Staff Summary for April 16-17, 2025

24. Market Squid

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

(A) ***Market Squid Fishery Management Plan (FMP)*:** Receive and conduct a public hearing on the draft amended Market Squid FMP.

(B) ***Commercial take of market squid:*** Consider authorizing publication of notice of intent to amend regulations for the commercial take of market squid.

Summary of Previous/Future Actions

• Adopted Market Squid FMP and implementing regulations	December 2004
• Referred market squid fishery management and FMP review to Marine Resources Committee (MRC)	April 2021
• Process updates and MRC vetting	2021-2023, various; MRC
• Department Squid Fishery Advisory Committee (SFAC) meetings	February 2023-May 2024
• Received and discussed SFAC report and proposed recommendations	July 17-18, 2024; MRC
• MRC recommendation for amended Market Squid FMP and regulations	November 7, 2024; MRC

(A) *Draft amended Market Squid FMP*

• **Receive and discuss draft amended Market Squid FMP**	**April 16-17, 2025**
• Discuss draft amended Market Squid FMP	June 11-12, 2025
• Adopt amended Market Squid FMP	August 13-14, 2025

(B) *Amended regulations for commercial take of market squid*

• **Today's notice hearing**	**April 16-17, 2025**
• Discussion hearing	June 11-12, 2025
• Adoption hearing	August 13-14, 2025

Background

The California market squid fishery is regularly the largest commercial fishery in California, in both landings volume and value. Managed under the Commission's authority since 2001, the fishery has operated within the framework of the Market Squid FMP adopted by the Commission in 2004 pursuant to the requirements and guidelines of the Marine Life Management Act (MLMA) (Section 7072 et seq., California Fish and Game Code). The Market Squid FMP defines fishery control rules, a restricted access program, environmental considerations, and fishery administration.

While regulations have been periodically adopted to adaptively manage various aspects of the fishery, 2021 marked initiation of the first comprehensive review of market squid fishery management since the FMP's adoption in 2004. The Department developed a multi-phase management review supported by the Commission, and anchored it in a Squid Fishery Advisory Committee (SFAC) established in 2023 by the Department's director in accordance with Commission regulations (Section 53.02). SFAC played a crucial role in assisting with developing and reviewing fishery assessments, management options and proposals, and in advising the Department on potential FMP amendments and regulatory changes.

In November 2024, MRC recommended the Commission schedule Market Squid FMP amendments and management changes for the Commission's consideration based on the SFAC's management review and Department-proposed recommendations. The Department subsequently prepared the draft amended Market Squid FMP, and proposed regulations necessary to implement the amended plan and management recommendations, based on SFAC recommendations and MRC and Commission input.

(A) ***Draft Amended Market Squid FMP***

Following tribal review, the Department is now submitting the draft amended Market Squid FMP for public review and potential adoption by the Commission (exhibits 1-3). The draft amended FMP integrates information from the Department's market squid enhanced status report (Exhibit 4), SFAC recommendations on proposed management measures, and other updated information regarding market squid. Proposed changes to management components from the original Market Squid FMP are shown in Exhibit 2, Executive Summary (pages i-iii).

MLMA requires that the Commission hold at least two public hearings prior to adopting an FMP amendment; however, the Commission has opted to hold three public meetings for this proposed Market Squid FMP amendment process to provide ample time for stakeholder and public input. MLMA also requires that the draft be available to the public for review at least 30 days prior to the first hearing and discussion. The Department complied with this 30-day requirement by posting the draft amended Market Squid FMP on its website. After the Department posted the draft, Commission staff identified several revisions necessary to align the amended Market Squid FMP language with final proposed regulatory language concerning gear definitions, and to update references to the status of seabird species with respect to special status or listing under the California Endangered Species Act or federal Endangered Species Act. Commission staff requests Commission direction to make updates to the draft amended Market Squid FMP, which the Department would again make available for public review at least 30 days prior to the next hearing and discussion in June.

Today marks the first amendment process for any fishery management plan adopted by the Commission pursuant to the MLMA.. The MLMA master plan for fisheries clarifies the adoption process and provides that, in addition to public hearings, written comments may be submitted at any time up to adoption. The Commission may either adopt the FMP amendment, or, if it determines changes are warranted, may reject the FMP amendment for the Department to revise and resubmit for further public review before adoption.

(B) ***Amended Regulations for Commercial Take of Market Squid***

Consistent with updates in the draft amended Market Squid FMP, several regulatory amendments are necessary to implement management recommendations. Draft proposed amendments to market squid regulations reflect Department recommendations discussed and agreed upon during the multiyear SFAC process, and include scientific and enforcement input (see exhibits 5-7 for details).

- *Add a definition for "rib line" and require the use of a rib line on all purse seine nets after December 31, 2030*.

  Current squid fishing regulations permit purse seine nets – the most widely-used of authorized gear types – which Department data suggests can scrape the seafloor when fishing in shallow areas, potentially increasing benthic bycatch and damaging squid eggs. To address the potential for damage, proposed regulations will require the use of a "rib line" on all purse seine nets after December 31, 2030. Defined as a non-metallic line, "rib line" is positioned at least 36 inches above the leadline and within 60 feet of both net ends, creating a "ribbing" effect that makes the net flutter rather than drag and reducing seafloor contact. The 2030 timeline allows for net retrofitting.

- *Extend the current market squid fishery weekend closure*

  Current regulations prohibit squid fishing from noon on Friday to noon on Sunday statewide to allow for uninterrupted spawning. The proposed regulations extend the closure by five hours (from noon to 7 a.m.) on Friday statewide and an additional twelve-hour extension (from noon to 11:59 pm) on Sundays in the Monterey Bay area to allow additional uninterrupted spawning and benefit squid reproduction and spawning success (Table 1).

Table 1: Summary of draft proposed amendments to extend weekend closure

Location	Current Squid Fishing Closure	Proposed Squid Fishing Closure
Statewide	noon Friday to noon Sunday	7 a.m. Friday to noon Sunday
Monterey Bay area	noon Friday to noon Sunday	7 a.m. Friday to midnight (11:59 p.m.) Sunday

The Department recommends additional amendments to the regulations that were developed outside the SFAC process, including:

- *Reference to Market Squid FMP*: Remove the definition and incorporation by reference in Title 14, as the FMP is an informational document, not a regulation.
- *Repeal sections*: Repeal sections 53.02 and 53.03 as they either duplicate existing authority or are general policy statements, not regulations.
- *Define "purse seine skiff"*: Define and explicitly state that it does not require its own market squid vessel permit.

- *Fishery closure notification*: Change the method of notification of fishery closure from broadcast by the U.S. Coast Guard (USCG) on VHF Channel 16 to the Department's website, due to USCG discontinuing VHF notifications.
- *National Marine Sanctuary name*: Update the name Gulf of the Farallones National Marine Sanctuary to the current name, Greater Farallones National Marine Sanctuary in regulations concerning the prohibition of using attracting lights for squid fishing within the sanctuary to protect seabirds.
- *Lights as take and weekend closure*: Clarify that using lights to attract and aggregate squid constitutes a form of take and is prohibited during the weekend closures, with the exception of live bait vessels, specifying that the use of such lights serves as "prima facie" evidence of commercial intent.
- *Live bait lighting exemption conditions*: Amend the weekend exemption for lighting on the weekend to take market squid as live bait, to ensure vessels do not use lights for other purposes while claiming to be engaged in the take of live bait, through the following exemption conditions:
  - Weekend use of lights is permitted only to aggregate squid when actively fishing for squid for live bait, to minimize use of lights and disturbance to squid spawning.
  - All squid taken must be maintained in a condition to be sold as live bait, not be used as live bait aboard the vessel that took it, and returned to the water prior to the end of the weekend closure if not sold.
  - Vessels intending to use this exemption to take squid for live bait during a weekend closure must notify the Department by email before leaving port on that fishing trip.
- *Lighting Shield Requirements*: Update lighting requirements that reduce light scatter of fishing operations from shielding the entire filament "of each light" to the entire filament "of each *device capable of emitting light*," to accommodate evolving lighting technology.
- *Minor Clarifications*: Make other minor changes for improved clarity and consistency throughout the regulations.

The MRC recommendation approved by the Commission at its December 2024 meeting included requiring electronic logs. The intent was to support the development of electronic logs for future implementation; therefore, electronic log requirements are not included in this rulemaking.

For today's meeting, the Department will give a presentation covering both the draft amended Market Squid FMP (A), and draft proposed amendments to Commission regulations governing the commercial take of market squid (B) (Exhibit 9).

Significant Public Comments (N/A)

Recommendation

Commission staff: (A) Direct staff to work with the Department to update the draft amended FMP to align with proposed regulatory descriptions and the status of seabird species; and (B) authorize staff to publish notice of the Commission's intent to amend commercial market squid regulations as discussed today and recommended by the Department.

Department: (B) Authorize staff to publish notice of the Commission's intent to amend commercial fishing regulations as reflected in exhibits 6 and 7, and identify a proposed effective date of January 1, 2026 for amendments to the regulations.

Exhibits

1. Department memo transmitting draft amended Market Squid FMP, received March 27, 2025
2. 2025 draft *Market Squid,* Doryteuthis *(*Loligo*)* opalescens*, Fishery Management Plan – Amendment 1*
3. *Market Squid Fishery Management Plan*, dated April 1, 2005, with draft 2025 Amendment 1 revisions in track changes
4. 2024 market squid enhanced status report, extracted from the California Marine Species Portal on February 3, 2025
5. Department memo transmitting ISOR, received April 10, 2025
6. Draft ISOR
7. Draft proposed regulatory language
8. Draft Form 399 economic and fiscal impact statement
9. Department presentation

Motion

Moved by _____ and seconded by _____ that the Commission directs staff to work with the Department to integrate updates into the draft Market Squid Fishery Management Plan – Amendment 1, as discussed today, and authorizes the publication of a notice of its intent to amend sections 53.01, 149 and 149.1, and repeal sections 53.02 and 53.03, related to commercial take of market squid.

State of California
Department of Fish and Wildlife

Received 3/27/2025;
Original signed copy on file

M e m o r a n d u m

Date: March 10, 2025

To: Melissa Miller-Henson
Executive Director
Fish and Game Commission

From: Charlton H. Bonham
Director

Subject: **Agenda item for April 16-17 2025, Fish and Game Commission Meeting Re: Receipt of the Draft Market Squid Fishery Management Plan Amendment**

The Department of Fish and Wildlife (Department) is submitting a Draft Amendment to the California Market Squid Fishery Management Plan (Market Squid FMP) to the California Fish and Game Commission (Commission) for receipt at its April meeting.

In 2023, the Department convened a new Squid Fishery Advisory Committee (SFAC) that was charged with reviewing the fishery and advising the Department on potential changes to California market squid fishery management. The amended Market Squid FMP includes information from the Market Squid Enhanced Status Report, SFAC recommendations to proposed management measures, and other updated information regarding market squid.

Receipt of the Markert Squid FMP by the Commission in April will allow for discussion at the June 11-12, 2025, meeting and potential adoption of the Market Squid FMP at the August 13-14, 2025, meeting.

If you have any questions or need additional information, please contact Dr. Craig Shuman, Marine Regional Manager at (916) 215-9694.

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

ec: Chad Dibble, Deputy Director
Wildlife and Fisheries Division

Craig Shuman, D. Env., Regional Manager
Marine Region

Eric Kord, Assistant Chief
Law Enforcement Division

John Ugoretz, Environmental Program Manager
Marine Region

Susan Ashcraft, Marine Advisor
Fish and Game Commission

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.

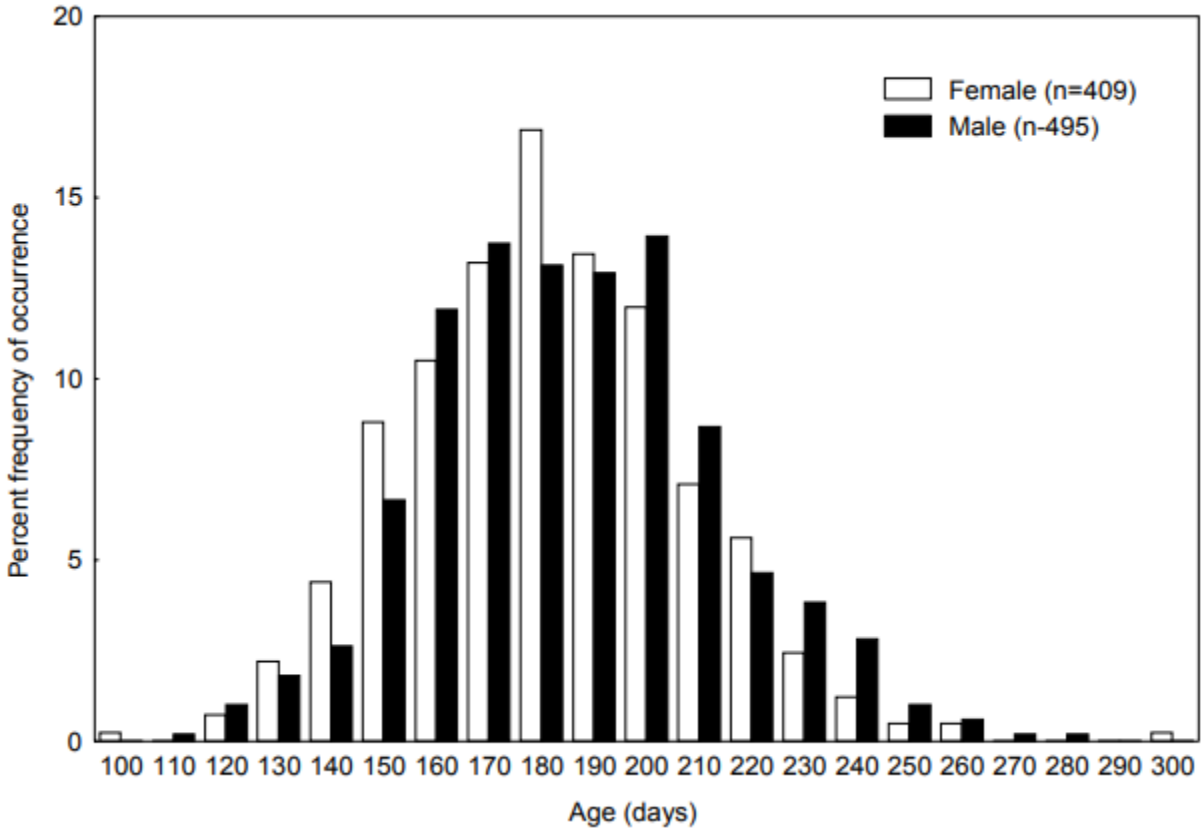


Figure 2-1. Number of market squid by age from port samples by sex. Port samples used to determine percent frequency of occurrence were collected from November 1998 through July 2000 (CDFW Port Sampling database).

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).

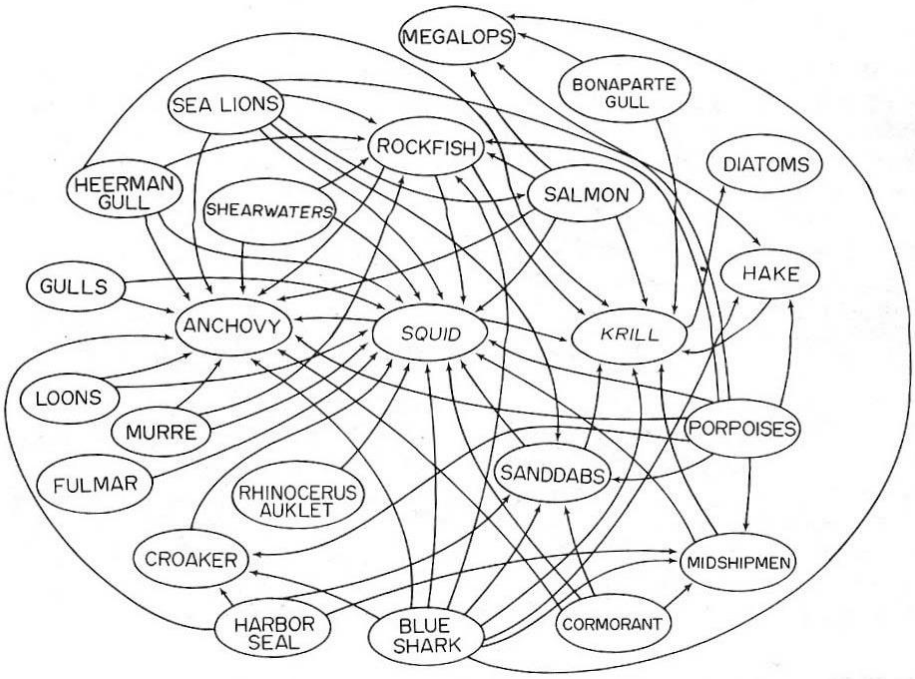


Figure 2-2. Food web for market squid, *Doryteuthis (Loligo) opalescens*, involving commercially important or abundant fish, birds, and marine mammals (from Morejohn, et al. 1978).

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).

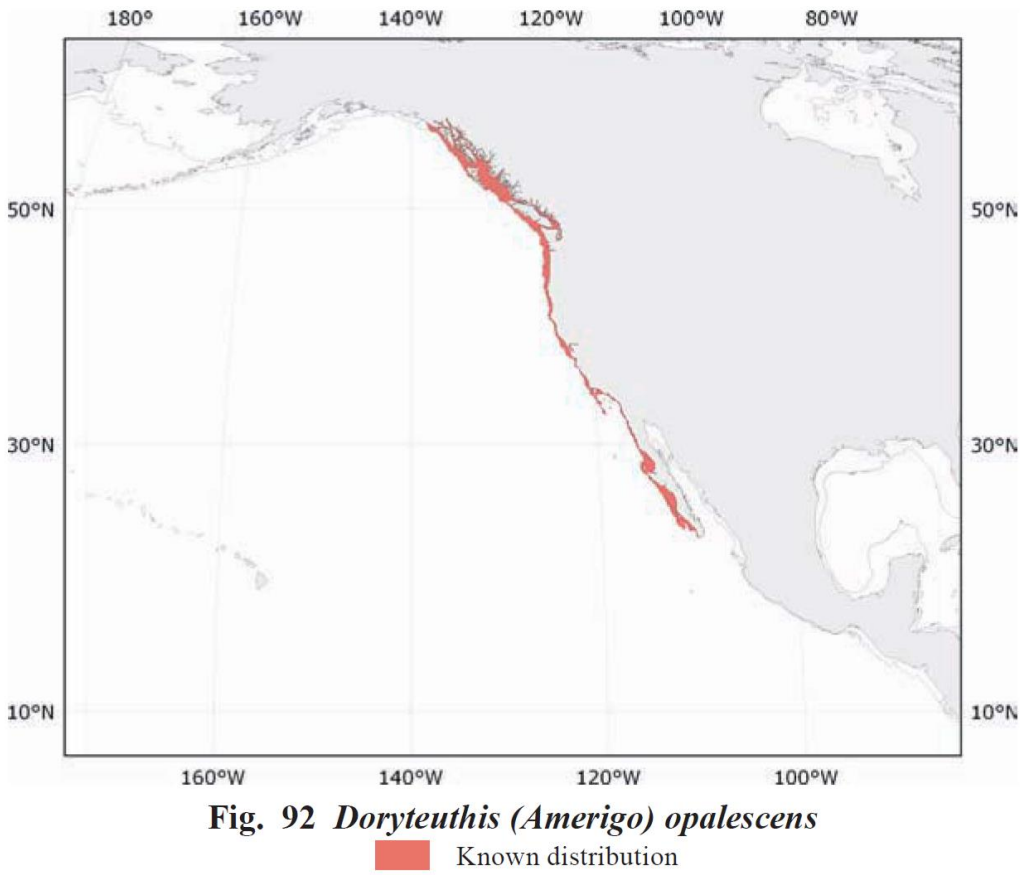


Figure 2-3. Range of market squid (Reproduced from Jereb et al. 2010).

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.

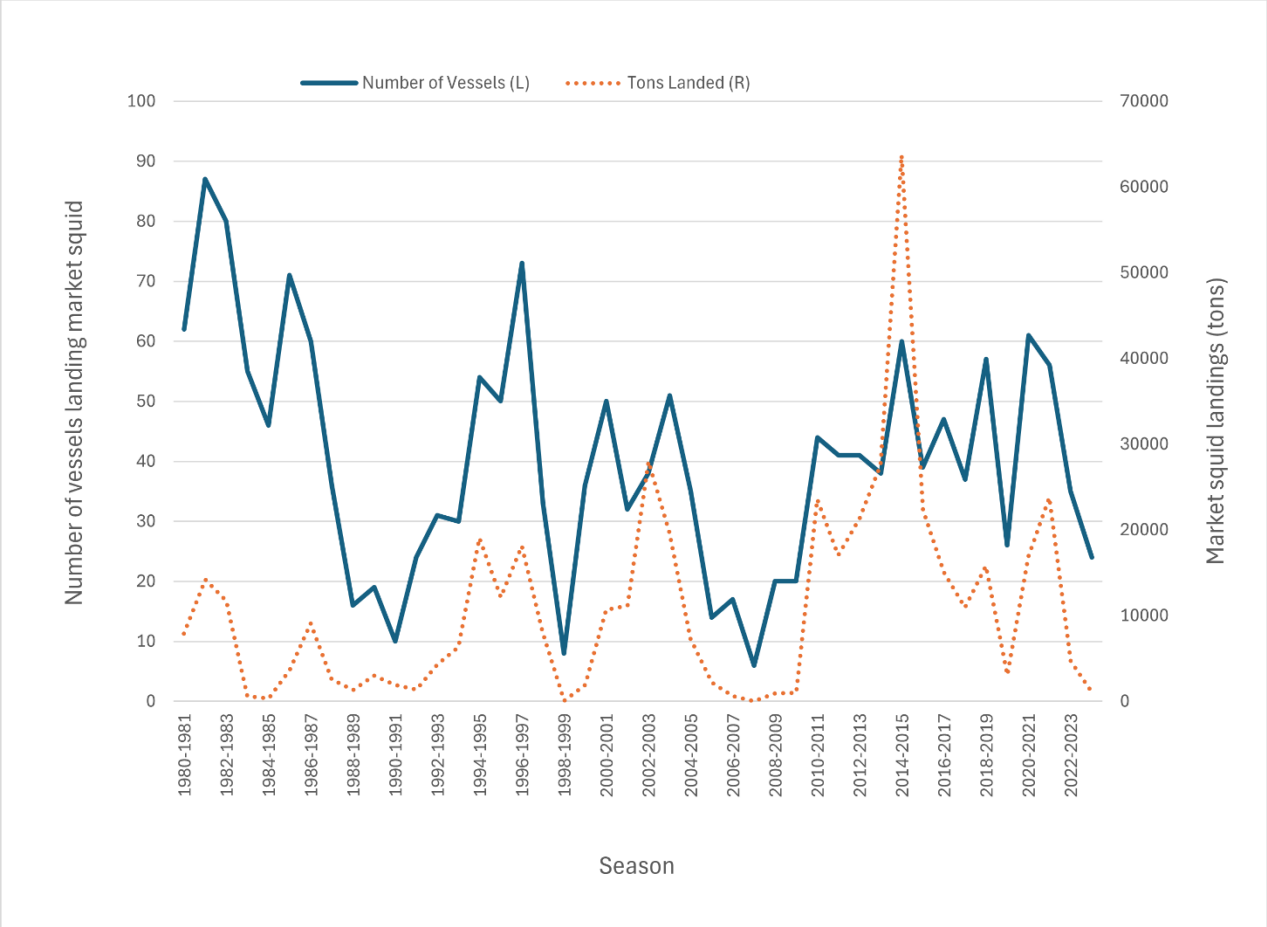


Figure 2-4. Number of vessels and market squid landings by season for Northern California (MLDS).

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.

