Of those alternatives, the ED examines in detail only the ones that could feasibly attain most of the basic objectives of the project. It does not consider alternatives whose effect cannot be reasonably ascertained and whose implementation is remote and speculative.

At its 27 August 2004 meeting in Morro Bay, the Commission certified the MSFMP's ED for consistency with the provisions of CEQA and adopted the MSFMP. As the MSFMP A-1 does not change the scientific basis for the management framework, and proposed changes are more protective of the environment, a new CEQA document was not prepared as the process falls under a no action certified regulatory program.

1.6.4. Federal Law

The Federal government manages the marine resources and fishing activities of the United States (U.S.) through the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). The purpose of the MSFCMA is to provide conservation and management of U.S. fishery resources, develop domestic fisheries, and phase out foreign fishing activity within the Exclusive Economic Zone (EEZ) consisting of ocean waters from three miles to 200 miles offshore. Under MSFCMA, the federal government also has jurisdiction over fish species that occur predominately in the EEZ and may preempt state jurisdiction over such fisheries in state waters when state management conflicts with a federal FMP.

Eight Regional Fishery Management Councils implement the goals of the MSFCMA in coordination with NOAA Fisheries, U.S. Department of Commerce. PFMC manages several fisheries off Washington, Oregon, and California through FMPs. The State of California has representation on the PFMC. Five coastal pelagic species (CPS) are regulated under the federal

Coastal Pelagic Species FMP (CPS FMP) including Pacific sardine (*Sardinops sagax*), Pacific mackerel (*Scomber japonicus*), northern anchovy (*Engraulis mordax*), jack mackerel (*Trachurus symmetricus*), and market squid (*Doryteuthis (Loligo) opalescens)* (PFMC 2023).

Amendment 8 of the CPS FMP placed Pacific mackerel, Pacific sardine, jack mackerel, and market squid in a management unit with northern anchovy. In 2003, Amendment 10 established a proxy maximum sustainable yield (MSY), using egg escapement, for market squid to bring the CPS FMP into compliance with MSFCMA. In 2010, Amendment 13 incorporated new National Standard 1 guidelines that were developed in response to the Magnuson-Stevens Reauthorization Act of 2006 to end and prevent overfishing.

1.6.5. State Management of Market Squid

Management of the market squid fishery has been divided between the Legislature and the Commission. The market squid fishery was minimally regulated until the passage of SB 364 in 1997. Since that time, both the Legislature and the Commission have adopted management measures for various components of this fishery (see Appendix B in the original 2005 MSFMP).

1.6.5.1. Legislative Responsibilities

Statues passed by the Legislature regulating commercial fishing are contained in the FGC. Some provisions of law apply specifically to market squid, while others apply generally to the take of all fish including some area closures and gear restrictions.

Statutes pertaining specifically to the commercial take of market squid are listed in Appendix B in the original 2005 MSFMP.

The MLMA identifies a number of policies, goals, objectives, requirements, and processes for managing California's marine resources. These resources are to be managed to assure ecological, recreational, long-term economic, cultural, and social benefits.

The MLMA requires that FMPs form the primary basis for managing the State's marine fisheries. An FMP is a planning document that is based on best available scientific information and contains a comprehensive review of the fishery along with clear objectives and measures to promote sustainability of that fishery.

1.6.5.2. Commission and Department Responsibilities

The authority and responsibility of the Commission and the Department to make and enforce regulations governing recreational and commercial fishing are provided by the Legislature. General policies for the conduct of the Department are formulated by the Commission (FGC §704). General policy for conservation of aquatic resources is provided by FGC §7055, and specific policy for the management of marine resources (MLMA) is provided in FGC § 7050-7090.

1.6.5.3. Commercial Fisheries

Commercial fishing is regulated by the Legislature through statutes and by the Commission through regulations. Provisions relating to the taking and possession of fish for commercial purposes are provided in FGC §7600-9101 and CCR Title 14. With the passage of the SB 209 (2001), authority to regulate the market squid fishery was delegated to the Commission.

1.6.5.4. Rulemaking Process under the Administrative Procedures Act (APA)

The California Constitution and Legislative statutes create public entities and can authorize them to make regulations to carry out their duties. The APA of the CGC §11340-11359 guides the rulemaking process for such entities.

The Commission's general rulemaking authority is provided in FGC §200-221 and in other statutes throughout the FGC. Basic minimum procedural requirements for the adoption, amendment or repeal of regulations are provided in the CGC §11346. Emergency rulemaking authorities are found in CGC §11346.1 and in FGC §240.

Chapter 2. Background: A Description of the Species, the Fishery, and Social and Economic Components of the Market Squid Fishery

2.1. Species Description

Market squid (*Doryteuthis (Loligo) opalescens*) or opalescent squid, are part of the class Cephalopoda and the phylum Mollusca (Berry 1911). Approximately 750 recognized species of squids are recognized today and more than 10,000 fossil forms of cephalopods. Market squid belong to the family Loliginidae and generally have a mixed, iridescent (opalescent) coloration of milky white and purple; however, color changes can occur rapidly. Similar to most squid species, market squid possess an ink sac that serves as a defense mechanism by expelling ink to confound predators. Squid have eight arms and two longer feeding tentacles. Squid have large, well-developed eyes and strong parrot-like beaks. Males are larger and more robust than females. Market squid are terminal spawners; spawning occurs at the end of their life span (6 to 10 months after hatching) (Butler et al. 2001).

At the Cephalopod International Advisory Council Symposium in Phuket, Thailand in February 2003, a consensus was reached that based on morphology and molecular evidence, the scientific name for market squid should be changed from *Loligo opalescens* to *Doryteuthis* (Amerigo) *opalescens* (Anderson 2000, Vecchione et al. 2005). The name change was not formalized or published (CDFG 2005). The State currently refers to *Loligo opalescens* as market squid in statute (Fish and Game Code (FGC) §8420, §8597) and the Department uses the name market squid or *Loligo opalescens* throughout the original 2005 MSFMP (CDFG 2005).

2.2. Range, Distribution, and Migration

Market squid range from the southern tip of Baja California, Mexico to southeastern Alaska. Juveniles and adults range throughout the California and Alaska Current systems (Jereb et al. 2010). In California, market squid typically spawn in shallow, nearshore areas, and are generally found in central California in summer months, and southern California in winter months (Hardwick and Spratt 1979).

Ocean currents disperse newly hatched market squid (called paralarvae) off egg bed areas. Paralarvae are found most commonly 1.0 to 3.0 kilometers (km) (0.6 to 1.9 miles (mi)) from shore, concentrated in areas where water masses converge (Okutani and McGowan 1969; Zeidberg and Hamner 2002). Market squid distribution is patchy, yet if squid are found at one site, it

is likely that additional squid will be found in close proximity (contagious distribution). Market squid are found at depths of 30 meters (m) (98 feet (ft)) by day and 15 m (49 ft) at night, suggesting diel movement, and have been found as deep at 600 m (1,969 ft) during the day (Hunt et al. 2000; Zeidberg and Hamner 2002).

Juvenile squid begin to school at a dorsal mantle length (DML) of 15.0 millimeters (mm) (0.6 inches (in)) (Yang et al. 1983, 1986) or 2.5 months of age (based on the growth curve presented in Butler et al. 2001) and occur on the continental shelf just off the bottom by day and throughout the water column at night (Zeidberg et al. 2004). As market squid reach 55.0 mm (2.2 in) DML they move off the continental slope (Zeidberg et al. 2004). Market squid use their fins for swimming in much the same way fish do and their funnel for extremely rapid "jet" propulsion forward or backward, which allows squid to migrate long distances from offshore pelagic waters to nearshore areas and form dense aggregations for spawning at an age of 6 to 10 months (Butler et al. 2001).

The number of different stocks or subpopulations of market squid along the entire Pacific Coast is currently unknown and genetic studies have drawn differing conclusions. Results from Cheng et al. (2020) provide preliminary support to the existence of smaller genetically distinct cohorts that continually spawn in California, as opposed to the prevailing notion that spawning occurs in two asynchronous peaks in the central California and southern California regions. A cohort is defined as a group of squid spawned during the same period. Both Gilly (2003) and Reichow and Smith (1999, 2001) concluded that spawning populations that are commercially harvested from the Channel Islands are not genetically distinguishable from those landed in Monterey Bay. While Gilly et al. (2001) found slight but significant genetic differences between samples taken from central California and southern California, no temporal or spatial genetic differences for market squid within the SCB and no temporal differences between samples in the Monterey areas were evident.

2.3. Age and Growth

Market squid egg hatching rate is determined by temperature, with incubation time ranging from 22 to 90 days at temperatures from 42 to 68°Fahrenheit (F) (5.6 to 20 °Celsius(C)) (Isaac et al. 2001). Squid eggs are commonly deposited in areas with water temperatures between 50 and 58°F (10 to14.4 °C) resulting in incubation periods lasting from 34 to 52 days.

The age of market squid is determined using statoliths, balance structures analogous to otoliths in fish. Rings are deposited daily on statoliths and used

to determine the market squid life span. Daily ring deposition has been validated for several squid species including *D. opalescens* and other members of the family Loliginidae and has been shown to be an accurate method for ageing squid (Jackson and Domeier 2003; Hurley et al. 1985; Lipinski 1986; Jackson 1990a, 1990b, 1994, 1998; Bettencourt et al.1996; Spratt 1978).

Butler et al. (2001) found that market squid growth increases with age and is best described with a power function:

$$\text{DML (mm)} = 0.001342 * \text{Age}^{2.132}$$

where DML is dorsal mantle length in mm and age is in days ($r^2 = 0.95$, $df = 275$, $P < 0.001$). Paralarvae growth is slow [0.05 mm DML/day] during the first month, but growth rates increase dramatically as squid mature. Growth may vary based on location and environmental conditions (Jackson 1994; Butler et al. 1999), with lower growth observed in years with warmer water conditions, likely due to a reduction in food availability (Jackson and Domeier 2003). Macewicz et al. (2004) fit an exponential function to describe the weight-length relationship for female squid:

$$W = 0.000051L^{2.8086}$$

Because the body weight of squid declines as eggs are released, the weight-length function was fit to data for mature females that had not yet spawned (pre-ovulatory females).

Market squid begin to reach sexual maturity 5 or 6 months after hatching (Butler et al. 1999; Butler et al. 2001). Once sexually mature, market squid begin to recruit to the fishery and are fully vulnerable by 6 months of age (Butler et al. 2001). Maturation is thought to be size rather than age dependent, occurring at approximately 100 mm (4 in) in DML for females (Butler et al. 1999; Jackson and Domeier 2003; Maxwell et al. 2005). Females may lay a large proportion of their eggs within the first few days following maturity (Macewicz et al. 2004) and gradually lay less throughout the spawning window and prior to dying.

Squid are a short-lived species, and the average age of squid taken in the fishery is 6 months (range 4 to 10 months) (Butler et al. 2001). Available age data exhibit little variation among months and suggest that a new cohort enters the fishery almost monthly. Figure 2-1 shows the age structure of the market squid catch by sex from port samples collected from November 1998 through July 2000. The mean age of harvested market squid was 188 days. More than 99% of the squid aged could be sexed, suggesting that the fishery primarily targets mature squid.

Statolith samples from the 2000-2024 commercial catch have not been aged, and thus it is not yet possible to tell if the age structure of the stock has changed over time. Because it is thought that size is a better indicator of sexual maturity, potential changes in both size and age structure of the stock could provide valuable insight into fishing mortality and natural mortality. Average size fluctuates between and among fishing seasons, which could be attributed to different cohorts (Protasio et al. 2014). However, since age data have not been analyzed, attributing size differences to different cohorts cannot be determined at present. Future analyses of collected statoliths would provide useful information.

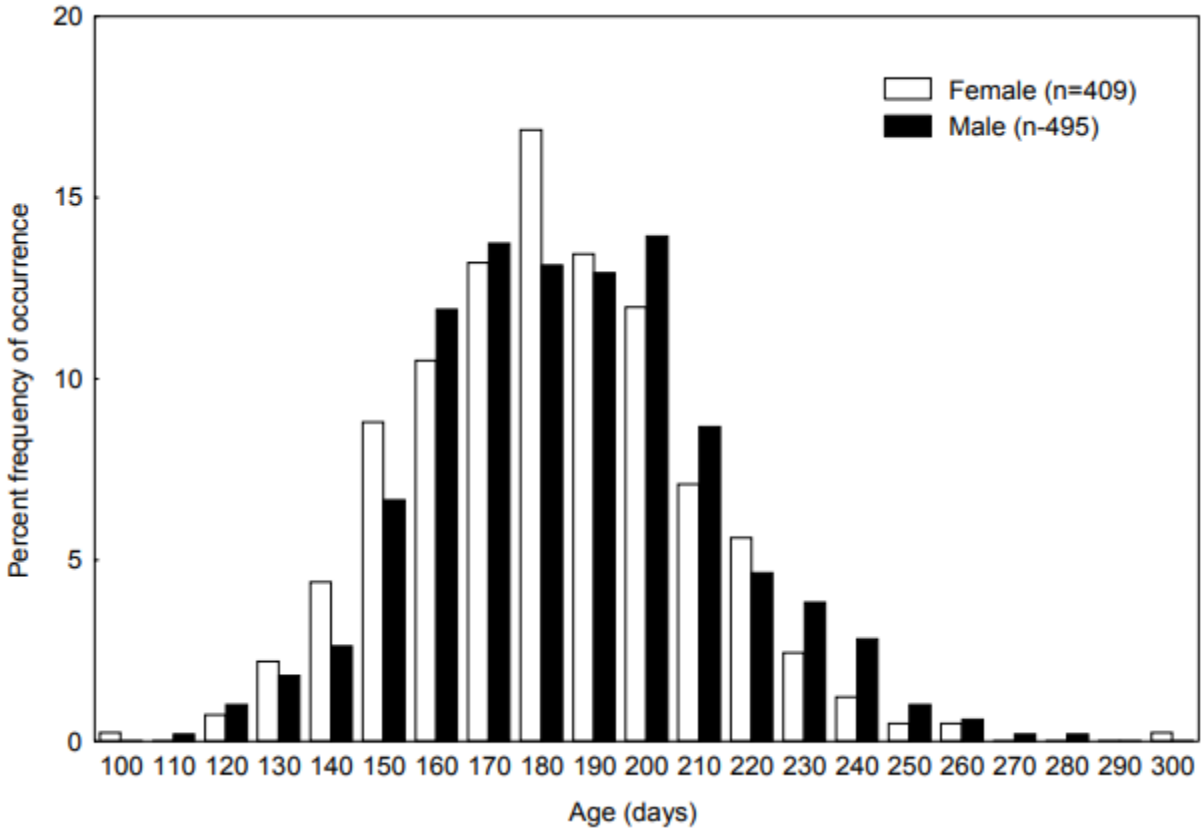

Figure 2-1. Number of market squid by age from port samples by sex. Port samples used to determine percent frequency of occurrence were collected from November 1998 through July 2000 (CDFW Port Sampling database).

2.4. Reproduction, Fecundity, and Spawning Season

While there are year-round reports of spawning along the coast, generally, in central California, spawning activity starts around April and ends in October. In southern California, spawning tends to begin around October and end in April or May. The seasonality of spawning between central and southern California is attributable to ocean bottom temperatures rather than any biological difference (Zeidberg et al. 2011b). During some years,

reproductive activity and landings may occur throughout most of the year along the coast. Year-round spawning in several areas statewide at different times of the year likely reduces the effects of poor local conditions on survival of eggs or hatchlings and indicates that stock abundance is not solely dependent on availability of squid from a single spawning area. Spawning typically occurs at night but has been observed during daylight hours (Forsythe et al. 2004). Squid are terminal spawners, but females can spawn multiple times within a spawning period and may not die immediately after a single spawning event, as was previously believed (Hanlon et al. 2004).

Market squid aggregate to spawn, usually over sandy habitats where they deposit extensive egg masses. Mating takes place on spawning grounds but may also occur before squid move to their spawning sites. Gametes are exchanged directly, with male squid placing spermatophores with their hectocotylized arm into the mantle cavity of females and eggs are fertilized as they are extruded (Hurley 1977). Zeidberg et al. (2004) observed market squid mating in groups of 1 to 2 males per female and small males appeared to insert spermatophores into the mantles of females that were being held in a mating embrace by larger males. The observed mating interactions were termed "sneaker mating."

Off California, a female squid produces approximately 20 egg capsules, with each capsule containing about 200 individual eggs that are suspended in a gelatinous matrix (Recksiek and Frey 1978). The number of egg cases deposited and the number of eggs within egg cases vary by locale and decline throughout the spawning season. Females attach each egg capsule individually to the bottom substrate. As spawning continues, mounds of egg capsules covering more than 100 square meters may be formed and appear to carpet the sandy substrate. After fertilization, embryonic development of egg cases in aquaria at 60.8°F (16.0°C) usually takes between 3 to 4 weeks, with hatching occurring on day 22 or 23 (Fields 1965). Hatching continues for about a week with numerous individuals appearing, but in decreasing volume. In cooler conditions the development time is probably at least a week longer and in warmer waters the longfin inshore squid (*Doryteuthis pealeii*) emerges after only 11 to 12 days of incubation (Fields 1965). While the embryo develops, considerable change takes place in the protective capsule. The capsules continue to take on water and when hatching begins, the volume and weight of each capsule reaches about five times its original value. When a juvenile squid is ready to hatch it makes an opening large enough to escape using strong mantle contractions and then becomes free-swimming. Based on laboratory observations, it is theorized that most of the juveniles emerge during the first several hours of darkness and with upward

swimming and tidal drift, they are able to clear the egg beds and spawning grounds before light (Fields 1965).

Macewicz et al. (2001a, 2001b, 2004) found that female squid have a fixed reproductive output and die before developing and spawning all possible eggs in their ovaries. The fecundity-size relationship was found to be linear, and the potential fecundity is calculated as 29.8 multiplied by the DML (in mm) (Macewicz et al. 2004). For an average female with a DML of 129.0 mm (5.1 in), the potential fecundity is 3,844 eggs. Dorval et al. (2013) found that the linear model did not account for a substantial amount of the total variation in potential fecundity and proposed using mean potential fecundity.

Market squid egg hatching rate is determined by temperature, with incubation time ranging from 22 to 90 days at temperatures ranging from 42.0 to 68.0 °F (5.6 to 20.0 °C) (Isaac et al. 2001). Eggs are commonly deposited in areas with water temperatures between 50 and 58 °F (10.0 to 14.4 °C), resulting in incubation periods lasting from 34 to 52 days.

2.5. Natural Mortality

Determining the natural mortality of marine species is important for understanding the health and productivity of their stocks. Natural mortality results from all causes of death not attributable to fishing such as age, disease, predation, or environmental stress. Natural mortality is generally expressed as a rate that indicates the percentage of the population dying in a year. Fish with high natural mortality rates must replace themselves more often and thus tend to be more productive. Natural mortality along with fishing mortality result in the total mortality operating on the fish stock.

Based on a short life span of 6-10 months, market squid appear to exhibit a very high natural mortality rate (Macewicz et al. 2004) and the adult population is composed of almost entirely new recruits, suggesting that the entire stock is replaced annually, even in the absence of fishing. Natural mortality is attributed in part to heavy predation, as market squid are prey for a variety of fish and marine mammal predators in the California Current Ecosystem (CCE) (Figure 2-2). However, market squid also die shortly after spawning occurs, and it is thought that their fast growth and high metabolic rates contribute to these high natural mortality rates (O'Dor and Webber 1986).

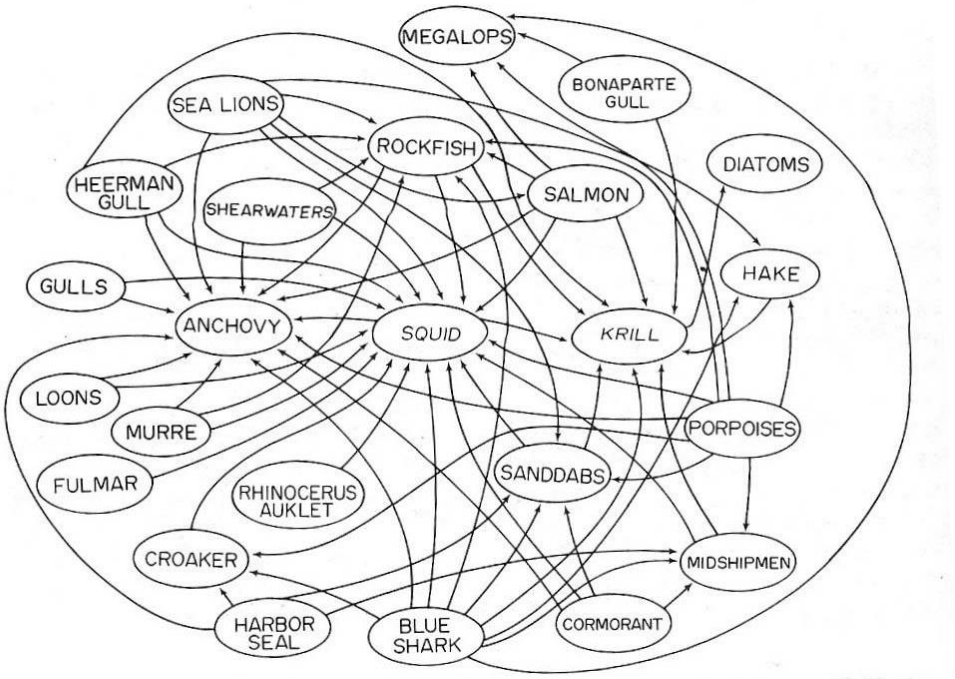

Figure 2-2. Food web for market squid, *Doryteuthis (Loligo) opalescens*, involving commercially important or abundant fish, birds, and marine mammals (from Morejohn, et al. 1978).

No studies directly estimate the natural mortality rate of squid. However, the total mortality has been estimated to range from 0.3 to 0.6 per month based on squid ageing data (Maxwell et al. 2005; Butler et al. 2001)

2.6. Associated Species

Several marine worms use squid as a host species; larval nematodes (roundworms), cestodes (tapeworms) and polychaetes (bristleworms) all have been recovered from squid and/or squid eggs. Nematodes, cestodes, and their larval stages have been found in market squid (Walthers and Gillespie 2002). In Monterey Bay, Riser (1949) cited infestation of squid by two types of plerocercoid larvae. These Plerocercoid larvae are tetraphyllidean cestodes that infest the large intestine of the squid. At Point Mugu, squid sampled from a commercial seafood outlet exhibited infestation by larval cestodes (orders Tetraphyllidea and Pseudophyllidea) and nematodes. Parasites were found to infect the eye, stomach, intestines, body cavity and tissues at a rate of 76.9% (Dailey 1969). The polychaete worm *Capitella ovincola* was thought to be a predator of market squid eggs, because it has been found inside squid egg capsules (Fields 1965). In fact, *C. ovincola* eat the outer casing of the egg capsule, not the embryo itself (Zeidberg et al. 2011a). *C. ovincola* does not appear to affect squid fitness either by decreasing the egg hatching rate or triggering premature hatching (Morris et

al. 1980) and was found to slightly increase the hatch rate of market squid eggs reared under laboratory conditions, suggesting a symbiotic relationship (Zeidberg et al. 2011a).

2.7. Predator/Prey Relationships

2.7.1. Market Squid as Predators

Market squid feed on a variety of prey during their life cycle. As larvae and juveniles, squid consume copepods and euphausiids. As adults, market squid feed on fish, polychaete worms, squid (cannibalism), and crustaceans such as shrimp and pelagic red crab. Market squid feed with and likely upon coastal pelagic species and have also been found in commercial catches of northern anchovy, Pacific sardine, Pacific herring (*Clupea pallasii*), Pacific mackerel, jack mackerel and Pacific saury (*Cololabis saira*) where they feed with and most likely upon these fish (Fields 1965).

Prey composition fluctuates with squid age, size, by depth and location, and reproductive status (Karpov and Cailliet 1979). The availability of prey and the behavior of market squid at different depths and locations may influence feeding behavior. Karpov and Cailliet (1978, 1979) found that crustaceans and cephalopod fragments were ingested at higher frequencies on spawning grounds than on non-spawning grounds. Inshore versus offshore samples of squid indicated differences in diet composition. In deeper waters, euphausiids and copepods were dominant prey items, while true cannibalism (intake of whole cephalopods) and fish consumption dominated in shallow waters.

2.7.2. Market Squid as Forage

Market squid are an integral part of the food web to many marine organisms. A meta-analysis of dietary studies in the CCE found market squid in the diet of 51 predators (Szoboszlai et al. 2015). Fish, seabirds, and marine mammals all consume squid as a prey item, as does the Humboldt squid (*Dosidicus gigas*) (Stewart et al. 2014). Bat stars (*Patiria miniata*), Kellet's whelks (*Kelletia kelletii*), and chestnut cowries (*Cypraea spadicea*) have also been observed to eat market squid eggs (Zeidberg et al. 2004).

Squid has been documented as a prevalent dietary component of marine mammals (Sinclair 1992; Fields 1965) and seabirds (Morejohn et al. 1978). In Monterey Bay, 19 species of fish were found to feed on market squid, including many commercially fished species such as Pacific bonito (*Sarda chiliensis*), salmon, halibut, and tuna (Figure 2-2) (Fields 1965; Morejohn et al. 1978). Predators from many trophic levels consume both small pelagic fishes,

such as northern anchovy and Pacific sardine, and market squid as either a primary or supplementary food source (Table 2-1).