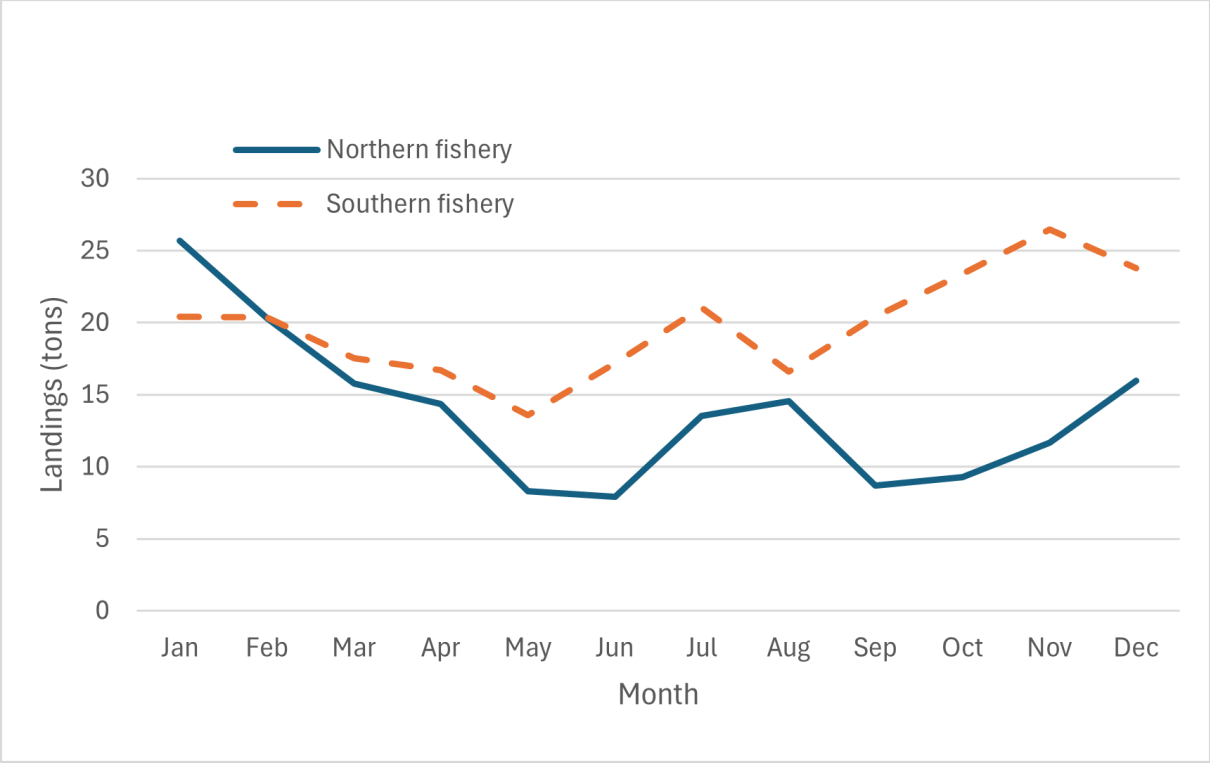


Figure 2-5. Average monthly landings in tons for the market squid fishery divided at Point Conception into northern and southern fisheries from 1969 through 2024 (MLDS).

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.

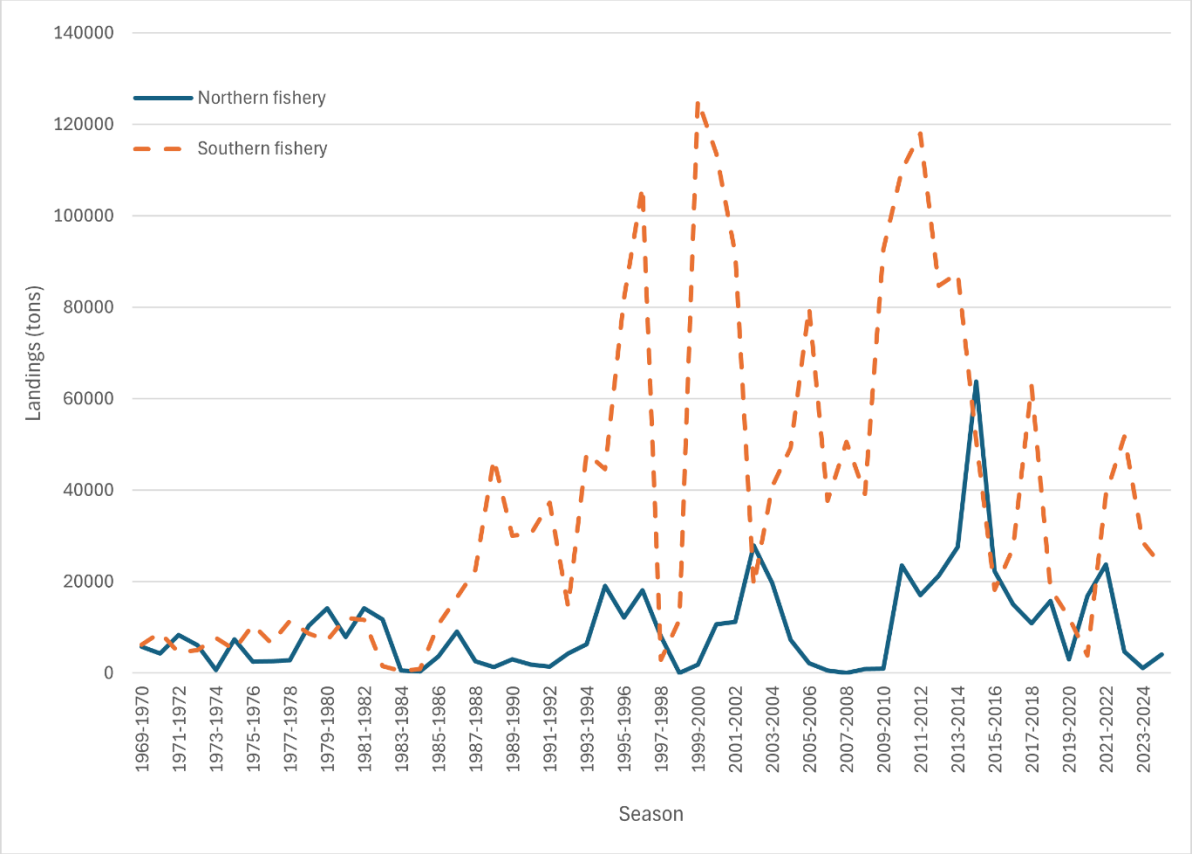


Figure 2-6. Market squid landings in tons from 1969-1970 through 2023-2024 seasons showing the increase in landings for the fishery south of Point Conception (MLDS).

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

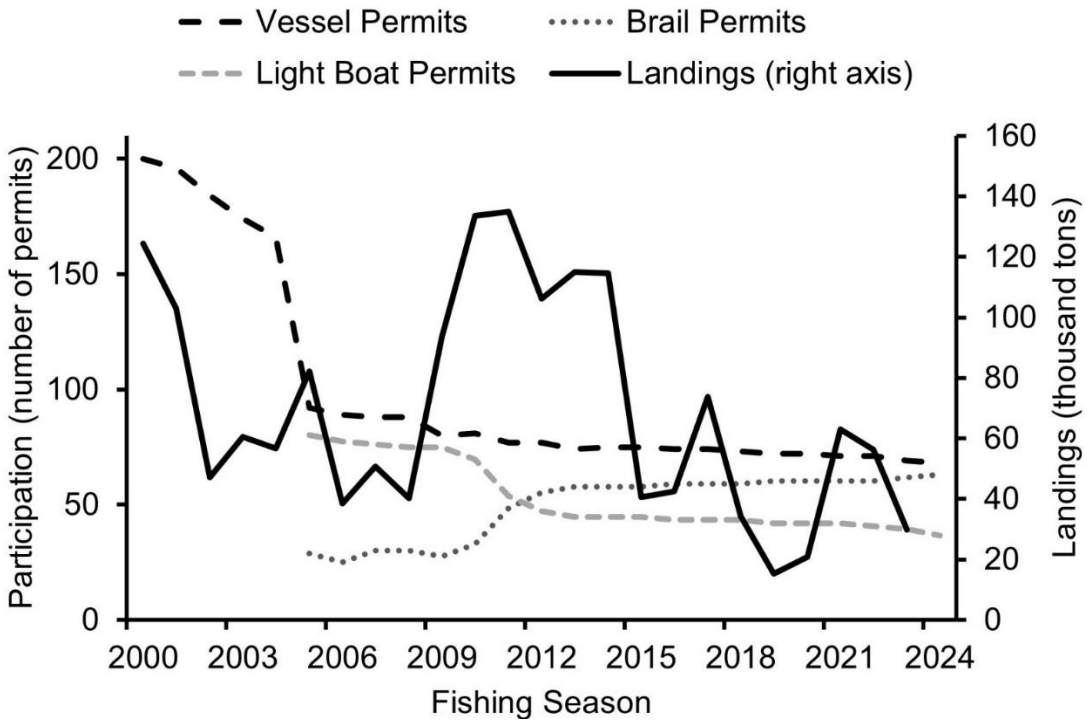


Figure 2-7. Market squid fishery participation (number of limited entry permits by type; left axis) and landings (thousand tons; right axis) from 2000 to 2024 fishing seasons (MLDS).

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).

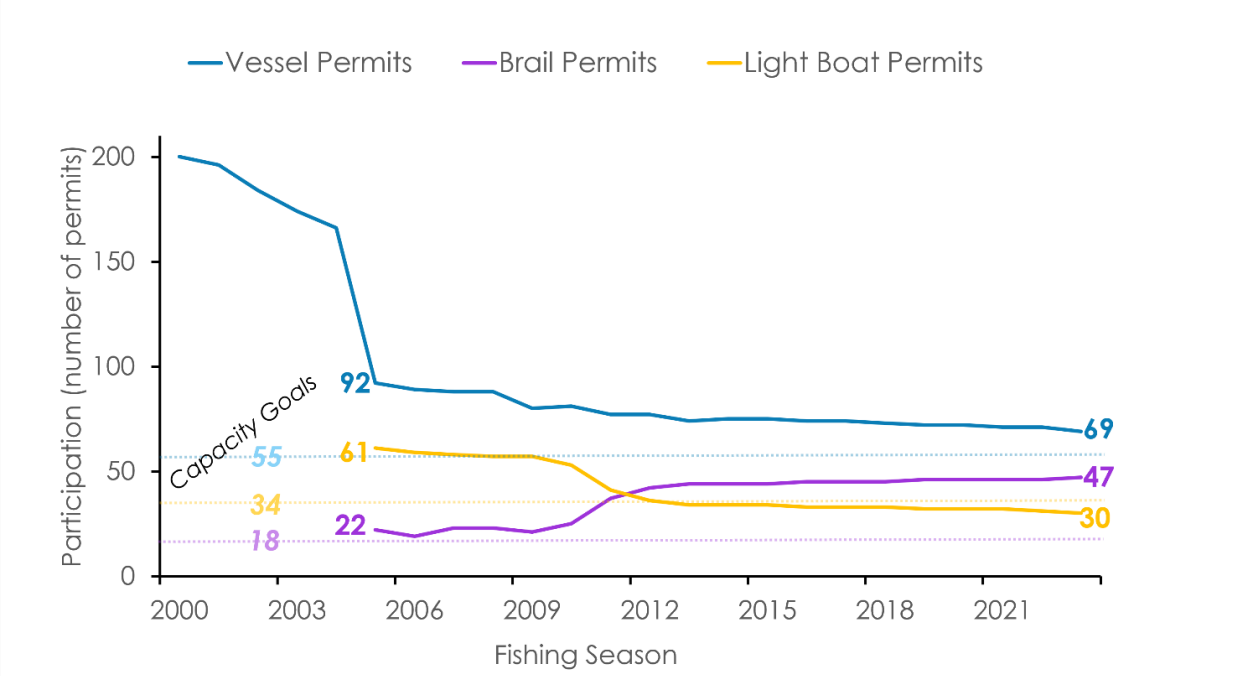


Figure 2-8. Participation (number of permits) in the commercial market squid restricted access fishery from 2000 to 2023. Capacity goals are delineated as dotted lines.

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).

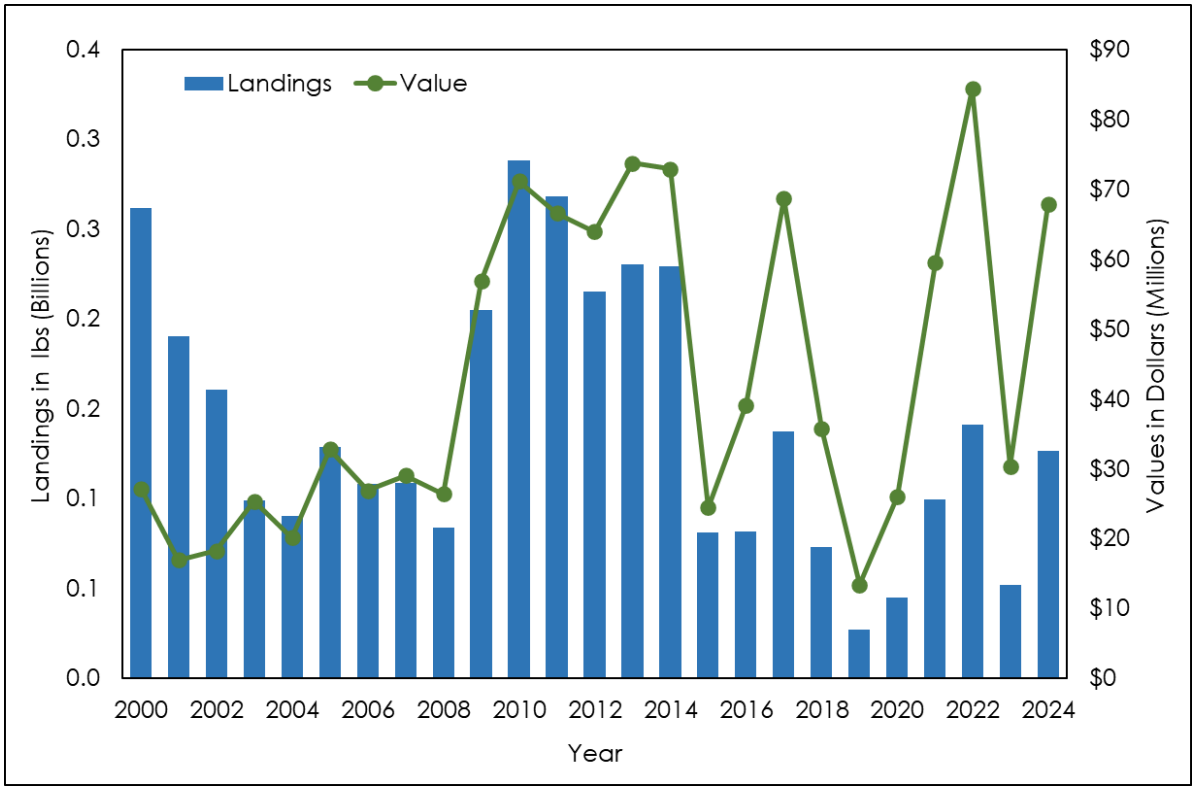


Figure 2-9. Dollars paid ex-vessel and landings in tons 2000 through 2024 (MLDS).

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).

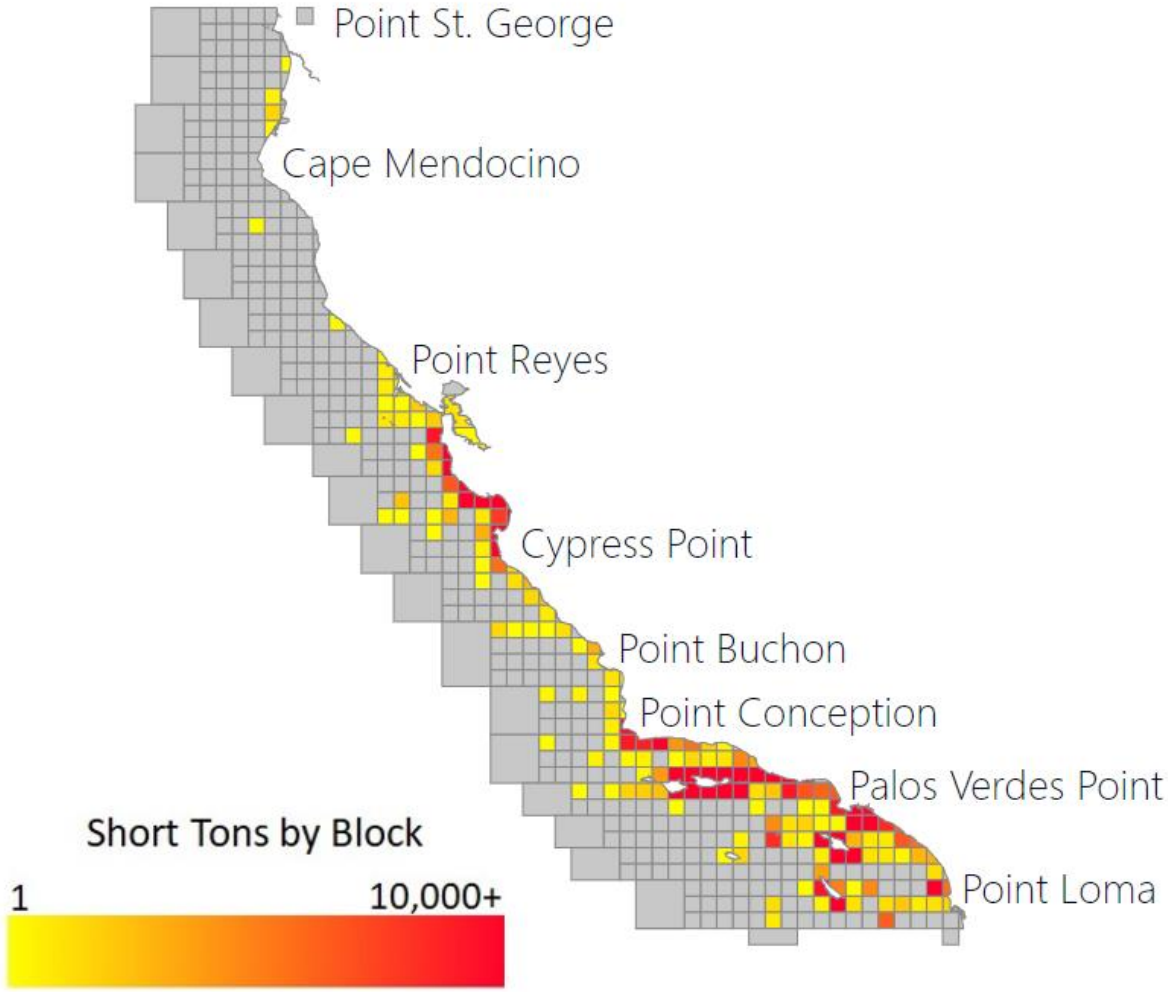


Figure 2-10. Geographic location of major fishing areas in California by CDFW blocks (10' x 10') from 1999 through 2023 (MLDS).

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.

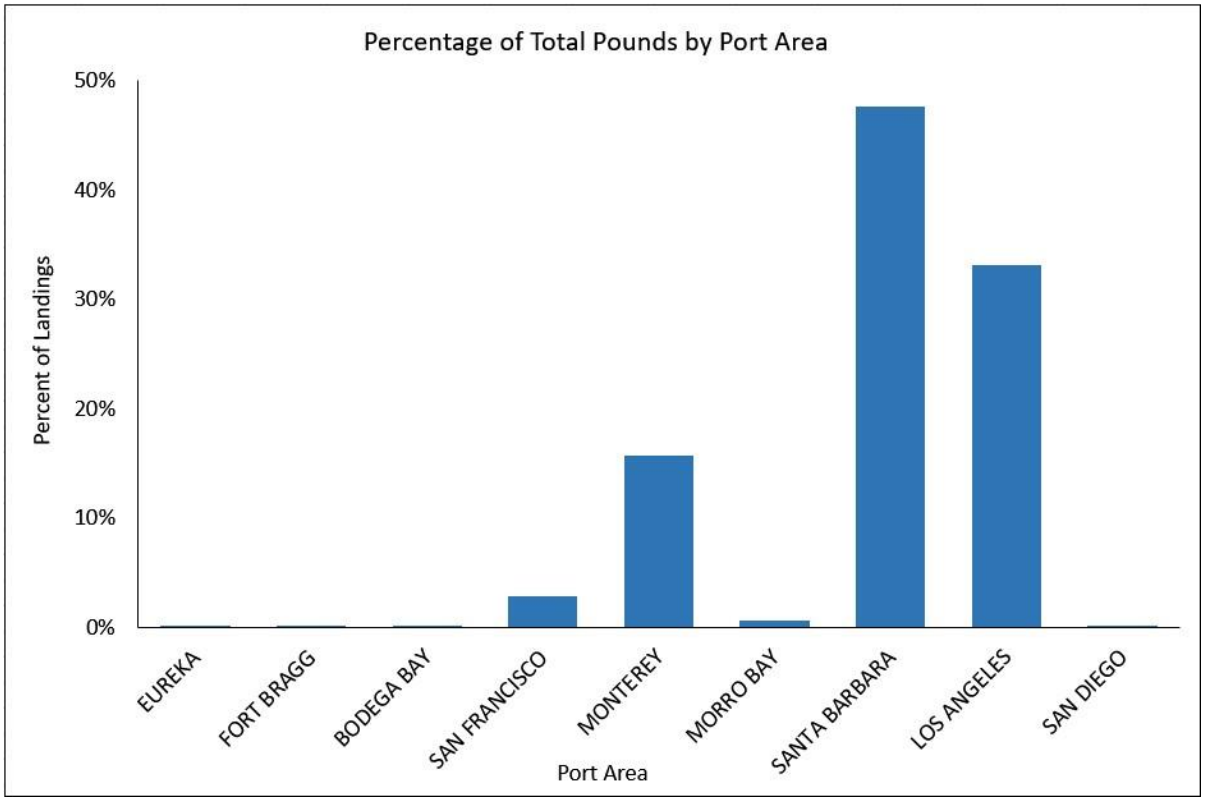


Figure 2-11. Percentage of market squid total landings (by weight) by port complex from 1980 to 2024 (MLDS).

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.

FINAL
MARKET SQUID
FISHERY MANAGEMENT PLAN

01 April 2005

STATE OF CALIFORNIA
RESOURCES AGENCY
DEPARTMENT OF FISH AND GAME
MARINE REGION

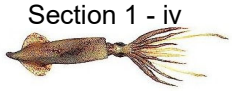
California Department of Fish and Game Marine Region Offices

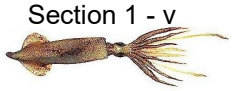
Belmont Field Office and Laboratory Contact: Connie Ryan 350 Harbor Blvd. Belmont, CA 94002 Public Information: (650) 631-7730 FAX: (650) 631-6793	**Los Alamitos Field Office and Laboratory** Contact: Valerie Taylor 4665 Lampson Ave., Suite C Los Alamitos, CA 90720 Public Information: (562) 342-7100 FAX: (562) 342-7139
Bodega Bay Field Office Contact : Tom Moore 1850 Bay Flat Road P.O. Box 1560 Bodega Bay, CA 94923 (707) 875-4260 FAX: (707) 875-4269	**Monterey Field Office and Laboratory** Contact: Travis Tanaka 20 Lower Ragsdale Drive, Suite 100 Monterey, CA 93940 Public Information: (831) 649-2870 FAX: (831) 649-2894
Eureka Field Office and Laboratory Contact: Mike Prall 619 2nd Street Eureka, CA 93940 Public Information: (707) 445-6493 FAX: (707) 445-6664	**Morro Bay Field Office and Laboratory** Contact: Christine Pattison 213 Beach Street Morro Bay, CA 93442 Public Information: (805) 772-3011 FAX: (805) 772-7569
Fort Bragg Field Office and Laboratory Contact: Lucy Johnson 19160 South Harbor Drive Fort Bragg, CA 95437 Public Information: (707) 964-9078 FAX: (707) 964-0642	**San Diego Field Office and Laboratory** Contact: Bob Read 4949 Viewridge Avenue San Diego, CA 92123 Public Information: (858) 467-4213 FAX: (858) 467-4299
La Jolla Field Office and Laboratory Contact: Dale Sweetnam 8604 La Jolla Shores Drive La Jolla, CA 92037 Public Information: (858) 546-7170 FAX: (858) 546-5644	**Santa Barbara Field Office and Laboratory** Contact: Briana Brady 1933 Cliff Dr., Suite 9 Santa Barbara, CA 93109 Public Information: (805) 568-1220 FAX: (805) 568-1235

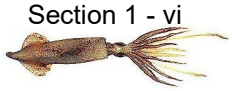
Availability

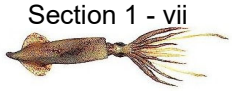
The Final Market Squid Fishery Management Plan is available for reference beginning 1 April 2005 at the CDFG offices listed above. To comply with California's Paper Reduction Act, a CD-ROM of the MSFMP, with Appendices, will be at each office. Copies may be requested by contacting Bob Read, (858) 467-4213, RRead@dfg.ca.gov. Copies are available on CD-ROM, in Braille, in large print, on the computer (via the Web), and on audio cassette. To request a copy in an alternative format, please contact Bob Read (contact information above). The Final MSFMP is also available at http://www.dfg.ca.gov/mrd/marketsquid/index.html.

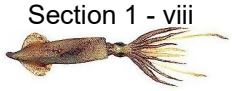
Market Squid Fishery Management Plan
Table of Contents

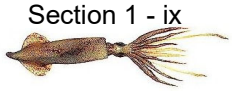


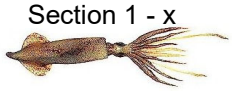




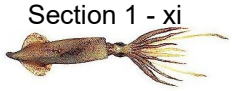


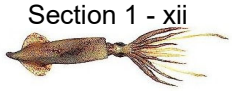




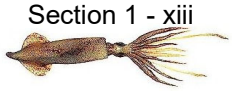


Market Squid Fishery Management Plan
List of Tables

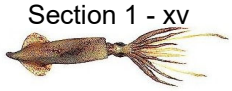




Market Squid Fishery Management Plan
List of Figures



Appendices



Executive Summary

~~The Final Market Squid Fishery Management Plan (MSFMP) is presented in four sections. Section 1 presents background on the California market squid fishery as well as the MSFMP Project. Section 2 includes the environmental documentation (see California Code of Regulations Title 14 §15250-15253). This includes a review of alternatives and options presented to the Fish and Game Commission (Commission) during the adoption process. The environmental document was certified by the Commission as meeting California Environmental Quality Act (CEQA) requirements at its 27 August 2004 meeting. Section 3 includes the regulations that will implement the MSFMP Project's management strategy. Section 4 includes public comments and Fish and Game Department (Department) responses received during the adoption process.~~

~~The market squid~~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. ~~It~~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 ~~this process~~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 ~~Marine Life Management Act (MLMA).~~ 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 ~~develop~~maintain a framework for management that ~~will be~~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 ~~will manage~~manages the market squid resource.

Market squid fishery management~~, as described in Chapter 3,~~ 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 final project and the implementing regulations adopted by the Commission at the 27 August 2004 and 3 December 2004 meetings include:~~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

- ~~Establish a~~A seasonal catch limitation of 118,000 tons~~;~~ **(unchanged)**;
- ~~Continue existing~~Full fishery closures from ~~noon~~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)**;

- ~~Continue existing squid~~ Squid fishery monitoring programs (~~port sampling~~biological monitoring and logbooks~~);~~ **, unchanged)**;
- ~~Continue existing regulations that~~ 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 ~~or incidental take of two tons or less;~~ **(unchanged)**;
- ~~Maintain existing~~Squid lighting wattage ~~requirements~~limits (maximum of 30,000 watts) and ~~modify~~ shielding ~~requirements~~regulations that require the lower edges of the lighting shields ~~shall~~ 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

- ~~Establish a~~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)**;

~~• Initial Issuance of Permits:~~
~~o Transferable vessel permits - possession of a current market squid vessel permit (2004-2005) and a minimum of 50 landings in a window period (January 1, 2000 through March 31, 2003);~~
~~o Transferable brail permits - possession of a current market squid vessel permit (2004-2005) and a minimum of 10 landings made with brail gear in a window period (January 1, 2000 through March 31, 2003);~~
~~o Transferable light boat permits - possession of a current market squid permit (either vessel or light for 2004-2005) and have submitted one light boat log by December 31, 2000;~~
~~o Non-transferable vessel permits - possession of a current market squid vessel permit (2004-2005), possessed a California commercial fishing license for at least 20 years and made a minimum of 33 squid landings at any time prior to August 27, 2004;~~
~~o Non-transferable brail permits - possession of a current market squid vessel permit (2004-2005), possessed a California commercial fishing license for at least 20 years and made a minimum of 10 landings with brail gear during one fishing season in a window period (January 1, 2000 through March 31, 2003);~~

- ~~Establish annual~~Annual permit fees ~~at:~~ 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;
- ~~Establish full~~Full transferability of ~~market squid vessel permits~~Market Squid Vessel Permits based on comparable capacity (within 10%); establish transferability of ~~market squid vessel permits~~Market Squid Vessel Permits to a vessel of larger capacity under a "2 for 1" permit retirement~~;~~ **(unchanged)**;
- ~~Establish full~~Full transferability of ~~market squid brail permits~~Market Squid Brail Permits based on comparable capacity~~;~~ **(unchanged)**;
- ~~Establish full~~Full transferability of ~~light boat permits~~Market Squid Light Boat Permits and establish an upgrade from a ~~light boat permit~~Market Squid Light Boat Permit to a ~~transferable brail permit~~Transferable Market Squid Brail Permit on a "1 for 1" permit retirement;
- ~~Set the~~An initial transfer fee at $500, and an upgrade fee of $1500~~;~~ **(unchanged)**;

- ~~Establish 3 experimental non-transferable market squid vessel permits;~~

Acknowledgements

~~Hunter, John, Ph. D~~

~~Sydeman, William, Ph. D~~

~~Thomson, Cindy, Ph. D~~

~~Squid Fishery Advisory Committee (SFAC) Members:~~

The Department would like to thank the members of the Squid Fishery Advisory Committee who helped with the ~~MSFMP. Participants on the committee were:~~2024 review of market squid fishery management, regulations and science.

~~Domeier, Michael, Ph. D (Chair)~~

2024 Squid Fishery Advisory Committee Members:
Allen Akselrud, Caitlin
Ashley, Richie
Augello, Ryan
Barry~~Amoroso, Orlando~~

~~Borman~~, John
Bates, Ken*
Cappuccio, Joe~~Brockman, Donald~~
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 ~~has been~~was in analysis and design phases ~~since~~beginning in January 2001. The efforts of many ~~CDFG~~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 ~~have~~ contributed to the ~~final~~2005 document. The Department acknowledges the concerted work of ~~the~~ all ~~of these people.~~ individuals who contributed to the development of the MSFMP. For a listing of ~~these~~ contributors, please refer to the Draft MSFMP dated 12 April 2004.

MSFMP Lead Authors and Editors:
The ~~Final~~2005 MSFMP ~~is~~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 ~~includes~~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. ~~FWS~~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 ~~scientists~~external experts to review any proposed Fishery Management Plan. The MSFMP Peer Review Panel ~~analyzes~~analyzed the strengths and ~~weakness~~weaknesses of the FMP and ~~recommends~~recommended strategies that ~~will guide~~guided and ~~secure~~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
~~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 ~~this important~~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. ~~The growing~~In the 1990s, the international market for squid and declining squid production from other parts of the world ~~has resulted in an~~ increased demand for California market squid~~. That demand~~ and resulted in rapid growth in the number of vessels harvesting squid and the ~~amount~~volume of squid harvested. ~~In order to~~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 ~~that sustains both~~to sustain the squid population and the marine life ~~that depends~~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 ~~will~~ support ~~these~~management objectives completes ~~this~~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. ~~This legislation,~~ Senate Bill (SB) 364 (Sher~~),~~) was incorporated into Fish and Game Code (FGC) §8420-8429.7 which identified the problem as follows:

(a) ~~(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) ~~*(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) ~~*(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) ~~*(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) ~~*(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.

~~This~~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, ~~a~~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 ~~a~~an MSFMP.

The Legislature recognized that little ~~is~~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. ~~This~~The program ~~has and will continue~~continues to provide critical information necessary to ~~the development of sound~~ 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. ~~Some of this research examined market squid life history and discovered~~Research showed that the lifespan of market squid is less than one year~~. Fishery dependent research shows~~, and that market squid availability, and likely their abundance, is highly variable among seasons. ~~These~~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 determined a 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. 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, 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

~~1.1.2.~~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 ~~the California Code of Regulations (~~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. Generally, market squid are harvested nearshore on sandy bottom habitats. ~~Landing records indicate that the fishery is~~Seasonal shifts in resource availability and timing of peak market squid spawning results in vessel participation

typically concentrated in two distinct fishing areas~~: Monterey Bay, central California in the summer~~ and ~~the~~ Southern California Bight~~, primarily around the Channel Islands. Thirty years ago, the commercial fishery was primarily focused in Monterey Bay; however, since the 1985-1986 season the vast majority of the catch is taken from the Southern California Bight. An in-depth description of the habitat preferences and life history characteristics of market squid is found in Chapter 2.~~ (SCB) in the late fall and early winter.

~~1.1.3~~ 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)]. ~~This~~The goal includes the conservation of healthy and diverse marine ecosystems and marine living resources [FGC §7050(b)(1~~)]. To achieve this goal, the MLMA calls~~)], 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~~ and the NFMP~~.

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

1. ~~1.~~ Conserve the health and diversity of marine ecosystems and marine living resources [FGC §7050(b)(1)].
2. ~~2.~~ Allow and encourage only those activities and uses of marine living resources that are sustainable [FGC §7050 (b)(2)].
3. ~~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

~~At the core of the MLMA is the principle of basing decisions on sound science and other useful information. With this in mind, the~~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. ~~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. ~~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. ~~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. ~~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. ~~2.~~ Allow fishery participants to propose methods to prevent or reduce excess effort in market squid fishery [FGC §7056(e)].
3. ~~3.~~ Involve constituents in preparing Fishery Management Plans (FMPs) [FGC §7076(a)].
4. ~~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, ~~as many of these purposes~~ should be encouraged ~~as~~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 ~~sport~~ 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 ~~EFI~~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/

~~1.1.4~~ .

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. ~~1.1.5~~ Constituent Involvement

The MLMA calls for meaningful constituent involvement in the development of each ~~fishery management plan (~~FMP~~),~~ and requires the Department to develop a process to involve interested parties in ~~that process.~~ 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 (~~PCR~~PRC) §21080.5(d)(2); see also CCR Title 14~~,~~ §781.5]. The MSFMP 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. ~~These~~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 ~~these~~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. ~~This document~~ 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. ~~Based on those reviews~~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~~. It does so by embracing~~ and embraces the principle of adaptive management. The MLMA defines ~~this principle~~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)]. ~~This process mirrors the federal government's process~~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 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. ~~1.2.1~~ Process of Plan Review

The MLMA requires public and peer review for all ~~fishery management plans (~~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.

~~1.2.2~~ Following adoption of the amended MSFMP, 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: 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 itself to implementing a routine administrative matter, such as closing the fishery when seasonal catch limit (SCL) is reached. Brief descriptions of each ~~of these types~~action type and the conditions for their use follow.

~~1.2.2.1~~ *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 does not adequately provide effective management of the market squid fishery. Under such circumstances, the Commission could amend the MSFMP.

The MSFMP must be amended if the change in management is a major or controversial action outside the scope of the MSFMP. 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 ~~will~~may require environmental analysis of proposed changes under CEQA.

~~1.2.2.2~~ *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~~full rulemaking process is required. This process, which must follow standard

Administrative Procedures Act procedures, normally requires at least three Commission meetings. ~~Full Rulemaking~~full rulemaking may also be used to declare a management measure "routine." In the ~~Full Rulemaking~~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 ~~of the Department (Director)~~ or the Commission to take emergency regulatory action under FGC §7710, California Government Code (CGC) §11346.1, or FGC §240.

~~1.2.2.3~~ *Notice Actions*

Once a measure (such as establishing annual catch quotas) has been classified as routine through the ~~Full Rulemaking~~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.

~~1.2.2.4~~ *Prescribed Actions*

When an action is non-discretionary and the impacts have already been analyzed through ~~Full Rulemaking~~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~~full rulemaking process that authorized the Prescribed Action must specify methods for notifying the public.

1.5.1.2. ~~1.2.2.5~~ 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 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. ~~This~~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, the Department ~~will~~may present ~~the results of this review~~such information to ~~the~~an advisory committee(s) established under the MSFMP 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 ~~needs to~~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 or a full rulemaking action for the regulations implementing it.

1.6. ~~1.3~~ 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. ~~1.3.1~~ 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." ~~[~~PCR[PRC §21000(b)] CEQA also codifies State policy to, among other things, ~~"[p]revent~~"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., ~~PCR~~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" [~~PCR~~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., ~~PCR~~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., ~~PCR~~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 ~~projects~~ required to be approved by public agencies" (Id., ~~PCR~~PRC §21001.1).

Unlike its "procedural" federal counterpart, the National Environmental Policy Act ~~(NEPA)~~ (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; ~~PCR~~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 ~~EIRs (~~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 ~~recently~~ 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. ~~1.3.1.1~~ Functional Equivalent

There is ~~one~~an alternative to the CEQA ~~Environmental Impact Report (~~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 (~~PCR~~PRC §21080.4 of CEQA). With certification, an agency may prepare functional equivalent environmental documents (ED) in lieu of EIRs or NDs (~~PCR~~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 ~~environmental document~~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. ~~1.3.1.2~~ MSFMP Environmental Document

The ~~Environmental Document (~~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 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 ~~Market Squid Fishery Management Plan's Environmental Document~~MSFMP's ED for consistency with the provisions of ~~the California Environmental Quality Act~~CEQA and adopted the MSFMP. As the amended FMP 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. ~~1.3.1.3~~ Federal Law

The Federal government manages the marine resources and fishing activities of the United States (~~US~~)U.S.) through the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). The purpose of the MSFCMA is to provide conservation and management of ~~US~~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, ~~United States~~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 ~~Fishery Management Plan~~FMP (CPS FMP~~). Under this plan, two species are actively managed:~~) including Pacific sardine ~~and~~*(Sardinops sagax)*, Pacific mackerel~~; three species are monitored only:~~ *(Scomber japonicus)*, northern anchovy~~,~~ *(Engraulis mordax)*, jack mackerel~~,~~ *(Trachurus symmetricus)*, and market squid~~. The~~ *(Doryteuthis opalescens)* (PFMC ~~delegated management authority for market squid to the State.~~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~~).

~~1.6.4.1.~~1.6.5.1. ~~1.4.1~~ 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.~~

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. ~~A~~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.

~~1.6.4.2.~~1.6.5.2. ~~1.4.2~~ 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.

~~1.6.4.3.~~1.6.5.3. ~~1.4.3~~ 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.

~~1.6.4.4.~~1.6.5.4. ~~1.4.4~~ Rulemaking Process under the Administrative Procedures Act (APA)

The California Constitution and Legislative statutes create public entities and can authorize them to make regulations ~~in order~~ to carry out their duties. The APA of the ~~California Government Code (~~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 ~~Fish and Game Code.~~ 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~~

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

2.1. ~~2.1~~ Species Description

~~Squid (also referred to as Cephalopods) belong to the~~ Market squid (*Doryteuthis (Loligo) opalescens*) or opalescent squid, are part of the class Cephalopoda ~~of~~and the phylum Mollusca~~. There are approximately~~ (Berry 1911). Approximately 750 recognized species of squids ~~alive~~are recognized today and more than 10,000 fossil forms of cephalopods. ~~Squid have large, well-developed eyes and strong parrot-like beaks. They use their fins for swimming in much the same way fish do and their funnel for extremely rapid "jet" propulsion forward or backward. The squid's capacity for sustained swimming allows it to migrate long distances as well as to move vertically through hundreds of meters of water during daily foraging (feeding) bouts.~~

~~The common name for *Loligo opalescens* Berry, 1911 is market squid or opalescent squid. At a recent international cephalopod meeting (February 2003), the consensus was that, based on morphology and molecular evidence, the scientific name for market squid should be changed to *Doryteuthis (Amerigo) opalescens* (F. G. Hochberg, pers. ~~comm.~~). This has not been formalized nor published. Current authority for the squid fishery [Fish and Game Code (FGC) §8420] refers to *L. opalescens* as "market squid" and this common name is used throughout the Market Squid Fishery Management Plan (MSFMP) (FGC §8045).~~

Market squid belong to the family Loliginidae~~. These squid~~ and generally have a mixed, iridescent (opalescent) coloration of milky white and purple; however, color changes can occur rapidly ~~in response to environmental conditions.~~. Similar to most squid species, market squid possess an ink sac~~, which~~ that serves as a defense mechanism by expelling ink to confound predators. ~~Market squid are less than 3 mm at hatching and grow to an average mantle length of 152 mm at the time of spawning.~~ 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 ~~lifespan. In California, commercial fisheries target adults during spawning events. Recent age studies indicate that squid are a semi-annual species; the average age of squid taken in the fishery is six months (range 4-~~ life span (6 to 10 months~~,~~ after hatching) (Butler et al. 2001).

~~2.1.1~~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, ~~Stock Biomass, Genetic Stock Structure~~ and Migration

~~The range of market~~Market squid ~~is~~range from the southern tip of Baja California, Mexico ~~(23° N latitude)~~ to southeastern Alaska ~~(55° N latitude).~~. Juveniles and adults range throughout the California and Alaska Current systems (~~Roper~~ 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 ~~Sweeney 1984). Paralarvae, the life stage of~~southern California in winter months (Hardwick and Spratt 1979).

Ocean currents disperse newly hatched market squid ~~at the time of hatching,~~(called paralarvae) off egg bed areas. Paralarvae are ~~often collected in the waters closer to the shoreline (~~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). ~~Their~~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).

~~The California fleet currently fishes only adult squid during spawning events in limited geographic areas. The abundance of market squid at these known fishing areas is dramatically affected by environmental conditions, especially during El Niño events (when landings are minimal).~~
~~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.~~
~~Little is known about the present size, age structure, or status of the market squid population. At present, no direct, statistically valid population estimates are available.~~

~~Genetic analyses have not been successful in distinguishing separate stocks within the California fishery. Both Gilly (2003) and Reichow and Smith (~~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. ~~Although~~While Gilly et al. (2001) found slight but significant genetic ~~distances~~differences between samples taken from central California and southern California, no temporal or spatial genetic differences for market squid within the ~~Southern California Bight~~SCB and no temporal differences between samples in the Monterey areas were evident.~~ Presently, additional genetic research is now focusing on genetic differences at the extremes of the market squid range (Alaska and Baja California). Thus, the number of different stocks or subpopulations of market squid along the entire Pacific Coast is unknown at this time.~~

~~Market squid paralarvae are dispersed off egg bed areas by ocean currents and are found most commonly inshore, concentrated in areas where water masses converge (Okutani and McGowen 1969, Zeidberg and Hamner 2002). Although they are often widely distributed, the migration patterns of juveniles and prespawning adults are unknown. Midwater trawl surveys in 1999 collected juvenile market squid at 45% of the stations throughout the Southern California Bight (CDFG, unpublished data). Adult market squid migrate from pelagic waters to nearshore areas and form dense aggregations for spawning. Their vertical distribution during daylight hours ranges from 100 to 600 meters. At night, adults are located within the upper 100 m of the water column (Zeidberg and Hamner 2002).~~

2.3. ~~2.1.2~~ 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 ~~was~~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~~ of these invertebrates. .~~ Daily ring deposition has been validated for several squid species including *L. 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, ~~b~~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 ~~millimeters~~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:

$$~~\text{The}~~W = 0.000051L^{2.8086}$$

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 ~~fishery~~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 ~~California targets~~) 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 ~~squid that are believed to die shortly after spawning, thus, samples collected directly~~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 ~~fishing vessels are assumed to represent squid at or very near the end of their life span. From~~ port samples collected from November 1998 through July 2000~~, 908 statoliths were aged (Figure 2-1).~~ . The mean age of harvested market squid was 188 days. ~~The average male (190 days) was slightly older than average female (186 days); however, the range for females (108 - 302 days) was broader than males (114 – 281 days).~~ More than 99% of the squid aged could be sexed, suggesting that the fishery primarily targets mature squid.

~~The age data exhibit little variation between months. This strongly suggests that a new cohort, a group of squid spawned during a certain period, enters the fishery almost monthly. Further, ageing techniques indicate that the average market squid lives approximately six months, but may be sexually mature as early as 3.6 months (108 days) and can spawn as late as 10 months (302 days). Less than 1 percent (4/908 or 0.4%) of the squid aged could not be sexed, demonstrating that sexually immature squid are rare among spawning or harvested 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.

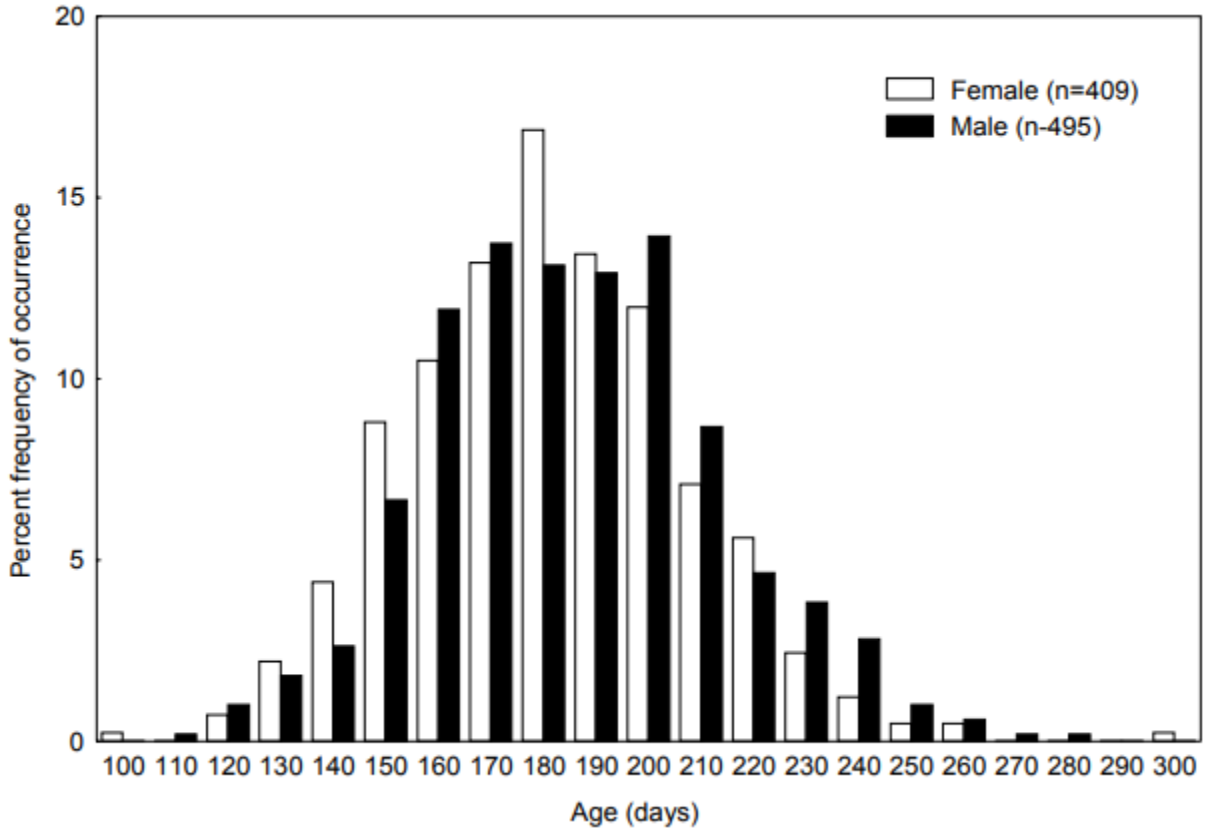


Figure 2-1~~2-1.~~. Number of market squid by age from port samples by sex. Port samples used to determine percent frequency of occurrence were collected from November 1998 through July 2000 (CDFW Port Sampling database).

~~Reproduction, Seasonality and Fecundity~~

2.4. Reproduction, Fecundity, and Spawning ~~market squid tend to congregate in dense schools, usually over sandy habitats where they deposit extensive egg masses. In~~ 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~~, while in~~. In southern California, spawning ~~events~~tends to begin around October and end in April or May. The seasonality ~~in~~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. ~~Male~~Gametes are exchanged directly, with male squid ~~place~~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 ~~(egg cases),~~ 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 ~~(numbers are reduced in Oregon). Further, the number of eggs within a capsule~~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. ~~Market squid~~

~~have been reported to die after completing their first and only spawning period (McGowan 1954, Fields 1965), but the duration of the spawning period is unknown. Recently, Hanlon et al. (2004) observed that females can spawn multiple times within a spawning period and do not die immediately after a single spawning event. In Monterey, spawning has been observed during daylight hours (Forsythe et al, 2004) as well as during the night (CDFG, unpublished data~~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).

~~The lifetime fecundity of market squid is a critical life history trait; fecundity must be known to estimate the biomass using either egg deposition or larval production methods (Hunter and Lo 1997).~~ Macewicz et al. (2001a, 2001b, 2004) found that female~~ Macewicz et al. (2001b, 2003) found that~~ 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 ~~dorsal mantle length~~DML of ~~129mm,~~129.0 mm (5.1 in), the potential fecundity is 3,844 eggs~~which increases with increasing length (Potential fecundity = 29.8 * dorsal mantle length (Macewicz et al. 2003).~~. 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.