Table 2-1. Known predators of coastal pelagic species, including market squid. (From Table 1.1.2-1, Federal CPS FMP; Table 7A from CDFG Report to the Legislature).

Common Names	**Scientific Names**
MARINE MAMMALS	--
Northern fur seal	*Callorhinus ursinus*
Guadalupe fur seal*	*Arctocephalus townsendi*
Steller sea lion	*Eumetopias jubatus*
California sea lion	*Zalophus californianus*
Northern elephant seal	*Mirounga angustirostris*
Harbor seal	*Phoca vitulina*
Common dolphin	*Delphinus delphis*
Harbor porpoise	*Phocoena phocoena*
Dall's porpoise	*Phocoenoides dalli*
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*
Common? Bottlenose dolphin	*Tursiops truncatus*
Short-finned pilot whale	*Globicephala macrorhynchus*
Blue whale*	*Balaenoptera musculus*
Fin whale*	*Balaenoptera physalus*
Sei whale	*Balaenoptera borealis*
Common? Minke whale	*Balaenoptera acutorostrata*
North Pacific right whale*	*Eubalaena japonica*
Humpback whale*	*Megaptera novaeangliae*
Gray whale	*Eschrichtius robustus*
MARINE BIRDS	--
Black-footed albatross	*Phoebastria nigripes*
Northern fulmar	*Fulmarus glacialis*
Sooty shearwater	*Ardenna grisea*
Manx shearwater	*Puffinus puffinus*
Short-tailed shearwater	*Ardenna tenuirostris*
Pink-footed shearwater	*Ardenna creatopus*
Leach's storm petrel	*Hydrobates leucorhous*
Ashy storm petrel*	*Hydrobates homochroa*
Black storm petrel	*Hydrobates melania*
Brown pelican*	*Pelecanus occidentalis*
Double-crested cormorant	*Nannopterum auritum*
Brandt's cormorant	*Urile penicillatus*
Pelagic cormorant	*Urile pelagicus*
Glaucous-winged gull	*Larus glaucescens*
Western gull	*Larus occidentalis*

Common Names	**Scientific Names**
Heermann's gull	*Larus heermanni*
Ring-billed gull	*Larus delawarensis*
California gull	*Larus californicus*
Black-legged kittiwake	*Rissa tridactyla*
Common murre	*Uria aalge*
Pigeon guillemot	*Cepphus columba*
Marbled murrelet*	*Brachyramphus marmoratus*
Craveri's murrelet	*Synthliboramphus craveri*
Scripps's murrelet**	*Synthliboramphus scrippsi*
Guadalupe murrelet**	*Synthliboramphus hypoleucus*
Ancient murrelet	*Synthliboramphus antiquus*
Cassin's auklet	*Ptychoramphus aleuticus*
Rhinoceros auklet*	*Cerorhinca monocerata*
Horned puffin	*Fratercula corniculata*
Tufted puffin*	*Fratercula cirrhata*
Bald eagle	*Haliaeetus leucocephalus*
Osprey	*Pandion haliaetus*
Elegant tern*	*Thalasseus elegans*
Caspian tern	*Hydroprogne caspia*
Forster's tern	*Sterna forsteri*
Least tern*	*Sternula antillarum*
MARINE FISH	--
Northern anchovy	*Engraulis mordax*
Pacific sardine	*Sardinops sagax*
Pacific whiting	*Merluccius productus*
Common thresher shark	*Alopias vulpinus*
Shortfin Mako shark	*Isurus oxyrinchus*
Soupfin shark	*Galeorhinus galeus*
Blue shark	*Prionace glauca*
Pacific electric ray	*Torpedo californica*
Silver (coho) salmon*	*Oncorhynchus kisutch*
King (Chinook) salmon*	*Oncorhynchus tshawytscha*
Steelhead*	*Oncorhynchus mykiss irideus*
Rockfish (many species)	*Sebastes spp.*
Striped bass	*Morone saxatilis*
Barred sand bass	*Paralabrax nebulifer*
Kelp bass	*Paralabrax clathratus*

Common Names	Scientific Names
Spotted sand bass	*Paralabrax maculatofasciatus*
Ocean whitefish	*Caulolatilus princeps*
Jack mackerel	*Trachurus symmetricus*
Yellowtail	*Seriola dorsalis*
White seabass	*Atractoscion nobilis*
Queenfish	*Seriphus politus*
California corbina	*Menticirrhus undulatus*
White croaker	*Genyonemus lineatus*
Surfperches (many species)	*Embiotocidae*
Pacific barracuda	*Sphyraena argentea*
Pacific (chub) mackerel	*Scomber japonicus*
Pacific bonito	*Sarda chiliensis*
Albacore	*Thunnus alalunga*
Pacific bluefin tuna	*Thunnus orientalis*
Swordfish	*Xiphias gladius*
Striped marlin	*Kajikia audax*
Giant seabass	*Stereolepis gigas*
Lingcod	*Ophiodon elongatus*
Scorpionfish	*Scorpaena guttata*
Dogfish	*Squalus spp.*
INVERTEBRATES	--
Market squid	*Doryteuthis (Loligo) opalescens*
Ocean squids	Family: *Loliginidae*

* Endangered, threatened, or candidate species
** Updated in 2025; Split from Xantus's murrelet in 2012 due to genetics, morphological differences, and apparent lack of interbreeding at areas where the two are sympatric (Birt et. al 2012), Additionally, endangered, threatened, or candidate species.

The proportion of squid in predators' diets varies dramatically between species, geographical location, and environmental conditions. Most squid predators are not squid specialists - squid is rarely the sole prey item. Squid cannot be relied on as a stable food source because of its highly variable abundance and limited energetic value (O'Dor and Webber 1986). Therefore, squid predators often switch to more abundant or energetically profitable prey species (Ainley et al. 1996; Sydeman et al. 1997), or target squid when they are most abundant during spawning aggregations and minimal energy is needed for capture.

In terms of frequency-of-occurrence, the presence of squid in diets varies dramatically. For seabirds such as the common murre (*Uria aalge*), squid composes 6 to 20% of the diet (by weight) depending on season and is usually ranked 3rd or 4th after northern anchovy, Pacific herring, and shiner surfperch (*Cymatogaster aggregata*) (Ainley et al. 1996). For diving birds such as rhinoceros auklets (*Cerorhinca monocerata*), common murres, Artic loons (*Gavia arctica*), and Brandt's cormorants (*Phalacrocorax penicillatus*), the frequency-of-occurrence of squid in the diet can range from 33 to 85% (Baltz and Morejohn 1977). For plunging, surface feeding birds, such as shearwaters and gulls, the frequency-of-occurrence ranges from 0-67% (Baltz and Morejohn 1977).

Market squid are also prey for commercial and recreational fishes, such as white seabass (*Atractoscion nobilis*), yellowtail (*Seriola dorsalis*), kelp bass (*Paralabrax clathratus*), barred sand bass (*Paralabrax nebulifer*), Pacific barracuda (*Sphyraena argentea*), California halibut (*Paralichthys californicus*), and other nearshore species.

For Chinook salmon (*Oncorhynchus tshawytscha*), squid composed only 7 to 9% of diet (by volume) and ranked 3rd or 4th behind northern anchovy,

euphausiids, and juvenile rockfish depending on location (Morejohn et al. 1978). At other locations along the west coast, squid is not a significant Chinook salmon prey item since they prey mainly on fish (Groot and Margolis 1991). For chilipepper rockfish (*Sebastes goodei*), squid ranked 3rd behind juvenile rockfish and other fishes (Morejohn et al. 1978). Other fish predators in which squid ranked high as a prey item include mainly bottom dwelling species such as curlfin sole *(Pleuronichthys decurrens*), speckled sanddab (*Citharichthys stigmaeus*), Pacific sanddab (*Citharichthys sordidus*), lingcod (*Ophiodon elongatus*), petrale sole (*Eopsetta jordani*), and Pacific halibut (*Hippoglossus stenolepis*) (Morejohn et al. 1978). Several pelagic species also feed on squid when available such as blue shark (*Prionace glauca*), common thresher shark (*Alopias vulpinus*), and albacore tuna (*Thunnus alalunga*) (Morejohn et al. 1978).

Squid occurs in 35 to 44% of California sea lion (*Zalophus californianus*) scat samples collected at rookery sites in the SCB, which can represent volumes as high as 27% of the diet by weight in non-El Niño years and 16% in El Niño years (Lowry and Carretta 1999). In terms of prey rank, squid was either the primary or secondary sea lion prey item after northern anchovy, depending on location and environmental conditions. Sea lions have a diverse diet and are opportunistic feeders suggesting that an individual can fulfill intake needs by combining multiple prey sources when one energy taxa is absent (Fiechter et al. 2016).

Fishery-independent data suggest that squid distribution is widespread, fishing does not occur in all areas of distribution, and not all spawning grounds are targeted. Historical evidence from research cruises along the west coast, as well as recent catch data, suggests that squid biomass may be very large at times and distributed widely along the entire west coast (CCIEA 2023), suggesting that a large portion of the squid biomass is available to other trophic levels (Figure 2-3).

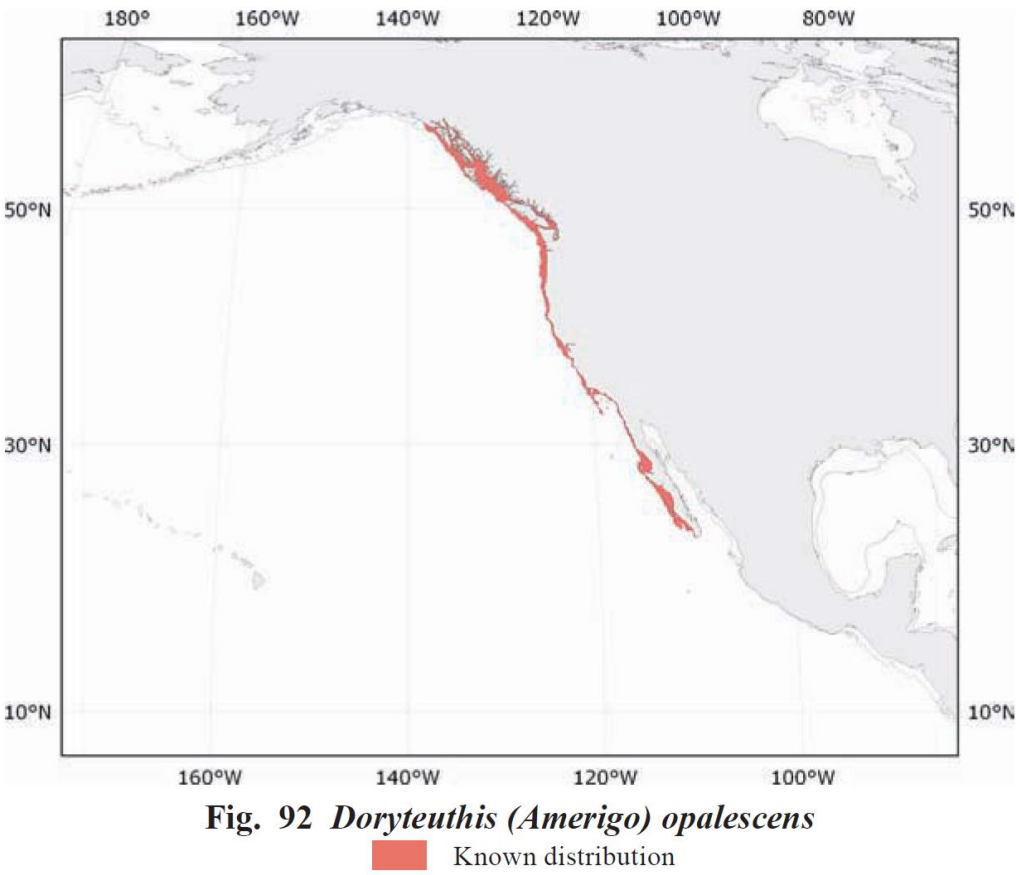

Figure 2-3. Range of market squid (Reproduced from Jereb et al. 2010).

2.7.3. Competition

Market squid feed with a variety of coastal pelagic finfish species, namely anchovies, sardines, herring, and mackerel. Market squid are often found together in commercial catch targeting species; however, little information is available regarding the competition for resources. Dense spawning aggregations of market squid may result in an increased incidence of cannibalism (Karpov and Cailliet 1978).

Trophic interactions between squid and higher-trophic-level fish are still not fully understood. It is not known if the value of market squid as a food source to adult coastal pelagic finfish predators outweighs the negative effects of predation by squid on larvae and juveniles of those species, in addition to competitive removal of phytoplankton, zooplankton and other fish.

2.8. Critical Habitat

The description and identification of Essential Fish Habitat (EFH) for market squid was updated through the federal fishery management process in 2023. The CPS FMP describes the east-west geographic boundary from the

shoreline along the California, Oregon, and Washington coast offshore to the limits of the EEZ and above the thermocline, where sea surface temperatures range between 44-75°F (7-24°C). This definition includes U.S. waters of Puget Sound and the Salish Sea and excludes other estuarine waters on the Pacific Coast. Market squid EFH also includes soft, sandy substrates 13 m to 93 m (43 ft to 305 ft) of depth for spawning adults and the egg capsule stage.

Market squid inhabit the inshore and offshore waters of the California Current from British Columbia to Baja California. The California Current is a region of transport, coastal jets, divergence, and upwelling. Changes in the Pacific Basin atmospheric pressure systems result in seasonal and interannual environmental variability within the CCE. Variations are caused by local winds and Ekman transport, flows of the equatorward California Current, the poleward undercurrent, and the inshore countercurrent. Temporal variations associated with the California Current are on time scales of several years to decades [i.e., the El Niño Southern Oscillation (ENSO) and cold vs. warm water regimes]. ENSO and other temperature related events markedly alter flow and temperature of currents within the CCE.

Refuges, preserves and MPAs are areas that are legally defined and regulated by the state or federal government, with the primary intent of managing areas for their conservation, recreational, ecological, historical, research, educational, or aesthetic qualities. National marine sanctuaries specifically prohibit exploring for, developing, or producing oil, gas, or minerals within their boundaries. Three national marine sanctuaries, the Channel Islands National Marine Sanctuary, Chumash Heritage National Marine Sanctuary and the Monterey Bay National Marine Sanctuary encompass the main fishing areas for market squid.

Non-spawning market squid are pelagic and believed to be associated with the deep scattering layer that migrates vertically to the upper levels of the water column at night. Spawning occurs over a wide depth range, but the extent and significance of spawning in deep water are unknown. Known market squid spawning grounds are characterized by a sandy substrate in shallow waters; major spawning grounds fished in California are located in Monterey Bay and near the Channel Islands. Egg cases have been found at depths of 792 m (2,598 ft). Adults and juveniles prefer oceanic salinities and are most abundant between temperatures of 50-60°F (10-16°C) (Roper and Sweeney 1984).

2.9. Status of the Stocks

Market squid population dynamics are poorly understood. Some information exists on the coastwide distribution and abundance of market squid from

fishery-independent midwater and bottom trawl surveys aimed at assessing other species. Because fishing activity occurs only on shallow-water spawning aggregations, it is not apparent if landings reflect availability to the fishery or overall stock size, since squid have been documented at greater depths using other gear.

Historically, the squid resource was considered to be underutilized. Until improved estimates of abundance are available, the true status of the population will remain unknown. The CPS FMP required that MSY be established for all species in the plan (PFMC 2023). Setting MSY for market squid has proven problematic because an accurate biomass has yet to be determined. Hence, the PFMC approved the use of egg escapement as a proxy for MSY for the market squid fishery. Egg escapement is the number (or proportion) of a female squid's potential lifetime fecundity that she is able to spawn, on average, before being taken in the fishery. The MSY control rule for market squid is founded generally on conventional spawning biomass "per recruit" model theory (Gabriel et al. 1989; Macewicz et al. 2004). Specifically, the MSY control rule for market squid is based on evaluating levels of egg escapement associated with the exploited population. The estimates of egg escapement are evaluated in the context of a "threshold" that is believed to represent a minimum level that is considered necessary to allow the population to maintain its level of abundance into the future (e.g., allow for "sustainable" reproduction year after year) (PFMC 2023). The threshold is currently set to a level of egg escapement of at least 30%. Egg escapement is reported in the reported in the Department's online Market Squid Enhanced Status Report (https://marinespecies.wildlife.ca.gov/market-squid/management/).

Therefore, the Overfishing Fishing Limit and Acceptable Biological Catch for market squid are an F_{MSY} proxy resulting in egg escapement ≥ 30%. The egg escapement model, as a proxy for MSY, was intended to be a temporary measure until an acceptable biomass estimate could be determined for market squid. Since an accurate biomass estimate has not yet been developed for market squid, NOAA and the Department continue to improve and refine the egg escapement method (Dorval et al. 2024).

Notably, the California market squid fishery has been certified as sustainable by the Marine Stewardship Council (MSC), an independent international non-profit organization with a mission to end overfishing and ensure seafood is fished sustainably (MSC 2023). The MSC uses a comprehensive standard and review process, which engages industry participants, external scientists, and management agencies to determine whether a fishery can be certified as sustainable. The review concluded that the basis of the proxy indicator used to assess stock status (egg escapement monitoring) is well established, and

appropriate for the biology of the stock. The review found that ecological monitoring is broad in scope, and a great deal of quantitative information is available showing that the fishery is highly unlikely to disrupt ecosystem structure and function under present conditions. The review also noted that the combination of gear and fishing methods is selective and allows larger animals to be released alive, thus limiting the impacts to endangered, threatened, or protected species. Finally, the review concluded that the market squid fishery exhibits an effective legal system and framework for cooperation that is transparent in its process, and with the roles and responsibilities of those involved in the fishery's management.

2.10. Areas Involved

Two major fishery areas account for the majority of landings in California. The northern fishery is centered in Monterey Bay, and squid are landed primarily at Monterey and Moss Landing. The northern fishery has operated predominately within a half mile of the Monterey Bay shoreline, and has expanded to other areas of the bay. The southern fishery targets a multitude of fishing spots including the Channel Islands and coastal areas from Point Conception south to La Jolla. Squid are landed chiefly at the ports of Ventura, Port Hueneme, San Pedro, and Terminal Island.

2.11. History of Exploitation

The commercial fishery has a long history in California, dating back to the mid- nineteenth century, although annual catches were usually less than 10,000 short tons (tons) until the 1960s (Table 2-2). During the 1980s, California's squid fishery grew rapidly in fleet size and landings when international demand for squid increased due to declining squid fisheries in other parts of the world (CDFG 2001). In 1997, a permit was created for the squid fishery and the rapid growth of fleet size was halted by a moratorium on new permits. Although it is not known when recreational fisheries in California started to use market squid as bait, recreational fisheries currently use market squid as either live or dead bait throughout the state.

Table 2-2. Historical market squid landings in tons for California divided at Point Conception into north and south. The market squid season is from 1 April through 31 March of the following year (MLDS).

Season	North	South	Total landings
1927-1928	1,567	4	1,571
1928-1929	686	44	730
1929-1930	2,303	16	2,319
1930-1931	5,494	16	5,510
1931-1932	792	71	863
1932-1933	2,072	28	2,100
1933-1934	430	4	434
1934-1935	736	19	755
1935-1936	329	19	347
1936-1937	451	17	469
1937-1938	245	61	306
1938-1939	754	11	765
1939-1940	522	53	575
1940-1941	818	86	904
1941-1942	694	47	741
1942-1943	406	34	440
1943-1944	4,529	18	4,546
1944-1945	5,435	38	5,472
1945-1946	7,586	27	7,613
1946-1947	19,777	18	19,795
1947-1948	8,728	64	8,792
1948-1949	7,599	59	7,658
1949-1950	3,087	2	3,089
1950-1951	2,997	2	2,999
1951-1952	5,844	374	6,219
1952-1953	1,746	2,649	4,394
1953-1954	2,076	391	2,467
1954-1955	3,772	77	3,849
1955-1956	6,714	119	6,833
1956-1957	9,828	478	10,306
1957-1958	5,496	1,753	7,249
1958-1959	1,902	2,848	4,750
1959-1960	7,140	94	7,235
1960-1961	1,103	996	2,099
1961-1962	1,987	4,075	6,062
1962-1963	2,886	2,028	4,914
1963-1964	3,174	1,641	4,815
1964-1965	4,551	5,223	9,774
1965-1966	4,439	4,508	8,947
1966-1967	5,597	4,211	9,808
1967-1968	5,617	6,088	11,705
1968-1969	7,289	2,668	9,957
1969-1970	5,780	6,186	11,966
1970-1971	4,314	8,861	13,175
1971-1972	8,328	4,475	12,803
1972-1973	6,124	5,057	11,181
1973-1974	621	7,696	8,317
1974-1975	7,248	5,302	12,549
1975-1976	2,495	10,563	13,058
1976-1977	2,511	6,587	9,098
1977-1978	2,235	12,050	14,285
1978-1979	10,343	8,680	19,024
1979-1980	14,169	7,213	21,381
1980-1981	7,860	12,087	19,947
1981-1982	14,132	11,700	25,833
1982-1983	11,697	1,516	13,213
1983-1984	1,061	27	1,087
1984-1985	549	804	1,354
1985-1986	4,276	10,100	14,376
1986-1987	6,967	18,636	25,603
1987-1988	6,632	18,582	25,214
1988-1989	5,765	42,430	48,195
1989-1990	7,829	25,222	33,051
1990-1991	8,871	23,602	32,472
1991-1992	9,013	29,653	38,666
1992-1993	9,450	9,343	18,793
1993-1994	10,012	44,440	54,452
1994-1995	19,103	44,489	63,592
1995-1996	3,676	90,157	93,833
1996-1997	5,828	118,481	124,309
1997-1998	9,275	1,623	10,898
1998-1999	26	11,673	11,699
1999-2000	308	126,464	126,772
2000-2001	7,730	115,681	123,411
2001-2002	10,094	92,621	102,715
2002-2003	27,828	19,166	46,994
2003-2004	19,673	40,803	60,476
2004-2005	7,303	49,270	56,572
2005-2006	2,206	79,902	82,108
2006-2007	630	37,736	38,366
2007-2008	35	50,600	50,635
2008-2009	923	39,223	40,146
2009-2010	967	92,637	93,604
2010-2011	23,568	110,074	133,642
2011-2012	17,061	117,957	135,018
2012-2013	21,360	84,727	106,087
2013-2014	27,607	87,494	115,101
2014-2015	63,731	50,841	114,573
2015-2016	22,324	18,283	40,607
2016-2017	15,037	27,360	42,397
2017-2018	10,934	62,768	73,702
2018-2019	15,780	18,491	34,271
2019-2020	3,066	12,147	15,213
2020-2021	16,865	3,904	20,768
2021-2022	23,785	39,069	62,854
2022-2023	4,679	51,700	56,379
2023-2024*	1,090	28,678	29,768

*Preliminary data.

2.11.1. Description of User Groups

2.11.1.1. Commercial Fishery

California's market squid fishery began in 1863; Chinese immigrants harvested small quantities of squid from Monterey Bay (Dickerson and Leos 1992). Skiffs were used to encircle a net around another skiff that used a torch to attract the squid to the surface. The product was dried and exported to China. In 1905, Italian immigrant fishermen introduced the more efficient lampara net. The lampara net (Table 2-3) was the only legal form of round haul gear in the southern bight of Monterey Bay until 1989. Once purse and drum seines were legalized for use in this district, the squid fleet switched gear types and the lampara became obsolete. In Fishing Districts 16 and 17 (Monterey and Santa Cruz Counties), attracting lights were prohibited between 1959 and 1988; in 1989 lights were again allowed in the northern fishery. Landings in the northern fishery had not expanded until the 2002-2003 season, while the number of vessels making landings has fluctuated from year-to-year (Figure 2-4).

Table 2-3. Description of market squid fishery gear types.

Gear type	Description
Purse seine	A round haul net with a "purse" line to close the bottom of the net. One end is attached to a skiff and the deploying vessel encircles the squid. The other end of the net is brought to the deploying vessel and the purse line is drawn, closing the bottom of the net to prevent escaping squid.
Drum seine	Like a purse seine, but a large drum stores, deploys and retrieves the net.
Lampara	A round haul net with the sections of netting made and joined to create bagging. The net is pushed beneath squid to encircle it from each side. The "wings" of the net are pulled back to the boat and the squid end up in the bag portion of the net. This gear has no arrangement for pursing.
Brail	A large dip net sometimes used with the assistance of the vessel's hydraulics.