~~Squid~~ 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 M 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~~. No spawner-recruit relationship has been demonstrated. These observations suggest~~, suggesting that the entire stock is replaced annually, even in the absence of fishing. ~~Thus, the stock is entirely dependent on successful~~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 ~~that~~ occurs ~~throughout each year coupled with good survival of recruits to adulthood.~~, and it is thought that their fast growth and high metabolic rates contribute to these high natural mortality rates (O'Dor and Webber 1986).

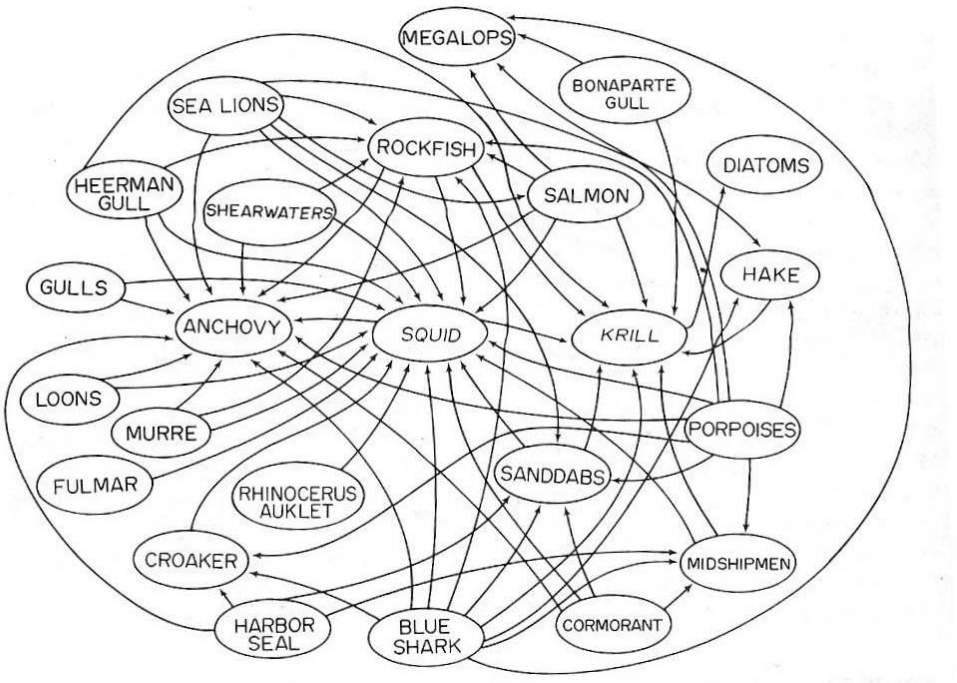


Figure 0-1

~~Total mortality (natural and fishing)~~. 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 ~~(Maxwell 2001)~~ based on squid ageing data (~~squid from six to 10 months)~~ ~~(~~Maxwell et al. 2005; Butler~~,~~ et al. 2001~~). Full recruitment of market squid into the fishery occurs at six months. Additional studies on market squid mortality are needed.)~~

2.6. Associated Species

Several marine worms ~~utilize the~~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 (~~Benjamins 2000).~~ 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. ~~These parasites~~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* ~~is~~was thought to be a predator of market squid eggs~~. This worm~~, because it has been found inside squid egg capsules (~~MacGinite and MacGinite 1949) but~~Fields 1965). In fact, *C. ovincola* eat the outer casing of the egg capsule, not the embryo itself (Zeidberg et al. 2011a). *Capitella ovincola* does not appear to affect squid fitness either by decreasing the egg hatching rate or triggering premature hatching (Morris et al. ~~1980).~~ 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).

~~2.4.~~2.7. ~~2.1.6~~ Predator/Prey Relationships

~~2.4.1.~~2.7.1. ~~2.1.6.1~~Market Squid as Predators

Market squid feed on a variety of prey during their life cycle. As larvae and juveniles, squid consume copepods and ~~euphasiids. These fast-moving prey items are a challenge to young squid; they enhance the development of prey-capture and escape skills (Preuss and Gilly 2000).~~ euphausiids. As adults, market squid feed on fish, polychaete worms, squid (cannibalism), and

crustaceans such as shrimp and pelagic red crab. ~~Also,~~Market squid ~~are~~feed with and likely upon coastal pelagic species and have also been found in commercial catches of ~~anchovies, sardines,~~northern anchovy, Pacific sardine, Pacific herring~~,~~ (*Clupea pallasii*), Pacific mackerel, jack mackerel and ~~sauries~~Pacific saury (*Cololabis saira*) where they feed with and most likely upon these fish (Fields 1965). ~~In Monterey Bay, larger squid have been found to feed chiefly on fish and cephalopods; however, there are significant differences in prey intake between depth and location rather than size classes (Karpov and Cailliet 1979).~~

Prey composition fluctuates with squid age, size, by depth and location, and reproductive status~~, as well as, spatially.~~ (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, ~~euphasiids~~euphausiids and copepods were dominant prey items, while true cannibalism (intake of whole cephalopods) and fish consumption dominated in shallow waters.

~~2.4.2.~~2.7.2. ~~2.1.6.2~~Market Squid as Forage

Market squid are an integral part of the food web to many marine ~~vertebrates.~~ 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 ~~utilize~~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 ~~an important~~a prevalent dietary component of ~~the sea otter, northern elephant seal, northern fur seal, California sea lion (Lowry and Carretta 1999), Dall's porpoise, Pacific striped dolphin, Risso's dolphin, toothed whales such as the short-finned pilot whale (Hacker 1992), the sperm whale, and the bottlenose whale (Fields 1965). In addition, seabirds such as the common murre, ashy storm-petrel, black storm-petrel, fork-tailed storm-petrel, and rhinoceros auklets feed on market squid~~ marine mammals (Sinclair 1992; Fields 1965) and seabirds (Morejohn et al. 1978). In Monterey Bay, 19 species of fish were found to feed ~~upon~~on market squid, including many commercially ~~important~~fished species such as Pacific bonito~~,~~ (*Sarda chiliensis*), salmon, halibut, and tuna (Figure 2-2) (Fields 1965~~,~~; Morejohn et al. 1978~~) (Figure 2-2). These fishes include all depleted,~~

~~threatened, and endangered salmon stocks along the coast. In fact predators~~). Predators from many trophic levels ~~utilize~~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).

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

~~Understanding how an ecosystem functions requires information on the trophic relationships of key species, including squid (May et al. 1979, Sydeman et al. 1997, Furness and Tasker 2000). Under MLMA, the Department must consider ecosystem impacts of a fishery, namely the conservation of not only the exploited species, but the other species that depend on that resource. In order to assess these fishery impacts on other species that also compete for that resource it is necessary to know how much that competitor depends on that resource. In fisheries which target lower trophic levels, such as market squid or sardines, natural predators are often thought of as competitors for the fishery resource (May et al. 1979, Dayton et al. 2002). At present, we do not have a complete understanding of the dynamics of many of these trophic relationships for squid; therefore, as additional research becomes available it will be incorporated into the MSFMP to better manage this fishery.~~

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*

Common Names	**Scientific Names**
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*
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*

Common Names	**Scientific Names**
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*

Common Names	**Scientific Names**
Rockfish (many species)	*Sebastes spp.*
Striped bass	*Morone saxatilis*
Barred sand bass	*Paralabrax nebulifer*
Kelp bass	*Paralabrax clathratus*
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 ~~the diet that~~ squid ~~makes up~~in predators' diets varies dramatically between species, geographical location, and environmental conditions. Most squid predators are not squid specialists~~, i.e.,~~ - squid is rarely the sole prey item~~; because of its highly variable abundance, squid~~. Squid cannot be relied on as a stable food source~~, additionally, it has~~ because of its highly variable abundance and limited energetic value (O'Dor and Webber 1986). Therefore, squid predators often ~~must~~ 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). ~~In terms of frequency-of-occurrence, the presence of squid varies dramatically.~~ For diving birds such as ~~rhinoceros~~rhinoceros auklets~~,~~ *(Cerorhinca monocerata),* common murres, ~~artic~~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 ~~important as forage to a long list of fish and they serve as an important food source~~ also prey for ~~many larger pelagic fish that are commercially and recreationally important~~commercial and recreational fishes, such as white seabass~~,~~ *(Atractoscion nobilis),* yellowtail~~,~~ *(Seriola dorsalis),* kelp bass~~,~~ *(Paralabrax clathratus),* barred sand bass~~, California~~ *(Paralabrax nebulifer),* Pacific barracuda~~,~~ *(Sphyraena argentea),* California halibut~~,~~ *(Paralichthys californicus),* and other nearshore species.

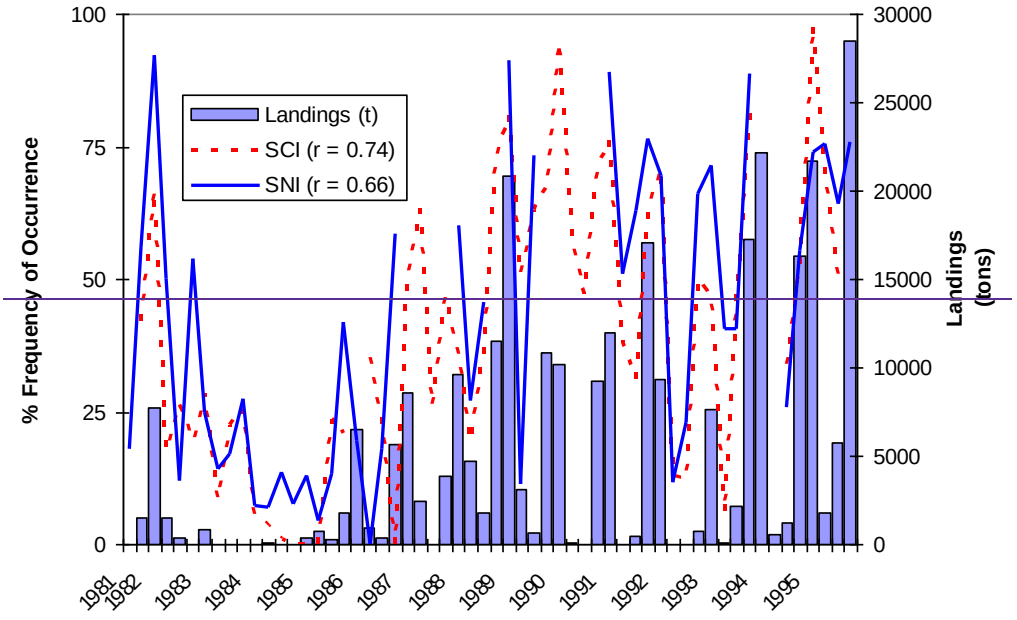
For ~~chinook~~Chinook salmon~~,~~ *(Oncorhynchus tshawytscha),* squid composed only 7~~-~~ to 9% of diet (by volume) and ranked 3rd or 4th behind northern anchovy, ~~euphausids~~euphausiids, and juvenile rockfish depending on location~~, Monterey or San Francisco, respectively~~ (Morejohn et al. 1978). At other locations along the west coast, squid is not ~~an important~~a significant Chinook salmon prey item ~~for chinook~~ since they prey mainly on fish (Groot and Margolis 1991). ~~In~~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 ~~includes~~include mainly bottom dwelling species ~~including~~such as curlfin ~~turbot,~~sole *(Pleuronichthys decurrens),* speckled ~~and Pacific sanddabs,~~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).

~~For the~~ Squid occurs in 35 to 44% of California sea lion~~, squid occurs in 35-44% of~~ *(Zalophus californianus)* scat samples collected at rookery sites in the ~~Southern California Bight~~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. ~~During an El Niño event, the presence of market squid in California sea lion and Pacific harbor seal scat~~

~~samples decreased more than three-fold as compared to non El Niño periods (Henry 1997, Lowry and Carretta 1999).~~

~~Consumption estimates are known for some squid predators, although these can vary dramatically because squid availability changes with location and environmental conditions. For example, sea~~Sea lions ~~in southern California~~ have ~~been estimated to consume 68,000 tons of squid in non El Niño years and 30,000 tons in El Niño years (STAR Panel Working Paper #4, Appendix E). Dr. William Gilly estimated that three species, California sea lion, Dall's porpoise, and Risso's dolphin combined consume 125,000 tons of squid annually (pers. comm.). The changing availability of squid also affects potential predators. Short-finned pilot whales, blue sharks, and Pacific bonito increase their consumption of market squid during the squid spawning season. It has been suggested that short-finned pilot whales in the Southern California Bight (Hacker 1992, Miller~~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. ~~1983, Dohl et al. 1980) and blue sharks near Santa Catalina Island (Tricas 1979) may move inshore as the squid spawning season begins. Pacific bonito consumption of squid is influenced by the shoaling behavior of squid spawning in nearshore waters of southern California (Oliphant 1971).~~ 2016).

~~Seasonal landings of market squid in southern California ports have been strongly correlated with percent frequency of occurrence in sea lion diets (Figure 2-3). In El Niño years, resource availability is low for all species. In non El Niño years, squid appears to be serving as adequate forage for sea lions, even with high levels of fishing activities, as sea lion pup production or population trends do not appear to be affected. As a result of the 1998 El Niño, sea lion pup production at the Channel Islands declined 64% (Carretta et al. 2002). However in 1999, pup production increased by 185% resulting in the highest net productivity rate observed in sea lions for the past 20 years (Carretta et al. 2002). During that same period, commercial squid landings in California were the highest on record (126,772 tons) with over 99% of those landings coming from southern California. In recent years, concurrent with squid landings in excess of 100,000 tons annually, the sea lion population in California continues to increase at a rate of 5.4-6.1% per year (Carretta et al. in prep).~~



~~Figure 2-3. Seasonal Comparison of Sea Lion Scat Squid Frequency-of-Occurrence at San Clemente (SCI) and San Nicholas Islands (SNI) vs Squid landings in Southern California Ports (from Lowry and Carretta 1999~~

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 (~~Groundfish Triennial Bottom Trawl Survey, Midwater trawl surveys, Kenny Mais survey, etc., STAR Panel Working Paper #5~~A California Current Integrated Ecosystem Assessment), suggesting that a large portion of the squid biomass is available to other trophic levels (Figure 2-~~4).~~ 3).

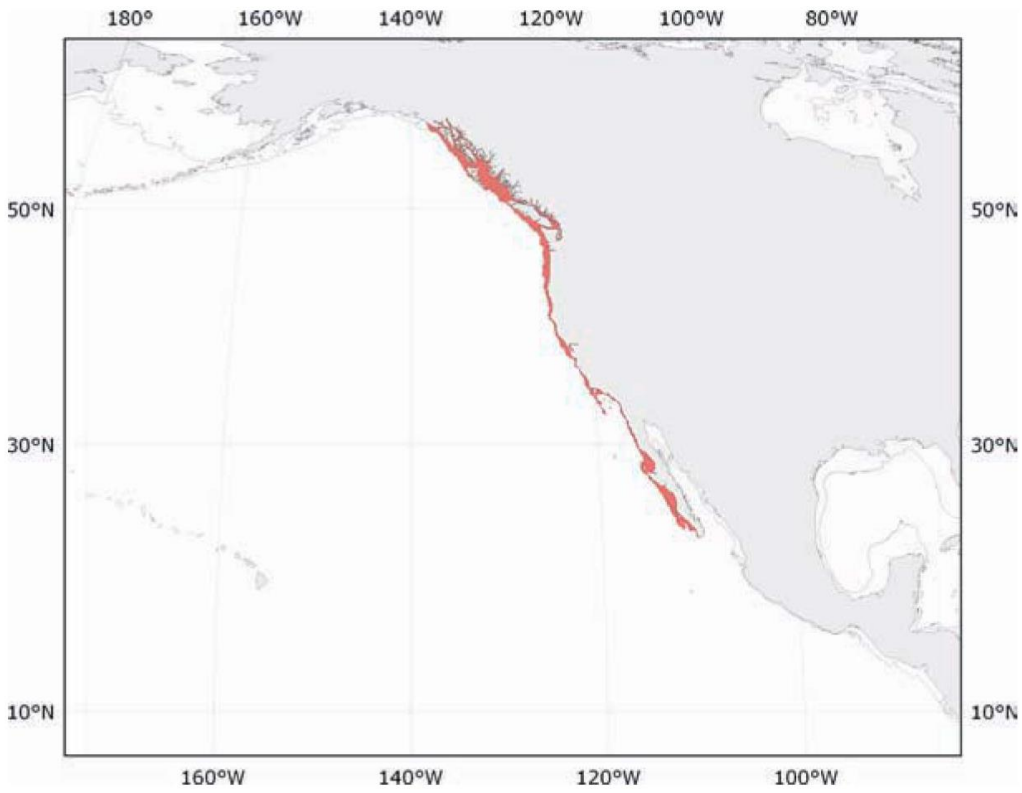


Fig. 92 *Doryteuthis (Amerigo) opalescens*

Figure 0-2

~~Figure 2-4. Expanding symbol plots of distribution and abundance of *Loligo opalescens* juveniles collected as part of the by-catch in the summer triennial groundfish survey conducted by NOAA Fisheries/NWFSC (from Reiss et al. in submission).~~

~~As briefly identified above, market squid, along with anchovy and sardine, are important as forage to predators at many trophic levels. Although it is not currently possible to estimate the total amount of squid used as forage in the California Current ecosystem or the size of squid populations necessary to sustain predator populations, the MSFMP contains the goal of providing adequate forage for dependent species. This goal is implemented through management measures that reserve a portion of the biomass as forage for all dependent species using such tools as fishery control rules and harvest replenishment areas.~~

~~Table 2-1. Known fish, bird, mammal and invertebrate predators of coastal pelagic species, including market squid. (Table 1.1.2-1 from Federal Coastal Pelagic Species FMP; Table 7A from CDFG Report to the Legislature).~~

~~MARINE BIRDS~~ ~~MARINE FISH~~

~~Table 2-1. Known fish, bird, mammal and invertebrate predators of coastal pelagic species, including market squid. (Table 1.1.2-1 from Federal Coastal Pelagic Species FMP; Table 7A from CDFG Report to the Legislature).~~

~~MARINE MAMMALS~~

~~Northern fur seal~~
~~Guadalupe fur seal*~~
~~Steller sea lion~~
~~California sea lion~~
~~Northern elephant seal~~
~~Harbor seal~~
~~Common dolphin~~
~~Harbor porpoise~~
~~Dall's porpoise~~
~~Pacific white-sided dolphin~~
~~Bottlenose dolphin~~
~~Pilot whale~~
~~Blue whale*~~
~~Fin whale*~~
~~Sei whale~~
~~Minke whale~~
~~Pacific right whale*~~
~~Humpback whale*~~
~~California gray whale~~

~~INVERTEBRATES~~

~~Market squid~~
~~Ocean squids~~

~~Black-footed albatross~~
~~Fulmar~~
~~Sooty shearwater~~
~~Manx shearwater~~
~~Short tailed shearwater~~
~~Pink footed shearwater~~
~~Leach's Storm petrel~~
~~Ashy Storm petrel*~~
~~Black Storm petrel~~
~~Brown pelican*~~
~~Double-crested cormorant~~
~~Brandt's cormorant~~
~~Pelagic cormorant~~
~~Glaucous-winged gull~~
~~Western gull~~
~~Heerman's gull~~
~~Ring-billed gull~~
~~California gull*~~
~~Black-legged kittiwake~~
~~Common murre~~
~~Pigeon guillemot~~
~~Marbled murrelet*~~
~~Craveri's murrelet~~
~~Xantus's murrelet*~~
~~Ancient murrelet~~
~~Cassin's auklet~~

~~Northern anchovy~~
~~Pacific sardine~~
~~Pacific whiting~~
~~Common thresher shark~~
~~Bonito shark~~
~~Soupfin shark~~
~~Blue shark~~
~~Pacific electric ray~~
~~Silver (coho) salmon*~~
~~King (Chinook) salmon*~~
~~Steelhead*~~
~~Rockfish (many species)~~
~~Striped bass~~
~~Barred sand bass~~
~~Kelp bass~~
~~Spotted sand bass~~
~~Ocean whitefish~~
~~Jack mackerel~~
~~Yellowtail~~
~~White seabass~~
~~Queenfish~~
~~California corbina~~
~~White croaker~~
~~Surfperches (many species)~~
~~California barracuda~~
~~Pacific (chub) mackerel~~

~~Table 2-1. Known fish, bird, mammal and invertebrate predators of coastal pelagic species, including market squid. (Table 1.1.2-1 from Federal Coastal Pelagic Species FMP; Table 7A from CDFG Report to the Legislature).~~

~~Rhinoceros auklet*~~	~~Pacific bonito~~
~~Horned puffin~~	~~Albacore~~
~~Tufted puffin*~~	~~Bluefin tuna~~
~~Bald eagle~~	~~Swordfish~~
~~Osprey~~	~~Striped marlin~~
~~Elegant tern*~~	~~Giant seabass~~
~~Caspian tern~~	~~Lingcod~~
~~Forster's tern~~	~~Scorpionfish~~
~~Least tern*~~	~~Dogfish~~

~~* = endangered, threatened, or candidate species~~

~~2.1.7~~. Range of market squid (Reproduced from Jereb et al. 2010).

~~2.4.3.~~2.7.3. Competition

Market squid feed with a variety of coastal pelagic ~~fish~~finfish species, namely anchovies, sardines, herring, and mackerel. ~~They~~Market squid are often found together in commercial catch targeting ~~these~~ species; however, ~~there is~~ little information is available regarding the ~~actual~~ 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 ~~poorly~~still not fully understood. ~~Among coastal pelagic finfish species (sardines, anchovies, and mackerel), it~~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 ~~predator fish~~those species ~~plus~~, in addition to competitive removal of phytoplankton, zooplankton and other fish.

~~2.5.~~2.8. ~~2.1.8~~ Critical Habitat

The description and identification of Essential Fish Habitat (EFH) for market squid ~~is generalized because data are incomplete for this species.~~ was updated through the federal fishery management process in 2023. The CPS

FMP describes the east-west geographic boundary ~~to be all marine and estuarine waters~~ from the shoreline along the California, Oregon, and Washington coast offshore to the limits of the ~~exclusive economic zone (~~EEZ~~)~~ and above the thermocline, where sea surface temperatures range between ~~50-79°F, the upper tolerance~~ 44-75°F (7-24°C). This definition includes U.S. waters of ~~CPS finfish~~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 ~~California Current ecosystem.~~ 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 ~~California Current system~~CCE.

Refuges, preserves and ~~marine sanctuaries (now termed marine protected areas and marine managed areas due to recent legislation)~~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. ~~Two~~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 squid concentrate in dense schools near spawning grounds, but habitat requirements for spawning are not well understood.~~ 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 ~~are most often deposited at depths~~

~~between 18 and 55 m (CDFG-NOAA Fisheries unpublished data), but~~ 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).

~~2.6.~~2.9. ~~2.1.9~~ Status of the Stocks

Market squid population dynamics are poorly understood. ~~Although some~~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~~, there is no good measure of annual recruitment success beyond information obtained from the fishery.~~ . 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/

~~Historically, the squid resource was considered by some to be underutilized. Until improved estimates of abundance are available, the true status of the population will remain unknown. In 1998, a cooperative scientific research program between the Department and NOAA Fisheries was initiated and efforts to model the population began. This program may eventually give rise to a more thorough and detailed stock assessment similar to those for other coastal pelagic species.~~

~~2.1.10~~).

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.

~~2.7.~~2.10. Areas Involved

~~There are two~~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 ~~operates~~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.

~~2.8.~~2.11. ~~2.2~~ 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 ~~2001c).~~ 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, ~~it is~~ recreational fisheries currently ~~used~~use market squid as either live or dead bait ~~for recreational fisheries~~ 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).

~~Table 2-2. Historical market squid landings in tons for California divided at Point Conception into northern and southern fisheries. The market squid season is from 1 April through 31 March of the following year. Source: CDFG Landing Receipts.~~

Season	~~Northern fishery~~North	~~Southern fishery~~South	Total Landings	~~Northern fishery~~North	~~Southern fishery~~South	Total
1927-1928	~~1567~~1,567	4	1971-1972 ~~1,571~~4,571	8,328	4,475	
1928-1929	686	44	1972-1973 730	6,124	5,057	
1929-1930	2,303	16	1973-1974 2,319	621	7,696	
1930-1931	5,494	16	1974-1975 5,510	7,248	5,302	
1931-1932	792	71	1975-1976 863	2,495	10,563	
1932-1933	2,072	28	1976-1977 2,100	2,511	6,587	
1933-1934	430	4	1977-1978 434	2,235	12,050	
1934-1935	736	19	1978-1979 755	10,343	8,680	
1935-1936	329	19	1979-1980 347	14,169	7,213	
1936-1937	451	17	1980-1981 469	7,860	12,087	
1937-1938	245	61	1981-1982 306	14,132	11,700	
1938-1939	754	11	1982-1983 765	11,697	1,516	
1939-1940	522	53	1983-1984 575	1,061	27	
1940-1941	818	86	1984-1985 904	549	804	
1941-1942	694	47	1985-1986 741	4,276	10,100	
1942-1943	406	34	1986-1987 440	6,967	18,636	
1943-1944	4,529	18	1987-1988 4,546	6,632	18,582	
1944-1945	5,435	38	1988-1989 5,472	5,765	42,430	
1945-1946	7,586	27	1989-1990 7,613	7,829	25,222	
1946-1947	19,777	18	1990-1991 19,795	8,871	23,602	
1947-1948	8,728	64	1991-1992 8,792	9,013	29,653	
1948-1949	7,599	59	1992-1993 7,658	9,450	9,343	
1949-1950	3,087	2	1993-1994 3,089	10,012	44,440	
1950-1951	2,997	2	1994-1995 2,999	19,103	44,489	
1951-1952	5,844	374	1995-1996 6,219	3,676	90,157	
1952-1953	1,746	2,649	1996-1997 4,394	5,828	118,481	
1953-1954	2,076	391	1997-1998 2,467	9,275	1,623	
1954-1955	3,772	77	1998-1999 3,849	26	11,673	
1955-1956	6,714	119	1999-2000 6,833	308	126,464	
1956-1957	9,828	478	2000-2001 10,306	7,730	115,681	
1957-1958	5,496	1,753	2001-2002 7,249	10,094	92,621	
1958-1959	1,902	2,848	2002-2003 4,750	27,828	19,166	
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			

2.2.9

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.

~~2.8.1.~~2.11.1. Description of User Groups

~~2.8.1.1.~~*2.11.1.1.* ~~2.2.1.1~~ 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 ~~CDFG~~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. ~~Catch~~Landings in the northern fishery had not expanded ~~in terms of volume or location~~ until the 2002-2003 season~~. Excluding El Niño events, the number of vessels participating in the northern fishery landing greater than two tons daily of market squid has remained relatively constant (Figure 2-5)~~, while the number of vessels ~~increased in the 1990s~~making landings has fluctuated from year-to-year (Figure 2-~~6). 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.

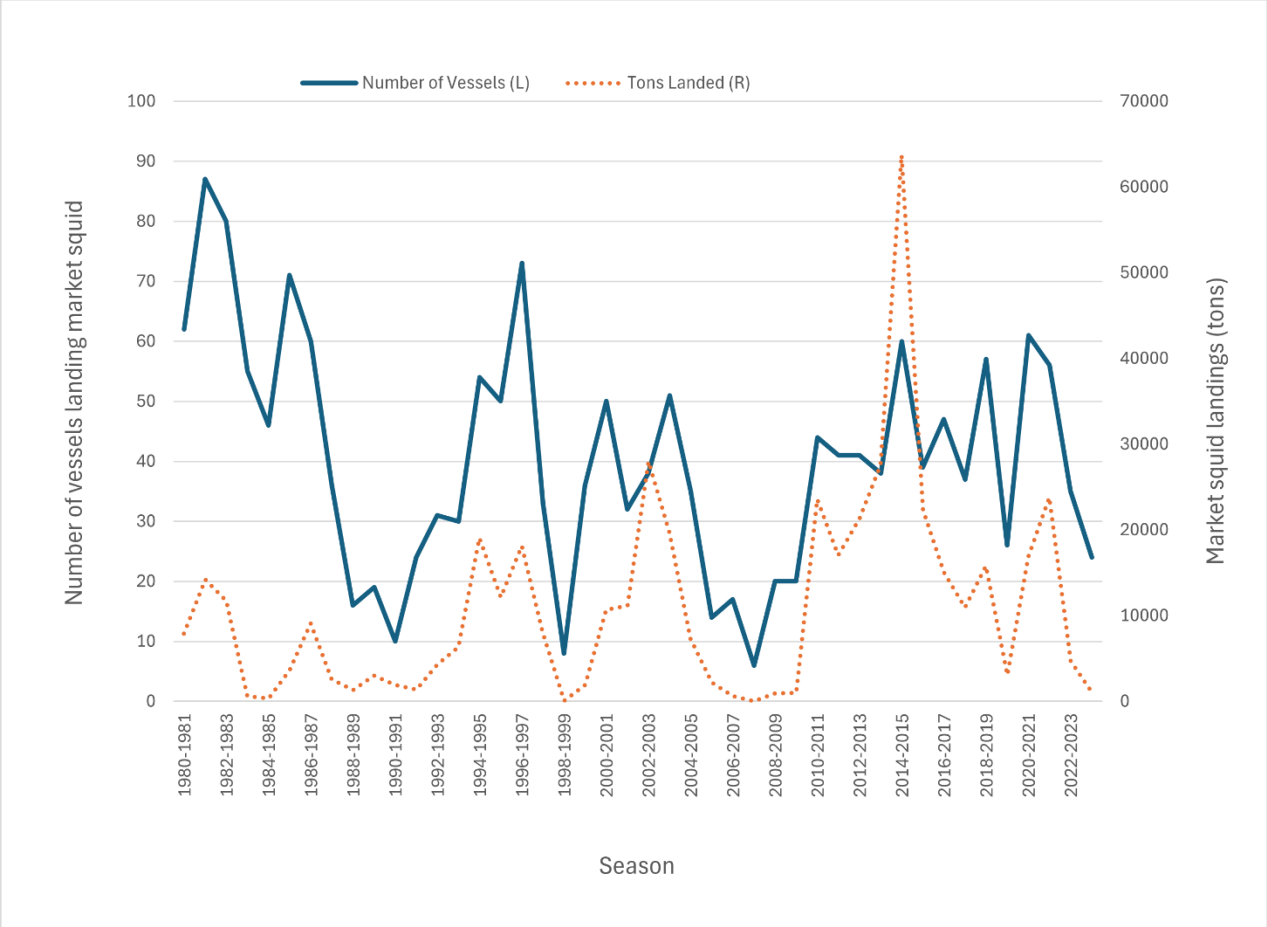


Figure 0-3. Number of vessels and market squid landings by season for Northern California (MLDS).

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 ~~2~~3.0% in ~~2000-2001~~2023-2024 season). ~~These~~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 ~~(Figure 2-7).~~. As of the 2023-2024 season, purse and drum seine remain the dominant gear responsible for 97% of total landings (MLDS).

~~Figure 2-5. Number of vessels and market squid landings by season for Northern California. Source: CDFG Landing Receipts; note: data for 2002-2003 season is preliminary.~~

According to Department records during the drafting of the MSFMP, the average purse seine vessel length ~~is~~was 18.9 m (62 ~~feet~~ft) and 81 gross tons. The average hold capacity ~~is 84 tons. During the past three years, over two-thirds of the fleet (70%) used a purse seine, 23% used a drum seine and 4% used brail gear. Nearly all vessels use side-scan sonar and fathometers. The average vessel power is 428 HP and auxiliary power is148 HP. Most vessels (82%) use~~ 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 ~~their~~ catch cold, while others (live bait vessels) use circulated seawater, brine or no cooling system at all. ~~The average purse seine net is 381 m (1250 feet) long with a depth of 48 m (156 feet). The stretched mesh size is one inch.~~ 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, ~~in order~~ to catch the squid located under the lights.

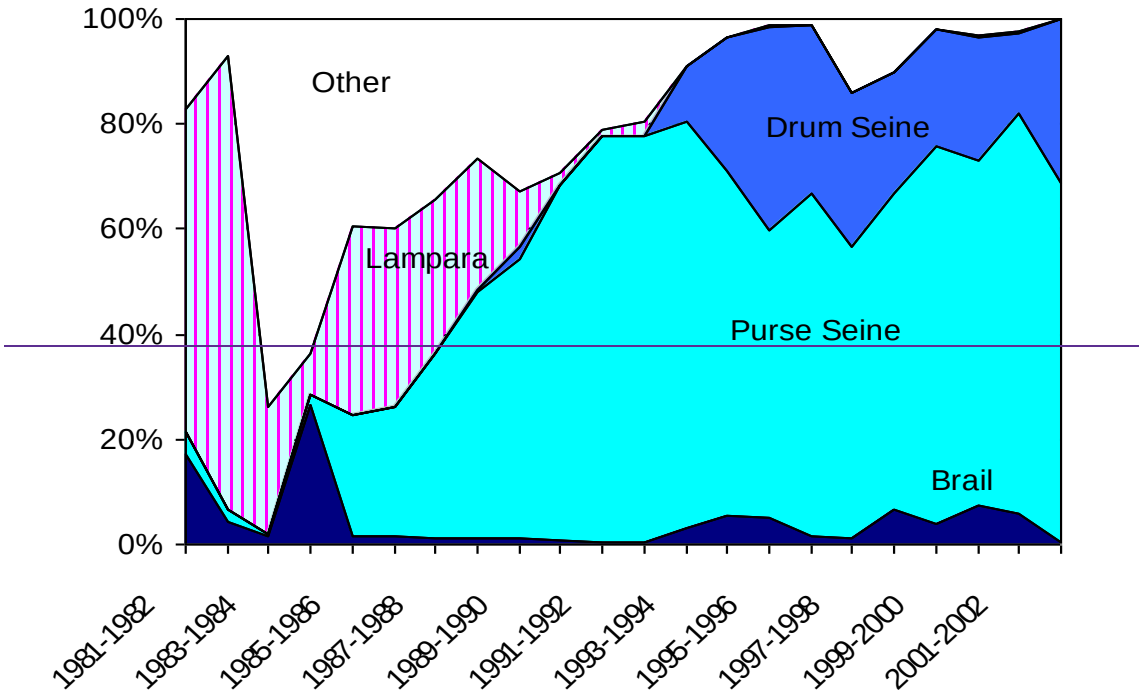
~~According to logbook records, the average light boat is 11.8 m (39 feet) in length with a gross tonnage of 19 tons. Wattage for~~The squid ~~attracting lights averages approximately 22,500 watts (30,000 watts is the legal maximum). Nearly all light boats use side-scan sonar and fathometers. Light boat power and auxiliary power average 379 HP and 63 HP, respectively.~~

~~Squid~~ fishing ~~supplements the~~ income of the many seine vessels from southern California ~~that also participate~~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 ~~in these other states. In recent years~~. 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).

~~The number of businesses purchasing squid has remained constant since the early 1980s (mean = 54; range 41-86), however, since the 1994-1995 season, the majority (80% or more) of the squid purchased was bought by nine or fewer dealers. The majority (approximately 72%) of the dealers purchase less than 100 tons per year.~~

~~Figure 2-6. Number of vessels and market squid landings by season for Southern California. Source: CDFG Landing Receipts.~~



~~Figure 2-7. Percent of landings by season and gear type. (note: "Other" includes, but is not limited to jig, hook and line, trawl nets, and other roundhaul nets). Source: CDFG Landing Receipts.~~

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).

~~Table 2-4. Historical California landing receipt information for permitted and non-permitted vessels, 1981-1982 to 2002-2003. Vessels fishing for squid were not required to have a squid fishing permit until the 1998-1999 season; this table shows the historical activity by the vessels currently permitted as of the 2002-2003 squid fishing season. Source: CDFG Landing Receipts.~~

Season	Landings (tons)	Landings (tons) by ~~current~~ permittees	Percent landings made by permittees	Number of vessels	Number of ~~currently~~ permitted vessels
1980-1981	5,768	1,459	25.~~3~~30%	55	10
1981-1982	25,851	11,349	43.~~9~~90%	152	31

~~Table 2-4. Historical California landing receipt information for permitted and non-permitted vessels, 1981-1982 to 2002-2003. Vessels fishing for squid were not required to have a squid fishing permit until the 1998-1999 season; this table shows the historical activity by the vessels currently permitted as of the 2002-2003 squid fishing season. Source: CDFG Landing Receipts.~~

Season	Landings (tons)	Landings (tons) by ~~current~~ permittees	Percent landings made by permittees	Number of vessels	Number of ~~currently~~ permitted vessels
1982-1983	13,213	7,049	53.~~3~~30%	125	28
1983-1984	1,087	740	68.~~1~~10%	81	17
1984-1985	1,354	476	35.~~1~~10%	95	21
1985-1986	14,376	8,833	61.~~4~~40%	126	34
1986-1987	25,603	14,184	55.~~4~~40%	122	34
1987-1988	25,214	15,547	61.~~7~~70%	117	37
1988-1989	48,195	31,371	65.~~1~~10%	119	43
1989-1990	33,051	22,705	68.~~7~~70%	100	39
1990-1991	32,472	24,764	76.~~3~~30%	102	41
1991-1992	38,666	30,503	78.~~9~~90%	85	40
1992-1993	18,793	16,176	86.~~1~~10%	82	40
1993-1994	54,452	44,335	81.~~4~~40%	92	45
1994-1995	63,592	51,006	80.~~2~~20%	110	54
1995-1996	93,833	72,749	77.~~5~~50%	128	65
1996-1997	124,315	95,082	76.~~5~~50%	143	77
1997-1998	10,898	9,917	91.~~0~~00%	86	46
1998-1999	11,699	9,433	80.~~6~~60%	117	67
1999-2000	127,248	107,934	84.~~8~~80%	168	95
2000-2001	124,379	108,831	87.~~5~~50%	152	85
2001-2002	102,667	96,757	94.~~2~~20%	118	85
2002-2003	46,970	45,031	95.~~9~~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

~~2.2.1.2~~ *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.

~~2.8.1.2.~~*2.11.1.2.* Recreational Fishery

~~The other market squid user group is the recreational sector of the 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. ~~This~~The relatively small volume of squid caught for recreational use is a high value fishery, ~~which~~and supplies bait to recreational fisheries along the California coast, primarily in southern California (CDFG ~~2001b).~~ 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. ~~Sport~~Recreational fishing vessels and privately owned skiffs catch their own squid bait by using attracting lights and brail nets and/or rod and reel. ~~Live and dead squid are ideal bait for a variety of California sport fisheries, especially rockfish and white seabass.~~ 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.

~~2.8.2.~~2.11.2. ~~2.2.2~~ Fishing Effort

~~2.8.2.1.~~*2.11.2.1.* ~~2.2.2.1~~ Commercial Fishing Effort

~~In the 1990s~~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 ~~six~~the last 15 years and number one for dollars paid ex-vessel for ~~three~~9 of those 15 years (~~CDFG 2001c).~~ CDFW 2024a). Although quite successful, the commercial squid fishery is unpredictable due to environmental ~~(e.g., El Niño)~~ 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 ~~for the~~in southern ~~fishery~~California and during the summer for ~~the~~ northern ~~fishery~~California (Figure 2-~~8).~~ 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. ~~If ex-vessel prices drop too low, effort may also drop because of less economic incentive to fish.~~

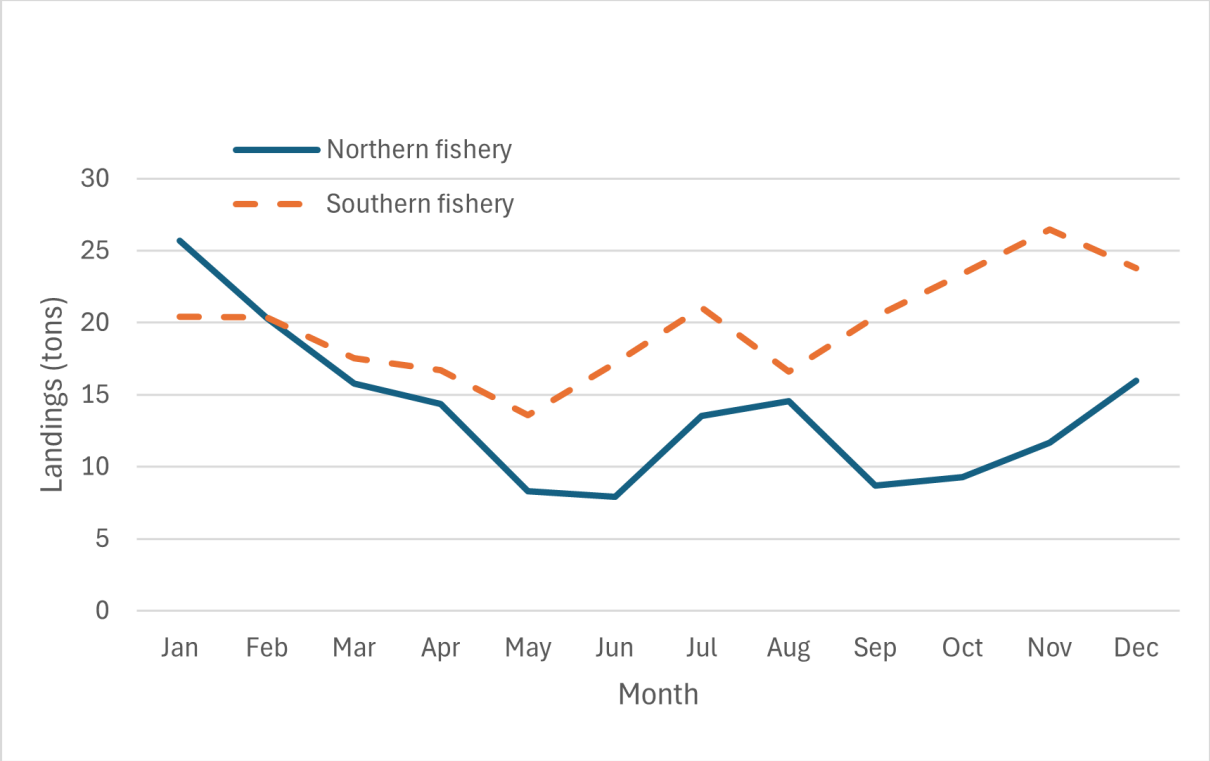


Figure 0-~~4~~2-8. Average monthly landings in tons for the market squid fishery divided at Point Conception into northern ~~(left axis)~~ and southern ~~(right axis)~~ fisheries ~~for the period of 1981~~from 1969 through ~~2001~~. ~~Source: CDFG Landing Receipts.~~2024 (MLDS).

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 ~~this~~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-~~9~~6; also see Table 2-2). Fishery landings reached a peak of ~~126,772~~135,018 tons in the ~~1999-2000~~2011-2012 season. The rapid fishery expansion of the last ~~25~~40 years is a result of rising demand for squid in foreign markets, especially Europe and China.

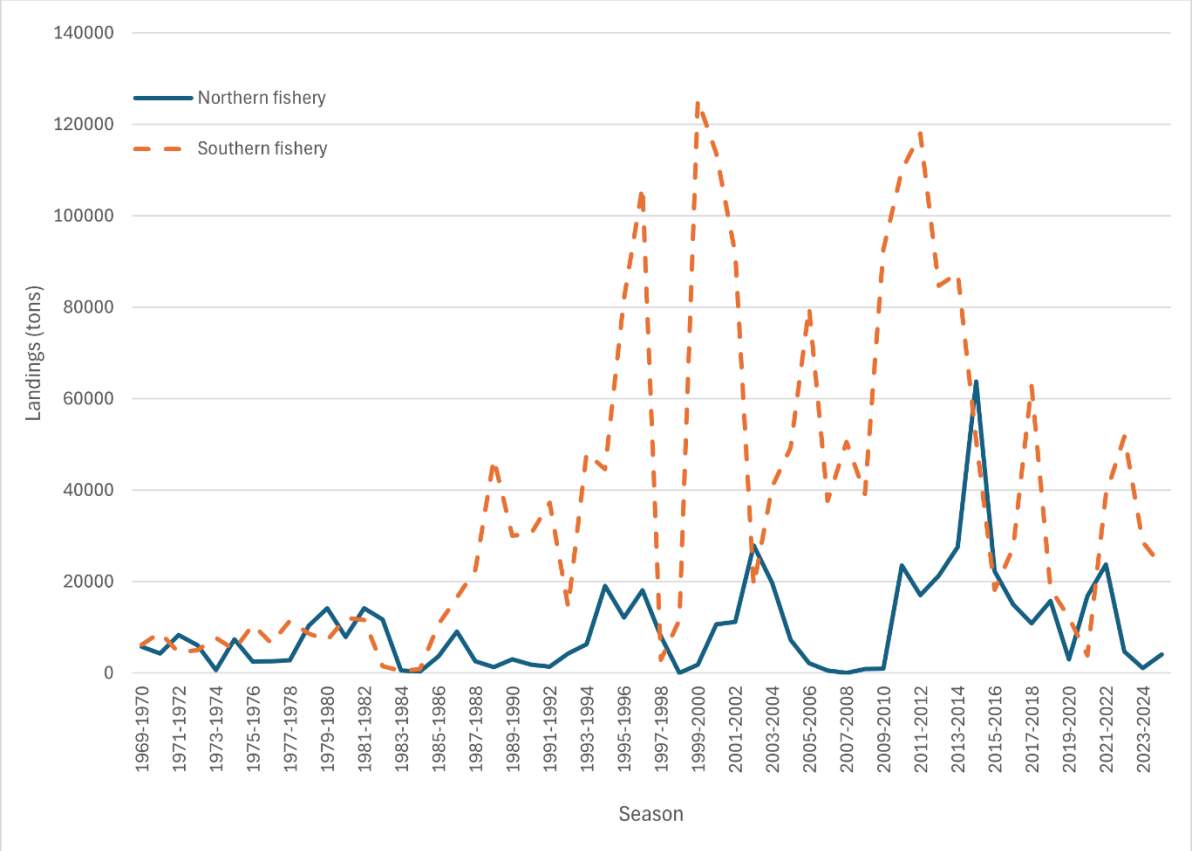


Figure 0-5~~2-9.~~. Market squid landings in tons from ~~1927-1928~~1969-1970 through ~~2002-2003 seasons showing the increase in landings for the fishery south of Point Conception. Source: CDFG Landing Receipts.~~2023-2024 seasons showing the increase in landings for the fishery south of Point Conception (MLDS).

Because the squid fishery was primarily an open-access fishery before 1998 and due to ~~recent~~ increases in statewide landings, legislation was enacted to ensure the sustainability of the squid resource and the marine life that depends on squid. ~~This~~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). ~~In the 2002-2003 season, there were 185 vessel permits and 40 light boat owner permits issued. Since 1998, the number of vessel and light boat owner permits has declined.~~ 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 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).

~~Table 2-5. Vessel and light boat owner's permit issuances, 1998-99 to 2002-03 seasons Source: CDFG Landing Receipts.~~

~~Season~~**Year**	**Number of Vessel Permits** ~~Issued~~	~~Vessel Attrition (%)~~**Number of Brail Permits**	**Number of Light** ~~Boat Owner~~**boat Permits** ~~Issued~~
~~1998-1999~~	~~248~~	~~--~~	~~53~~ ~~--~~
~~1999-~~2000	~~218~~200	~~12.1~~--	~~51~~--
~~2000-~~2001	~~195~~196	~~9.6~~--	~~50~~--
~~2001-~~2002	~~195~~184	~~0.0~~--	~~44~~--
~~2002-~~2003	~~185~~174	~~5.1~~--	~~40~~--
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

~~Table 2-5. Vessel and light boat owner's permit issuances, 1998-99 to 2002-03 seasons Source: CDFG Landing Receipts.~~			
2020	72	46	32
2021	71	46	32
2022	71	46	31
2023	69	47	30
2024	68	48	28

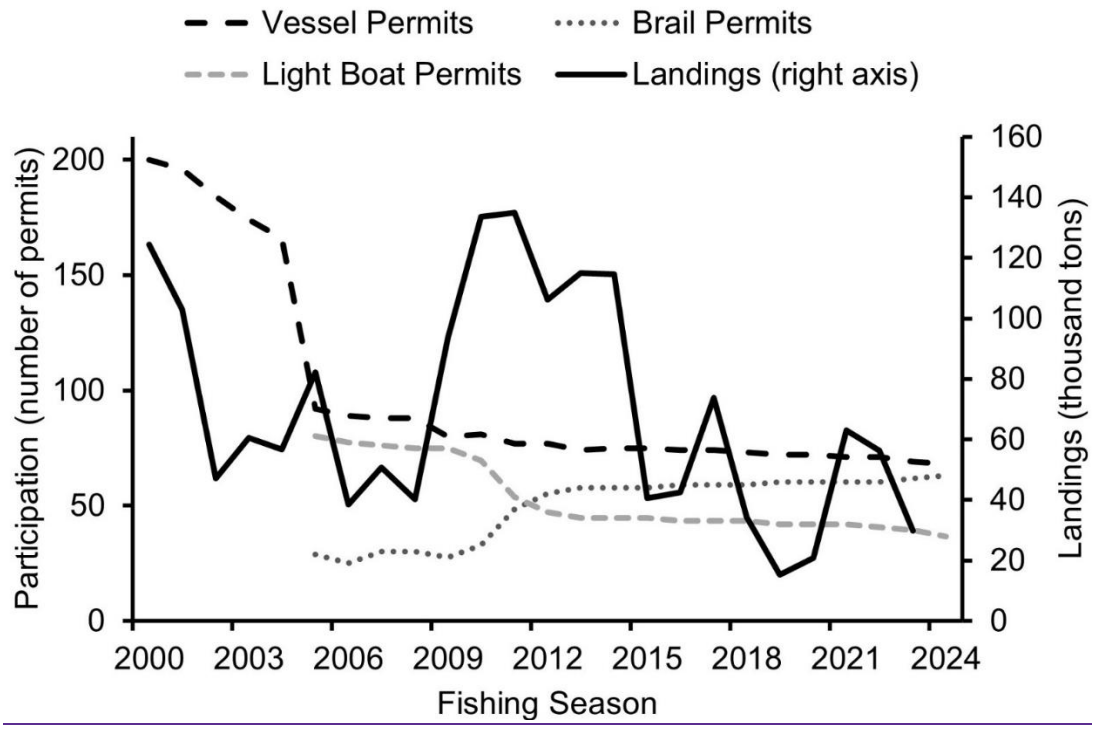


Figure 0-6~~—~~

~~Not all~~. 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).