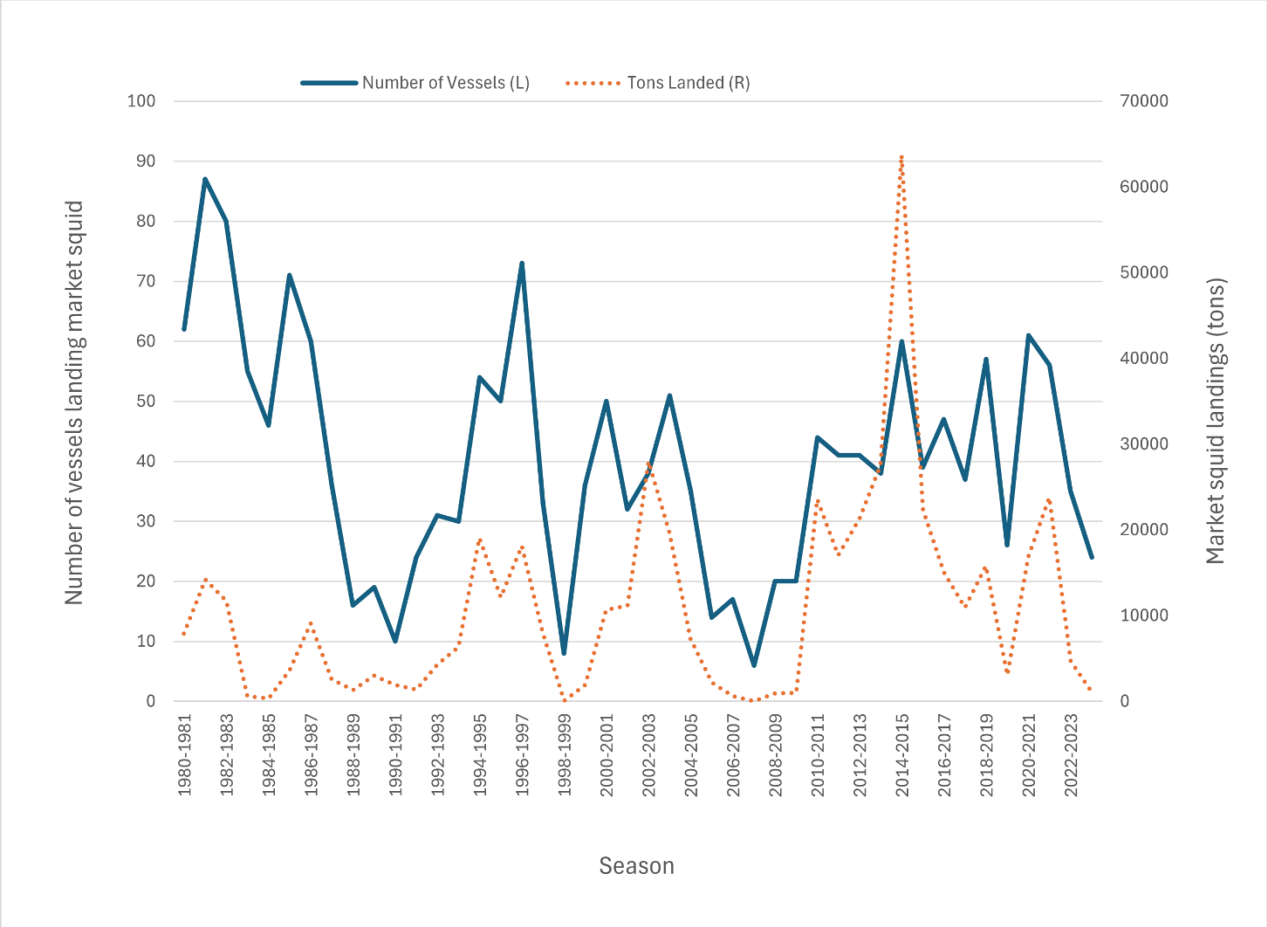

Figure 2-4. Number of vessels and market squid landings by season for Northern California (MLDS).

During the 1970s brail vessels were the major harvesters in the southern California market squid fishery, using a power-assisted brail or dip net in conjunction with attracting lights (Kato and Hardwick 1975). In 1977, the fleet shifted from using brail vessels to purse seine vessels (Vojkovich 1998). Vessels brailing for squid still land a small portion of the catch (less than 3.0% in 2023-2024 season). Brailing vessels have the advantage of fishing in some areas that are closed to roundhaul gear and can land smaller volumes at a higher value. However, purse seine and drum seine vessels are more effective at landing large volumes of squid and by the early 1990s, the purse seine became the dominant gear on the entire coast, with the drum seine gaining popularity by the mid-1990s. As of the 2023-2024 season, purse and drum seine remain the dominant gear responsible for 97% of total landings (MLDS).

According to Department records during the drafting of the original MSFMP, the average purse seine vessel length was 18.9 m (62 ft) and 81 gross tons. The average hold capacity was 84 tons. The average purse seine net was 381 m (1250 ft) long with a depth of 48 m (156 ft). Gross tonnage (GT) is a volumetric measurement used as a proxy for harvesting capacity. At the start

of the 2024 squid fishing season, the average seiner was 18.4 m (60.28 ft) in length with an average GT of 83.6 tons. The average light and brail boat length was 13.5 m (44.4 ft) with an average GT of 46.5 tons for brail boats. The stretched mesh size is 1 ¼ - 1 ½ inch. Some vessels use refrigerated seawater to keep catch cold, while others (live bait vessels) use circulated seawater, brine or no cooling system at all. The fleet currently uses a combination of round haul gear (purse seine or drum seine) or brail/dip net to harvest squid. Lampara nets, a legal round haul gear, are mostly obsolete in the limited entry fishery. In the 2023 squid fishing season (April 1, 2023 to March 31, 2024), approximately 97% of directed landings (by weight) came from seine (purse or drum) fishing, and less than 3% from brail/dip net fishing. Nearly all vessels use side-scan sonar and fathometers.

In most cases, squid seiners work with light boats. A light boat is typically a smaller vessel with several high-powered lights located at various levels around the vessel. The purpose of the lights is to attract and aggregate spawning squid to surface waters. The light boat actively searches for squid. Once squid are located and aggregated, the light boat will signal the seiner to deploy its net, encircling the light boat, to catch the squid located under the lights.

The squid fishing income of the many seine vessels from southern California is often supplemented by participation in the tuna and CPS finfish fisheries. Many vessels in the southern fishery have homeports in the states of Alaska, Washington and Oregon and participate in salmon, herring and sardine fisheries. Historically, some vessels from the squid fishery participated in a high value sardine fishery off the Columbia River at the border of Oregon and Washington. Many light boats also participate in other local fisheries that do not use attracting lights such as herring, hook- and-line and gillnet. Declines in other fisheries led to an influx of fishing vessels from other states in the 1990s. Some fishermen have complained about user conflict and territorial disputes between "local" and out-of-state fishermen. Non-permitted vessels, including vessels in other fisheries (such as trawlers) that periodically catch small volumes of squid, are allowed to make incidental landings of up to two tons daily (Table 2-4).

Table 2-4. California landing receipt information for permitted and non-permitted vessels, 1980-1981 to 2002-2003 and 2020-2021 to 2023-2024. Vessels fishing for squid were not required to have a squid fishing permit until the 1998-1999 season; this table shows the activity by the vessels permitted through the 2023-2024 squid fishing season (MLDS).

Season	Landings (tons)	Landings (tons) by permittees	Percent landings made by permittees	Number of vessels	Number of permitted vessels
1980-1981	5,768	1,459	25.30%	55	10
1981-1982	25,851	11,349	43.90%	152	31
1982-1983	13,213	7,049	53.30%	125	28
1983-1984	1,087	740	68.10%	81	17
1984-1985	1,354	476	35.10%	95	21
1985-1986	14,376	8,833	61.40%	126	34
1986-1987	25,603	14,184	55.40%	122	34
1987-1988	25,214	15,547	61.70%	117	37
1988-1989	48,195	31,371	65.10%	119	43
1989-1990	33,051	22,705	68.70%	100	39
1990-1991	32,472	24,764	76.30%	102	41
1991-1992	38,666	30,503	78.90%	85	40
1992-1993	18,793	16,176	86.10%	82	40
1993-1994	54,452	44,335	81.40%	92	45
1994-1995	63,592	51,006	80.20%	110	54
1995-1996	93,833	72,749	77.50%	128	65
1996-1997	124,315	95,082	76.50%	143	77
1997-1998	10,898	9,917	91.00%	86	46
1998-1999	11,699	9,433	80.60%	117	67
1999-2000	127,248	107,934	84.80%	168	95
2000-2001	124,379	108,831	87.50%	152	85
2001-2002	102,667	96,757	94.20%	118	85
2002-2003	46,970	45,031	95.90%	105	78
2020-2021	20,768	20,767	99.90%	80	66
2021-2022	62,854	62,853	99.90%	87	77
2022-2023	56,379	56,378	99.90%	89	78
2023-2024*	29,768	29,767	99.90%	82	72

*Preliminary data.

The number of businesses purchasing squid has decreased since the early 1980s. Since the 2020-2021 season, the majority (90% or more) of the squid purchased was bought by 22 or fewer dealers. The other dealers purchase less than 100 tons per year.

2.11.1.2. Recreational Fishery

Market squid are taken by individual recreational anglers to use for bait or personal consumption. The primary recreational use of market squid is through the live bait commercial market, when fishing for other species like rockfish, white seabass, and other key recreational target species. Market squid used as recreational bait are primarily caught by bait haulers using seine, lampara or brail nets. The relatively small volume of squid caught for recreational use is a high value fishery, and supplies bait to recreational fisheries along the California coast, primarily in southern California (CDFG 2001). Recreational fishing effort for market squid is unable to be determined due to insufficient data. Live bait is sold from the catcher vessel at sea or from one of the many harbor-based bait dealerships. Recreational fishing vessels and privately owned skiffs catch their own squid bait by using attracting lights and brail nets and/or rod and reel. Historically, commercial squid catch had been voluntarily reported on live bait logs. Beginning in 2019, live bait logs were discontinued, and all live bait has since been reported on Department fish tickets. Additionally, light boat operators record live squid bait catch in their market squid logbooks. As reported in the Department's Marine Landings Data System (MLDS), less than 7 tons of market squid were taken as live bait in the 2022-2023 season, about 0.01% of the total harvest.

2.11.2. Fishing Effort

2.11.2.1. Commercial Fishing Effort

For decades, the market squid fishery has ranked as one of the highest in volume and value among the state's commercial fisheries: squid ranked number one in landings for the last 15 years and number one for dollars paid ex-vessel for 9 of those 15 years (CDFW 2024a). Although quite successful, the commercial squid fishery is unpredictable due to environmental and market conditions.

During an El Niño event (i.e., 1997-1998), squid availability declines along with fishing effort and catch. In years when squid are readily available, fishing effort appears to be determined by market conditions. Vessel participation is at its greatest during the late fall and early winter in southern California and during the summer for northern California (Figure 2-5). When squid processors have full freezers or the demand for California squid is low, vessels are generally put on market-imposed limits, and ex- vessel prices may be lowered. As squid availability declines as the season progresses, many vessels leave for other fisheries.

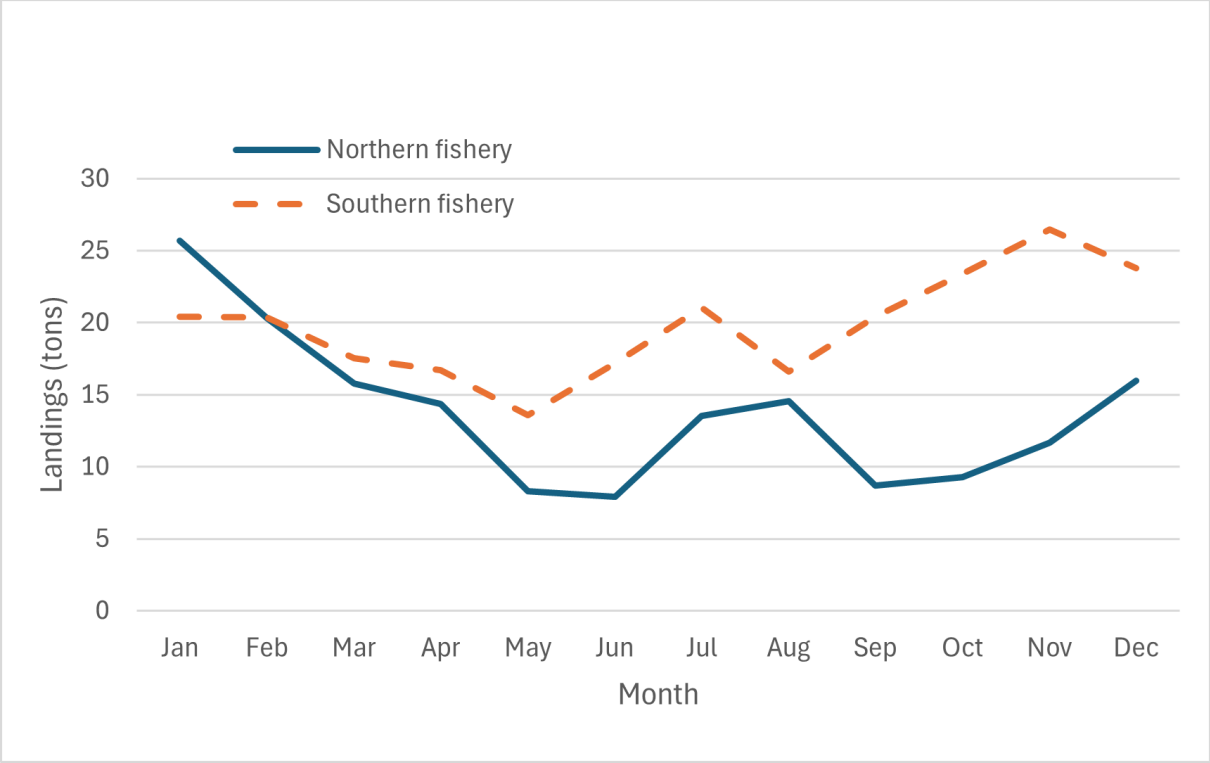

Figure 2-5. Average monthly landings in tons for the market squid fishery divided at Point Conception into northern and southern fisheries from 1969 through 2024 (MLDS).

Although market squid may be available in commercial quantities from Baja California to Oregon, the fishery is centered in two areas of California: Monterey Bay and the Channel Islands off southern California. The earliest fishery, in Monterey Bay, caught less than 1,000 tons per year from 1916 (when the Department began keeping records) to 1923 (Dickerson and Leos 1992). From 1924 to 1932, landings averaged more than 2,000 tons per year. Most of the catch from 1924 to 1932 was dried and exported to China; some was used domestically as canned or frozen product. The Asian market closed in 1933 due to financial conditions and the domestic market supported the Monterey fishery for many years. Landings in California were minimal until 1942 when demand from international aid programs triggered a rise in the need for squid the following year.

Landings peaked at close to 20,000 tons in the 1946-1947 season, then averaged 9,100 tons until the 1981-1982 season when greater than 25,000 tons were landed (Table 2- 2). Before the 1960s, the majority of squid landings were in the Monterey Bay area. In 1961, the fishery in southern California experienced a dramatic increase in landings.

The southern fishery centers around the northern Channel Islands, Santa Catalina Island, and southern coastal nearshore areas (Hill and Yaremko 1997).

Since the early 1980s, landings in southern California have exceeded those of the northern fishery (Figure 2-6; also see Table 2-2). Fishery landings reached a peak of 135,018 tons in the 2011-2012 season. The rapid fishery expansion of the last 40 years is a result of rising demand for squid in foreign markets, especially Europe and China.

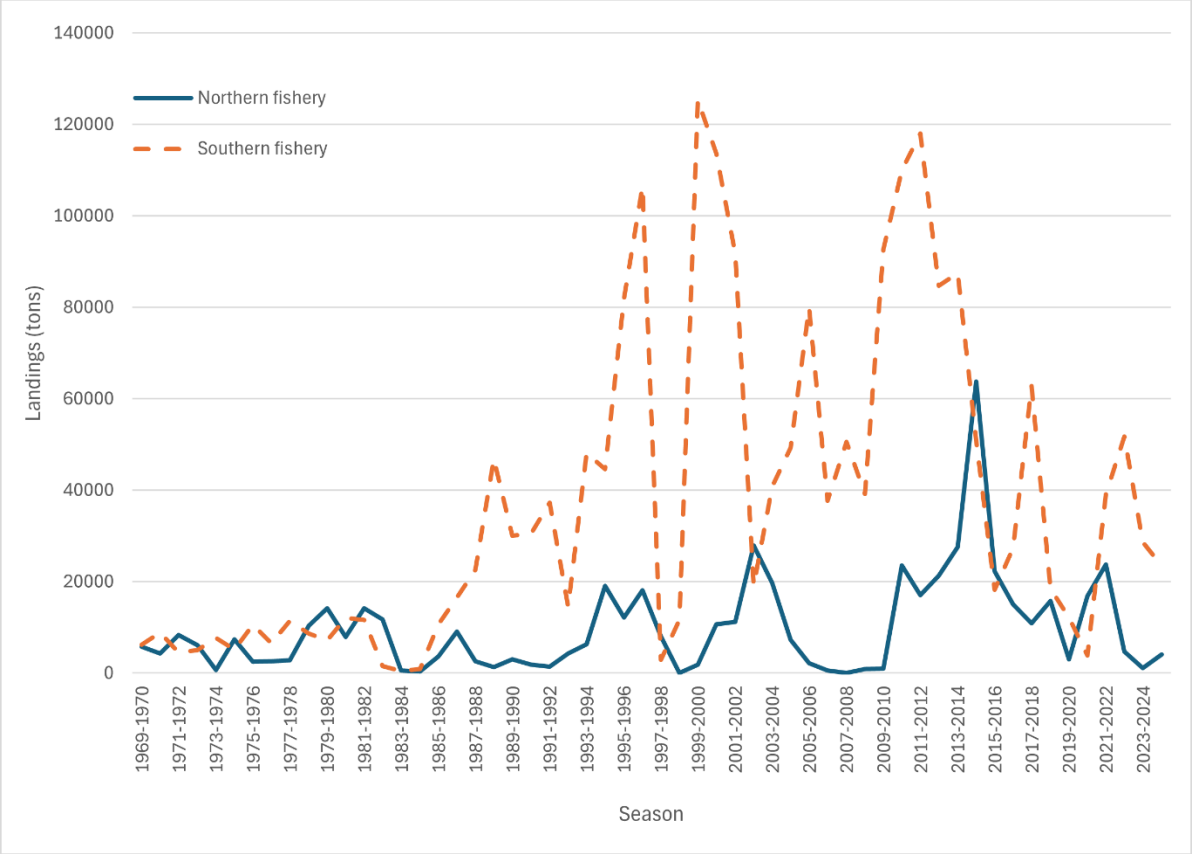

Figure 2-6. Market squid landings in tons from 1969-1970 through 2023-2024 seasons showing the increase in landings for the fishery south of Point Conception (MLDS).

Because the squid fishery was primarily an open-access fishery before 1998 and due to increases in statewide landings, legislation was enacted to ensure the sustainability of the squid resource and the marine life that depends on squid. The legislation required the purchase of an annual permit to land more than two tons or to attract squid by using light for purposes of commercial squid harvest. Eligibility has been determined by the purchase of a permit in the initial 1998-1999 season and subsequently from the previous year (Table 2-5). Ninety-two Market Squid Vessel Permits (12 of which were non-transferable and 3 of which were experimental), 14 Market Squid Brail Permits, and 61 Market Squid Light Boat Permits were issued (CDFW 2024b) when the original MSFMP was implemented in 2005. In the 2023-24 season, 68 Market Squid Vessel Permits and 28 Market Squid Light Boat Permits were issued. Since 2005, there have been 34 upgrades from light boat to brail

permits. The influx of brail permits, particularly from 2010 to 2013, was the direct result of light boat permit upgrades (Figure 2-7).

Table 2-5. Vessel, brail, and light boat permit numbers, 2000 to 2024 (CDFW Automated License Data System).

Year	Number of Vessel Permits	Number of Brail Permits	Number of Light boat Permits
2000	200	--	--
2001	196	--	--
2002	184	--	--
2003	174	--	--
2004	166	--	--
2005	92	22	61
2006	89	19	59
2007	88	23	58
2008	88	23	57
2009	80	21	57
2010	81	25	53
2011	77	37	41
2012	77	42	36
2013	74	44	34
2014	75	44	34
2015	75	44	34
2016	74	45	33
2017	74	45	33
2018	73	45	33
2019	71	46	32
2020	72	46	32
2021	71	46	32
2022	71	46	31
2023	69	47	30
2024	68	48	28

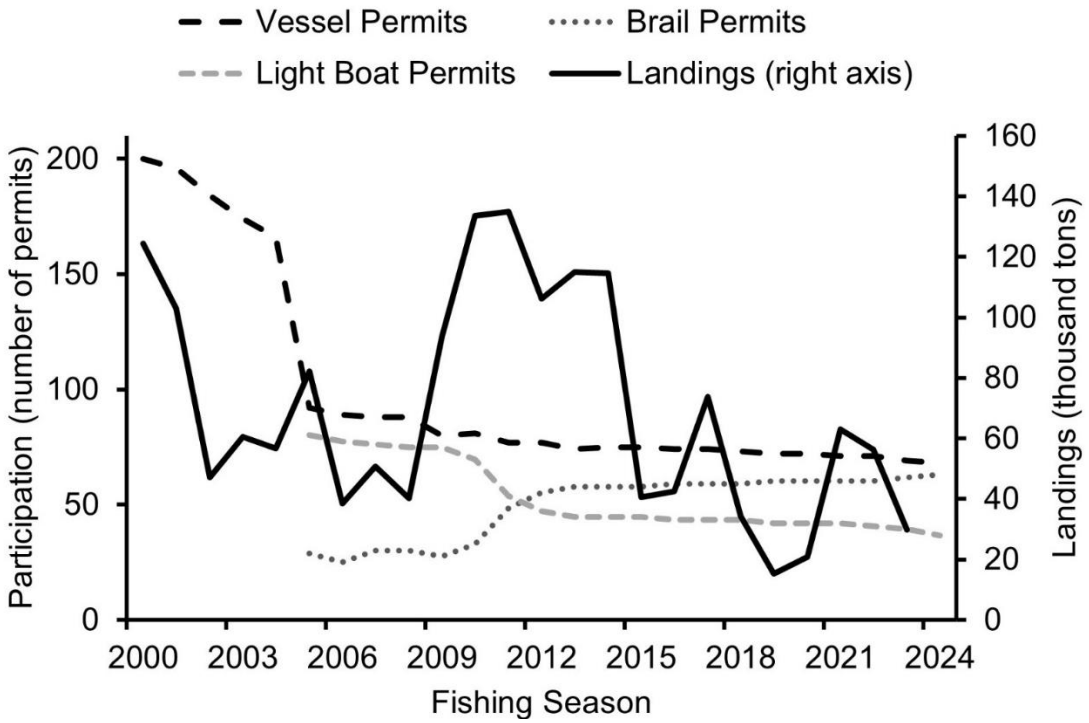

Figure 2-7. Market squid fishery participation (number of limited entry permits by type; left axis) and landings (thousand tons; right axis) from 2000 to 2024 fishing seasons (MLDS).

Of the 68 limited entry Market Squid Vessel Permits issued in 2024, 58 vessels reported market squid landings. As with many fisheries, a select number of vessels make the majority of the catch. Twenty-nine vessels made 80% of the landings (by weight) in 2023. Of the 48 brail permits issued in 2023, 14 brail-permitted vessels reported landing squid, suggesting that most brail-permitted vessels are solely acting as light boats with a portion catching squid for sale as live bait. Since 1998, the number of vessel and light boat owner permits has declined (Figure 2-8).

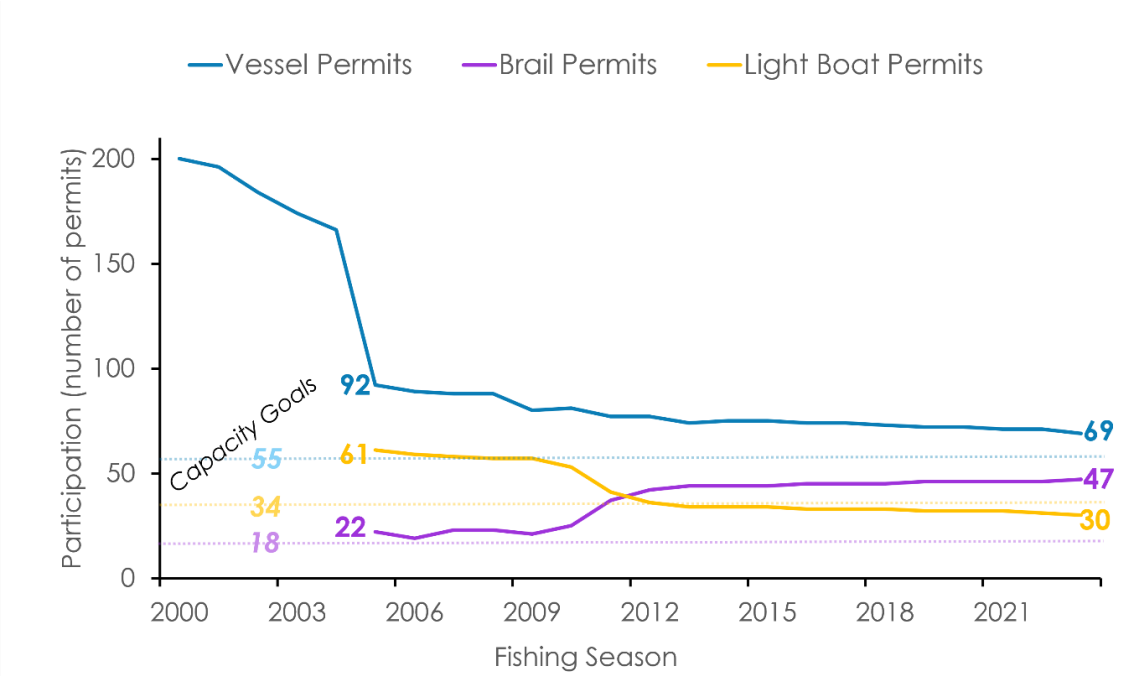

Figure 2-8. Participation (number of permits) in the commercial market squid restricted access fishery from 2000 to 2023. Capacity goals are delineated as dotted lines.

Despite the large number of permits issued, the current squid fleet consists of approximately 75 dedicated vessels. As with many fisheries, a select number of vessels made the majority of the catch. In the last four seasons, only 23, 30, 31, and 29 permitted vessels, respectively, made 75% of the catch.

2.11.2.2. Recreational Fishing Effort

Due to limited data, recreational fishing effort for market squid is unable to be determined. Live bait logs used by commercial vessels that supply bait to the recreational fishery to voluntarily report catch (e.g., northern anchovy, Pacific sardine) had regularly reported squid taken. Beginning in 2019, live bait logs were discontinued, and all live bait has been reported on electronic landing receipts. This landings information, however, does not provide data on effort of individual anglers taking market squid for their own consumption or use as bait. As reported in the Department's MLDS, less than 7 tons of market squid was taken as live bait in the 2022-23 season, about 0.01% of the total harvest.

2.12. Fishery Impacts

The adverse effects from fishing activities may include physical, chemical and biological alterations of habitat, loss of and or injury to benthic organisms, prey species and their habitat, and other components of the ecosystem. FMPs must include management measures that minimize adverse effects on

marine ecosystems from fishing to the extent practicable, and to identify conservation and enhancement measures. In addition, FMPs must contain an assessment of the potential adverse effects of all fishing activities and should consider the relative impacts of all fishing equipment used in varying habitats (PFMC 1998.)

Fishing for market squid could have important trophic implications and other ecological impacts. For example, the use of chains as a seine weight in the commercial fishery have the potential of digging deeper into the ocean floor than the suggested alternatives, such as small diameter cables (Hastings and MacWilliams 1999). Net bottoms may also scrape the ocean floor and do harm to squid eggs. A suggestion was previously made for a maximum depth and length of net to avoid disturbance to egg cases or to require that the net shall be no deeper that the depth fished. Further, squid caught which have not yet spawned by targeting schools of squid using sonar which are in transit to spawning grounds could impact the sustainability of the fishery. The MSFMP A-1 now includes special provisions that will help reduce the potential ecological impacts described above. Chain purse lines will no longer be allowed, and nets will be required to be pursed using a rib line. The removal of chain purse lines and the use of a rib line minimize the amount of scraping and were selected as the most appropriate option rather than net depth or length restrictions. Additional weekend closures will allow for more uninterrupted spawning time.

Bycatch is minimal in the commercial market squid fishery, although is not avoided entirely. While bycatch is known to occur in the fishery, certain species are required to be discarded by other statutes and regulations not encompassed by this FMP. Very few interactions have been observed between the California market squid fishery and threatened or endangered marine species of birds and mammals. The market squid fishery is classified as a Marine Mammal Protection Act Category III fishery in terms of impact on marine mammal stocks. A Category III fishery is defined by an annual mortality and serious injury of a stock is less than or equal to 1% of the Potential Biological Removal level (e.g., a remote likelihood of or no known incidental mortality and serious injury to marine mammals). According to the NOAA List of Fisheries for 2023, documented interactions in the California squid purse seine fishery include California sea lion, long-beaked common dolphin, Risso's dolphin, and short-beaked common dolphin (NOAA 2023).

From data gathered through the Department's dockside sampling program, 1,031 of 1,521 samples (68%) collected between January 2010 and December 2020 contained incidentally caught fish and/or invertebrates, excluding other CPS and squid egg cases (Table 2-6). Approximately 25.8% of sampled landings from July 2010 to December 2020 contained squid egg cases. Incidental catches of squid egg cases and other species increase in the squid fishery when the nets are set in shallower water (less than 40.0 m (131.2 ft)), where bottom contact may occur (Lutz and Pendleton 2001).

The species with the highest average frequency of occurrence from 2019 to 2023 include Pacific sardine, unspecified kelp, Pacific mackerel, jack mackerel, and unspecified jellyfish respectively (Table 2-6). Less than 2% of the sampled landings contained species that are prohibited from being landed (e.g., barracuda, salmon, and white seabass). Most commercial fishing for CPS finfish and market squid takes place south of Pigeon Point. The potential for taking salmon exists in this area, but diminishes south of Monterey, California (37° N latitude) (PFMC 2010). As noted above, other fishery regulations may prohibit the catch of certain species encountered as bycatch in the market squid fishery. In those cases, if species are taken incidentally but prohibited for catch, they must be discarded.

Table 2-6. Percent frequency of occurrence of bycatch in observed loads of California market squid from 2019 to 2023. Table values represent the presence of a species in observed loads for that year. Any species with fewer than 1% occurrence during the entire timeframe is not listed. **Note** that presence of a species in dockside observations does not indicate the species is necessarily legal to possess or land in the market squid fishery.

Common name	**Scientific name**	**2019**	**2020**	**2021**	**2022**	**2023**
Finfish	--	--	--	--	--	--
Anchovy, northern	*Engraulis mordax*	25	31.33	31.43	19.51	8.06
Barracuda, Pacific	*Sphyraena argentea*	2.78	2.41	1.43	0.81	0
Bass, kelp	*Paralabrax clathratus*	1.85	1.2	0.71	0	1.61
Blacksmith	*Chromis punctipinnis*	0	0	0.71	2.44	3.23
Bonito, Pacific	*Sarda lineolata*	2.78	2.41	0.71	1.63	1.61
Butterfish (Pacific pompano)	*Peprilus simillimus*	16.67	16.87	13.57	17.07	3.23
Croaker, White (kingfish)	*Genyonemus lineatus*	5.56	6	5.7	6.5	0
Fish, unspecified	--	0	1.2	7.1	1.6	1.6
Flatfish, unspecified	--	17.59	14.5	13.6	8.1	4.8
Flying fish, California	*Cheilopogon pinnatibarbatus californicus*	0.93	0	1.4	5.7	3.2
Halfmoon	*Medialuna californiensis*	0	2.4	0.7	0	6.5
Halibut, California	*Paralichthys californicus*	7.41	4.8	2.1	10.6	1.6
Herring, Pacific	*Clupea pallasii*	1.85	0	2.1	1.6	0
Herring, red-eye round	*Etrumeus teres*	11.11	1.2	2.9	4.1	4.8
Jacksmelt	*Atherinopsis californiensis*	18.52	37.4	30	24.4	16

Common name	**Scientific name**	**2019**	**2020**	**2021**	**2022**	**2023**
Mackerel, jack	*Trachurus symmetricus*	47.22	33.7	27.9	49.6	37.1
Mackerel, Pacific (chub)	*Scomber japonicus*	52.78	48.2	21.4	53.7	58.1
Midshipman, unspecified	*Porichthys spp.*	2.78	0	0	1.6	1.6
Midshipman, plainfin	*Porichthys notatus*	3.7	14.5	11.4	6.5	0
Midshipman, specklefin	*Porichthys myriaster*	0	0	2.1	1.6	1.6
Pacific sardine	*Sardinops sagax*	74.07	71.1	58.6	67.5	54.8
Rockfish, unspecified	*Sebastes spp.*	2.78	1.2	3.6	3.3	1.6
Rockfish, bocaccio	*Sebastes paucispinis*	0.93	3.6	2.1	1.6	0
Sablefish	*Anoplopoma fimbria*	0	1.2	0.7	4.9	0
Salmon, Chinook	*Oncorhynchus tshawytscha*	1.85	6	0.7	0	0
Sanddab, unspecified	*Citharichthys spp.*	6.48	1.2	3.6	3.3	0
Sanddab, longfin	*Citharichthys xanthostigma*	0.93	1.2	0	0	1.6
Sanddab, Pacific	*Citharichthys sordidus*	11.11	27.7	27.1	21.1	1.6
Sanddab, speckled	*Citharichthys stigmaeus*	4.63	3.6	4.3	4.9	1.6
Scorpionfish, California	*Scorpaena guttata*	9.26	9.6	2.9	16.3	17.7
Sculpin, staghorn	*Leptocottus armatus*	0	1.2	1.4	3.3	0
Smelt, night	*Spirinchus starksi*	0	3.6	2.1	0	0
Sole, English	*Pleuronectes vetulus*	4.63	6	7.9	8.9	0
Sole, sand	*Psettichthys melanostictus*	1.85	1.2	2.1	6.5	0
Sunfish, ocean	*Mola mola*	0	3.6	0.7	4.9	0
Topsmelt	*Atherinops affinis*	1.85	4.8	0.7	0.8	0
Turbot, unspecified	*Pleuronectidae*	1.85	0	2.1	1.6	0
Turbot, hornyhead	*Pleuronichthys verticalis*	3.7	9.6	8.6	8.9	1.6
Wrasse, rock	*Halichoeres semicinctus*	0	0	0	0.8	1.6
Elasmobranchs	--	--	--	--	--	--
Ray, bat	*Myliobatis californica*	3.7	0	2.9	10.6	9.7
Ray, Pacific electric	*Torpedo californica*	8.33	13.3	9.3	8.9	0
Shark, horn	*Heterodontus francisci*	6.48	0	2.1	2.4	0
Skate, big	*Raja binoculata*	2.78	6	0	3.3	0
Skate, California	*Raja inornata*	2.78	1.2	1.4	0.8	0
Skate, unspecified	*Rajidae*	0	1.2	2.1	0.8	1.6
Stingray	*Dasyatidae*	0.93	1.2	2.1	0	0
Invertebrates	--	--	--	--	--	--
Anemones, unspecified	*Anthozoa*	0	3.6	0.7	0.8	0
Crab, unspecified	*Cancer spp.*	6.48	12.1	7.9	7.3	3.2
Crab, claws	*Cancer spp.*	2.78	2.4	5	2.4	0
Crab, decorator	*Bivalvia*	0.93	2.4	0	0.8	0
Crab, Dungeness	*Metacarcinus magister*	5.56	9.6	17.1	7.3	0
Crab, red rock	*Cancer productus*	5.56	3.6	5.7	4.1	0
Crab, rock unspecified	*Cancer spp.*	0.93	2.4	1.4	2.4	0
Crab, shells	--	8.33	15.7	12.1	8.9	0

Common name	Scientific name	2019	2020	2021	2022	2023
Crab, swimming unspecified	--	12.04	7.2	2.1	0.8	0
Jellyfish, unspecified	*Hydrozoa*	35.19	49.4	37.9	26.8	9.7
Lobster, California spiny	*Panulirus interruptus*	1.85	6	0.7	1.6	1.6
Mussel, unspecified	*Mytilus spp.*	6.48	1.2	2.1	0.8	6.5
Octopus, unspecified	*Octopus spp.*	2.78	2.4	1.4	0.8	0
Prawn, spot	*Pandalus platyceros*	0.93	1.2	4.3	1.6	0
Pyrosome	*Pyrosoma atlanticum*	27.78	31.3	16.4	28.5	24.2
Salps	--	6.48	3.6	4.3	4.9	8.1
Sand dollar	*Dendraster excentricus*	0.93	1.2	1.4	0	0
Sea cucumber, unspecified	*Holothuroidea*	1.85	3.6	2.9	3.3	1.6
Shrimp, target	*Sicyonia penicillata*	3.7	7.2	2.1	4.1	6.5
Squid egg cases	--	31.48	45.8	30	35	1.61
Marine Plants and Algae	--	--	--	--	--	--
Algae, marine	*Phycophyta*	21.3	13.3	20	9.8	9.7
Eelgrass	*Zostera spp.*	3.7	2.4	2.9	5.7	1.6
Kelp, unspecified	*Laminariales*	60.19	73.5	35.7	62.6	56.5
Kelp, feather boa	*Egregia menziesii*	7.41	6	6.4	7.3	1.6
Kelp, giant	*Macrocystis pyrifera*	11.11	4.8	22.9	4.1	6.5
Surfgrass	*Phyllospadix spp.*	35.19	57.8	34.3	22	4.8

2.13. Social and Economic Characteristics of the Market Squid Fishery

Squid fishing supplements the income of many seine vessels that also participate in fisheries such as salmon, tuna, herring, and other CPS throughout California, Oregon, Washington, and Alaska. A substantial number of market squid vessels have home ports outside California, likely due to declines in other fisheries. Some light boats also participate in other fisheries that do not use attracting lights.

The number of businesses purchasing squid had remained constant since the early 1980s; however, since the 1994-1995 season, the majority (80% or more) of the squid purchased was bought by nine or fewer dealers. In 2023, at least 80% of the catch was purchased by six dealers. Currently, the California squid industry is centered on global markets that have placed an increased demand upon California market squid. Vessels targeting squid usually have a relationship with one market from which they receive orders for specific amounts of squid.

When demand or storage space is limited, fishing is limited regardless of squid availability (Pomeroy and FitzSimmons 2001). The price paid to vessels depends on the market demand and the availability of the resource. Historically, when volume was low, the price paid per ton was high, and the

price is driven down when volume is high. Since 2000 the median ex-vessel price of market squid increased from $0.10 to $0.50 per pound and remained at $0.50 per pound from 2016 to 2019. In 2020, the median ex-vessel price increased to $0.60 per pound with an average price of $1,160.00 per ton and remained at a median price of $0.60 per pound through the 2023-2024 fishing season (Figure 2-9).

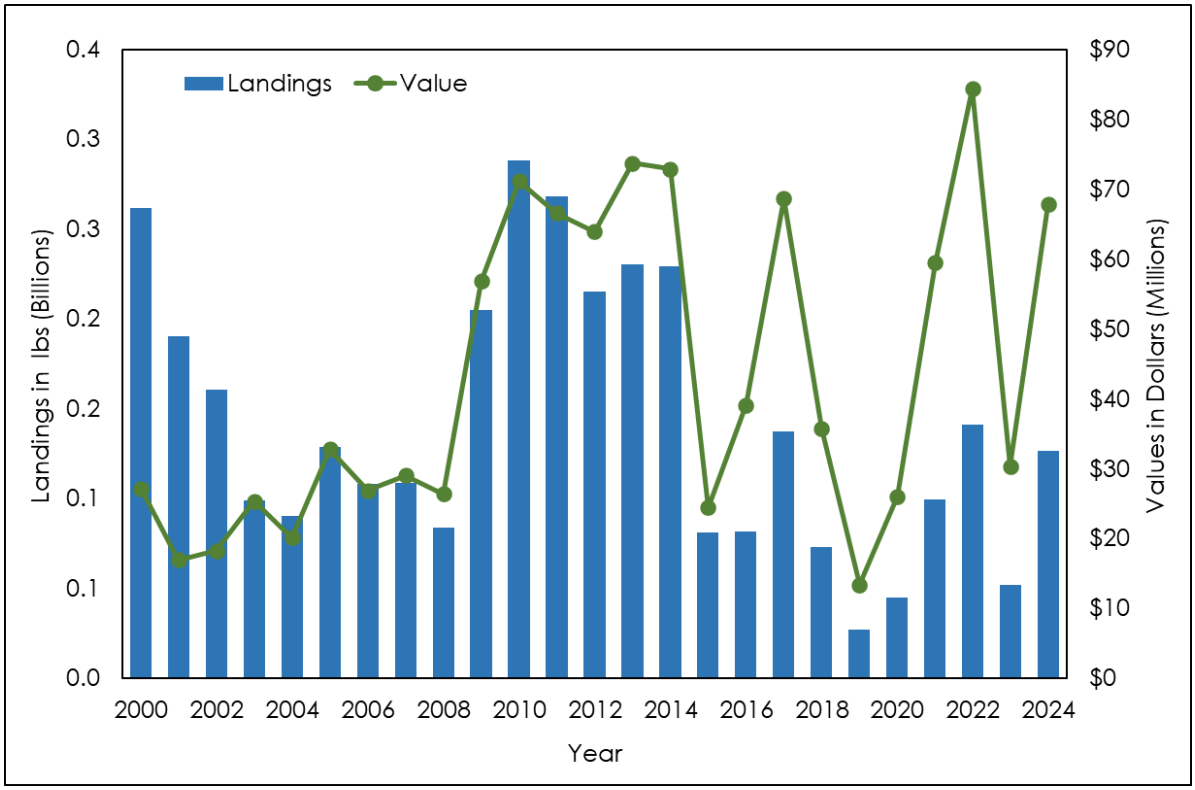

Figure 2-9. Dollars paid ex-vessel and landings in tons 2000 through 2024 (MLDS).

Although the volume of squid produced by the state's fleet is primarily dependent on the international market, the price paid for landings has influenced fishing effort, volume of squid caught, and size of squid caught. If squid processors reach capacity or supply exceeds demand, effort may decline due to lower economic incentive to fish. In recent years, international demand for market squid has remained constant with occasional size-based limits (Diane Pleschner-Steele, pers. comm.). Crew wages are typically 50% of ex-vessel revenue after operating costs. Light boats are typically paid 20% of the catch value after costs (Lutz and Pendleton 2000).

Most of the revenue in the squid fishery is generated by purse and drum seine fishermen (Table 2-7). Revenue from squid fishing using lampara nets declined 99% from 2.7 million dollars in 1981-1982 to zero dollars in recent years.

Table 2-7. Dollars paid ex-vessel by gear type for market squid fishery from 1981-1982 to 2023-2024 seasons. Note: dollars are not adjusted for inflation (MLDS).

Season	Brail	Purse seine	Drum seine	Lampara	Other	Total Value
1981-82	$784,085	$485,689	--	$2,736,398	$544,990	$4,551,162
1982-83	$220,933	$232,256	--	$2,256,622	$17,260	$2,727,070
1983-84	$9,884	$1,973	--	$88,548	$168,499	$268,905
1984-85	$313,559	$26,941	--	$37,497	$192,358	$570,355
1985-86	$22,772	$1,836,397	--	$755,088	$1,059,659	$3,673,915
1986-87	$46,771	$2,208,225	--	$819,332	$1,109,205	$4,183,532
1987-88	$30,728	$1,831,687	--	$473,646	$867,786	$3,203,847
1988-89	$25,106	$2,621,290	$10,924	$956,279	$1,262,613	$4,876,212
1989-90	$16,809	$1,792,182	$23,630	$168,002	$953,209	$2,953,832
1990-91	$12,810	$2,576,712	--	$109,038	$1,199,802	$3,898,362
1991-92	$5,218	$2,243,108	$2,118	$12,063	$924,899	$3,187,407
1992-93	$5,808	$2,080,155	--	$22,029	$208,549	$2,316,541
1993-94	$68,758	$6,611,752	$441,568	$1,811	$251,916	$7,375,804
1994-95	$280,832	$8,181,704	$5,857,551	$9,658	$338,642	$14,668,386
1995-96	$213,986	$12,327,482	$6,912,266	$45,053	$146,942	$19,645,729
1996-97	$109,399	$16,506,397	$6,901,917	$28,358	$211,777	$23,757,850
1997-98	$17,566	$1,752,117	$870,181	--	$9,137	$2,649,001
1998-99	$97,272	$2,483,404	$1,138,391	--	$725	$3,719,794
1999-00	$260,915	$27,750,936	$8,009,106	$37,693	$26,235	$36,084,885
2000-01	$437,870	$18,146,102	$5,502,793	$17,042	$54,960	$24,158,768
2001-02	$146,345	$11,601,275	$1,691,986	$2,894	$6,040	$13,448,542
2002-03	$33,392.00	$8,369,379	$3,651,143	$119	$3,233	$12,057,268
2004-05	$255,622	$19,888,469	$6,600,510	$96,483	$214,001	$27,055,085
2005-06	$0	$28,783,257	$11,310,135	$25,178	$29,120	$42,335,964
2006-07	$203,937	$13,868,319	$4,626,069	$2,784	$40,426	$18,741,533
2007-08	$529,044	$21,708,163	$7,180,469	$15,047	$226	$29,432,950
2008-09	$145,636	$20,103,331	$7,160,752	$26	$523	$27,410,268
2009-10	$1,509,856	$34,752,417	$11,896,157	$0	$19,905	$48,178,334
2010-11	$1,653,189	$42,556,518	$22,005,745	$1,980	$18,874	$66,236,306
2011-12	$3,307,709	$44,777,948	$19,210,014	$19,066	$2,918	$67,317,655
2012-13	$2,400,491	$45,133,287	$15,193,840	$6,137	$48,617	$62,782,371
2013-14	$2,282,399	$50,960,802	$20,478,753	$0	$15,351	$73,737,304
2014-15	$26,795	$51,368,803	$21,298,309	$6,748	$92,059	$72,792,713
2015-16	$8,332	$15,224,186	$9,252,200	$0	$1,646	$24,486,365
2016-17	$759,874	$28,501,457	$11,358,631	$9,055	$4,970	$40,633,988
2017-18	$994,642	$52,797,856	$19,559,007	$348	$102,915	$73,454,767
2018-19	$762,875	$24,841,341	$7,852,440	$20,093	$41,012	$33,517,762
2019-20	$80,863	$11,902,036	$3,206,836	$0	$12,821	$15,202,556
2020-21	$88,068	$17,573,544	$7,464,312	$0	$892	$25,126,815
2021-22	$1,340,376	$52,913,859	$20,855,574	$0	$8,189	$75,177,998
2022-23	$792,706	$50,145,172	$16,436,809	$0	$6,262	$67,380,949
2023-24*	$1,302,598	$45,147,953	$15,907,465	$0	$27,688	$62,385,703

*Preliminary data.

2.14. Location of the Fishery

The market squid fishery is centered in the nearshore waters off California, though market squid may be available in commercial quantities from British Columbia to Baja, California. Market squid harvest is allowed statewide in all areas defined as ocean water in CCR Title 14 §27.00, except where prohibited or restricted, as specified, in state MPAs and round haul gear closure areas (FGC §8750-8757). California squid landings have occurred at various times from as far south as San Diego and as far north as Eureka, spanning the entire state (Figure 2-10).

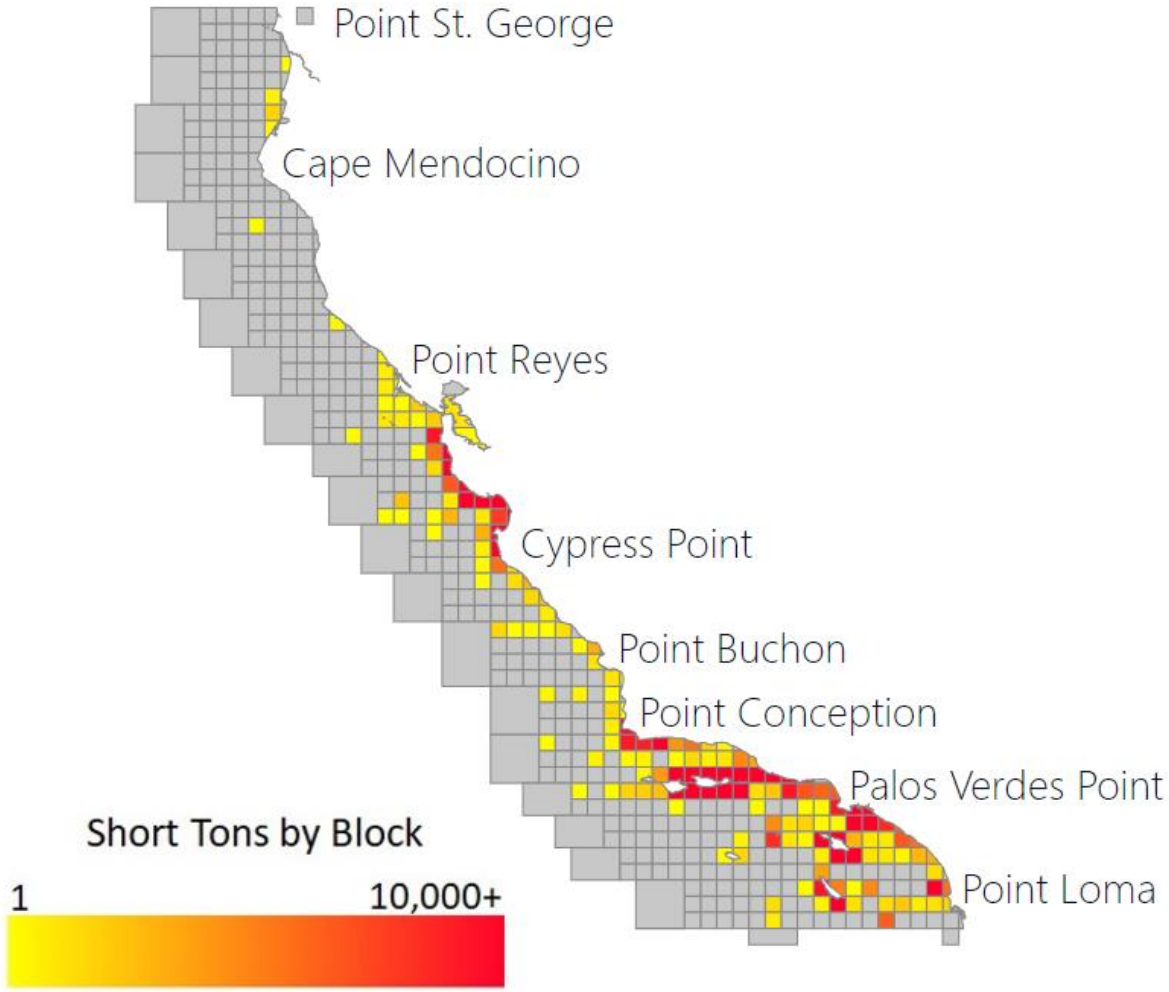

Figure 2-10. Geographic location of major fishing areas in California by CDFW blocks (10' x 10') from 1999 through 2023 (MLDS).

Seasonal shifts in resource availability and timing of peak spawning have produced two distinct fishing areas. Vessel participation is greatest during the late fall and early winter for southern California and during the summer for central California. Summertime fishing effort in central California is focused

around Monterey Bay and tends to occur between April and September, coinciding with the upwelling season (Zeidberg et al. 2006). The southern portion of the fishery encompasses most of the SCB including the northern and southern Channel Islands southward along the coast to La Jolla and is most active from October to February. During this time there is less stratification of the water column and more mixing due to winter storms and colder air temperatures (Zeidberg et al. 2006).