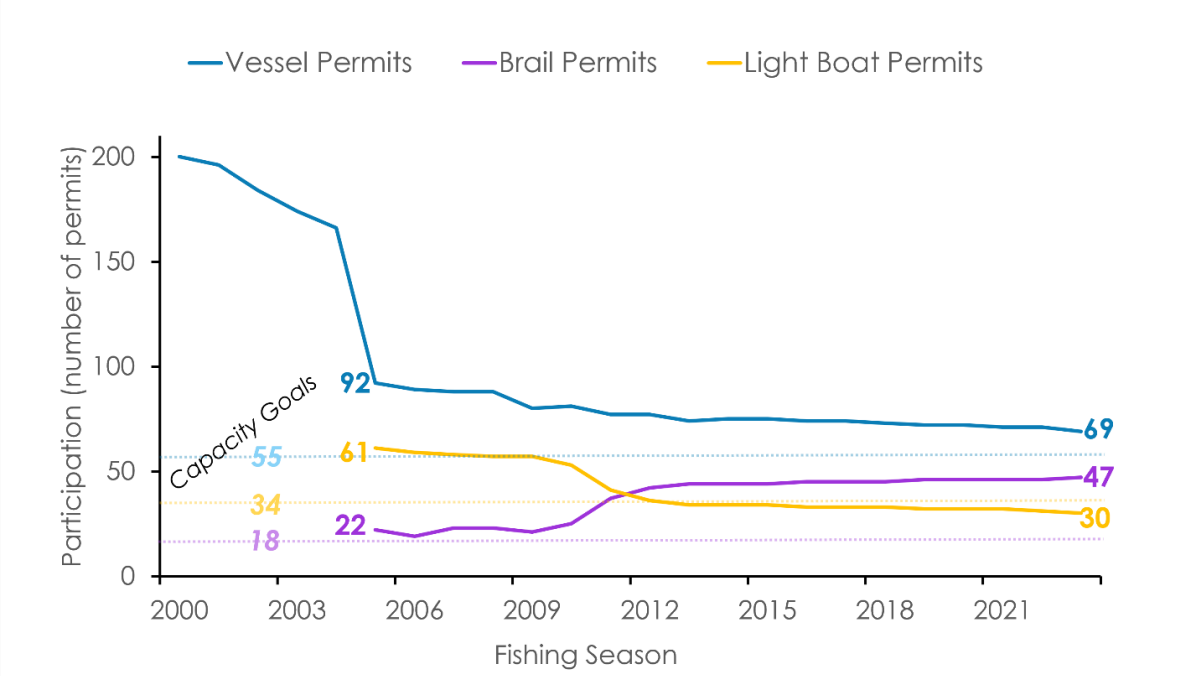


Figure 0-7~~were active in the fishery during the moratorium period.~~ . Participation (number of permits) in the commercial market squid restricted access fishery from 2000 to 2023. Capacity goals are delineated as dotted lines.

Despite the large number of permits issued, the current squid fleet consists of approximately ~~60~~75 dedicated ~~seiners.~~ vessels. As with many fisheries, a select number of vessels made the majority of the catch. In the last four seasons, only 23, 30, ~~34, 28~~31, and ~~21~~29 permitted vessels, respectively, made 75% of the catch.

~~2.8.2.2.~~*2.11.2.2.* ~~2.2.2.2~~ Recreational Fishing Effort~~-~~

~~There are insufficient~~Due to limited data ~~to describe,~~ 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) ~~do~~had regularly ~~report~~reported squid taken. ~~Additionally, some light boat operators record scooping live squid for bait in their logbooks. Preliminary~~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 ~~2001-2002 season recorded 49~~Department's MLDS, less than 7 tons of market squid was taken as live bait~~, less than~~ in the 2022-23 season, about 0.~~05~~01% of the total harvest. ~~Again, these data are voluntary and should be considered as a minimum amount of squid harvested for bait.~~

~~2.9.~~2.12. ~~2.2.3~~ Fishery Impacts

The adverse effects from fishing activities may include physical, chemical and biological alterations of ~~the substrate~~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, ~~they~~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 (~~Bargmann et. al.~~PFMC 1998~~).~~.

Fishing for market squid could have important trophic implications and other ecological impacts. ~~There is concern over~~For example, the use of chains as a seine weight in the commercial fishery~~. Chains~~ 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 ~~has been~~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, ~~there is concern for~~ 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. This amended FMP 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 ~~it cannot be~~is not avoided entirely. ~~Through~~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 ~~port~~dockside sampling program, ~~886~~1,031 of ~~2,402~~1,521 samples (~~37~~68%) collected between ~~October 1998~~January 2010 and ~~October 2003~~December 2020 contained incidentally caught fish and/or invertebrates, excluding other CPS and squid egg cases (Table 2-6). ~~Two or more species were observed as bycatch in 47% of landings with bycatch. Most of this bycatch was other coastal pelagic species, including Pacific sardine, Pacific mackerel, northern anchovy and jack mackerel.~~ Approximately ~~3.2~~25.8% of sampled landings from July 2010 to December 2020 contained squid egg cases. ~~Previous drafts of this MSFMP reported that incidental catch of squid eggs was 2%. In addition, squid eggs occurred in 8.3% of the Monterey samples. This higher level of observed egg cases is most likely due to the shallower nature of the northern fishery and is a source of concern. Under the proposed management strategy, the fishery is monitored by evaluating escapement of squid eggs from the fishery. If the fishery damages squid spawning beds, and this damage is a significant source of egg mortality, the monitoring program will be biased unless this additional source of mortality is accounted for.~~

~~Currently, the type of net used to fish for squid is unregulated, although purse seines used for squid typically do not hang as deep as purse seines used for other species, so contact with the bottom is reduced. Incidental catches of squid eggs~~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).~~ Damage to the substrate, and thus, mortality of squid eggs associated with purse seining for squid has not been quantified.~~

~~A research study to measure the effect of purse seine fishing on squid spawning grounds has been undertaken by NOAA Fisheries and the Department. So far, preliminary results of this study are unavailable. The study will use three approaches to measure the effect of purse seines on squid beds: 1) Direct observation of egg capsule bycatch in the net from an observation boat; 2) ROV surveys of the squid egg capsule distributions in fished and unfished habitats, and 3) Determination of the natural mortality of squid eggs in heavily fished areas versus unfished areas. If current fishing practices are shown to affect squid egg survival, changes in gear or fishing practices can be proposed to the squid fishing industry to find the most efficient way to reduce the risk of egg loss due to fishery gear interaction. Potential future management options may include altering the mesh size or depth of the net, or closing some of the shallow water habitats to fishing.~~

~~Less than 2 percent of the observed landings contained species that are prohibited~~

~~from being landed using seine gear (e.g., barracuda, yellowtail). In terms of species of concern, there have been seven observations of Chinook (King) salmon representing 1.6% of observed landings in Monterey as well as one observation of salmon (species unknown). In addition, bocaccio was observed in 1.2% of the Monterey landings.~~

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~~name	~~Total All Ports~~Scientific name	~~Monterey Moss Landing~~2019	~~Santa Barbara Ventura~~2020	~~San Pedro Terminal Is.~~2021	2022	2023
~~PACIFIC SARDINE~~**Finfish**	~~18.5~~--	~~9.5~~--	~~18.9~~--	~~21.5~~--	--	--
~~PACIFIC MACKEREL~~Anchovy, northern	~~6.9~~*Engraulis mordax*	~~2.3~~25	~~6.0~~31.33	~~9.7~~31.43	19.51	8.06
~~NORTHERN ANCHOVY~~	~~5.0~~	~~3.9~~	~~4.0~~	~~6.2~~		
~~JACK MACKEREL~~	~~4.0~~	~~6.7~~	~~0.1~~	~~6.6~~		
~~**MARKET SQUID EGGS**~~Barracuda, Pacific	*Sphyraena argentea*	~~3.~~2.78	~~8.3~~2.41	1.~~7~~43	~~2.3~~0.81	-
~~PACIFIC BUTTERFISH~~Bass, kelp	~~2.0~~*Paralabrax clathratus*	~~4.4~~1.85	1.~~8~~2	0.71	-	1.~~0~~61
Blacksmith	*Chromis punctipinnis*	-	-	0.71	2.44	3.23
~~BAT RAY~~Bonito, Pacific	~~1.9~~*Sarda lineolata*	~~1.4~~2.78	2.~~3~~41	0.71	1.~~6~~63	1.61
Butterfish (Pacific pompano)	*Peprilus simillimus*	16.67	16.87	13.57	17.07	3.23
~~JACKSMELT~~Croaker, White (kingfish)	~~1.3~~*Genyonemus lineatus*	5.56	6	~~6~~5.7	~~0.1~~6.5	~~0.1~~-
~~**CALIFORNIA BARRACUDA**~~Fish, unspecified	~~0.9~~--	-	1.~~0~~2	~~1~~7.1	1.6	1.6

Common ~~Name~~name	~~Total All Ports~~Scientific name	~~Monterey Moss Landing~~2019	~~Santa Barbara Ventura~~2020	~~San Pedro Terminal Is.~~2021	2022	2023
~~PACIFIC ELECTRIC RAY~~Flatfish, unspecified	~~0.9~~--	~~4.9~~17.59	14.5	13.6	8.1	4.8
~~PELAGIC RED CRAB~~Flying fish, California	*Cheilopogon pinnatibarbatus californicus*	0.~~9~~93	-	~~0.~~1.4	5.7	3.2
~~DUNGENESS CRAB~~	~~0.7~~ ~~3.9~~	-	-			
~~SANDDAB~~Halfmoon	~~0.6~~*Medialuna californiensis*	~~2.1~~-	~~0~~2.4	0.~~2~~7	-	6.5
~~SEA STAR~~Halibut, California	~~0.6~~*Paralichthys californicus*	~~0.9~~7.41	4.8	~~0~~2.1	~~0.9~~10.6	1.6
~~SCULPIN~~Herring, Pacific	~~0.6~~*Clupea pallasii*	1.85	-	2.1	1.46	-
~~HORN SHARK~~	~~0.4~~ -	-	~~0.9~~			
~~TURBOT~~Herring, red-eye round	~~0.4~~*Etrumeus teres*	11.11	1.~~9~~2	2.9	4.1	4.8
~~SOLE~~Jacksmelt	*Atherinopsis californiensis*	18.52	~~0~~37.4	30	~~0.6~~24.4	~~0.3~~16
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
~~CABEZON~~Midshipman, unspecified	~~0.3~~*Porichthys spp.*	~~0.~~2.78	0.~~1~~	0	~~0~~1.6	1.6
~~ROCK CRAB~~Midshipman, plainfin	*Porichthys notatus*	~~0.~~3.7	14.5	11.4	~~0~~6.5	0.~~3~~
~~**CHINOOK (KING) SALMON**~~Midshipman, specklefin	~~**0.3**~~*Porichthys myriaster*	0	0	2.1	1.6	1.6
Pacific sardine	*Sardinops sagax*	74.07	71.1	58.6	67.5	54.8
~~MEXICAN POMPANO~~Rockfish, unspecified	*Sebastes spp.*	2.78	1.2	3.6	~~0~~3.3	~~0~~1.6
~~CALIFORNIA HALIBUT~~	~~0.3~~ ~~0.5~~	~~0.1~~	~~0.4~~			
~~RAY~~Rockfish, bocaccio	*Sebastes paucispinis*	0.93	~~0.~~3.6	~~0.~~2.1	~~0~~1.6	0
~~MIDSHIPMAN~~Sablefish	~~0.2~~*Anoplopoma fimbria*	0	~~0~~1.2	0.7	~~0.5~~4.9	0
~~PACIFIC SANDDAB~~Salmon, Chinook	~~0.2~~*Oncorhynchus tshawytscha*	1.85	6	0.7	0	0.~~3~~
~~**BOCACCIO**~~Sanddab, unspecified	~~**0.2**~~*Citharichthys spp.*	6.48	1.2	3.6	3.3	0
~~QUEENFISH~~Sanddab, longfin	~~0.2~~*Citharichthys xanthostigma*	0.93	~~0~~1.2	0.~~2~~	0	1.6
~~SMELT~~Sanddab, Pacific	~~0.2~~*Citharichthys sordidus*	11.11	27.7	~~0.4~~27.1	21.1	1.6

Common ~~Name~~name	~~Total All Ports~~Scientific name	~~Monterey Moss Landing~~2019	~~Santa Barbara Ventura~~2020	~~San Pedro Terminal Is.~~2021	2022	2023
~~WHITE CROAKER~~Sanddab, speckled	~~0.2~~*Citharichthys stigmaeus*	4.63	3.6	~~0.~~4.3	4.9	1.6
~~PACIFIC SAURY~~Scorpionfish, California	~~0.2~~*Scorpaena guttata*	9.26	9.6	~~0~~2.9	16.3	17.7
~~FLYINGFISH~~Sculpin, staghorn	~~0.2~~*Leptocottus armatus*	0	~~0.~~1.2	1.4	~~0~~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
~~ROCKFISH~~Sole, sand	~~0.2~~*Psettichthys melanostictus*	1.85	1.2	2.1	~~0~~6.5	0~~.1~~
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
~~PACIFIC HERRING~~Turbot, hornyhead	~~0.2~~*Pleuronichthys verticalis*	3.7	~~0.~~9.6	8.6	8.9	1.6
Wrasse, rock	*Halichoeres semicinctus*	0	0	0	0.8	1.6
Elasmobranchs	--	--	--	--	--	--
~~ENGLISH SOLE~~Ray, bat	~~0.2~~*Myliobatis californica*	~~0~~3.7	0	~~0.1~~2.9	10.6	9.7
Ray, Pacific electric	*Torpedo californica*	8.33	13.3	9.3	8.9	0
~~MISCELLANEOUS FISH~~Shark, horn	~~0.2~~*Heterodontus francisci*	6.48	0	2.1	~~0~~2.4	0
~~CURLFIN TURBOT~~Skate, big	~~0.1~~*Raja binoculata*	~~0.5~~2.78	6	0~~.1~~	3.3	0
~~MACKEREL UNCLASSIFIED~~Skate, California	~~0.1~~*Raja inornata*	~~0.5~~2.78	~~0.~~1.2	1.4	0.8	0
~~OCTOPUS~~Skate, unspecified	~~0.1~~*Rajidae*	0	~~0~~1.2	~~0~~2.1	0.8	1.6
Stingray	*Dasyatidae*	0.93	1.2	2.1	0	0
Invertebrates	--	--	--	--	--	--
~~SALEMA~~Anemones, unspecified	~~0.1~~*Anthozoa*	0	3.6	0.7	0.8	0
~~BLUE SHARK~~Crab, unspecified	~~0.1~~*Cancer spp.*	6.48	~~0.2~~12.1	7.9	7.3	3.2
~~HORNYHEAD TURBOT~~Crab, claws	~~0.1~~*Cancer spp.*	2.78	2.4	~~0.2~~5	2.4	0
~~SPECKLED SANDDAB~~Crab, decorator	~~0.1~~*Bivalvia*	0.~~2~~93	2.4	0~~.1~~	0.8	0
Crab, Dungeness	*Metacarcinus magister*	5.56	9.6	17.1	7.3	0
~~SURFPERCH~~Crab, red rock	~~0.1~~*Cancer productus*	~~0.~~5.56	3.6	5.7	4.1	0

Common ~~Name~~name	~~Total All Ports~~Scientific name	~~Monterey Moss Landing~~2019	~~Santa Barbara Ventura~~2020	~~San Pedro Terminal Is.~~2021	2022	2023
~~SEA URCHIN~~Crab, rock unspecified	~~0.1~~*Cancer spp.*	0.93	~~0.~~2.4	1.4	2.4	0
~~CALIFORNIA LIZARDFISH~~Crab, shells	~~0.1~~--	8.33	15.7	~~0.2~~12.1	8.9	0
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
~~SAND SOLE~~Mussel, unspecified	~~0.1~~*Mytilus spp.*	~~0.5~~6.48	1.2	2.1	0.8	6.5
~~DIAMOND TURBOT~~Octopus, unspecified	~~0.1~~*Octopus spp.*	2.78	2.4	~~0.2~~1.4	0.8	0
~~BARRED SAND BASS~~Prawn, spot	~~0.1~~*Pandalus platyceros*	0.93	1.2	~~0.2~~4.3	1.6	0
~~BIGMOUTH SOLE~~Pyrosome	~~0.1~~*Pyrosoma atlanticum*	27.78	31.3	~~0.2~~16.4	28.5	24.2
~~CALIFORNIA SPINY LOBSTER~~Salps	~~0.0~~--	6.48	~~0.1~~3.6	4.3	4.9	8.1
~~BLACKSMITH~~Sand dollar	~~0.0~~*Dendraster excentricus*	0.93	1.2	~~0.~~1.4	0	0
~~GREENSPOTTED ROCKFISH~~Sea cucumber, unspecified	~~0.0~~*Holothuroidea*	1.85	~~0.1~~3.6	2.9	3.3	1.6
~~BIG SKATE~~Shrimp, target	~~0.0~~*Sicyonia penicillata*	~~0.2~~3.7	7.2	2.1	4.1	6.5
~~WAHOO~~Squid egg cases	~~0.0~~--	31.48	45.8	~~0.1~~30	35	1.61
~~BLUE ROCKFISH~~**Marine Plants and Algae**	~~0.0~~--	~~0.2~~--	--	--	--	--
~~**YELLOWTAIL**~~Algae, marine	~~**0.0**~~*Phycophyta*	21.3	13.3	~~**0.1**~~20	9.8	9.7
~~SKATE~~Eelgrass	~~0.0~~*Zostera spp.*	3.7	~~0.1~~2.4	2.9	5.7	1.6
~~SHRIMP UNCLASSIFIED~~Kelp, unspecified	~~0.0~~*Laminariales*	60.19	73.5	~~0.1~~35.7	62.6	56.5
~~SHOVELNOSE GUITARFISH~~Kelp, feather boa	~~0.0~~*Egregia menziesii*	7.41	6	~~0.1~~6.4	7.3	1.6
~~**SALMON**~~ Kelp, giant	~~**0.0**~~*Macrocystis pyrifera*	~~0.2~~11.11	4.8	22.9	4.1	6.5
~~**Total Port Samples Taken**~~Surfgrass	~~**2,402**~~*Phyllospadix spp.*	~~**415**~~35.19	~~**988**~~57.8	~~**999**~~34.3	22	4.8

2.13. ~~2.3~~ 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).

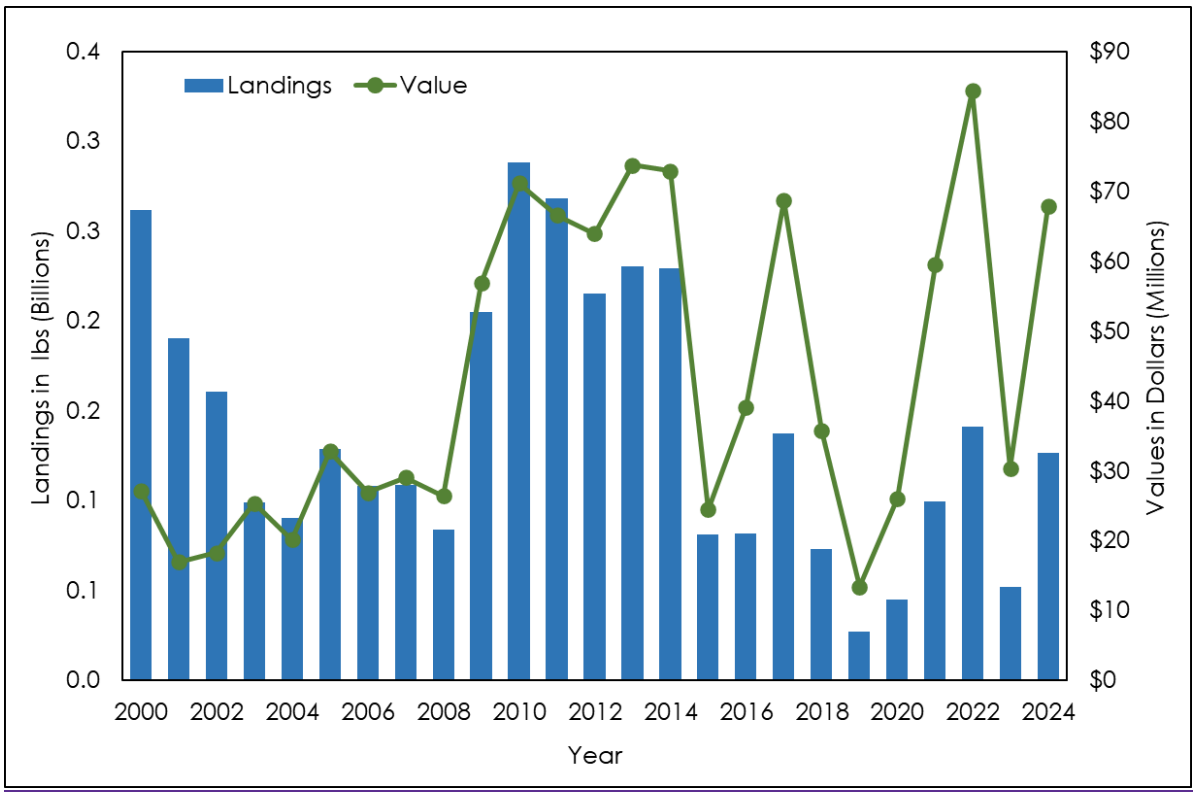


Figure 0-8. Dollars paid ex-vessel and landings in tons 2000 through 2024 (MLDS).

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. ~~California's fishing industry ranks among the top five seafood producing states in the nation (CSC 1997), and growth or decline in commercial fishing, including the market squid industry, affects production, trade and employment throughout the California economy. California market squid is the most valuable commercial fishery product to the state in terms of volume and revenue, generating more than $35 million ex-vessel revenue in recent years. Among California fishery exports, market squid ranked first by volume and value; further, market squid has ranked first in both volume and revenue several times during the 1990s (Table 2-7). The vast majority of squid is frozen for export to China, Japan and Europe where it is used mainly for human consumption. Minor amounts are sold fresh or canned.~~

Table 2-7. Market squid volume and value exported and respective rankings of California fishery exports from 1990 through 2000 (last year data available Source: NOAA Fisheries.

Year	Squid exported (tons)	Export value*	Rank by volume	Rank by value	Percent catch exported
1989	5,267	$5,667,283	1	7	11.7
1990	4,571	$4,110,021	2	10	14.6
1991	2,619	$2,637,344	12	20	6.4
1992	4,187	$3,938,031	2	8	29.0
1993	4,569	$5,448,155	1	6	9.7
1994	15,801	$15,817,174	1	3	25.8
1995	24,107	$21,196,325	1	1	30.2
1996	36,377	$32,802,620	1	2	41.1
1997	49,745	$45,989,317	1	1	64.2
1998	1,554	$2,109,087	8	20	48.7
1999	37,411	$36,355,586	1	1	29.8
2000	92,701	$71,637,625	1	1	75.2

*Note: export value not adjusted for inflation.

The role of international buyers in the success of the California market squid fishery is substantial. After decades of generally low catches, volume increased during the 1990s because of new markets and higher prices. Landings and ex-vessel revenue declined during the 1997-1998 El Niño when squid became harder to catch. In 1999, overseas markets collapsed due to poor economic conditions in Asia. Since then, there has been some recovery of the Asian market, although demand is affected greatly by performance of other worldwide fisheries, particularly the Falkland Islands *Loligo gahi* fishery.