Prior to the 1980s the majority of market squid landings were primarily from Monterey Bay; however, since the 1985-1986 season, the majority of the catch has come from the SCB. Landings spiked dramatically in Monterey Bay area in 2010 and continued through 2014 (Figure 2-6, Table 2-8). Monterey, Ventura, and Los Angeles Counties are the principal counties where squid is offloaded and distributed (Figure 2-11). While some vessels fish near home ports year-round, in general, the fleets' mobility continues to grow. Vessels based out of Monterey will travel south and vessels from Ventura or Los Angeles will also travel north to fish.

Table 2-8. Percent of revenue received by port area complex from 1981-1982 through 2023- 2024 fishing seasons. Note: dollars were not adjusted for inflation (MLDS).

Season	Monterey Area	Santa Barbara/Ventura	Los Angeles	Other Areas
1981-1982	71.8	4.5	23.7	0
1982-1983	84.1	0.1	15.8	0
1983-1984	62.7	3.2	3.3	30.8
1984-1985	32.1	21.5	43.9	2.6
1985-1986	42.9	22.3	34.8	0
1986-1987	30.5	21.2	46	2.2
1987-1988	31.1	34.2	34.2	0.4
1988-1989	23.5	7.3	67.6	1.6
1989-1990	38.9	6.4	54.6	0.1
1990-1991	33.3	31.4	34.5	0.8
1991-1992	27.4	26	35.7	10.8
1992-1993	28.2	33	19.2	19.7
1993-1994	13.7	35.4	39.6	11.2
1994-1995	19.1	55.6	17.8	7.5
1995-1996	2.2	68.4	28.2	1.2
1996-1997	2.2	62.3	35.2	0.3
1997-1998	80.7	16.2	0.7	2.4
1998-1999	0	83.1	16.6	0.3
1999-2000	0.2	68.9	30.8	0
2000-2001	7.7	48.1	44.1	0.1
2001-2002	13.2	35.5	50.7	0.7
2002-2003	54.1	33.7	9.7	2.4

Season	Monterey Area	Santa Barbara/Ventura	Los Angeles	Other Areas
2003-2004	27.3	40.6	25.5	6.6
2004-2005	10.5	74.9	12.5	2.1
2005-2006	2.3	16.3	81.4	0
2006-2007	1.4	65.8	32.8	0.1
2007-2008	0	53.9	46	0.1
2008-2009	1.8	67.7	30.3	0.2
2009-2010	0.7	62	36.9	0.4
2010-2011	16.1	42.6	40.7	0.6
2011-2012	11.3	44.9	43.2	0.6
2012-2013	9.3	29.5	51.7	9.5
2013-2014	13.3	43	34.8	8.9
2014-2015	40.9	30	14.7	14.4
2015-2016	37.2	41.5	2.6	18.7
2016-2017	17.6	42.6	25.3	14.5
2017-2018	10	61.8	23.8	4.4
2018-2019	40.1	37	18.1	4.8
2019-2020	16.1	38.6	40.6	4.7
2020-2021	66.6	6.7	12.3	14.4
2021-2022	31.8	46	17.1	5
2022-2023	5.5	68.6	25.8	0.1
2023-2024*	1.3	44.3	53.2	1.2

*Preliminary data.

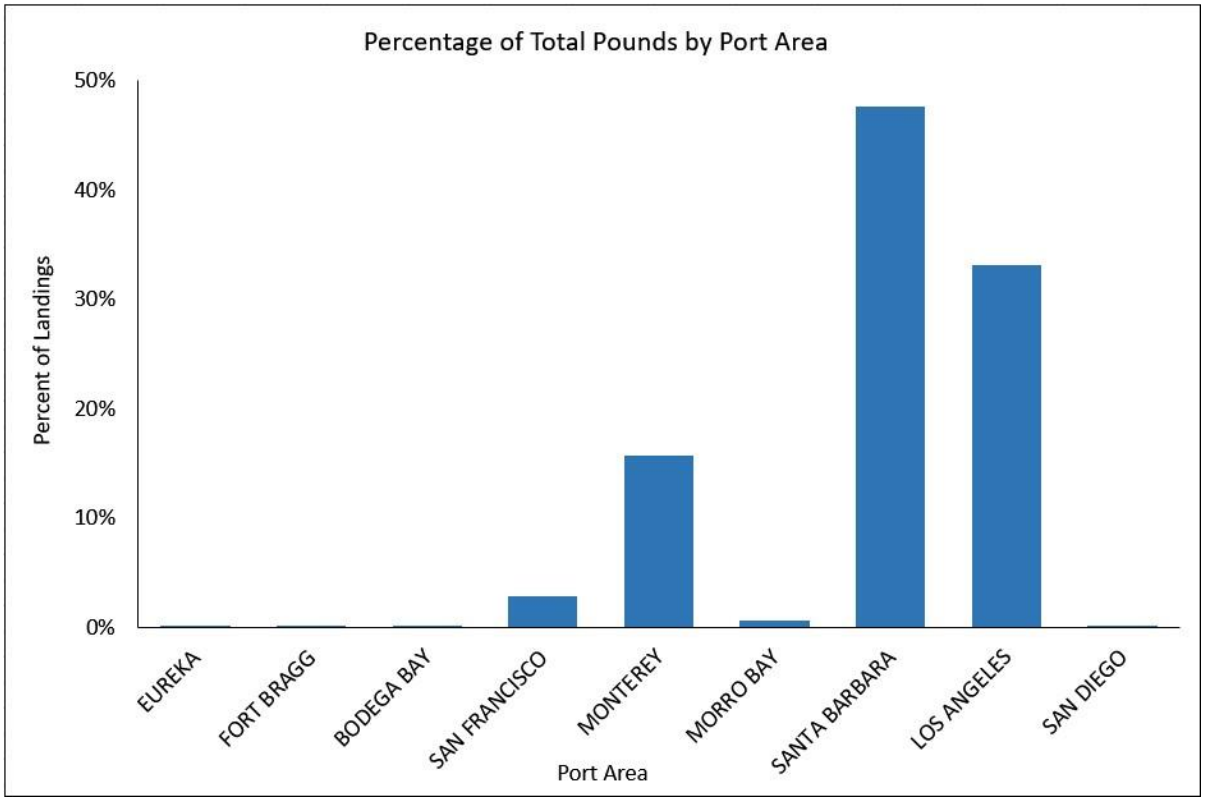

Figure 2-11. Percentage of market squid total landings (by weight) by port complex from 1980 to 2024 (MLDS).

2.15. History of Conservation and Management Measures

2.15.1. State Management

The regulatory history of the commercial market squid fishery by the State of California began with a ban on squid attracting lights in 1959 (Table 2-9). The addition of former FGC §8397 in 1957 prohibited the use of squid attracting lights in the Monterey Bay fishery.

Table 2-9 Summary of market squid regulations from 1959 to the present.

Date	Bill # (Author) / Regulatory Section	Management Action
1959	§8397	It is unlawful to use any artificial light to lure or attract squid in Districts 16 and 17. This section applies to all artificial lights except those lights necessary for the usual operation of a vessel not used to lure or attract, or intended to lure or attract, squid.
1983	AB 513 (Farr)	Authorizes the Commission to adopt regulations specifying the days of the week and times of the day when squid may be taken north of Point Conception.

Date	Bill # (Author) / Regulatory Section	Management Action
1984	CCR Title 14 §149	The Commission adds CCR Title 14 §149, to prohibit any vessel, using or possessing a roundhaul net in Districts 16 and any Monday through Thursday.17, from taking market squid between noon Friday and midnight Sunday and between noon and midnight on
1987	AB 123 (Farr)	Allows the use of lights to attract squid in District 17.
1988	AB 4055 (Farr)	Allows the use of lights to attract squid in District 16.
1989	SB 1080 (Mello)	Allows the use of all roundhaul nets, including purse seine and half-purse seine nets, to take squid in all portions (including the southernmost portion) of 16, subject to the same area and season restrictions previously in effect for lampara nets.
1993	AB 14 (Hauser)	Restricts the use of attracting lights in District 10.
1993	SB 1030 (Thompson)	A landing fee of $0.0019/lb. is imposed.
1997	SB 364 (Sher)	Authorizes the take of market squid north of Pt. Conception between noon on Sunday and noon on Friday. Requires a permit for the take of squid with a dip, purse seine, or lampara net for commercial purposes. Requires a permit to attract squid by light from a vessel. Establishes a fee for a commercial squid Market Squid Light Boat Permit. Allows for transfer of vessel or light boat permits under certain conditions. A three-year moratorium on commercial squid vessel permits is established; the possession of a permit from the previous year is required in order to renew.
1998	AB 1928 (Morrow)	No permit is necessary, nor is a landing fee imposed, for the take of live bait. Drum seines and other roundhaul nets excepted from prohibition of rings along lead line and pursing of net bottoms.
1998	AB 1241 (Keeley)	Marine Life Management Act passes.
2000	CCR Title 14 §149	Amendment – Prohibits commercial take of market squid between noon on Friday and noon on Sunday from Pt. Conception south to the U.S.-Mexico border. Requires commercial squid vessels and light boats to maintain logbooks detailing fishing/lighting activities.
2000	CCR Title 14 §149	Amendment – Vessels fishing or lighting for squid are restricted to using no more than 30,000 watts of light. Each vessel fishing or lighting for squid must shield the entire filament of each light, directing the light downward, or the vessel must keep the illumination completely submerged underwater.
2000	SB 1544 (Sher)	Establishes a $400 fee for a commercial Market Squid Vessel Permit. Extends the sunset date for SB364 to 1 January 2004. Extends existing duties imposed on the Department and the Commission and makes an appropriation.

Date	Bill # (Author) / Regulatory Section	Management Action
2001	SB 209 (Sher)	Requires the Commission to adopt an MSFMP by 31 Dec 2002, after consideration and public hearings. Requires the Commission to establish fees for commercial Market Squid Vessel Permits and commercial Market Squid Light Boat Permits annually commencing April 1, 2003. Prohibits each person who is issued a commercial Market Squid Light Boat Permit from selling, trading or transferring the permit to another person. Provides that specified provisions will become inoperative upon the adoption by the Commission of an MSFMP and the adoption of implementing regulations and will be repealed 6 months thereafter.
2001	CCR Title 14 §149	Proposed regulatory changes establish catch limits in order to protect the squid resource and manage the fishery sustainably; a harvest guideline of 125,000 tons was selected.
2001	Title 14, CCR §159	Market Squid is included under Commercial Fishing for CPS.
2003	Title 14, CCR §1.39	Market Squid is included in CPS under General Provisions and Definitions.
2004	Title 14, CCR §149	Establishes a seasonal (April 1 to March 31 of the following year) catch limit of 118,000 tons (107,047 mt) for commercial catch of Market Squid. Continues closures between 1200 hours (noon) on Friday and 1200 hours (noon) on Sunday of each week from the U.S.-Mexico border to the California-Oregon border. When the commercial fishery is closed, squid may be taken for commercial purposes only incidentally to the take of other target species or for live bait. Prohibits take of Market Squid for commercial purposes using attracting lights in all waters of the Greater Farallones National Marine Sanctuary. This regulation also applies to vessels pursuing squid for live bait purposes. Requires any operator of a commercial market squid vessel or permit holder of any commercial market squid permit to submit an accurate record of his/her squid fishing, lighting, or brailing activities on market squid logbooks provided by the Department, as appropriate to the type of fishing activity. Prohibits attracting squid by light except as authorized by restricted access market squid fishery permits. This regulation does not apply to seine skiffs of a permitted vessel or to vessels pursuing squid for live bait purposes only. Allows incidental take of market squid when fishing for other target species. This volume shall not exceed 2 tons per trip. Prohibits the take of live bait for purposes other than use as live bait or sale as live bait.
2005	Title 14, CCR §149.1	Establishes a market squid fishery RA program.
2005	§149.3, Title 14, CCR	Allows the commission to issue three-Non-Transferable Market Squid Vessel Permits for purposes of developing a squid fishery in areas previously not utilized for squid production.

Date	Bill # (Author) / Regulatory Section	Management Action
2014	§149, Title 14, CCR	Allows incidental take of market squid when fishing for other target species. This volume shall not exceed 2 tons per trip or 10% of the total volume by weight of all fish landed of possessed.
2022	§149.3, Title 14, CCR	Repealed.
2025	Title 14, CCR §149	Amended the original MSFMP to include language requiring a rib line, rope purse line, and extending the weekend closure. Amended market squid regulation to change closure notification from U.S. Coast Guard Channel 16 to wildlife.ca.gov/marine. Reiterated the regulation that weekend closures include any type of lighting for squid.

Processors believed that squid caught with the aid of attracting lights were of poorer quality and smaller in size than those caught without lights. The fishermen also felt that the lights disrupted spawning. Further, banning attracting lights would prevent canneries from harvesting squid directly from their docks. The prohibition on attracting lights was lifted in 1987 for most of Monterey Bay (District 17); in 1988, attracting lights were once again allowed in the Pacific Grove area in Monterey Bay (District 16).

In 1983, the Commission adopted regulations that limited the days of the week and times of day that fishermen could engage in the take of market squid. CCR Title 14, §149 prohibited any vessel, using or possessing a roundhaul net in Monterey, from taking market squid between noon on Friday and midnight on Sunday, and between noon and midnight on any day Monday through Thursday. In 1989, Senate Bill (SB) 1080 (Mello) allowed fishermen to utilize all types of roundhaul nets, including purse and half-purse seine nets, in the take of market squid in the Pacific Grove area (District 16). In 1990, the Commission amended its regulations (CCR Title 14 §149) to allow for the take of squid by roundhaul gear before midnight Monday through Thursday north of a line running 252° magnetic from the Moss Landing Harbor entrance.

In 1993, the market squid landing fee was increased to $0.0019 per pound (SB 1030, Thompson). The same year, Assembly Bill (AB) 14 (Hauser) restricted vessels from the use of squid attracting lights in District 10 (ocean waters of San Mateo, San Francisco, Marin and Sonoma Counties).

Before April 1998, the market squid fishery was largely an unregulated, open access fishery. Because of increasing market interest and rising squid landings, SB 364 (Sher), was passed in 1997. This legislation established a $2,500 permit for market squid vessels and light boats and a three-year

moratorium on entry into the fishery; called for a three-year study of the fishery; and provided for the creation of an SFAC and an SRSC to advise the Department on research and interim measures. Senate Bill 364 also required that the Department present a report on the fishery to the Legislature, with recommendations for a conservation and management plan by April 2001.

In 1998, the MLMA was enacted. In 1999, the Legislature appropriated $5.2 million to implement the MLMA. The MLMA removed from the Legislature the burden of micro-managing fisheries by transferring that oversight role to the Commission and directing several actions, including:

- development of a master plan for implementing the MLMA;
- development of management plans for California state fisheries; and
- development of a plan for dealing with emerging fisheries as they become operational in California.

In 2000, SB 1544 (Sher) was enacted, reducing the market squid permit fee to $400 from $2,500 until April 2003 and extending the sunset date for FGC Article 9.7 to 1 January 2004. When Governor Davis signed SB 1544, he did so to ensure uninterrupted protection and regulations for the squid fishery, but requested that the Legislature, squid fishermen and their representatives as well as other stakeholders "review the appropriateness of the squid permit fee."

In 2000, the Commission adopted interim measures for the market squid fishery under CCR Title 14 §149. The regulations prohibited the commercial take of market squid between noon on Friday and noon on Sunday from Pt. Conception south to the U.S.- Mexico border and required commercial squid vessels and light boats to maintain logbooks detailing fishing/lighting activities. In response to potential negative effects on nesting seabirds of vessels lighting for squid on several of the Channel Islands, the regulations restricted attracting lights to a maximum of 30,000 watts and required that lights be shielded.

In 2001, SB 209 (Sher) was enacted, authorizing the Commission to manage the squid resource and to adopt an MSFMP. Other features of SB 209 included providing that specified provisions will become inoperative upon the adoption by the Commission of an MSFMP and the adoption of implementing regulations and will be repealed 6 months thereafter.

In 2004, the Commission adopted the original MSFMP. The MSFMP was reviewed through an extensive Commission process and was developed under the provisions set forth by California's MLMA. The MSFMP established a management program for California's market squid resource and procedures by which the State manages the market squid fishery. The goals

of the MSFMP A-1 are to manage the market squid resource to ensure long-term conservation and sustainability, reduce the potential for overfishing, and institute a framework for management that is responsive to environmental and socioeconomic changes. The tools implemented to accomplish the original MSFMP goals were:

Fishery control rules, including:

- An SCL to prevent the fishery from over-expanding;
- Weekend closures, which provide for periods of uninterrupted spawning;
- Gear regulations regarding light shields and wattage used to attract squid and;
- Monitoring programs designed to evaluate the impact of the fishery.
- A restricted access program, including provisions for initial entry into the fleet, types of permits, permit fees, and permit transferability that produced a moderately productive and specialized fleet.
- A seabird protection measure restricting the use of attracting lights for commercial purposes in any waters of the Greater Farallones National Marine Sanctuary.

Chapter 3. Management Measures for a Sustainable Market Squid Fishery

3.1. Project Objectives

The MLMA sets sustainability as an overall goal for the fishery management system (FGC §7056). Within the definition of sustainability, the MLMA includes not only the maintenance of the fishery populations, but also the fullest possible range of present and long-term benefits (including ecological benefits), and biological diversity (FGC §99.5). The MLMA calls for achieving its primary goal of sustainability by meeting several objectives:

- preventing overfishing;
- rebuilding depressed stocks;
- ensuring conservation;
- promoting habitat protection and restoration.

FMPs must identify measures that will be used for the conservation and management of the fishery (FGC §7082). Among other measures, the MLMA identifies area and time closures, size limits, gear restrictions, and restricted access. The Department meets the requirements, goals, and objectives of the MSFMP A-1 using management based on four components: 1) fishery control rules, 2) a restricted access program, 3) ecological considerations, and 4) administrative items. The MSFMP A-1 protects the market squid resource and the marine life that depends on squid by minimizing the risk of overfishing, adverse social and economic impacts on the fishing communities whenever possible, and ecological impacts that result from the commercial squid fishery; together the MSFMP A-1 forms an integral approach to meeting MLMA guidelines.

The MSFMP A-1 establishes a fisheries management program for market squid and procedures by which the Commission will manage the market squid resource and various fishery components. In addition, the MSFMP A-1 defines the scope of management authority for the Commission when acting under the MSFMP A-1. Management measures implementing the MSFMP A-1, which directly control fishing activities, must be consistent with the goals and objectives of the MLMA and other applicable laws. Also, management measures must be consistent with federal management requirements in the CPS FMP. Management actions are to be considered repeatedly within the streamlined process that provides for more timely Commission action under certain specific conditions. Procedures in this FMP do not affect the authority of the Director of the Department to take emergency regulatory action under FGC §7710.

3.1.1. Fishery Control Rules

Fishery control rules provide a protocol for managing sustainable levels of market squid fishing that is enforced through the adoption of specific regulatory tools such as an SCL, gear restrictions, weekend closures, and sustainable levels of egg escapement. The MLMA concept of adaptive management is particularly relevant to the fishery because information regarding the biology of market squid is limited, and no reliable estimate of market squid abundance is available. Control rules established in the MSFMP A-1 include:

- **Seasonal Statewide Catch Limitation** – Maintain an SCL based on recent average catch and the assumption that squid biomass is above average spawning biomass (currently set at 118,000 tons).
- **Weekend Closures** – Full fishery closures from 0700 Friday to noon Sunday from the U.S.-Mexico border to the California-Oregon border with an extended closure from noon to midnight Sunday in the Monterey Bay area (a line due west from Point Lobos (36° 31.461' North Latitude) to a line due west from Pigeon Point (37 ° 11.000' North Latitude)).
- **Monitoring Program** - Continue existing squid monitoring programs (biological sampling and fishery logbooks). Support the development of an electronic logbook (e-log) for the California market squid commercial fishery.
- **Live Bait Fishery and Incidental Catch of Market Squid** – An exemption from the squid fishery permit requirement when fishing for live bait or incidental take two tons or less.
- **Gear Restrictions** –
    - Limit the total squid light wattage to 30,000 watts.
    - Require that squid lights reduce light scatter by shielding the entire light emitting portion of each light used to attract squid and orient the illumination directly downward so that the lower edge of the shield is parallel to the deck of the vessel.
    - Require that any purse seine used to take squid or onboard a vessel possessing squid be fitted with and pursed with a soft (non-metallic) rib line.

3.1.2. Restricted Access Program

The MSFMP A-1 restricts access to the fishery based upon the MLMA and the Commission's restricted access policy, along with the established capacity goal (the optimum number of vessels in the fleet that will promote resource sustainability and economic viability of the fishery), and transferability conditions for the commercial market squid fishery.

3.1.3. Ecological Considerations

The market squid fishery is part of a larger ecosystem that includes the effects of ecological interactions of the project on non-target species and habitat. In addition, the market squid resource is a significant forage component in the diets of seabirds, marine mammals, and fish. Harvest replenishment and general habitat closure areas provide for specific areas where no squid fishing can occur. Harvest replenishment areas can provide areas of uninterrupted spawning. General habitat closures are intended to prevent squid fishery interactions in areas that have not been traditionally utilized for commercial squid fishing and where there is the potential for interactions with non-target species such as salmon, seabirds, and marine mammals. Gear restrictions, including the use of a rib line, are implemented in order to reduce impact to squid egg beds. Seabird closure areas reduce the potential for interactions between the squid fishery and seabirds that are sensitive to disturbance from lights and noise.

3.1.4. Administrative Items

This category contains items that are administrative in nature to the MSFMP A-1, namely the creation of a squid advisory committee.

3.2. Fishery Control Rules

3.2.1. Definition of Maximum Sustainable Yield and Optimum Yield

Fishery control rules are the primary mechanism for achieving sustainable use, preventing overfishing, preserving habitat, rebuilding depressed stocks, and recognizing the importance of non-consumptive uses. In addition, control rules must be based on objective, measurable criteria such as population size, productivity, density, or other inputs. Formulas are often used to calculate an allowable catch (fishing mortality); however, control rules do not have to be cast in terms of fishing mortality rates or biomass levels. In general, fishery control rules help identify key management measures appropriate to the fishery.

The MLMA defines MSY as "the highest average yield over time that does not result in a continuing reduction in stock abundance, taking into account fluctuations in abundance and environmental variability" (FGC §96.5). The MSY model determines catch limits, which most often are expressed as a fixed fishing rate such that a constant fraction of the stock may be harvested each year. It is specific for each species or stock of fish and is calculated from knowledge of abundance, life history, and population dynamics. Environmental factors are also considered since they affect growth, reproduction, and mortality rates. In many cases, providing a range of

estimates for MSY may be reasonable since there are different assumptions in the model. In addition, scientific information may be inadequate to directly calculate MSY for a particular species, and a proxy or substitute is used. For example, recent average catch may be used as a proxy for MSY if a period is chosen when there is no evidence of long-term declining abundance.

The MLMA additionally defines Optimum Yield (OY) to give specific direction for resource managers:

"Optimum yield, with regard to a marine fishery, means the amount of fish taken in a fishery that does all of the following: (a) provides the greatest benefit to the people of California, particularly with respect to food production and recreational opportunities, and takes into account the protection of marine ecosystems; (b) is the maximum sustainable yield of the fishery, reduced by relevant economic, social, or ecological factors; (c) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing maximum sustainable yield in the fishery" (FGC §97).

It is not uncommon that the status of knowledge for a given stock is limited to the catch history and incomplete life history information. This fact is acknowledged by the Legislature in both the MLMA [see FGC §90.1, 7056(g), 7059, 7060, 7072(b), 7073(b) 7081] and in the squid statutes [see FGC §8420(b), 8426(c)]. A precautionary approach to calculating OY in data-moderate or data-poor situations is to multiply MSY, or its proxy, by a fraction. A tenet of this principle is that less aggressive (more restrictive) harvest policies are adopted as uncertainty increases concerning the status of stocks and the stock's response to fishing pressure (Restrepo et al. 1998). And, as mentioned above, an alternative approach is to select a proxy when information needed to calculate MSY is lacking.

3.2.2. Proxy for MSY and Precautionary OY

MSY is not always calculatable for data limited fisheries or for species with a natural mortality of one year or less. Restrepo et al. (1998) provided an alternative approach for federal fisheries management, and the State used a variant of the Restrepo approach in the regulations for the market squid fishery.

A proxy for MSY is calculated when MSY-related parameters cannot be estimated from available data or when estimated values are deemed unreliable for various reasons (e.g., extremely low precision, insufficient contrast in the data, or inadequate models). The proxy for MSY in data-poor and data-moderate situations is based on the historical average catch, selecting a period when abundance is not declining. A proxy for OY is then determined by reducing the proxy MSY by a percentage that can vary

depending on the amount of information available. As uncertainty decreases about the status of stocks and their response to fishing pressure, less precautionary management can be adopted. This approach to risk management reduces the chance of inadvertent overfishing when little is known about the status of a stock.

No definitions or standards for measuring the level of data richness exists for a fishery other than the general guidance provided in Restrepo et al. (1998), although it is important to remember the guidelines were established for fish that are considered long-lived in comparison with the market squid, which only live less than one year:

- Data-rich cases: Reliable estimates of MSY-related quantities and current stock size are available. Stock assessments may be sophisticated, and provide a reasonably complete accounting of uncertainty;
- Data-moderate cases: Reliable estimates of MSY-related quantities are either unavailable or of limited use due to peculiar life history, poor data contrast, or high recruitment variability, but reliable estimates of current stock size and all critical life history (e.g., growth) and fishery (e.g., selectivity) parameters are available. Stock assessments may range from simple to sophisticated and uncertainty can be reasonably characterized and quantified;
- Data-poor cases: Reliable estimates of MSY-related quantities are unavailable, as are reliable estimates of either current stock size or certain critical life history or fishery parameters. Stock assessments are minimal, and measurements of uncertainty may be qualitative rather than quantitative.

3.2.3. Seasonal Catch Limitation

3.2.3.1. A Proxy for MSY Based on Historical Landings

Guidance taken from NOAA Fisheries (Restrepo et al. 1998) propose that for species such as market squid, a proxy may be used for MSY, and to use recent average catch from a period when no qualitative or quantitative evidence of declining abundance was observed.

El Niño events are a recurring phenomenon of the CCE and thus, are a factor in landings when considering MSY. Historic market squid data indicate that low landing periods correspond with El Niño events when availability of squid to the fishery is greatly reduced. In addition, market conditions are volatile and influenced by the international demand and availability of supply from other fisheries. Demand for California market squid from the Republic of China during the period between the 1993-1994 and 1997-1998 El Niño events

increased significantly, a situation that kindled rapid development of fishing and expansion of processing for export. The expansion ended with the onset of the1997-1998 El Niño event during which market squid availability dropped to very low levels and landings declined.

The first fishing season (1999-2000) following the 1997-1998 El Niño event resulted in the highest squid landings on record (Table 3-1). Nearly all of the landings were from the southern California fishery (99.7%); landings reported from the northern fishery were minimal (0.3%). The disparity between southern and northern landings was not predicted given the understanding of the market squid fishery at the time, nor by utilizing temperature inclusive models. Average landings from 1991 to 2003, used as the proxy for market squid MSY, are presented in Table 3-1.

Table 3-1. Market Squid landings by season, 1991-1992 through 2002-2003 and average landings based on 10, 5, or 3 years using different seasons. Averages are rounded to the nearest thousand.

Season	Total landings (tons)	10-yr Avg. ('93-'94 to '02-'03)	5-yr Avg. ('98-'99 to '02-'03)	3-yr Avg. ('00-'01 to '02-'03)	10-yr Avg. ('92-'93 to '01-'02)	5-yr Avg. ('97-'98 to '01-'02)	3-yr Avg. ('99-'00 to '01-'02)
1991-1992	38,666	--	--	--	--	--	--
1992-1993	18,793	--	--	--	18,793	--	--
1993-1994	54,452	54,452	--	--	54,452	--	--
1994-1995	63,592	63,592	--	--	63,592	--	--
1995-1996	93,833	93,833	--	--	93,833	--	--
1996-1997	124,309	124,309	--	--	124,309	--	--
1997-1998	10,898	10,898	--	--	10,898	10,898	--
1998-1999	11,699	11,699	11,699	--	11,699	11,699	--
1999-2000	126,772	126,772	126,772	--	126,772	126,772	126,772
2000-2001	123,411	123,411	123,411	123,411	123,411	123,411	123,411
2001-2002	102,715	102,715	102,715	102,715	102,715	102,715	102,715
2002-2003	46,994	46,994	46,994	46,994	--	--	--
Average (rounded)	**68,000**	**76,000**	**82,000**	**91,000**	**73,000**	**75,000**	**118,000**

3.2.3.2. Establishment of a Seasonal Catch Limitation

The Commission established a statewide SCL using a 3-year average catch from the 1999-2000 to 2001-2002 fishing seasons (Table 3-1). The seasonal catch limitation assumed that the stock was above the average spawning biomass (B_{MSY}) and used a precautionary multiplier of 1.0. The SCL is currently set at 118,000 tons.

The ability of the market squid fishery to support landings of greater than 100,000 tons in the 1999-2000 season with repeat landings of the same magnitude in the following two seasons suggests that the stock is robust enough to withstand the level of landings. This is likely due to the semiannual lifespan and the presence of several (minimum seven) cohorts throughout the year. A multiplier of 1.0 was chosen to be most appropriate for market squid as opposed to more precautionary OY multipliers since traditional assessment methods are normally used for much longer-lived fish species.

Setting an SCL serves to curtail growth of the fishery, should market demand allow for such expansion. It is prudent not to allow landings to expand beyond present levels without better methods to assess the status of the resource.

3.2.3.3. The Use of Egg Escapement as a Proxy for MSY

As was mentioned above, no biomass estimate exists for market squid, nor is it possible to define an overfished condition for the species. It is important to recognize that setting an actual MSY for market squid is impractical for the squid fishery because the species is short-lived, and landings are strongly influenced by market demand rather than effort. Overfishing is defined as harvests of squid are occurring at times when either the egg escapement threshold is not being met, or that catches are exceeding specified allowable levels that may not be sustainable.

Consequently, the egg escapement method will also be used as a proxy for MSY/OY. The egg escapement method of assessing fishery impacts to the squid resource is identified in Amendment 10 of the Federal CPS FMP (PFMC 2002) and brings the state in compliance with federal regulations. The egg escapement method of regulating the fishery relies on the Department to monitor the squid fishery at an appropriate level to collect adequate biological information. The egg escapement model, as a proxy for MSY, was intended to be a temporary measure until an acceptable biomass estimate can be determined for market squid. Since an accurate biomass estimate cannot be determined for market squid, agencies will continue to utilize and improve the egg escapement method.

3.2.4. Weekend Closure for Commercial Market Squid Fishery

The current weekend closure begins noon Friday and continues through noon Sunday from the U.S.-Mexico border to the California-Oregon border. The weekend closure allows for two days of uninterrupted spawning in areas where squid are harvested. The closure provides protection to the resource

by allowing spawning to occur and egg cases to be deposited without disturbance from the fishery. The use of attracting lights is not allowed during the weekend closures for commercial harvest per CCR Title 14 §149, with an exception for vessels actively engaged in the commercial take of squid for sale as live bait. Unlike a seasonal quota or closure, a weekend closure spreads the spawning escapement throughout the year, rather than concentrating spawning escapement during one particular period. Furthermore, without the ability to establish a biomass estimate for squid and the fact that landings scale with effort, temporal closures that allow uninterrupted spawning (i.e., the weekend closure) as opposed to catch controls (i.e., SCL or daily catch limits) are considered more effective when squid abundance is low.

Prohibiting fishing activity on weekends may also help alleviate conflict with other interest groups (e.g., divers, recreational fishermen, commercial passenger fishing vessels), allows for other activities operating in the same area, and reduces potential disturbance to seabirds.

In 2021, a petition was submitted to the Commission requesting a weekend closure extension and incorporation of half-day closures on weekdays in the Monterey Bay area. The rationale for the proposed change was the concern that increased fishing pressure in the Monterey Bay area was not allowing enough time for squid to spawn. The petition was referred to the SFAC process.

Extension of the weekend closure was discussed during the 2023-2024 SFAC process. After review of Empirical Dynamic Modeling (EDM) results, monitoring data, and feedback from the SFAC, an extension to the front end of the weekend closure Statewide and an extended Sunday closure in the Monterey Bay area was recommended. The extended closure provides an added buffer for sustainability, is unlikely to negatively impact overall yields, and is enforceable.

The exemption for lighting on the weekend when taking market squid as live bait was amended to make the provision clearer and more enforceable. The change is intended to ensure vessels do not use lights for other purposes, while claiming to be engaged in the take of live bait. The amendment clarifies that lighting on the weekend is only allowed when actively taking market squid for live bait. Revisions to the regulation specify that live market squid must be kept in a condition to be sold as live bait and returned to the water if it is not sold as live bait. Also, vessels engaged in the take of market

squid for live bait must notify the Department in advance, to indicate their intent to take live bait during a weekend closure.

3.2.5. Monitoring Programs

Commercial fisheries landings data, collected since 1969, are now submitted by fish businesses through electronic fish tickets (E-tix). A separate market squid fishery logbook program includes effort and location information submitted on paper logs by vessel operators. A dockside sampling time series began in 1998. Department staff monitor offloads at the docks and subsample squid for processing in a laboratory. The dockside sampling program supports bycatch monitoring and provides inputs for the egg escapement modelling as a measure of relative spawning potential over time.

3.2.6. Live Bait Fishery and Incidental Catch of Market Squid

The Commission decided not to require a Market Squid Vessel Permit when fishing for live bait or when landing or taking market squid less than two tons incidentally in any calendar day. Market squid are an important source of live bait for the California recreational fishing industry. A relatively small volume is taken by the live bait industry using brail, lampara, or drum seine gear. This fishery is a high value use of squid, supplying bait to recreational fisheries along the West Coast, primarily in southern California. Live bait catch, largely dependent on local availability, is sold by vessels either at sea or at live bait dealerships in several harbors statewide. Since the sale of live bait in California was not previously documented in a manner similar to that used for the commercial landings of squid, accurate estimates of tonnage and value are not available. Some operators record scooping live squid for sale as bait in market squid logbooks. Since 2019, reporting requirements to submit landing receipts has provided data on live bait catch.

Because squid frequently school with CPS finfish, mixed landings of market squid and CPS finfish are common. With an SCL in place, once the catch limit is reached, an allowance for incidental catch of market squid from other commercial fisheries is needed and would prevent squid from being discarded.

3.2.7. Gear Restrictions

The Commission chose to maintain lighting restrictions, which state that each vessel fishing for squid or lighting for squid will utilize a total of no more than 30,000 watts of light to attract squid at any time. As part of those restrictions, each vessel fishing for squid or lighting for squid will reduce the light scatter of its fishing operations by shielding the entire filament or device capable of

emitting light for each light used to attract squid and orient the illumination directly downward or provide for the illumination to be completely below the surface of the water.

In addition, the Commission chose to modify existing shielding regulations to require that the lower edges of the shield be parallel to the deck of the vessel to provide the maximum shielding possible to reduce impacts to seabird or coastal communities. Since light shields are currently required, there would not be any significant change in net economic benefits and fishery community economic activities while reducing impacts to seabirds and coastal communities.

Department data show nets are at times interacting with bottom habitats, egg beds, benthic species, and prohibited species. As a result, the Department determined it prudent to consider additional measures as guided by the MLMA to minimize adverse effects on habitat caused by fishing. A rib line creates a "ribbing" or additional webbing between the leadline and the purse line. When contacting the bottom, this causes the net to flutter or bounce as opposed to dragging. The rib line is intended to reduce the likelihood of pursing benthic bycatch, including squid eggs, and to reduce the impact on the sandy bottom habitat, while also preserving the integrity of and preventing damage to the net. Observations of squid eggs in the offloads were roughly half as likely when vessels had a rib line.

3.2.8. Restricted Access (Limited Entry) Program

The goal of the limited entry program was to produce a moderately productive and specialized fleet. Limited entry programs are designed to match fishing effort with the sustainability of the resource and to address economic issues associated with excess harvest capacity in open access fisheries. Specifically, the Commission's purposes for restricting access or entry to a fishery are described as: (1) promote sustainable fisheries; (2) provide for an orderly fishery; (3) promote conservation among fishery participants; and (4) maintain the long-term economic viability of fisheries. Fisheries characterized by excess harvesting capacity are described as overcapitalized in terms of the number of vessels and the amount of gear and equipment devoted to harvesting. If the fishery becomes overcapitalized, harvesting costs increase while catches remain the same. This situation represents an economically inefficient use of society's productive resources and causes several problems for managers and the fishing industry when abundance and demand decline, and catches are reduced. At the time of its conception, the limited entry program for the market squid fishery was widely supported by most members of the SFAC, the

SRSC, and other squid fishing industry and conservation groups, with some processors and fishermen in opposition.

The fleet size in 2005 was 165 squid vessels and 40 light boats. Eligibility was determined after purchase of a permit in the initial 1998-1999 season. Any licensed individual could participate during this initial year if the fisherman presented evidence that he or she had been a licensed California commercial fisherman for at least 20 years and had participated in the market squid fishery. There were three components to the Commission's policy to determine qualification: (1) initiating the program would not increase the recent level of fishing effort, (2) initial issuance of permits would only be to the current owners of qualifying vessels and, (3) to meet the needs of a fishery, it may be desirable to modify the approach of giving permits to current owners of qualifying vessels.

3.2.8.1. Scope of the Market Squid Limited Entry Program

Vessels landing less than two tons of squid incidentally on a per trip basis will not be required to possess a limited entry permit. Additionally, landing of squid beyond the jurisdiction of the state of California will not be affected by any limited entry requirements. Recreational fishing for squid will not require a limited entry permit, nor does fishing for squid for use as live bait.

Five major squid fishery permit categories have been established: 1) transferable market squid vessel owner permits, 2) non-transferable market squid vessel owner permits, 3) transferable Market Squid Brail Permits, 4) non-transferable Market Squid Brail Permits, and 5) Market Squid Light Boat Permits.

Any vessel engaged in taking squid, landing squid, or attracting squid by light for commercial purposes must have a valid market squid permit. Vessels taking squid for live bait purposes only are exempt from the permit requirements (§149, Title 14, CCR). Market Squid Transferable Vessel Permits are transferable to vessels of comparable capacity (within 10%). These permits can also transfer to a vessel of larger capacity under a "two for one" permit retirement. Market Squid Brail Permits are transferable based on comparable capacity (within 10%). Transferable Market Squid Light Boat Permits are transferable, and permit holders can upgrade to a transferable Market Squid Brail Permit on a "one for one" permit retirement.

3.2.9. Capacity Goal

As directed under the MSFMP A-1 limited entry program, the Commission adopted a vessel-based capacity goal of 55 Market Squid Vessel Permits, 34

Market Squid Light Boat Permits, and 18 Market Squid Brail Permits, with the intent for non-transferable permits to decline through attrition.

The Commission initially adopted the following transfer criteria:

- Establish full transferability of Market Squid Vessel Permits based on comparable capacity (within 10%).
- Establish transferability of Market Squid Vessel Permits to a vessel of larger capacity (greater than 10%) under a "2 for 1" permit retirement – this option will allow vessel owners to increase their vessel capacity by transferring their permit to a replacement boat and surrendering one additional permit. Permit holders wishing to increase their current capacity by more than 10% must acquire another Market Squid Vessel Permit and surrender it to the Department for retirement.
- Once the capacity goal has been achieved, individuals wishing to gain entry into the fishery must secure two permits: one permit must be surrendered to the Department for retirement and one permit would be issued to a vessel of comparable capacity. Market Squid Light Boat Permits cannot be used to secure a Market Squid Vessel Permit.

For Market Squid Vessel Permits, the adopted project establishes transferability of these permits to a vessel of comparable capacity, within 10%. This gives the permit holder some flexibility when another vessel is required, because it is often difficult to find exact matches in capacity and provides fishermen who wish to retire the opportunity to sell their boat and/or permit to new participants. Additionally, the adopted project allows upgrades via transfer to vessels of larger capacity under specified conditions. Using a "2 for 1" permit retirement system, those in the fleet wishing to increase their catching capacity may do so while simultaneously generating a net loss in overall capacity of the fleet, which will aid in achieving the capacity goal.

For Market Squid Brail Permits, the Commission adopted full transferability of these permits (See 2005 MSFMP, Option L.3) based on comparable capacity (within 10%). The Commission also decided to establish full transferability of Market Squid Light Boat Permits. This was allowed only if the initial number of permits issued is equal to or less than the capacity goal.

On 22 March 2005, the Commission sent notice of a change in the original proposed language for upgrading a Market Squid Light Boat Permit to a transferable brail permit. The original language stated that a light boat permit holder may exchange 2 light boat owner permits for one Market Squid Brail Permit. The change reflects the Commission's decision to allow the holder of a transferable Market Squid Light Boat Permit to upgrade that

permit to a Transferable Market Squid Brail Permit, without the surrender of any additional permits (one-for-one upgrade).

3.2.10. Permit Fees

The adopted project required that an appropriate annual fee for market squid vessel, market squid brail, and Market Squid Light Boat Permits be established to: 1) cover the cost of squid research and management programs; and 2) provide adequate monitoring and implementation of a limited entry program (Table 3-2). Revenue is also generated from fees levied on squid landings ($3.80 per ton) this source of funding is variable and dependent entirely on the success of the fishery year-to-year. Any permit fee established needs to be reevaluated periodically.

Table 3-2. Annual permits fees and transfer fees as of April 2024 (Reproduced from California Commercial Fishing Regulations Digest, CDFW 2024b).

Permit Type	**Fee**
Market Squid Vessel (Transferable)	$3,636.00
Market Squid Vessel (Non-Transferable)	$1,822.25
Market Squid Brail (Transferable)	$3,636.00
Market Squid Light Boat (Transferable)	$1,096.00
Market Squid Light Boat (Non-Transferable)	$72.36
Market Squid Transfer Fee	$500.00
Market Squid Brail (Upgrade from light boat)	$1,500.00

Initial annual permit fees and transfer fees established by the original MSFMP in March 2005 (CDFG 2005) were: Market Squid Vessel Permit – Transferable = $2,000 Market Squid Vessel Permit – Non-Transferable = $1,000 Market Squid Brail Permit – Transferable = $2,000 Market Squid Brail Permit – Non-Transferable = $1,000 Market Squid Light Boat Permit - Transferable = $600

3.2.10.1. Permit Transfer Fees

The Commission chose to set the permit transfer fee at $500. The adopted project established an appropriate fee to transfer market squid vessel, market squid brail, and Market Squid Light Boat Permits to assist with transfer administrative costs. The permit upgrade fee from a transferable light boat permit to a transferable brail permit, with the surrender of the light boat permit, is $1500.

3.2.11. Experimental Market Squid Vessel Permits

In 2005, the Commission established 3 experimental market squid vessel non-transferable permits, which allowed the Commission to issue 3 non-transferable Market Squid Vessel Permits to any individual for placement on any vessel for purposes of developing a squid fishery in areas previously not utilized for squid production. Individuals issued permits pursuant to this section were required to adhere to all commercial squid fishing regulations in CCR Title 14 §149, and all terms and conditions for permits defined in CCR Title 14 §149.1, excepting initial issuance criteria defined in CCR Title 14 §149.1(c). These permits counted toward the capacity goal. In 2021, CCR Title 14 §149.3 was repealed in conjunction with of a newly created program for experimental fishing permits (EFP).

Individuals interested in pursuing small-scale opportunities should utilize the EFP program that was established in 2022. The Department will work with potential EFP applicants to develop EFPs that would allow for limited small-scale fishery opportunities outside the primary commercial fishing areas and not to compete with the existing limited entry program, and to allow for testing for the viability and enforceability of small-scale commercial fishing.

3.3. Ecological Considerations

As part of the 1997 legislation enacted to protect the market squid resource, the Department was directed to determine where there are areas, if any, that should be declared harvest replenishment areas for market squid where the taking of squid would not be permitted. Harvest replenishment areas for market squid would serve to:

- protect spawning habitat,
- function as forage reserves,
- offer protection against bycatch and fishery interactions, and
- provide areas of uninterrupted spawning for market squid.

In October 2002, the Commission designated 12 new MPAs at the northern Channel Islands (three of which replace existing reserves at Anacapa, Santa Barbara and San Miguel islands). These areas include known commercial squid fishing sites at Santa Barbara, Anacapa, Santa Cruz, and Santa Rosa islands. In addition to the closures at the Northern Channel Islands, commercial fishermen are not allowed to fish in state-designated ecological reserves using roundhaul nets. Several existing reserves are known to be market squid spawning sites (e.g., Carmel Bay Ecological Reserve, Point Lobos Ecological Reserve, northeast side of Santa Catalina Island and Santa Monica Bay); all serve as harvest replenishment areas for market squid. Also,

based on the large geographic range (Baja California north to Alaska) of market squid, there is an abundance of areas where squid are not fished. The MPAs and ecological reserves meet all of the goals of a harvest replenishment area. Marine protected areas have multiple uses, including 1) providing a buffer for species against the effects of environmental fluctuations and management uncertainties, 2) protecting specific areas or species from overexploitation, or 3) reducing user conflict.

The market squid resource is also important to the recreational fishery. Further, market squid is a significant component in the diets of numerous seabirds, marine mammals, and fish. The MPAs and ecological reserves will function as forage reserves for the many species that consume market squid.

Several seabird species are the focus of squid fishery interactions with seabirds, including: the federally and State-listed endangered and fully protected California brown pelican (*Pelecanus occidentalis*), State-listed threatened Guadalupe murrelet (*Synthliboramphus hypoleucus*) and Scripps's murrelet (Synthliboramphus scrippsi), and Department species of special concern (SSC) ashy storm-petrel (*Oceanodroma homochroa*).

In total, there are 15 seabird species that breed on Santa Barbara, Anacapa and San Miguel islands (including two endangered species, one threatened species and five SSC) while 12 seabird species breed at the Farallon Islands (including four SSC) (Table 3-3 and 3-4). In addition to these nesting species, there are numerous other species associated with State waters that forage near these islands.

Table 3-3 Diurnal seabird species that breed (indicated by an X) in the Channel Islands and the Farallon Islands. ANA= Anacapa, SBI= Santa Barbara, SMI= San Miguel, SRI= Santa Rosa, SCR= Santa Cruz, CAT= Santa Catalina, SCL= San Clemente, SNI= San Nicolas. R= Roost site.

Diurnal Species	**ANA**	**SBI**	**SMI**	**SRI**	**SCR**	**CAT**	**SCL**	**SNI**	**Farallon Is.**
California Brown Pelican*	X	X	R	--	R	--	R	R	--
Double-Crested Cormorant**	X	X	X	--	--	--	--	X	X
Brandt's Cormorant	X	X	X	X	X	--	X	X	X
Pelagic Cormorant	X	X	X	X	X	--	--	--	X
Western Gull	X	X	X	X	X	X	X	X	X
Pigeon Guillemot	X	X	X	X	X	--	--	--	X
Tufted Puffin**	--	--	X	--	--	--	--	--	X
Western Snowy Plover ǂ, **	--	--	-x	X	--	--	--	--	--
Black Oystercatcher	X	X	X	X	X	--	X	X	X
Common Murre	--	--	--	--	--	--	--	--	X

*Federally and State listed as endangered
** Department Species of Special Concern (SSC)
ǂ Federally listed as threatened

Table 3-4 Nocturnal seabird species that breed (indicated by an X) in the Channel Islands and the Farallon Islands. ANA= Anacapa, SBI= Santa Barbara, SMI= San Miguel, SRI= Santa Rosa, SCR= Santa Cruz, CAT= Santa Catalina, SCL= San Clemente, SNI= San Nicolas. P= probable nesting.

Nocturnal Species	ANA	SBI	SMI	SRI	SCR	CAT	SCL	SNI	Farallon Is.
Ashy Storm-Petrel**	P	X	X	--	X	X	X	--	X
Black Storm-Petrel**	--	X	X	--	--	X	X	--	--
Leach's Storm-Petrel	--	X	X	--	--	--	--	--	X
Guadalupe Murrelet**, ***	--	X	--	--	--	--	X	--	--
Scripp's murrelet	X	X	X	--	X	X	X	--	--
Rhinoceros Auklet**	--	--	X	--	--	--	--	--	X
Cassin's Auklet	X	X	X	--	X	--	--	--	X

** Department Species of Special Concern
*** State listed as threatened

3.3.1. Area and Time Closures to Address Seabird Issues

The Commission established an area closure to squid fishing with the use of attracting lights in the Greater Farallones National Marine Sanctuary with boundaries defined as of 27 August 2004. This would protect not only the seabirds that breed and rear on the Farallon Islands, but also protect a large forage area (3,250 km^2) in the waters surrounding the islands from light disturbance and interactions with squid vessels.

Under this option, noise associated with squid fishing activities has the potential to cause disturbances to seabirds.

The Department, with support from the SFAC, has developed a draft Fishery "Best Practices" document to be distributed to all commercial squid fishery participants. The Department will continue to collaborate with researchers to evaluate potential wildlife interactions (primarily nocturnal seabirds at the Channel Islands National Park) using squid fishery log data. The Best Practices document includes precautionary conservation measures that squid fishing vessels should implement near shorelines and in sensitive bird nesting regions. Evaluations of interactions will use long-term monitoring to inform potential wildlife interactions.

3.4. Administrative Items

3.4.1. Advisory Committee for Squid Fishery

The Commission in its adoption of §53.02 to Title 14, CCR established that the Director may create an advisory committee to assist the Department with development and review of fishery assessments, management options and proposals, and Plan amendments. This squid fishery advisory committee shall be comprised of industry, science, and environmental community members.

The committee will assist the Department by providing recommendations regarding the effectiveness of adopted squid management.

Chapter 4. Research to Support the Market Squid Fishery Management Plan

At the core of the MLMA is the principle of basing decisions on best available scientific information as well as other information that the Department and Commission possess [FGC §7050(b)(6)]. The MLMA includes, as a broad objective, promotion of marine ecosystem research that will enable better management decisions [FGC §7050(b)(5)]. Within the general policy on science and living marine resources, the MLMA establishes specific policies for the management of marine fisheries. Generally, fishery management decisions are to be based on best available scientific or other relevant information readily available, including what the MLMA calls EFI.

The MLMA defines EFI, with regard to a marine fishery, as information about fish life history and habitat requirements, the status and trends of fish populations, fishing effort, and catch levels, fishery effects on fish age structure and on other living marine resources and users. The MLMA calls upon the Department to collect EFI for all marine fisheries managed by the State in cooperation with participants in the fishery [FGC §7060(a)(b)]. To foster improvements in the management of individual fisheries, the MLMA requires that fishery management plans include research protocols that identify critical information gaps and the steps that will be taken to close gaps [FGC §7081].