There are three major port areas associated with California's commercial market squid fishing industry (Table 2-8): Northern California (Monterey County); Santa Barbara port area (Ventura and Santa Barbara Counties); and Los Angeles port area (Los Angeles and Orange Counties).

~~Table 2-8. Market squid landings (in tons) by port area (N-SFO = counties north of San Francisco; SFO = San Francisco County, M/SC = Monterey and Santa Cruz Counties; SLO = San Luis Obispo County; SB/VE = Santa Barbara and Ventura Counties; LA/OC = Los Angeles and Orange Counties; SD = San Diego County). Source: CDFG Landing Receipts.~~

~~Season~~	~~N-SFO~~	~~SFO~~	~~M/SC~~	~~SLO~~	~~SB/VE~~	~~LA/OC~~	~~SD~~	~~Total~~
~~1990-1991~~	~~1~~	~~142~~	~~8,728~~	~~<1~~	~~13,201~~	~~10,400~~	~~<1~~	~~32,472~~
~~1991-1992~~	~~2~~	~~1,622~~	~~7,389~~	~~<1~~	~~18,098~~	~~11,554~~	~~0~~	~~38,666~~
~~1992-1993~~	~~<1~~	~~2,698~~	~~6,751~~	~~1~~	~~7,297~~	~~2,028~~	~~18~~	~~18,793~~
~~1993-1994~~	~~<1~~	~~1,122~~	~~6,643~~	~~2,247~~	~~25,571~~	~~18,869~~	~~<1~~	~~54,452~~
~~1994-1995~~	~~77~~	~~2,464~~	~~15,021~~	~~1,540~~	~~32,685~~	~~11,802~~	~~2~~	~~63,592~~
~~1995-1996~~	~~2~~	~~823~~	~~2,700~~	~~151~~	~~67,824~~	~~22,331~~	~~2~~	~~93,833~~
~~1996-1997~~	~~0~~	~~367~~	~~5,235~~	~~226~~	~~90,039~~	~~28,441~~	~~1~~	~~124,309~~
~~1997-1998~~	~~4~~	~~226~~	~~9,045~~	~~<1~~	~~1,593~~	~~28~~	~~2~~	~~10,898~~
~~1998-1999~~	~~-~~	~~-~~	~~-~~	~~10~~	~~6,948~~	~~1,584~~	~~-~~	~~8,543~~
~~1999-2000~~	~~0~~	~~6~~	~~332~~	~~8~~	~~85,134~~	~~41,758~~	~~10~~	~~127,248~~
~~2000-2001~~	~~1~~	~~0~~	~~7,854~~	~~19~~	~~67,542~~	~~48,917~~	~~45~~	~~124,378~~
~~2001-2002~~	~~0~~	~~309~~	~~8,539~~	~~68~~	~~27,583~~	~~33,363~~	~~-~~	~~69,862~~
~~2002-2003~~	~~4~~	~~953~~	~~26,478~~	~~393~~	~~15,121~~	~~4,066~~	~~-~~	~~47,016~~

~~Since the 1993-1994 fishing season, the Santa Barbara and Los Angeles port areas have received the bulk of market squid revenues, with the highest revenues coming into the ports of San Pedro, Port Hueneme and Ventura (Table 2-9). Since the 1981-1982 season, these three areas account for an average of 98% of all squid landings except during El Niño periods (1982-1983 – 53% and 1992-1993 – 86%) when squid landings were minimal. Based on landings, other ports where squid are landed landing are of minor economic importance.~~

~~Table 2-9. Dollars paid ex-vessel for market squid by port area (N-SFO = counties north of San Francisco; SFO = San Francisco County, M/SC = Monterey and Santa Cruz Counties; SLO = San Luis Obispo County; SB/VE = Santa Barbara and Ventura Counties; LA/OC = Los Angeles and Orange Counties; SD = San Diego County). *Note: Dollars not adjusted for inflation. Source: CDFG Landing Receipts.~~

~~Season~~	~~N-SFO~~	~~SFO~~	~~M/SC~~	~~SLO~~	~~SB/VE~~	~~LA/OC~~	~~SD~~	~~Total~~
~~90-91~~	~~$144~~	~~$30,691~~	~~$1,299,765~~	~~$59~~	~~$1,223,192~~	~~$1,343,869~~	~~$643~~	~~$3,898,362~~
~~91-92~~	~~$1,452~~	~~$344,122~~	~~$873,987~~	~~$51~~	~~$830,200~~	~~$1,137,595~~	~~$0~~	~~$3,187,407~~
~~92-93~~	~~$40~~	~~$452,087~~	~~$652,164~~	~~$163~~	~~$764,033~~	~~$444,441~~	~~$3,612~~	~~$2,316,541~~
~~93-94~~	~~$6~~	~~$320,948~~	~~$1,012,803~~	~~$505,792~~	~~$2,612,486~~	~~$2,923,770~~	~~$0~~	~~$7,375,804~~
~~94-95~~	~~$17,477~~	~~$633,318~~	~~$2,807,522~~	~~$453,583~~	~~$8,149,029~~	~~$2,607,151~~	~~$306~~	~~$14,668,386~~
~~95-96~~	~~$463~~	~~$214,959~~	~~$432,174~~	~~$21,301~~	~~$13,432,243~~	~~$5,544,538~~	~~$50~~	~~$19,645,729~~
~~96-97~~	~~$0~~	~~$12,160~~	~~$521,737~~	~~$58,681~~	~~$14,810,588~~	~~$8,354,422~~	~~$262~~	~~$23,757,850~~
~~97-98~~	~~$2,180~~	~~$60,241~~	~~$2,136,685~~	~~$10~~	~~$429,861~~	~~$19,499~~	~~$525~~	~~$2,649,001~~
~~98-99~~	~~-~~	~~-~~	~~-~~	~~$621~~	~~$2,969,874~~	~~$749,300~~	~~-~~	~~$3,719,794~~
~~99-00~~	~~$6~~	~~$1,774~~	~~$79,518~~	~~$4,024~~	~~$24,883,285~~	~~$11,120,763~~	~~$7,000~~	~~$36,096,369~~
~~00-01~~	~~$16~~	~~$0~~	~~$1,881,726~~	~~$1,912~~	~~$11,609,928~~	~~$10,652,521~~	~~$12,683~~	~~$24,158,785~~
~~01-02~~	~~$0~~	~~$74,049~~	~~$1,773,494~~	~~$13,688~~	~~$4,774,247~~	~~$6,813,077~~		~~$13,448,556~~
~~02-03~~	~~$1,262~~	~~$214,582~~	~~$6,525,785~~	~~$76,546~~	~~$4,068,682~~	~~$1,171,035~~		~~$12,057,892~~

~~Generally, ex-vessel revenues have closely paralleled landings until the 2000-2001 season when dollars paid ex-vessel clearly dropped (Figure 2-10). Although the volume of squid produced by California markets is dependent on the international market, the price paid to fishermen can influence both effort and overall volume of catch. Additionally, price paid to fishermen depends on market demand as well as the availability of the resource. When volume of catch is low, the price paid per ton exceeds $500 per ton during the 1997-1998 and 2002-2003 El Niño events. When volume is high, the price may be as low as $100 per ton. Squid taken by brail and in small volumes tends to receive a better price. Often, the price of squid will start high at the beginning of the southern California fishery, and decline as the frozen product begins to accumulate in cold storage facilities. This may result in a reduced incentive for fishermen to fish later in the season. Therefore, declines in landings for springtime~~

~~months may reflect a reduction in the availability of squid as well as reduced effort. Additionally, many vessels participating in other fisheries (e.g. salmon, CPS finfish) will return to other ports during spring months. California markets (processors) play a role in determining the composition of the squid fleet. Although there are many California vessels that have historically participated in the fishery that are still active, there is an increasing proportion of fishery participants from Alaska, Washington and Oregon, reflecting a willingness of the processors to employ these vessels.~~

~~Figure 2-10. Dollars paid ex-vessel and landings in tons for the 1981-1982 through 2001-2002 seasons. Source: CDFG Landing Receipts.~~

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-~~10). Drum seine vessels have been increasing their revenues steadily since the 1994-1995 season (excluding El Niño periods).~~ 7). Revenue from squid fishing using lampara nets ~~has~~ declined 99% from 2.7 million dollars in 1981-1982 to ~~very low values~~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~~
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).

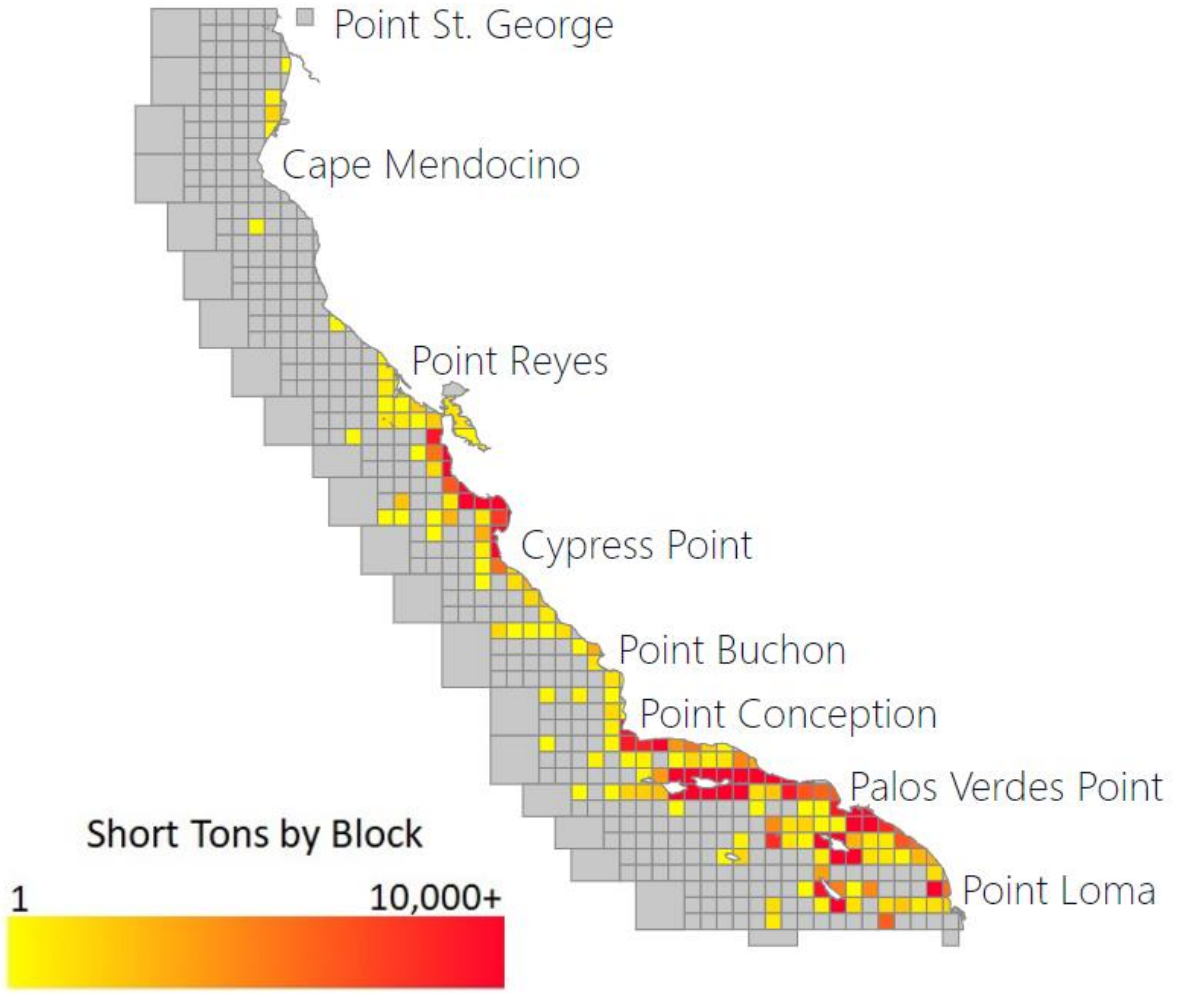


Figure 0-9

~~An average of 114 fishing vessels participate seasonally in the market squid fishery. For the entire squid fishery, the average crew size is 4.5 people (range 3-8, n = 33, Pomeroy et al.~~

~~2002). The average purse seine vessel in San Pedro has a crew size of 7.2 (range 4-10).~~ . 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).

~~Crew wages are typically 50% of ex-vessel revenue after operating costs. Light boats are paid 20% of the catch value after costs (Lutz and Pendleton 2001). Usually, there is a 1:1 ratio of light boats to seiners on the fishing grounds (A. Henry, pers. obs., O. Amoroso, pers. comm.).~~

~~Table 2-11. Percent of revenue received by port area complex from 1981-1982 through 2001-2002 fishing seasons. Note: dollars were not adjusted for inflation. Source: CDFG Landing Receipts.~~

Season	Monterey Area	Santa Barbara/Ventura	Los Angeles	Other Areas
1981-1982	71.8	4.5	23.7	~~0.~~0
1982-1983	84.1	0.1	15.8	~~0.~~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.~~0

~~Table 2-11. Percent of revenue received by port area complex from 1981-1982 through 2001-2002 fishing seasons. Note: dollars were not adjusted for inflation. Source: CDFG Landing Receipts.~~

Season	Monterey Area	Santa Barbara/Ventura	Los Angeles	Other Areas
1986-1987	30.5	21.2	46~~.0~~	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~~.0~~	35.7	10.8
1992-1993	28.2	33~~.0~~	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.~~0	83.1	16.6	0.3
1999-2000	0.2	68.9	30.8	~~0.~~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
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

~~From 1981-1982 through 2000-2001, an average of 54 dealers received market squid from fishing vessels each season. In the early 1980s, dealers in the Monterey port area received the majority of the squid business (Table 2-11). This trend has shifted south to the Santa Barbara/Ventura port area complex that has received, on average, 55% of market squid business in the last five years.~~

~~2.9.1.~~2.14.1. ~~2.3.1 Demographic and Social Communities Associated with the Market Squid Fishery~~

~~The market squid fishery consists of two major geographical regions: the northern and southern fisheries (Figure 2-11). The northern fishery occurs along the central coast of California centered on Monterey Bay; the southern fishery extends from the Channel Islands southward along the coast to La Jolla. Monterey, Santa Barbara, Ventura and Los Angeles Counties are the principle counties where squid is offloaded. Three primary squid fleets are recognized as distinct groups operating out of these areas: 1) Monterey and Moss Landing (northern fishery); 2) Ventura and Port Hueneme (Ventura and Santa Barbara Counties); and 3) San Pedro and Terminal Island [Los Angeles County, (Pomeroy and FitzSimmons 2001)].~~

~~2.3.1.1 Northern Fishery~~

~~2.3.1.1.1 Monterey County~~

~~In 1997, the Monterey County population was approximately 365,000 with 33,000 people in the city. The city encompasses 8.62 square miles. Monterey County has three main economic focuses: agriculture, tourism, and the military. Agriculture takes place mainly in the Salinas Valley, the stronghold of the Monterey County economy. In 1995, 30% of the county's labor and proprietor income was from agriculture. Tourism activity is concentrated primarily along the coastal areas. The military has the Naval Postgraduate School and the Defense Language Institute, which are located in the city of Monterey. In 1993, military downsizing began with the relocation of 13,000 soldiers and their families from Fort Ord in Monterey County. Currently, the community is working to replace the military industrial sector with an education sector (PFMC 2002). Another valuable economic component of Monterey County began in 1930 with the onset of a thriving fishing industry at Cannery Row. Today, all that remains of this industry is a small commercial fleet and a few fish businesses that operate out of Monterey Bay marinas.~~

~~Figure 2-11. Geographic location of major fishing areas in California by CDFG blocks (10' x 10') from 1991 through 2000 based on Department landing receipts~~

~~2.3.1.1.2 Monterey Area Squid Fishery~~

~~Monterey Harbor and Moss Landing are the two ports in Monterey Bay that receive~~

~~market squid. Monterey Harbor has been involved in the squid industry since the late 1800s. Today, space for fish packing and storage facilities at this harbor are limited, so the commercial wharf is used primarily for offloading purposes and squid are transported to processing facilities outside the city. Moss Landing Harbor did not become an active offloading site until 1947. Since then, it has been the site of squid and CPS finfish offloading operations, marine research, recreational fishing and tourism. These industries must share harbor space and sometimes tension exists between the groups (Pomeroy et al. 2002).~~

~~Currently, four major processors operate in Monterey Bay and each has historical family links to fishing in the region (Pomeroy et al. 2002). In addition, many current fishermen are descendants of Italian fishermen who settled here long ago and initiated early fishing efforts (Pomeroy and FitzSimmons 2001). Over time, many different vessels have landed squid in Monterey Bay; but the majority of landings are made by a small group of local fishermen collectively known as the Monterey Bay wetfish fleet (wetfish: sardine, anchovy, mackerel, squid and bonito). This subgroup of skippers has extensive social and cultural ties to the wetfish industry and the local community. Historically, the Monterey fleet has fished for a combination of CPS finfish and squid. Many have shifted to other fisheries such as San Francisco Bay herring or Alaska salmon to supplement their income, especially when wetfish catches are low (Pomeroy et al. 2002).~~

~~Today, the Monterey Bay fleet consists mostly of modern vessels and drum seines that tend to be larger with steel hulls and often two holds (Lutz and Pendleton 2000). Market squid is one of the primary targets of the Monterey Bay wetfish industry. However, following the El Niño in late 1997, squid landings were slow to recover in this region (Pomeroy et al. 2002) until February 2002.~~

~~2.3.1.2 Southern Fishery – Ventura and Port Hueneme~~

~~2.9.2.~~2.14.2. ~~2.3.1.2.1 Santa Barbara County~~

~~The population of Santa Barbara County increased from 369,608 in 1990 to 399,347 in 2000 (CTTCA 2000). Agriculture accounted for 11% of Santa Barbara's total income in 1997. In 1999, manufacturing overtook agriculture as the most important contributor to the economy of Santa Barbara County. Non-agricultural income from health care and social assistance, retail trade, professional, scientific and technical services, and construction followed manufacturing in terms of importance (PFMC 2002).~~

~~2.3.1.2.2 Ventura County~~

~~Similar to Santa Barbara, agriculture accounted for 9% of the county's labor and proprietor income, but was overtaken by manufacturing in 1999. Again, manufacturing was followed by other sources of non-agricultural income: retail trade, wholesale trade, health care and social assistance, and finance and insurance sectors~~

~~(PFMC 2002).~~

~~2.3.1.2.3 Ventura/ Port Hueneme Fishery~~

~~Four harbors play a role in the CPS industry: Santa Barbara, the Channel Islands Harbor, Ventura, and Port Hueneme. Santa Barbara's port is primarily geared towards coastal tourism and only minimal quantities of squid are landed here annually. Similarly, the Channel Islands Harbor is designed mainly to support recreation and does not support commercial fisheries. However, there are holding facilities containing live squid, anchovy, and sardine to provide bait for recreational and commercial fishermen in the area.~~

~~Ventura Harbor is of crucial importance for offloading squid. The harbor is used primarily for commercial fishing operations, although port space is shared with sport fishing and tourist operations. Ventura's commercial fishermen are largely composed of descendants of Slavic fishermen who arrived in the area long ago. The Ventura fleet targets squid as well as Alaska salmon and San Francisco herring, but CPS species are not often targeted (Pomeroy and FitzSimmons 2001). Concerns are now being raised about the future economic sustainability of the fishery since several areas of squid fishing at the Channel Islands have been designated as state marine reserves (Pomeroy et al. 2002).~~

~~Port Hueneme is located in Ventura County and was created to provide an ocean link from the California central coast agricultural community to global markets (PFMC 2002). Port Hueneme is the U.S. port of entry for the central coast area of California and the only deep-water harbor between Los Angeles and San Francisco harbors. It ranks among the top seaports in California for general cargo. Port Hueneme specializes in the import and export of automobiles, heavy agricultural equipment, industrial vehicles, fresh fruit and produce, forest products, and other cargo. Port Hueneme ranks as the top seaport in the United States for citrus export and it ranks among the top ten seaports for automobile and banana imports. Over $4 billion in cargo value moves through Port Hueneme annually. The port provides space for local sport and commercial fishing industries and related activities generate over $388 million for the local economy each year; 3,500 jobs in Ventura County are related to operations at Port Hueneme (PFMC 2002).~~

~~Since 1985, Port Hueneme has been the top squid receiving port in the state. The primary function of this deepwater port is cargo transportation. As a result, space allotted for commercial fishing operations is often cramped and crowded (Pomeroy et al. 2002). Historically, Port Hueneme has been an important receiving station for the wetfish industry. The number of processors fluctuates from year to year depending on the market; but, on average, there are eight processors working the region at a given time. In addition, the timing of the squid season complements the community's agricultural off-season providing ample labor, cold storage and transportation~~

~~resources. There are two distinct groups of fishermen in this fleet. The first group is composed of local in-state fishermen who primarily target CPS finfish, squid, and occasionally tuna and bonito. Many fishermen in this group are from Monterey and San Pedro/ Terminal Island areas and are drawn to the area in the winter for the squid fishery since revenues are declining in the Alaska salmon fishery and boats are being excluded from the San Francisco Bay herring fishery. The second group, over half of the fleet, are out of state fishermen attracted to the southern California market squid fishery after encountering problems in other fisheries (e.g., salmon, herring). The Ventura ports are utilized by many fishermen working the Channel Islands since they are closer and more convenient than Monterey or San Pedro ports (Pomeroy et al. 2002).~~

~~2.3.1.3 Southern Fishery - San Pedro/ Terminal Island~~

~~2.3.1.3.1 Los Angeles County~~

~~The ports of San Pedro and Terminal Island are located in the county of Los Angeles. The population of Los Angeles County increased from 8,863,000 to 9,519,000 between 1990 and 2000.~~

~~2.3.1.3.2 San Pedro~~

~~The population in San Pedro decreased from 85,987 in 1990 to 84,697 in 2001. In 1996, 51.6% of the community was Caucasian, 33.8% was Hispanic, 6.2% was African American, and 7.6% was Asian. The average per capita income in 1996 was $19,413 (Claritas 1996).~~

~~San Pedro is located in southwest Los Angeles on the southeastern slope of the Palos Verdes Peninsula. The community's roots developed over a century of participation in fishing and related industries and are described in the San Pedro Community Environmental Perspectives (1989). The community is relatively small with a hometown feeling and is enhanced by the fact that many residents are locally employed.~~

~~During the 1980s, the commercial fishing industry in Los Angeles declined, directly affecting the local economies of San Pedro and Wilmington. One reason for the decline was competition from foreign fisheries, which operated with lower labor costs and government subsidies. State and local taxes and high insurance costs were blamed as additional burdens on the struggling industry. By 1986, only one fish packing plant remained of the 14 that operated in 1960 (PFMC 1998). This plant has since closed.~~

~~2.3.1.3.3 San Pedro/Terminal Island Fishery~~

~~The San Pedro/Terminal Island fishery industry is not the primary focus of the ports in this region. The main priority at these ports is tourism and transportation of cargo, oil and~~

~~gas. However, San Pedro has long been recognized as a major center for the California CPS industry's purse seine fleet. Much of the revenue generated by the fleet remains in the community through slip fees, boat maintenance, fuel purchases, live bait sales, and by supplying squid for processing (Lutz and Pendleton 2001). Many fishery participants have ancestors from Italy and the country formerly known as Yugoslavia that participated in the fishery generations past. Most of the San Pedro fleet relies solely on market squid, coastal pelagic species (CPS) and coastal tuna for their income. As a result, the variability and uncertainty in the market affect fishermen, processors and receivers. Historically, participants in this fishery have survived by shifting their efforts between species (Pomeroy et al. 2002).~~

~~A survey of the San Pedro fleet initiated in 2000 revealed that most of the vessels were old with wooden hulls (Lutz and Pendleton 2000). The average age of the vessels in this fleet is 47 years and, thus, cost effective insurance is not available to over 1/3 of the fleet. Another problem is non-uniform fishing effort within the fleet. In 1999, four vessels landed 45.6% of the total fleet revenue because they were able to operate at higher production levels and thereby dominate the fleet (Lutz and Pendleton 2001). In the mid 1990s, San Pedro ports experienced an incursion of out of state vessels to participate in the market squid fishery. This resulted in a flooded market and caused squid prices to fall (Lutz and Pendleton 2001).~~

~~2.3.1.4 Summary of the Three Squid Fishery Areas~~

~~In all three regions, most skippers view commercial fishing as a family tradition. In fact, most have other family members involved in fishing, processing, or market activities.~~

~~The relationship between fishermen and the markets plays a vital role in the survival and sustainability of a fishery. The California market squid fishery began as a small industry that supplied squid to local markets. In recent years, the fishery has shifted away from local markets. Currently, the California squid industry is now centered on global markets that have placed an increased demand upon California market squid. Additionally, squid fishing is driven by market orders. Vessels targeting squid usually have a relationship with one market from which they receive orders for specific amounts of squid.~~ *Preliminary data.