Protocols are to describe the following:

- Past and current monitoring of the fishery;
- EFI, such as age structure of a population and spawning season, and other relevant information; and
- Plans for additional monitoring and research needed to acquire EFI.

The MLMA provides an opportunity for fishermen, scientists, fishery managers, conservationists, and others to develop a system for obtaining the information needed to manage our living marine resources.

Although much biological information has been gathered on market squid in the past 50 years, EFI is lacking in many areas for the species. Future research should be directed toward acquiring EFI and involving collaborative efforts of the fishing industry (both commercial and recreational) and qualified university or private fisheries research institutions. In accordance with MLMA, chapter 4 describes fishery research protocols designed to advance the MSFMP A-1. Additionally, chapter 4 identifies gaps in the current knowledge of market squid stocks and the fishery, and the steps needed to obtain

information for implementation to be successful. Chapter 4 describes a research plan that is designed to incorporate the goals of the MLMA with the objectives for the management of the California market squid fishery.

4.1. Past and Ongoing Monitoring of the Commercial Fishery

4.1.1. Sustainable Fishery Control Rules

Monitoring total market squid landings is necessary to ensure established limits are maintained. Fishery control rules determine levels for take and upper limits on take. Information on biomass, reproductive potential and productivity, and age composition, as well as other biological, social, and economic parameters, is necessary to directly and accurately calculate allowable fishing mortality. In some areas, market squid are in a data-rich situation while other areas are data-poor. The result is that some basic EFI is not generally available.

Although the PFMC adopted the egg escapement method to monitor the market squid fishery setting the egg escapement threshold level at 30%, there are several areas that require further research or refinement including:

- Verify that the current threshold level of egg escapement promotes sustainability of the fishery;
- Information is needed regarding duration of spawning, egg-laying rate, rate of maturation and natural mortality on spawning grounds;
- Fishery-dependent sources of mortality of eggs spawned such as impacts to egg beds by fishing gear should be investigated as they are not quantified in the egg escapement threshold
- Test and explore the potential use of EDM for management procedures and further evaluation under climate change
- Egg escapement methodologies need spatial and temporal evaluation of northern and southern fisheries.

4.1.2. Fishery-Dependent Monitoring

4.1.2.1. Past Fishery-Dependent Monitoring

Landing receipts were the earliest form of fishery-dependent data collected from the commercial market squid fishery. The Department began collecting receipts in 1927 for all commercial fisheries to provide general knowledge of fishing activity, specifically in terms of amount landed, landing location, gears used, and value of the catch. The Department actively monitors the commercial market squid fishery by collecting dockside port samples and logbook information. The monitoring program began in October 1998, and logbook information became mandatory in 2000. The Commission

maintained existing fishery-dependent market squid monitoring programs as one of the original MSFMP fishery control rules in 2004. The primary goal of collecting these data is to monitor changes in the biological characteristics and to characterize California's commercial market squid fishery for development of population models.

Sample collection is centered on the major port complexes of landing, which include Monterey (Monterey and Moss Landing), Santa Barbara (Santa Barbara, Ventura, and Port Hueneme), and Los Angeles (San Pedro and Terminal Island). Other ports such as Eureka, Bodega Bay, Half Moon Bay, and San Francisco are included when landings are significant in those areas. Standardized protocols are used to maintain consistent sampling among port complexes. During the offloading process samplers make visual observations of species composition and incidental catch. They also record % composition of CPS (Pacific sardine, Pacific mackerel, jack mackerel, northern anchovy) by volume of the total landing. All other incidental species observed in the landing are noted, with special attention paid to prohibited or protected species (e.g., salmon). The observations are reported in PFMC CPS Stock Assessment and Fishery Evaluation reports.

4.1.2.2. Market Squid Logbook Program

Market Squid Vessel and Light/Brail Boat Logbooks (logs) are a mandated system for fishermen to record their fishing activities. These data supplement landing receipts. Logbook data are used to monitor fishing locations, environmental conditions, fishing effort, catch amounts, use of catch, and fleet characterization and capacity. The Department is working with fishery participants to develop an electronic logbook (e-log) for the California market squid commercial fishery. Once developed and tested, the new e-log may replace the current paper logbooks.

4.1.2.3. Additional Sampling Efforts

The Department has assisted with additional market squid sample collections to supplement various independent and collaborative research projects over time. These studies were generally intended to increase understanding of market squid life history (Table 4-1).

Table 4-1. Summary of market squid sample collections for independent and collaborative research projects over time.

Time Period	Principal Investigator	Resulting Publications	Samples Collected	General Purpose
1999 - 2001	John Butler	Butler et al. 2001	Gonad weight, mantle weight, statoliths	To develop the ageing methodology for market squid, to look at fecundity in terms of batch fecundity and age at maturity, and to develop a population model for market squid.
1999 - 2002	William Gilly	Gilly 2003	Gill filaments	To determine if there are separate market squid stocks in California specifically between the northern fishery and the southern fishery, as well as between nearshore and offshore populations in Monterey.
2008 - 2009	Robert Warner	Warner et al. 2009	Egg cases	To identify geographic differences in trace element concentrations in adult natal core and early larval areas of statoliths, ultimately for use in identifying source populations of stocks.
2008 - 2009	Mark Lowry	Not Published	Mantle length	Regression analysis on mantle length to beak size.
2014 - 2015	Samantha Cheng	Cheng et al. 2020	Egg cases	To determine if there are separate market squid stocks in California specifically between the northern fishery and the southern fishery.

4.1.3. Fishery-Independent Research

4.1.3.1. Past Fishery-Independent Research

Fishery-independent data on juvenile market squid come from annual Rockfish Recruitment and Ecosystem Assessment reports (e.g., juvenile rockfish surveys). The CPUE of regional forage (northern anchovy, Pacific sardine, krill, market squid, juvenile rockfish, juvenile sanddabs, and juvenile Pacific hake (*Merluccius productus*) in the central CCE (defined as the nearshore region of the eastern Pacific between Crescent City Harbor and Point Conception) is measured annually using NOAA trawl surveys in spring or summer. These data are publicly available at the NOAA California Current Integrated Ecosystem Assessment (CCIEA) website (CCIEA 2023).

In addition, there is a long-standing data series of market squid paralarvae abundance from surveys conducted through collaborative efforts by multiple agencies and the fishing industry. These data, in part, come from California Cooperative Oceanic Fisheries Investigations (CalCOFI), a multi-agency

partnership between the Department, NOAA, and Scripps Institution of Oceanography formed in 1949 to study the ecological aspects of the Pacific sardine population. Recent focus has shifted to include the overall study of the marine environment off California, the management of its living resources, and monitoring the indicators of climate change. Quarterly surveys are conducted off southern and central California, collecting hydrographic and biological data on static stations over transect lines. Biological data collection methods include Continuous Underway Fish Egg Sampler, trawling, bongo net tows for displacement volumes of zooplankton and pelagic invertebrate, and fisheries acoustics. A bongo net consists of paired plankton net bags 2.5 m long attached to stainless steel rings 60 cm in diameter. CalCOFI data are accessible to the public through their data server (CalCOFI 2021).

Paralarvae abundance surveys make up the largest fisheries-independent data series for the market squid fishery. Sampling was opportunistic prior to 2010, but since then California Wetfish Producers Association (CWPA) has maintained standardized surveys. CWPA conducts the paralarval surveys at least four times each year in the SCB (following the CalCOFI schedule when possible) and twice a year in the greater Monterey Bay and Half Moon Bay area; during which they also collect water samples at select sampling stations. Original studies investigated the correlation between paralarvae abundance and CPUE of the fishery (Zeidberg et al. 2006; Koslow and Allen 2011). Zeidberg et al. (2006) used samples collected inshore from independent research cruises from 2000 to 2003. This paralarvae density index correlated with CPUE showing a significant stock recruitment relationship, although collections only spanned four years.

Koslow and Allen (2011) used manta tow samples taken from quarterly CalCOFI surveys from 1981 to 2008, which are located offshore from the Zeidberg et al. (2006) study. These manta tows were conducted 8 cm below the air-sea interface using a neuston net, which has a large, rectangular net frame. Results from the Koslow and Allen (2011) study were less significant; however, the data spanned 20 yr and were only correlated at an annual scale. The CWPA initially implemented bongo tows in 2005. The original intent of this work was to supplement the CalCOFI survey by providing samples nearshore, adjacent to known spawning sites, since CalCOFI sample sites rarely overlap squid paralarvae habitat. The CWPA trained operators to tow bongo nets, but comprehensive sampling was not always logistically possible. Beginning in January 2011, CWPA chartered dedicated fishing vessels for the specific purpose of conducting these small net tows on a systematic schedule. There is a difference, however, in the collection methods between these studies. Koslow and Allen (2011) analyzed CalCOFI manta tow data because squid presence was greater in the surface-oriented manta nets

than in the offshore obliquely deployed bongo tows. However, bongo tows are considered more appropriate since they tend to sample 2-week-old squid, which have survived the critical stage of first feeding. Manta tows may sample day old squid. Additionally, the older paralarvae begin to migrate to deeper depths, thereby avoiding mortality from radiation and surface predation.

This paralarvae sampling project aims to better understand the physical and ecological factors that control recruitment to major spawning grounds, and to improve the assessment of market squid stocks off California. The CWPA has also worked with the SWFSC to determine, through stoichiometry, if the chemistry in the water matches or differs from the chemistry of the paralarval and adult statoliths. The Department has collected market squid samples from commercial fishery landings that coincide with these surveys and similar research. Using paralarvae and adult samples, Warner et al. (2009) found geographic differences in trace element concentrations in the statoliths of paralarval market squid. The chemical signatures of adult statoliths closely matched those of paralarvae suggesting that matching fingerprints of ripe eggs and adults six months after could indicate the degree of mixing of market squid populations on ecological timescales.

4.2. Current Knowledge of Essential Fishery Information

Fishery-dependent EFI collected through the Department's Market Squid Monitoring and Sampling Program include:

- Landings and effort – tonnage per day and week, number of vessels, and fishing location/block. The Department monitors tonnage to ensure closure of the fishery before the catch limit of 107,048 mt (118,000 tons) is exceeded.
- Biological – individual weight, length, sex, maturity, dried mantle weight, and gonad weight. Gonad weights are used to provide information for the egg escapement model that is intended for use as F_{MSY} proxy.

4.3. Research to Obtain Essential Fishery Information

4.3.1. E-Logs

In the effort of modernizing and advancing the market squid logbook, the Department, EDM team, and SFAC described and discussed specific examples of modifications to data fields and the information collected. Electronic data collection in the form of an e-log could generate more timely and reliable information as well as reduce time and effort for vessel operators and Department staff. By minimizing manual entry and written records of detailed information such as GPS coordinates, the validity and accuracy of

data collected can improve. An e-log also enables more real-time monitoring, better quality assurance and quality control, and improved compliance.

4.3.2. Empirical Dynamic Modeling

While market squid is currently considered a sustainable fishery, a need exists to modernize management and planning in the context of climate change. In the primary fishing grounds, located in the southern region of California, market squid landings, larval abundance, and size at maturity declined during major El Niño events. Empirical dynamic modeling (EDM) captures nonlinear dynamics and system drivers that haven't been measured by including lags (i.e., previous measurements of the same data stream at different time steps). EDM can be used to make predictions based on patterns in long-term data such as environmental drivers and are unbiased by predetermined model equations. EDM can work particularly well for short-lived species (Giron-Nava et al., 2017; Munch et al., 2018). Preliminary work conducted using EDM indicated there is the capability to forecast market squid landings, tease out complex spatial and temporal dynamics, and highlight survey information of greatest value.

During the 2023-2024 SFAC process, members were interested in exploring alternative, forecast-driven, or in-season ways to manage catch. In response, the Department in collaboration with a post-doc investigator, explored the potential use of EDMs to forecast future squid landings in response to varying fishing effort and climate scenarios. EDM can be used to make predictions based on patterns in long-term data such as environmental drivers, and work particularly well for short-lived species. EDM work during the 2023-2024 SFAC process focused on forecasting future squid landings and CPUE in response to varying levels of effort and environmental conditions. EDM is an area for further exploration given that expansions, shifts, or dramatic changes in market squid landings (or proxies for abundance) at various life stages are likely to occur under environmental extremes and changes.

Chapter 5. Future Management Needs and Management Costs

5.1. Current Information Gaps

The primary information gaps for the market squid fishery are outlined in the Department's Market Squid Enhanced Status Report (https://marinespecies.wildlife.ca.gov/market-squid/true/) and include the following main areas: egg escapement model assumptions; further exploring climate readiness and oceanographic variables, and ageing. Additionally, moving fisheries-dependent data collection to a digital platform (e-logs) is a top priority. The Department would also greatly benefit from more long-term fisheries-independent data collection, including continued collaboration with academia scientists and organizations, non-governmental organizations, outside agencies, and commercial and recreational fishery participants. Future efforts could be aimed at expanding the inflow of fishery-independent data to help determine ecosystem level connections. Understanding how shifting oceanographic conditions govern changes in market squid physiology, behavior, and spawning success will help to inform future management.

5.2. Potential Future Management Changes

The California market squid population is inherently resilient to fishing and largely dependent on seasonal recruitments. The fishing fleet targets market squid when available and turns to alternative fisheries when squid are not aggregating. While market squid is currently considered a sustainable fishery with an adequate regulatory framework, opportunities may exist in the future to improve fishery management.

5.3. Annual Management Cost

The estimated costs for implementation of the MSFMP A-1 are grouped into two main categories: 1) enforcement and 2) ongoing management and research. These costs estimates were produced by projecting the time to perform certain tasks such as the enforcement of regulations, collection and analysis of data, and review of documents. Annual management costs of the market squid fishery have increased since implementation of the original MSFMP. Current annual management costs include work in the continuation, maintenance, and improvement of the port sampling and logbook programs. Costs also include Department staff support for various collaborative research projects over time. Management costs also include enforcement of adopted regulations used to ensure the fishery's

sustainability. Enforcement costs include both on-the-water monitoring as well as dockside and office-based work to follow through with enforcement actions. Estimated costs to implement the MSMFP, using 2025 staffing and salaries, are summarized in Table 5-1.

Table 5-1. Estimated annual implementation costs for the MSFMP A-1 (2025 baseline).

Cost Category	Annual Cost*	Percent of Year	Annual Cost
Environmental Program Manager	$287,490	20%	$57,498
Senior Environmental Scientist (Supervisor)	$248,622	30%	$74,587
Senior Environmental Scientist (Specialist)	$193,982	100%	$193,982
Environmental Scientist (2)	$300,852	50%	$150,426
Fish and Wildlife Scientific Aid (4)	$191852	75%	$143,859
Fish and Game Captain	$241,504	20%	$48,301
Fish And Game Lieutenant (Supervisor) (2)	$429,074	15%	$64,361
Fish and Game Warden (6)	$970,926	15%	$145,639
Management Operating Cost	$50,000	--	$50,000
Enforcement Operating Cost	$50,000	--	$50,000
Total Annual Cost	**--**	**--**	**$978,653**

*Annual personnel costs include salaries/wages and benefits.

Literature Cited

Ainley, D.G., Spear, L.B., Allen, S.G., and C.A. Ribic. 1996. Temporal and spatial patterns in the diet of the common murre in California waters. The Condor 98:691-705.

Anderson F.E. 2000. Phylogenetic relationships among loliginid squids (Cephalopoda: Myopsida) based on analyses of multiple data sets. Zoological Journal of the Linnean Society 130:603-633.

Baltz, D.M. and G. V. Morejohn. 1977. Food habits and niche overlap of seabirds wintering on Monterey Bay, California. The Auk, 94(3):526–543.

Berry, SS. 1911. Notes on some cephalopods in the collection of the University of California. University of California Publications in Zoology 8(7):301-310.

Bettencourt, B., Coelho, L., Andrade, J.P., and A. Guerra. 1996. Age and growth of the squid *Loligo vulgaris* off the south coast of Portugal, using statolith analysis. Journal of Molluscan Studies 62:359-366.

Birt, T.P., Carter, H.R., Whitworth, D.L., McDonald, A., Newman, S.H., Gress, F., Palacios, E., Koepke, J.S., and V.L. Friesen. 2012. Rangewide population genetic structure of Xantus's Murrelet (*Synthliboramphus hypoleucus*), The Auk, Volume 129, Issue 1, 1 January 2012, Pages 44–55, https://doi.org/10.1525/auk.2011.11011.

Butler, J., Fuller, D., and M. Yaremko. 1999. Age and growth of market squid (*Loligo opalescens*) off California during 1998. CalCOFI Reports 40:191-195.

Butler, J., Wagner, J., and A. Henry. 2001. Age and growth of *Loligo opalescens*. PFMC Squid Stock Assessment Review. 13 pp.

California Cooperative Oceanic Fisheries Investigations (CalCOFI). 2021. https://calcofi.org. Accessed on June 31, 2022.

California Current Integrated Ecosystem Assessment (CCIEA). 2023. https://oceanview.pfeg.noaa.gov/cciea-plotting/?opentab=0&ind=27. Accessed on July 9, 2024.

California Department of Fish and Game (CDFG). March 19, 2001. Status of the Market Squid fishery with Recommendations for a Conservation and Management Plan. California Department of Fish and Game Marine Region Report to Legislature. 73 p.

CDFG. March 25, 2005. Final Market Squid Fishery Management Plan. 566 p.

California Department of Fish and Wildlife (CDFW). 2024a. Market Squid, *Doryteuthis (Loligo) opalescens.* Enhanced Status Report. https://marinespecies.wildlife.ca.gov/market-squid/true/.

CDFW. 2024b. 2024 California commercial regulations fishing digest. https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=191712&inline.

Cheng, S., Gold, M., Rodriguez, N., and P. Barber. 2021. Genome-wide SNPs reveal complex fine-scale population structure in the California market squid fishery (*Doryteuthis opalescens*). Conservation Genetics 22:97-110.

Dailey, M.D. 1969. A survey of Helminth parasites in the squid *Loligo opalescens*, Smelt, *Osmerus mordax*, jack mackerel, *Trachurus symmetricus*, and Pacific mackerel, *Scomber japonicus*. California Fish and Game 55(3):221-226.

Dickerson, T. and R. Leos. 1992. California market squid. *In* California's living marine resources and their utilization, CA Sea Grant, pp. 36-39.

Dorval, E., Crone, P.R., and J.D. McDaniel. 2013. Variability of egg escapement, fishing mortality and spawning population in the market squid fishery in the California Current Ecosystem. Marine and Freshwater Research 64(1):80-90.

Dorval, E., Porzio, D., and K. Grady. 2024. An update of egg escapement, fishing mortality, and spawning stock biomass for the California market squid (*Doryteuthis opalescens*) fishery from 1999 to 2022. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-701. https://repository.library.noaa.gov/view/noaa/61452.

Fiechter, J., Huckstadt, L.A., Rose, K.A., and D.P. Costa. 2016. A fully coupled ecosystem model to predict foraging ecology of apex predators in the California Current. Marine Ecology Progress Series 556:273-285.

Fields, W.G. 1965. The structure, development, food relations, reproduction, and life history of the squid *Loligo opalescens* Berry. California Department of Fish and Game Fish Bulletin 131:1-108.

Forsythe, J., Kangas, N., and R. Hanlon. 2004. Does the California market squid *(Loligo opalescens)* spawn naturally during the day or night? A note on the successful use of ROVs to obtain basic fisheries biology data. Fishery Bulletin 102:389-392.

Gabriel, W.L., Sissenwine, M.P., and W.J. Overholtz. 1989. Analysis of spawning stock biomass per recruit: An example from Georges Bank haddock. North American Journal of Fisheries Management 9:383-391.

Gilly, W.M. 2003. Population analysis of the California market squid, *Loligo opalescens* using DNA microsatellite analysis. Final report to the California Department of Fish and Game. Contract Number FG7334MR.

Gilly, W., Fountain, M., and A. Novakovic. 2001. Population analysis of the California market squid, *Loligo opalescens*, using DNA microsatellite analysis. *In* Status of the market squid fishery with recommendations for a conservation and management plan. California Department of Fish and Game Marine Region Report to the Legislature. Appendix D.

Giron-Nava, A., James, C.C., Johnson, A.F., Dannecker, D., Kolody, B., Lee, A., Nagarkar, M. Pao, G.M., Ye, H., Johns, D.G., and G. Sugihara. 2017. Quantitative argument for long-term ecological monitoring. Marine Ecology Progress Series 572:269-274.

Groot, C. and L. Margolis. 1991. Pacific salmon life histories. UBC Press, Vancouver, Canada. 500 pp.

Hanlon, R.T., Kangas, N., and J.W. Forsythe. 2004. Egg-capsule deposition and how behavioral interactions influence spawning rate in the squid *Loligo opalescens* in Monterey Bay, CA. Marine Biology 145:923-930.

Hardwick, J,E. and J.D. Spratt. 1979. Indices of the availability of market squid, *Loligo opalescens*, to the Monterey Bay fishery. CalCOFI Reports 20:35-39.

Hastings, S., and S. MacWilliams. 1999. Multi-species and multi-interest management: an ecosystem approach to market squid (*Loligo opalescens*) harvest in California. Marine Sanctuaries Conservation Series MSD-99-1. U.S. Dept. of Commerce, NOAA, Marine Sanctuaries Division, Silver Spring, MD. 24 pp.

Hill, K.T. and M.L. Yaremko. 1997. Spatial and temporal distributions of market squid (*Loligo opalescens*) off California based on commercial landings and aerial observation data. Abstract in CalCOFI Program, 28-30 October 1997 at Lake Arrowhead, California.

Hunt, J.C., Zeidberg, L.D., Hamner, W.M., and B.H. Robison. 2000. The behavior of *Loligo opalescens* (Mollusca: Cephalopoda) as observed by remotely operated vehicle (ROV). Journal of Marine Biological Association U.K. 80: 873-883.

Hurley, A.C. 1977. Mating behavior of the squid *Loligo opalescens*. Marine Behavior and Physiology 4(3): 195-203.

Hurley, G.V., Odense, P., O'Dor, R.K. and E.G. Dawe, 1985. Strontium labelling for verifying daily growth increments in the statoliths of the short-finned squid (*Illex illecebrosus*). Canadian Journal of Fisheries and Aquatic Sciences 42: 380-383.

Isaac, G., Neumeister, H., and W.F. Gilly. 2001. The effects of temperature on early life stages of California squid (*Loligo opalescens*). PFMC Squid Stock Assessment Review. 15 pp.

Jackson, G.D. 1990a. The use of tetracycline staining techniques to determine statolith growth ring periodicity in the tropical loliginid squids, *Loliolus noctiluca* and *Loligo chinensis*. Veliger 33: 389-393.

Jackson, G.D. 1990b. Age and growth of the tropical nearshore loliginid squid *Sepioteuthis lessoniana* determined from statolith growth-ring analysis. Fishery Bulletin 88: 113-118.

Jackson, G.D. 1994. Statolith age estimates of the loligonid squid *Loligo opalescens* (Mollusca: Cephalopoda) corroboration with culture data. Bulletin of Marine Science 54: 554-557.

Jackson, G.,D. 1998. Research into the life history of *Loligo opalescens*: where to from here? CalCOFI Reports 39:101-107.

Jackson, G.D. and M.L. Domeier. 2003. The effects of an extraordinary El Niño / La Niña event on the size and growth of the squid *Loligo opalescens* off southern California. Marine Biology 142:925-935.

Jereb, P., Vecchione, M., and C.F.E. Roper. 2010. Family Loliginidae. In P. Jereb and C.F.E. Roper, eds. Cephalopods of the world. An annotated and illustrated catalogue of species known to date. Volume 2. Myopsid and Oegopsid Squids. FAO Species Catalogue for Fishery Purposes 4(2): 38-117.

Karpov, K.A. and G.M. Cailliet. 1978. Feeding dynamics of *Loligo opalescens*. California Department of Fish and Game, Fish Bulletin 169:45-65.

Karpov, K.A. and G.M. Cailliet. 1979. Prey composition of the market squid, *Loligo opalescens* Berry, in relation to depth and location of capture, size of squid, and sex of spawning squid. CalCOFI Reports 20:51-57.

Kato, S. and J.E. Hardwick. 1975. The California squid fishery. FAO Fisheries. Report 170:107-116.

Koslow, J.A. and C. Allen. 2011. The influence of the ocean environment on the abundance of market squid, *Doryteuthis* (= *Loligo*) *opalescens*, paralarvae in the Southern California Bight. CalCOFI Reports 52:205-13.

Lipinski, M. 1986. Methods for the validation of squid age from statoliths. Journal of the Marine Biological Association of the United Kingdom66:506-526.

Lowry, M.S. and J.V. Carretta. 1999. Market squid (*Loligo opalescens*) in the diet of California sea lions (*Zalophus californianus*) in southern California (1981-1995). CalCOFI Reports. 40:196-202.

Lutz, S. and L. Pendleton. 2000. An assessment of the market squid and other major commercial wetfish fisheries of southern California. USC- Southern California Fisheries Project.

Lutz, S. and L. Pendleton. 2001. Socio-economic study of the San Pedro historic purse seine fleet. Coastal Community Research, Wrigley Institute for Environmental Studies, University of Southern California. Los Angeles, CA. 39 pp

Macewicz, B.J., Hunter, J.R. and N.C.H. Lo. 2001a. Validation and monitoring of the escapement fecundity of market squid. Project report to California Department of Fish and Game. Document #2, PFMC Squid Stock Assessment Review. 8 pp.

Macewicz, B.J., Hunter, J.R., Lo, N.C.H., and E.L. LaCasella. 2001b. Lifetime fecundity of the market squid, *Loligo opalescens*. Document #1, PFMC Squid Stock Assessment Review. 19 pp.

Macewicz, B.J., Hunter, J.R., Lo, N.C.H., and E.L. LaCasella. 2004. Fecundity, egg deposition, and mortality of market squid (*Loligo opalescens*). Fishery Bulletin 102(2):306-327.

Maxwell M.R., Jacobson, L.D., and R.J. Conser. 2005. Eggs-per-recruit model for management of the California market squid (*Loligo opalescens*) fishery. Canadian Journal of Fisheries and Aquatic Sciences 62(7):1640-1650.

Morejohn, G.V., Harvey, J.T., and L.T. Krasnow. 1978. The importance of *Loligo opalescens* in the food web of marine vertebrates in Monterey Bay, California. California Department of Fish and Game, Fish Bulletin 169:67-98.

Morris, R.H., Abbott, D.P., and E.C. Haderlie. 1980. Intertidal Invertebrates of California. Stanford: Stanford University Press. 690 pp.

Marine Stewardship Council (MSC). 2023. California Market Squid Producers Alliance Purse Seine. Public Certification Report. https://cert.msc.org/FileLoader/FileLinkDownload.asmx/GetFile?encryptedKey=YBrd9qdSdYebTvdXylxCmpGLLSrND5YzuqFP6K1ejnD65qo8UjKGSI7dUl0+CvB4

Munch, S.B., Giron-Nava, A., and G. Sugihara. 2018. Nonlinear dynamics and noise in fisheries recruitment: A global meta-analysis. Fish and Fisheries 19:964-973.

NOAA. 2023. List of Fisheries https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-protection-act-list-fisheries#lists-of-fisheries. Accessed on July 9, 2024.

O'Dor, R.K. and D.M. Webber 1986. The constraints on cephalopods: why squid aren't fish. Canadian Journal of Zoology. 64:1591-1605.

Okutani, T. and J. McGowan. 1969. Systematics, distribution, and abundance of the epiplanktonic squid (Cephalopoda, Decapoda) larvae of the California Current April 1954 - March 1957. Bulletin of Scripps Institute of Oceanography University of California14: 1-90.

Pacific Fishery Management Council (PFMC). 1998. Amendment 8 to the northern anchovy fishery management plan incorporating a name change to: The coastal pelagic species fishery management plan. December 1998, p. D-9.

PFMC. 2002. Limited entry fleet capacity and market squid maximum sustainable yield control rule. Amendment 10 to the Coastal Pelagic Species Fishery Management Plan. July 2002. 224 pp.

PFMC. 2010. Status of the Pacific Coast Coastal Pelagic Species Fishery and Recommended Acceptable Biological Catches, Stock Assessment and Fishery Evaluation. 79 pp.

PMFC. 2023. Coastal Pelagic Species Fishery Management Plan. As amended through Amendment 21.

Pomeroy, C. and M. FitzSimmons. 2001. Socio-economic organization of the California Market Squid Fishery: Assessment for optimal resource management. California Sea Grant Project. Final Report. 18 pp.

Protasio, C.Q., Holder, A.M., and B.C. Brady. 2014. Changes in biological characteristics of the California market squid (*Doryteuthis opalescens*) from the California commercial fishery from 2000-01 to 2012-13. California Fish and Game 100(2):276-299.

Recksiek, C.W. and H.W. Frey (Editors). 1978. Biological, oceanographic, and acoustic aspects of the market squid, *Loligo opalescens* Berry. California Department of Fish and Game, Fish Bulletin 169:67-98.

Reichow, D. and M.J. Smith. 1999. Highly variable microsatellites in the California market squid, *Loligo opalescens*. Marine Biotechnology. 1(4) 403-406.

Reichow, D. and M.J. Smith. 2001. Microsatellites reveal high levels of gene flow among populations of California squid, *Loligo opalescens*. Molecular Ecology. 10(5) 1101-1109.

Restrepo, V.R., Gabriel, W.L., Low, L.L., MacCall, A.D., Mace, P.M., Methot, R.D., Powers, J.E., Taylor, B.L., Thompson, G.G., Wade, P.R., and J.F. Witzig. 1998. Technical guidance on the use of precautionary approaches to implementing National Standard 1 of the Magnuson-Stevens Fishery Conservation and Management Act. U.S. Dept. of Commerce, NOAA Technical Memorandum. 54 pp.

Riser, N.W. 1949. Studies on the Tetraphyllidea. Unpublished PhD. Thesis, Department of Biology, Stanford University.

Roper, C.F.E. and M.J. Sweeney. 1984. Cephalopods of the world: An annotated and illustrated catalogue of species of interest to fisheries. FAO Fisheries Synopses 125(3): 277 pp.

Sinclair EH. 1992. Stomach contents of four short-finned pilot whales (*Globicephala macrorhynchus*) from the Southern California Bight. Marine Mammal Science 8(1):76-81.

Stewart, J.S., Hazen, E.L., Bograd, S.J., Byrnes, J.E., Foley, D.G., Gilly, W.F., Robison, B.H., and J.C. Field. 2014. Combined climate-and prey-mediated range expansion of Humboldt squid (*Dosidicus gigas*), a large marine predator in the California Current System. Global Change Biology 20(6):1832-1843.

Spratt, J.D. 1978. Age and growth of the market squid, *Loligo opalescens* Berry, in Monterey Bay. California Department of Fish and Game, Fish Bulletin 169:35-44.

Sydeman, W.J., Hobson, K.A., Pyle, P., and E.B. McLaren. 1997 Trophic relationships among seabirds: Combined stable isotope and conventional dietary approach. The Condor 99:327-336.Szoboszlai, A.I., Thayer, J.A., Wood, S.A., Sydeman, W.J., and L.E. Koehn. 2015. Forage species in predator diets: synthesis of data from the California Current. Ecological Informatics 29: 45-56.

Vecchione M., Shea E., Bussarawit S., Anderson R., Alexeyev D., Lu C.-C, Okutani T., Roeleveld M., Chotiyaputta C., Roper C., Jorgensen E., and N. Sukramongkol. 2005. Systematics of Indo-West Pacific Loliginids. Phuket Marine Biological Center Research Bulletin 66:23-26.

Vojkovich, M. 1998. The California fishery for market squid (*Loligo opalescens*). *In* Symposium of the CalCOFI conference. CalCOFI Reports. 39:55-60.

Walthers, L.C. and G.E. Gillespie. 2002. A review of the biology of opal squid (*Loligo opalescens* Berry), and of selected Loliginid squid fisheries. Canadian Science Advisory Secretariat. 110 pp.

Warner, R.R., Hamilton, S.L., Sheehy, M.S., Zeidberg, L.D., Brady, B.C., and J.E. Caselle. 2009. Geographic variation in natal and early larval trace-elemental signatures in the statoliths of the market squid *Doryteuthis* (formerly *Loligo*) *opalescens*. Marine Ecology Progress Series, 379:109-121.

Weber, M.L. and B. Heneman. 2000. Guide to California's Marine Life Management Act. Bolinas, California: Common Knowledge Press. 133 pp.

Yang, W.T., Hanlon, R.T., Krejci, M.E., Hixon, R.F., and W.H. Hulet. 1983. Laboratory rearing of *Loligo opalescens*, the market squid of California. Aquaculture, 31(1):77-88.

Yang, W.T., Hixon, R.F., Turk, P.E., Krejci, M.E., Hulet, W.H., and R.T. Hanlon. 1986. Growth, behavior, and sexual maturation of the market squid, *Loligo opalescens*, cultured through the life cycle. Fishery Bulletin 84:771-798.

Zeidberg, L.D. and W.M. Hamner. 2002. Distribution of squid paralarvae, *Loligo opalescens* (Cephalopoda: Myopsida), in the Southern California Bight in the three years following the 1997-1998 El Niño. Marine Biology 141:111-122.

Zeidberg, L.D., Hamner, W., Moorehead, K., and E. Kristof. 2004. Egg masses of *Loligo opalescens* (Cephalopoda: Myopsida) in Monterey Bay, California

following the El Nino event of 1997–1998. Bulletin of Marine Science 74(1):129-141.

Zeidberg, L.D., Hamner, W.M., Nezlin, N.P., and A. Henry. 2006. The fishery for California (*Loligo opalescens*) (Cephalopoda: Myopsida), from 1981 through 2003. Fishery Bulletin 104(1):46-59.

Zeidberg, L.D., Isaac, G., Widmer, C.L., Neumeister, H., and W.F. Gilly. 2011a. Egg capsule hatch rate and incubation duration of the California market squid, *Doryteuthis* (*Loligo*) *opalescens*: insights from laboratory manipulations. Marine Ecology 32(4):468-79.

Zeidberg, L.D., Butler, J.L., Ramon, D., Cossio, A, Stierhoff, K.L., and A. Henry. 2011b. Estimation of spawning habitats of market squid (*Doryteuthis opalescens*) from field surveys of eggs off Central and Southern California. Marine Ecology 33(3):326-36.

Appendix A. Glossary of Terms and Abbreviations

A

Absolute Abundance - The total number of individuals in a population. This is rarely known, but usually estimated from relative abundance, although other methods may be used.

Abundance - See Relative Abundance or Absolute Abundance.

Acceptable Biological Catch (ABC) - A term used that refers to the range of allowable catch for a species or species group. It is set each year by a scientific group created by the management agency. The agency then takes the ABC estimate and sets the annual Total Allowable Catch (TAC).

Adaptive Management - In regard to a marine fishery, adaptive management is a scientific policy that seeks to improve management of biological resources, particularly in areas of scientific uncertainty, by viewing program actions as tools for learning. Actions are designed so that even if they fail, they will provide useful information for future actions. Monitoring and evaluation shall be emphasized so that the interaction of different elements within the system can be better understood.

Age Class - A group of individual organisms of the same age in a population. "Year-Class" or "cohort" are terms generally synonymous with age class, but are identified by the actual year in which the cohort was produced (e.g., 1991 year-class or sardines resulted from the 1991 spawning season).

Age Composition - Identifies the proportions of a population of fishes by age or age group.

Allocation - The opportunity to fish is distributed among user groups or individuals. The share that a user group receives is sometimes based on historic harvest amounts.

Assessment - A judgment made by a scientist or scientific body on the state of a resource (e.g., size, health, pollution impacts) usually for passing advice to management authority.

Availability - In a general sense, used to describe periods of poor (low availability) or good (high availability) catches, regardless of the size or health of a fish population. In a strict sense, it refers to the fraction of a population which is susceptible to fishing during a given fishing season.

B

Biomass - The total weight or numbers of a stock or population of fish at a given point in time. The **spawning biomass** is that portion of total biomass that is mature and spawning.

Brail net - A large dip net, sometimes used with the assistance of the vessel's hydraulics.

Bycatch - Fish or other marine life that are taken in a fishery but which are not the target of the fishery, including discards.

C

CalCOFI - California Cooperative Oceanic Fisheries Investigations.

Candidate Species - Officially noticed by the Commission as being under review by the Department of Fish and Game for addition to the rare, threatened, or endangered species lists.

Capacity Goal - The primary purpose of restricted access programs is to match the level of effort in a fishery to the health of the fishery resource, each restricted access program that is not based on individual transferable quotas shall identify a fishery capacity goal intended to promote resource sustainability and economic viability of the fishery.

Catch - Refers sometimes to the total amount (numbers or weight) caught, and sometimes only to the amount landed or kept. Catches that are not landed are called discards.

Catch Per Unit Effort (CPUE) - The catch obtained by a vessel, gear or fisherman per unit of fishing effort (e.g., number of fish caught per hour of trawling).

CCE - California Current Ecosystem.

CCIEA - California Current Integrated Ecosystem Assessment.

CCR - California Code of Regulations.

CDFG - California Department of Fish and Game.

CDFW - California Department of Fish and Wildlife.

CEQA - California Environmental Quality Act.

Cohort - A group of fish spawned during a given period, usually within a year. See also: **age class**.

Commission - California Department of Fish and Game Commission.

Competition - Active demand between organisms for a common resource that is in limited supply (e.g., food, space).

CPFV - Commercial Passenger Fishing Vessel.

CPS - Coastal pelagic species (northern anchovy, jack mackerel, Pacific mackerel, Pacific sardine, and market squid).

CWPA - California Wetfish Producers Association.

D

Department - California Department of Fish and Wildlife.

Depressed - With regard to a marine fishery, the condition of a fishery for which best available scientific and other relevant information indicates a declining population trend has occurred over a period of time appropriate to that fishery. With regard to fisheries for which management is based on maximum sustainable yield, or in which a natural mortality rate is available, "depressed" means the condition of a fishery that exhibits declining fish population abundance levels below those consistent with maximum sustainable yield.

Discards - Fish that are taken in a fishery but are not retained because they are of an undesirable species, size, sex, or quality, or because they are required by law to be released.

DML - Dorsal Mantle Length.

Drum seine - Like a purse seine, but a large drum stores, deploys, and retrieves the net.

E

Ecosystem - The relationships between the sum total biological and non-biological factors present in the area.

EEZ - Exclusive economic zone; consists of ocean waters from the edge of State waters three miles (5 km) to 200 miles (322 km) offshore.

Effort - The amount of time and fishing power used to harvest fish. Fishing power includes gear size, boat size, and horsepower.

EFH - Essential Fish Habitat.

EFP - Experimental Fishery Permit.

Egg and Larval Surveys - Involves the collection of larvae, usually with a tow net, within a predefined geographic area. These surveys are typically carried out in conjunction with other studies in order to determine fishery information such as abundance and recruitment. They can also be used to define the geographic extent and peak time of spawning activity.

Egg Escapement Method - A management tool which may be used to determine whether the fleet is fishing above or below a predetermined sustainable level of exploitation. The method requires establishing a threshold value to ensure that an adequate number of eggs are deposited prior to harvest.

EIR - Environmental Impact Report.

El Niño - An El Niño event occurs when the sea surface temperatures in the eastern equatorial Pacific region along the coasts of Peru and Ecuador increase significantly above the average temperature for three or more months. A La Niña is characterized by unusually cold ocean temperatures in the equatorial Pacific. Currently, El Niños have a return period of four to five years. An El Niño Southern Oscillation (ENSO) describes the full range of the Southern Oscillation that includes both warming and cooling of sea surface temperatures when compared to a long-term average. The ENSO has two parts: the El Niño is the oceanic component and the Southern Oscillation is the atmospheric component of the phenomenon.

Empirical Dynamic Model (EDM) - Captures nonlinear dynamics and system drivers that haven't been measured by including lags (i.e., previous measurements of the same data stream at different time steps). EDMs can be used to make predictions based on patterns in long-term data such as environmental drivers and are unbiased by predetermined model equations. EDMs can work particularly well for short-lived species. Capability to forecast landings, tease out complex spatial and temporal dynamics, and highlight survey information of greatest value.

Endangered Species - A native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more

causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease.

ENSO - El Niño Southern Oscillation. See El Niño.

Escapement - That part of the stock which survives at the end of a fishing period (e.g., season, year).

ESR - Enhanced Status Report.

Essential Fishery Information - Information about fish life history and habitat requirements; the status and trends of fish populations, fishing effort, and catch levels; fishery effects on fish age structure and on other living marine resources and users; and any other information related to the biology of a fish species or to taking in the fishery that is necessary to permit fisheries to be managed according to the requirements of §7060 FGC.

Ex-vessel - Refers to activities that occur when a commercial fishing boat lands or unloads a catch. For example, the price received by a captain for the catch is an ex- vessel price.

F

Fecundity - The production of eggs per individual or per unit weight of an individual.

FGC - Fish and Game Code.

Fishery- Both of the following:

(a) One or more populations of marine fish or marine plants that may be treated as a unit for purposes of conservation and management and that are identified on the basis of geographical, scientific, technical, recreational, and economic characteristics.
(b) Fishing for, harvesting, or catching the populations described in (a).

Fishing Effort - The amount of effort expended by a gear or person which is usually standardized (e.g., number of net hauls per unit of time per size of net) and summed before being used as an index of total effort. Also see **Effort**.

Fishing Mortality (F) - A measurement of the rate of removal of fish from a population by fishing. Fishing mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of fish dying in one year. Instantaneous is that percentage of fish dying at any one time. The acceptable rates of fishing mortality may vary from species to species.

Fishing year or fishing season - The period April 1 through March 31 under the Market Squid FMP.

Fishery Control Rules - Specific management strategies such as seasonal catch limits, daily trip limits, area closures, time closures, and sustainable levels of egg escapement which provide for a sustainable market squid fishery.

FMP - Fishery Management Plan.

Forage - the role of market squid in the food chain as a critical source of food for higher predators, including birds, fish and marine mammals.

G

Growth Rate - Usually refers to the average growth of individuals, in length or weight by successive ages over the life span of the particular species.

GT - Gross Tonnage.

H

Habitat - The physical, chemical, and biological features of the environment where an organism lives.

Habitat Enhancement – The improvement of habitat, typically for the benefit of a select number of species which depend on that habitat. Wetlands restoration, artificial reefs, and kelp reforestation are examples of habitat enhancement.

Hook and Line - Includes trolling, jigging, and longline gear types.

I

Incidental Catch - See **Bycatch Incidentally-Taken Species** - See **Bycatch.**

Indices of Abundance - These measures usually do not translate to an estimate of actual biomass of a population and are usually collected over time (years) to reflect trends in a population. The indices can be compiled from a number of sources, usually reported annually (e.g., CPUE, aerial spotter, and acoustic, egg, larval, or adult research survey data). Indices of abundance, because of their simplicity, are seriously evaluated regarding the assumptions in their calculation. When they can be closely matched to

more direct and precise of estimates of abundance, they can be cost-effective tools of tracking the trends of a population.

J K L

Lampara net – A round haul net with the sections of netting made and joined to create bagging. The net is pushed beneath squid to encircle it from each side. The "wings" of the net are pulled back to the boat and the squid end up in the bag portion of the net. This gear has no arrangement for pursing.

La Niña - A La Niña is characterized by unusually cold ocean temperatures in the equatorial Pacific. See El Niño.

Landings - The number or weights of fish unloaded at a dock by commercial fishermen or brought to shore by recreational fishermen for personal use. Landings are reported at the points at which fish are brought to shore. Note that landings, catch, and harvest define different things.

Light boat - a vessel engaged in the commercial taking or attempting to take market squid which uses bright lights to aggregate squid for commercial purposes including live bait.

Limited Entry - Restriction of the right to participate in a fishery, by the use of permits or other means.

Living Marine Resources - Includes all wild mammals, birds, reptiles, fish, and plants that normally occur in or are associated with salt water, and the marine habitats upon which these animals and plants depend for their continued viability.

M

Marine Mammals - Animals that live in marine waters and breathe air directly. Females give live birth and can produce milk. Includes porpoises, whales, and seals.

Maximum Sustainable Yield - In a marine fishery, it means the highest average yield over time that does not result in a continuing reduction in stock abundance, taking into account fluctuations in abundance and environmental variability.

Mesh Size - The size of openings in a fishing net. Minimum mesh sizes are often prescribed in an attempt to avoid the capture of young fish before they reach their optimal size for capture.

MLDS – California Department of Fish and Wildlife's Marine Landings Database System, used to manage all commercial fishing landings information.

MLMA - Marine Life Management Act.

MLPA - Marine Life Protection Act.

MPA - Marine Protected Area.

Mortality (Total) - The sum total of individual deaths within a population. Usually stated as an annual rate and calculated as the sum of deaths due to natural causes (e.g., predation, disease), fishing mortality (deaths due to fishing and natural mortality), and non-fishing, artificial causes (e.g., pollution, seismic surveys).

MSFCMA - Magnuson-Stevens Fishery Conservation and Management Act.

MSFMP – Original Market Squid Fisheries Management Plan as adopted by the Commission in 2004 and implemented in 2005.

MSFMP A-1 – Amended Market Squid Fisheries Management Plan as adopted by the Commission in 2025.

N

NOAA - National Oceanic and Atmospheric Administration.

NOP - Notice of Preparation.

NMFS - National Marine Fisheries Service or NOAA Fisheries.

O

Optimum Yield - With regard to a marine fishery, means the amount of fish taken in a fishery that does all of the following:

(a) Provides the greatest overall benefit to the people of California, particularly with respect to food production and recreational opportunities, and takes into account the protection of marine ecosystems.

(b) Is the maximum sustainable yield of the fishery, as reduced by relevant economic, social, or ecological factors.

(c) In the case of an overfished fishery, provides for rebuilding to a level consistent with producing maximum sustainable yield in the fishery.

Overfished - With regard to a marine fishery, means both of the following:

(a) A depressed fishery.
(b) A reduction of take in the fishery is the principal means for rebuilding the population.

Overfishing - A rate or level of taking that the best available scientific information, and other relevant information that the Commission or Department possesses or receives, indicates is not sustainable or that jeopardizes the capacity of a marine fishery to produce the maximum sustainable yield on a continuing basis.

P

Paralarvae – Life stage of market squid at the time of hatching (hatchlings).

Participants - The recreational fishing, commercial fishing, and fish receiving and processing sectors of the fishery.

Pelagic - Pertaining to the water column, or referring to organisms living in the water column.

PFMC - Pacific Fishery Management Council.

Population (see **Stock**) - A species, subspecies, geographical grouping, or other category of fish capable of management as a unit.

Predator - A species that feeds on other species. The species being eaten is the prey.

Prey - A species being fed upon by other species. The species eating the other is the predator.

Productivity - Generally used to refer to the capacity of a stock to provide a yield.

PSMFC - Pacific States Marine Fisheries Commission.

Purse Seine - A net used to encircle aggregations of fish by closing the bottom of the net. The net is continuous, with corks along the top and leads and rib line along the bottom. Purse seines have a drawstring running the length of the rib line, which is pulled tight after the set.

Q

Quota - A limit on the amount of fish which may be landed in any one fishing season or year. May apply to the total fishery or to an individual share.

R

Recreational Fishery - Harvesting fish for personal use, fun, and challenge. Recreational fishing does not permit sale of catch. Refers to and includes the fishery resources, fishermen, and businesses providing needed goods and services.

Recruit - A relatively young fish entering the exploitable stage of its life cycle.

Recruitment - Either the rate of entry of recruits into the fishery or the process by which such recruits are generated. Usually associated with attainment of a particular age or size, but can also be dependent on such factors as the fishes' appearance on a particular fishing ground, or how they grow to a size large enough to be captured by a certain mesh gear.

Relative Abundance - An estimate of biomass usually measured by indices that track trends in population biomass over time. This method is neither a direct nor usually precise estimate.

Restricted Access - A fishery in which the number of persons who may participate, the number of vessels that may be used in taking a specified species of fish, or the catch allocated to each fishery participant is limited by statute or regulation.

Rib line – A modification to a seine net which adds additional webbing between the weighted leadline and the purse line. This causes the net to flutter or bounce when it does contact the bottom as opposed to dragging. The rib line is intended to reduce the likelihood of pursing benthic bycatch, and to reduce the impact on the sandy bottom habitat, while simultaneously strengthening the integrity of and preventing damages to the net.

Round Haul - those that employ the use of lampara, purse seine, and drum seine net gear to commercially harvest squid.

S

SAFE - Stock Assessment and Fishery Evaluation.

SB - Senate Bill.

Seasonal Catch Limit - an amount of allowable catch which may be taken within a designated geographic area in a fishing season, specified in short tons and excluding discard mortality. The attainment (or expected attainment) of this limit will cause closure of the directed commercial fishery as specified in regulation.

Selectivity - Refers to the selective nature of fishing gear in that almost all kinds of gear catch fish of some sizes more readily than other sizes.

SCB - Southern California Bight.

SFAC - Squid Fishery Advisory Committee.

SMR - State Marine Reserve.

Spawning Biomass - See Biomass.

Spermatophore - A capsule or compact mass of spermatozoa extruded by the males of certain invertebrates and directly transferred to the reproductive parts of the female.

SRSC - Squid Research and Scientific Committee.

SST - Sea surface temperature.

Stock - A species, subspecies, geographical grouping, or other category of fish capable of management as a unit.

Sustainable, Sustainable Use, and Sustainability - with regard to a marine fishery, both of the following:

(a) Continuous replacement of resources, taking into account fluctuations in abundance and environmental variability.

(b) Securing the fullest possible range of present and long-term economic, social, and ecological benefits; maintaining biological diversity; and, in the case of fishery management based on maximum sustainable yield, taking in a fishery that does not exceed optimum yield.

SWFSC - Southwest Fisheries Science Center.

T

Threatened Species - a native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts.

Total Allowable Catch (TAC) - The annual recommended catch for a species or species group. The regional council sets the TAC from the range of the Allowable Biological Catch (ABC).

Total Length - The straight-line distance from the most forward tip of the snout to the end of the tail fin, when the mouth is closed and the lobes of the tail fin are squeezed together.

Trawl - A large bag net that is tapered and forms a flattened cone. The mouth of the net is kept open while it is towed or dragged over the sea bottom.

Trophic Level - Position in the food chain, determined by the number of energy- transfer steps to that level.

U

U.S. – United States of America.

USC - United States Code.

V W

Weekend Closure - a routine management measure which may be used to prohibit take of market squid during certain days of a week.

X Y Z

Year Class - see Age Class.

Yield - Sometimes this term is synonymous with catch, but it more often implies a degree of sustainability over a number of years.