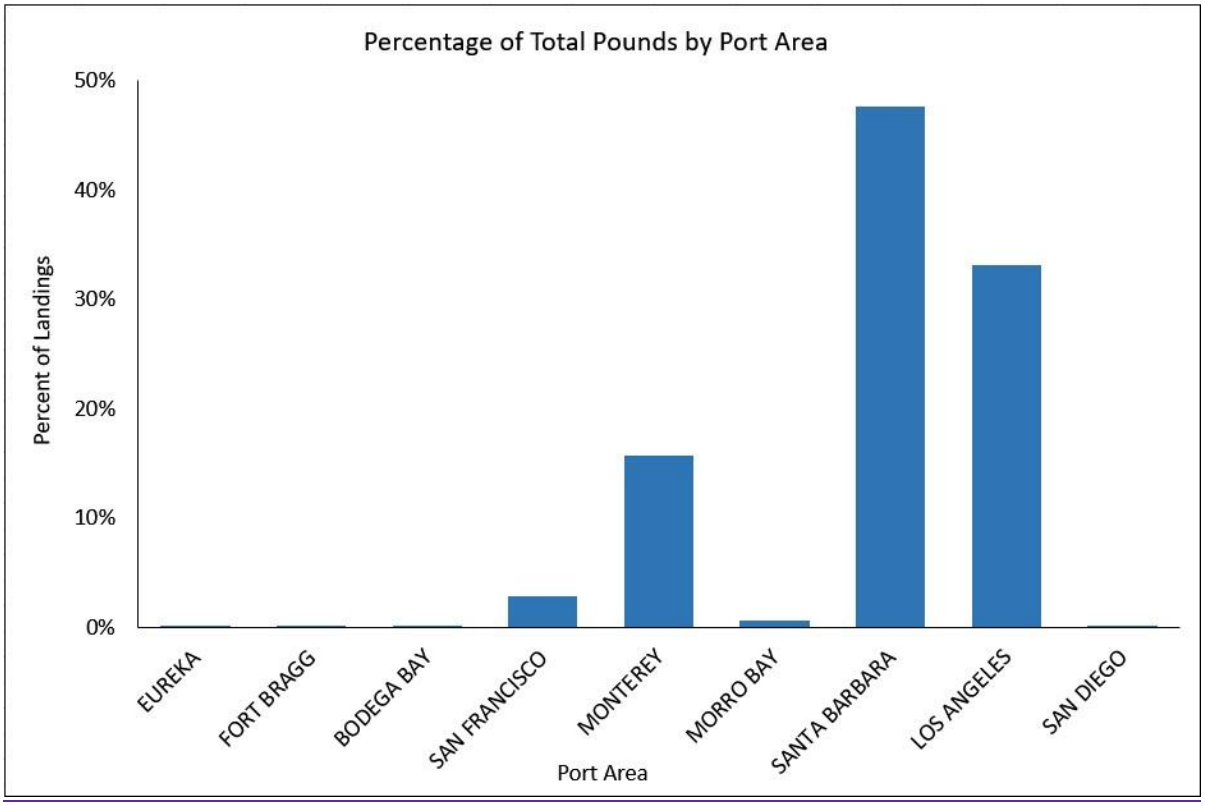


Figure 0-10 ~~When demand or storage space is limited, boats are placed on limits regardless of squid availability (Pomeroy and FitzSimmons 2001).~~

~~2.4~~. Percentage of market squid total landings (by weight) by port complex from 1980 to 2024 (MLDS).

2.15. History of Conservation and Management Measures

~~2.9.3.~~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-~~13).~~ 9). The addition of former FGC §8397 in 1957 prohibited the use of ~~these~~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.

Date	Bill # (Author) / Regulatory Section	Management Action
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.
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 the 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 a 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 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 ~~the~~ spawning. Further, banning attracting lights would prevent canneries from harvesting squid directly from their docks. ~~This~~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 ~~tax~~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 ~~a Squid Fishery Advisory Committee (~~an SFAC~~)~~ and ~~a Squid Research Scientific Committee (~~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 ~~this legislation.~~ 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 ~~the~~:

- 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 ~~this legislation~~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 ~~US~~-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 ~~a market squid fishery management plan.~~ an MSFMP. Other features of ~~this bill~~SB 209 included providing that specified provisions will become inoperative upon the adoption by the Commission of ~~a market squid fishery management plan~~an MSFMP and the adoption of implementing regulations and will be repealed 6 months thereafter.

~~In 2001, the Commission established a harvest guideline of 125,000 tons for the market squid fishery, which was based on the highest seasonal catch level for the fishery; its~~

~~purpose was to prevent volumetric growth of the fishery should market demand encourage such expansion.~~

~~Table 2-13 Summary of Market Squid Regulations from 1959 to the present~~

~~Date~~	~~Bill # (Author)~~	~~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.~~
~~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 17, from taking market squid between noon Friday and midnight Sunday and between noon and midnight on any Monday through Thursday.~~
~~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 District 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 tax of $0.0019/lb is imposed.~~

Table 2-13 Summary of Market Squid Regulations from 1959 to the present		
Date	Bill # (Author)	Management Action
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 light boat owner's permit. Allows for transfer of vessel or light boat owner's 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 tax 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 US 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.
2001	SB 209 (Sher)	Requires the Commission to adopt the MSFMP by 31 Dec 2002, after consideration and public hearings. Requires the Commission to establish fees for commercial market squid vessel permits and commercial squid light boat owner's permits annually commencing April 1, 2003. Prohibits each person who is issued a commercial squid light boat owner's 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 a MSFMP and the adoption of implementing regulations and will be repealed 6 months thereafter.

~~Table 2-13 Summary of Market Squid Regulations from 1959 to the present~~		
~~Date~~	~~Bill # (Author)~~	~~Management Action~~
~~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.~~

~~Amendment 8 of the CPS FMP placed Pacific mackerel (*Scomber japonicus*), Pacific sardine (*Sardinops sagax*), jack mackerel (*Trachurus symmetricus*), and market squid (*Loligo opalescens*) in a management unit with northern anchovy (*Engraulis mordax*). Managed species are divided into two categories: "Actively managed" and "monitored". Actively managed species are subject to annual harvest limits based on current biomass estimates. There are no mandatory harvest limits for monitored species; however, other management measures, such as area closures, could apply to monitored species. Initially, Pacific sardine and Pacific mackerel are designated as actively managed species, while jack mackerel, northern anchovy, and market squid are monitored species. However, the CPS FMP required that Maximum Sustainable Yield (MSY) be established for all species in the plan. Setting MSY for market squid is problematic because a biomass estimate has yet to be determined. A proxy for MSY, using egg escapement, has been approved for the market squid fishery. Details of this method are presented in section 3.2. Finally, the PFMC delegated management authority for market squid to the State.~~

~~Chapter 3.~~ In 2004, the Commission adopted the 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 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 MSFMP goals were:

Fishery control rules, including:

- An SCLto 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. ~~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.

~~To this end, fishery management plans (FMPs)~~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 ~~plans to meet these~~ meets the requirements ~~and the~~, goals, and objectives of the MSFMP using management based on four components: 1) fishery control rules, 2) a restricted access program, 3) ecological considerations, and 4) administrative items. The ~~project will protect~~MSFMP 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 ~~this program~~the MSFMP forms an integral approach to meeting ~~the~~ MLMA guidelines. ~~The final project and the implementing regulations adopted by the Commission at the 27 August 2004 and 3 December 2004 meetings are presented in Table 3-1.~~

~~This~~The MSFMP 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, ~~it~~the MSFMP defines the scope of management authority for the Commission when acting under the MSFMP. Management measures implementing the MSFMP, which directly control fishing activities, must be consistent with the goals and objectives of the MLMA and other applicable laws. Also, ~~they~~management measures must be consistent with federal management requirements in the CPS FMP. ~~These management~~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. ~~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 ~~seasonal catch limits~~an SCL, gear restrictions, weekend closures, and sustainable levels of egg escapement. The~~application of the~~ MLMA concept of adaptive management is particularly relevant to ~~this~~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 amended MSFMP include:

- ~~3.1.2~~ **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 ~~bases its approach to restricted~~restricts access to the fishery based upon the MLMA and the Commission's restricted access policy, ~~and establishes a~~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), ~~initial issuance criteria,~~ and transferability conditions for the commercial market squid fishery.

3.1.3. ~~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~~ 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. ~~3.1.4~~ Administrative Items

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

~~Table 3-1. Summary of Management Measures as Identified in the Draft MSFMP Adopted by the Commission 27 August 2004 and 3 December 2004.~~	
~~**FISHERY CONTROL RULES**~~	
~~**Seasonal Statewide Catch Limitation**~~	
	~~Establish a seasonal catch limitation based on recent average catch and the assumption that squid biomass is above average spawning biomass (currently set at 118,000 tons) to be reviewed in two years (Option A.2).~~
~~**Weekend Closures**~~	
	~~Continue closures from noon Friday to noon Sunday from the U.S.-Mexico border to the California-Oregon border (Option D.1)~~
~~**Monitoring Program**~~	
	~~Continue existing squid monitoring programs (port sampling and logbooks) (Option E.1).~~
~~**Live Bait Fishery and Incidental Catch of Market Squid**~~	
	~~Continue existing regulations that do not require a squid permit when fishing for live bait or incidental take two tons or less (Option F.1).~~
~~**Gear Restrictions**~~	
	~~Maintain existing gear options regarding wattage (30,000 watts) (Option G.1)~~

Table 3-1. Summary of Management Measures as Identified in the Draft MSFMP Adopted by the Commission 27 August 2004 and 3 December 2004.	
	Establish gear restrictions which state that each vessel fishing for squid and lighting for squid will utilize shielding that will reduce the light scatter of its fishing operations by shielding the entire filament of each light used to attract squid and orient the illumination directly downward so that the lower edge of the shield will be parallel to the deck of the vessel (Option G.4)
RESTRICTED ACCESS PROGRAM	
Market Squid Fleet Capacity Goal	
	Establish a capacity goal for market squid vessels that produces a moderately productive and specialized fleet (55 vessels, 18 brail vessels and 34 light boats, capacity goal for non-transferable permits is zero) (Option H.3)
Initial Issuance of Permits	
	Transferable Permits: Market Squid Vessel Permit: possession of a current market squid vessel permit (2004-2005) and a minimum of 50 landings in window period January 1, 2000 through March 31, 2003; Brail Permit: Possession of a current market squid vessel permit (2004-2005) and a minimum of 10 landings made with brail gear in window period January 1, 2000 through March 31, 2003; Light Boat Permit: Possession of a current market squid permit (either vessel or light for 2004-2005) and have submitted one light boat log by December 31, 2000. Non-Transferable Permits: Market Squid Vessel Permit: Possession of a current market squid vessel permit (2004-2005), possession of a California commercial fishing license for at least 20 years and a minimum of 33 landings prior to August 27, 2004. Only receipts that demonstrate catch aboard a vessel that does not already qualify for issuance of a transferable permit of any permit class are eligible. Brail Permit: Possession of a current market squid vessel permit (2004-2005), possessed a California commercial fishing license for at least 20 years and made a minimum of 10 landings with brail gear during one fishing season in a window period from January 1, 2000 through March 31, 2003. Only receipts that demonstrate catch aboard a vessel that does not already qualify for issuance of a transferable permit of any permit class are eligible. Light Boat Permit: There is not a non-transferable permit category (Option I.1).
Permit Fees	
	Annual permit fees: 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 (Option J.2)
Market Squid Vessel Permit Transferability	
	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 under a "2 for 1" permit retirement; individuals wishing to gain entry into the fishery must secure two permits (Option K.3)
Market Squid Brail Permit Transferability	
	Establish full transferability of market squid brail permits based on comparable capacity (Option L.3)

Table 3-1. Summary of Management Measures as Identified in the Draft MSFMP Adopted by the Commission 27 August 2004 and 3 December 2004.	
Market Squid Light Boat Owner's Permit Transferability	
	Establish full transferability of light boat owner permits with a '1 for 1' permit retirement (Option M.3)
	Upgrade 2-1 light boat owner permits for one brail permit (Option M.4)(Revised by Commission 22 March 2005).
Transferability Fee	
	Establish a transfer fee of $500 (Option N.1). Establish a **Market Squid Brail Permit Upgrade Fee of $1,500.**
Experimental Market Squid Vessel Permits	
	Establish three non-transferable experimental fishery permits (Option O.2).
ECOLOGICAL CONSIDERATIONS	
Area and Time Closures to Address Seabird Issues	
	Establish areas closed to squid vessels using attracting lights in all waters of the Gulf of the Farallones National Marine Sanctuary (Option R.9).
ADMINISTRATIVE ITEMS	
Market Squid Advisory Committee	
	Establish one advisory committee for the squid fishery, which includes scientific, environmental and industry representatives (Option S.1).

3.2. 3.2 Fishery Control Rules

3.2.1. 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, theyfishery control rules help identify key management measures appropriate to the fishery.

The MLMA defines maximum sustainable yield (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, there may be

~~situations where the~~ scientific information ~~is~~may be inadequate to directly calculate MSY for a particular species, and a proxy or substitute ~~may be~~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 ~~their~~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. ~~3.2.2~~ Proxy for MSY and Precautionary OY

~~There often~~ MSY is ~~insufficient knowledge to calculate MSY.~~ not always calculatable for data limited fisheries or for species with a natural mortality of one year or less. Restrepo et al. (1998) ~~provide~~provided an alternative approach for federal fisheries management, and the State used a variant of the Restrepo approach in the ~~interim~~ 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 ~~in this approach~~ is based on the historical average catch, selecting a period when ~~there is no indication that~~ 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.

~~There are no~~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 ~~these~~the guidelines were established for fish that are considered long-lived in comparison with the market squid, which only ~~lives 6 months:~~ 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. ~~3.2.3~~ Seasonal Catch Limitation

3.2.3.1. ~~3.2.3.1~~ A Proxy for MSY Based on Historical Landings

~~Due to the lack of adequate data to make a mathematical MSY determination, guidance was~~ Guidance taken from NOAA Fisheries (Restrepo et al. 1998~~). These guidelines~~) propose that ~~in data-poor situations~~for species such as ~~the~~ market squid ~~fishery~~, a proxy may be used for MSY, and ~~that it is reasonable~~ to use recent average catch from a period when ~~there is~~ no qualitative or quantitative evidence of declining abundance~~.~~ was observed.

El Niño events are a recurring phenomenon of the ~~California Current~~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. ~~In the period between the last two El Niño events (1993-1994 and 1997-1998) there was a nearly unlimited demand~~Demand for California market squid ~~in~~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-~~2).~~ 1). Nearly all of the landings were from the southern California fishery (99.7%); landings reported from the northern fishery were minimal (0.3%). ~~This~~The disparity ~~could~~between southern and northern landings was not ~~have been~~ predicted given the ~~current~~ understanding of the market squid ~~or~~fishery at the time, nor by utilizing temperature inclusive models. Average landings ~~for the last ten, five, and three years~~from 1991 to 2003, used as the proxy for market squid MSY, are presented in Table 3-~~2. These averages can be used as a proxy for MSY~~1.

~~3.2.~~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. ~~.2~~ Establishment of a Seasonal Catch Limitation

The Commission ~~has~~ 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 ~~based on a multi-year recent average catch (see Table 3-2). This approach assumes~~assumed that the stock ~~is~~was above the average spawning biomass (B_{MSY}) and ~~uses~~used a precautionary multiplier of 1.0. ~~This limitation~~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 ~~this~~the level of landings. This is likely due to the semiannual lifespan and the presence of several (minimum seven) cohorts throughout the year. ~~Therefore, a~~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.

Table 3.2. 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 (short tons)	10-yr Ave. (93-94 to 02-03)	5-yr Ave. (98-99 to 02-03)	3-yr Ave. (00-01 to 02-03)	10-yr Ave. (92-93 to 01-02)	5-yr Ave. (97-98 to 01-02)	3-yr Ave. (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**

Setting a seasonal catch limitation will serve 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. Given the number of squid vessels

~~permitted during the moratorium and significant excess capacity in the fleet, dramatic increases in catch could occur in a short time frame unless a safeguard is in place. Catch trends indicate that the market squid resource appears to be quite robust and is able to sustain the recent catch levels.~~

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

As was mentioned above, ~~because~~ no biomass estimate exists for market squid, ~~it~~nor is ~~not~~it possible to define an overfished condition for ~~this~~the species. It is important to recognize that setting an actual MSY for market squid is impractical for the squid fishery because ~~fishery and biological data are inadequate~~the species is short-lived, and landings are strongly influenced by market demand rather than effort. ~~However, if a minimum threshold for egg escapement is not realized, it can be considered that an overfished condition may exist, or that catches of squid exceed any specified allowable level.~~ 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 ~~and~~ that ~~these catches~~ may not be sustainable.

~~Consequently, the egg escapement method will also be used as a proxy for MSY/OY. This 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 in order to collect adequate biological information. The egg escapement model, as a proxy for MSY, is only a temporary measure until an acceptable biomass estimate can be determined for market squid. If a biomass estimate cannot be determined for market squid, agencies will continue to improve and refine the egg escapement method. This process of re-evaluation of the egg escapement model is ongoing through the PFMC CPS Management team.~~

~~3.2.4 Weekend Closure for Commercial Market Squid Fishery~~

~~The Commission has decided to continue closures beginning noon Friday through noon Sunday from the U.S.-Mexico border to the California-Oregon border. This weekend closure allows for two days of uninterrupted spawning in areas where squid are being harvested. This provides protection to the resource by allowing spawning to occur and egg cases deposited without disturbance from the fishery. This also includes the use of attracting lights on weekends for commercial harvest. Unlike a seasonal quota or closure, this measure spreads the spawning escapement throughout the year, rather than concentrating it during one particular period.~~

Consequently, the egg escapement method will also be used as a proxy for MSY/OY.

The egg escapement~~Prohibiting fishing activity on weekends may also help alleviate conflict with other interest groups (e.g., divers, recreational fishermen, commercial passenger fishing vessels, etc.) operating in the same area. For example, the weekend closure has probably reduced the amount of interactions between the fishery and recreational divers wanting to observe squid spawning events.~~

~~3.2.5 Monitoring Programs~~

~~The Commission has decided to continue the existing squid monitoring programs, including fishery-dependent sampling efforts and ongoing monitoring of catch information, especially those focused on developing management models. The fishery-dependent sampling is essential for real-time monitoring of the market squid fishery through the egg escapement method. The adopted project also maintains the Department's logbook system for squid vessels and light boats. These records provide valuable catch information other than landing data, and are critical to model the market squid population.~~

~~These monitoring programs (port sampling and logbooks) are designed to learn more about the fishery and resource and are intended to aid in the development of population models to sustain harvests. This~~ 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. ~~3.2.6 Live Bait~~Weekend Closure for Commercial Market Squid Fishery

The current weekend closure begins noon Friday and ~~Incidental Catch~~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~~Market Squid~~), 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.

~~3.2.4.~~3.2.6. Live Bait Fishery and Incidental Catch of Market Squid

The Commission ~~has~~ decided not to require a ~~market squid vessel permit~~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 ~~is~~was not previously documented in a manner similar to that used for the ~~market~~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.

~~FGC §8421(b) does not require vessels taking or landing market squid for commercial purposes to have a market squid permit if the catch does not exceed two tons in any calendar day.~~ Because squid frequently school with CPS finfish, mixed landings of market squid and CPS finfish are common. With ~~a seasonal catch limitation~~an SCL in place, once the catch limit is reached, an allowance for incidental catch of market squid from other commercial fisheries is needed~~. This~~ and would prevent ~~the~~ squid from being discarded.

~~3.2.5.~~3.2.7. ~~3.2.7~~ Gear Restrictions

The Commission chose to maintain ~~existing~~ 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. ~~And, as~~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 ~~of~~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 ~~in order~~ to provide the maximum shielding possible to reduce impacts to seabird or coastal communities ~~(Option G.4).~~ . 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.

~~3.3~~ 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.

~~3.2.6.~~3.2.8. Restricted Access ~~Program~~ (Limited Entry) Program

~~Restricted access~~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. ~~In a fishery such as the market squid commercial fishery, the main objective of a restricted access program would be to assure the greatest economic viability from the harvest of market squid.~~

~~Prior to the 1998-1999 season, the squid fishery was an open access fishery. In 1996, new demand and markets for squid attracted many fishing vessels from other states. This influx of fishing vessels and increased competition has resulted in conflict and territorial disputes between "local" and out-of-state fishermen.~~

~~A restricted access program for the squid fishery should serve to balance the need to provide a viable economic harvest with the need to protect the squid resource. Access into the market squid fishery may be restricted by issuing only a certain number of permits (limited entry). In the absence of a biomass estimate for market squid, a limited entry program, in conjunction with a seasonal catch limit, monitoring the fishery through the egg escapement method and weekend closures should collectively provide for a sustainable squid resource and fishery.~~

~~3.3.1 Summary of Commission Restricted Access Policy and the Market Squid Fishery~~

~~California's fisheries 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, as many of these purposes should be encouraged as possible, consistent with resource conservation.~~

~~If harvest and other human-caused factors affecting the sustainability of the squid fishery are not managed, fishery resources may be less than optimally productive or, in the worst case, may suffer serious declines. Restricting access to a fishery has become one of many standard fishery management tools used by public agencies in carrying out their conservation and management responsibilities for publicly held fishery resources. It is the policy of the Commission to design restricted access programs to enhance the State's ability to manage its commercial fishery resources. Restricted access programs should: 1) contribute to sustainable fisheries management by providing a means to match the level of effort in a fishery to the health of the fishery resource and by giving fishery participants a greater stake in maintaining sustainability; 2) provide a mechanism for funding fishery management, research, monitoring, and law enforcement activities; 3) provide long-term social and economic benefits to the State and fishery participants; and 4) broaden opportunities for the commercial fishing industry to share management responsibility with the Department.~~

~~More specifically~~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. ~~Restricted access programs may be instituted in order to carry out one or more of these purposes in a given fishery.~~

~~Because a 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. Fishery capacity goals can be expressed as some factor or combination of factors that fairly represents the fishing capacity of the fleet. These factors may include the number of permitted fishery participants, number of permitted boats, net tonnage of the permitted fleet, amount of gear used in the fishery, and cumulative hold capacity. Fishery capacity goals should be based on such biological and economic factors as what is known about the size and distribution of the target species, historic fleet size or harvest capacity, and distribution of harvest within the current fleet. Conflicts with other fisheries or ocean interest groups and economic conditions (current and future) within the fishery may also be factored in to such determinations. Depending on the fishery, the fishery capacity goal may be expressed as a single number or as a range.~~

~~3.2.7. Rationale for Implementation of a Limited Entry Program for the Market Squid Fishery~~

~~Vessels currently participating in the market squid fishery are capable of harvesting more squid than is available under current or likely future biomass conditions.~~ 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. ~~As fisheries become~~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. ~~As harvesting capacity in fisheries increases, problems arising from the need for more restrictive management measures and resolution of allocation issues become more acute. No relief from these problems will occur if harvesting capacity continues to rise. Taking action to reduce excess capacity before a resource reaches depleted status is a proactive management strategy that may thwart or alleviate potential problems with resource allocation in the future~~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.

~~3.2.7.1.~~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.

Evaluating the capacity of the current market squid fishery can be used to provide a basis for establishing a restricted access program that matches the level of effort in a fishery to the health of the fishery resource. The goal of such a program is to maintain a sustainable squid resource and provide for a fishery that is diverse, stable, and profitable. With the establishment of the moratorium in 1998, many vessels applied for permits that were not previously active in the squid fishery. These purchases led to a situation where excessive and currently unutilized capacity has been present among permitted vessels of the fleet. During peak landing periods, the number of active vessels was still significantly below the number of currently permitted vessels.

The Commission has adopted a capacity goal for market squid vessels that produces a moderately productive and specialized fleet of 55 market squid vessel permits, 18 market squid brail permits, and 34 light boat permits. A capacity goal of 55 market squid vessels instead of the 52 originally proposed was adopted to include the addition of three experimental non-transferable fishery permits (Option O.2). The adopted program sets the capacity goal for light vessels at 52 light boats. The adopted project supports a brail fleet capacity goal of 18 vessels as part of the total light boat capacity goal of 52 vessels.

3.3.3 Initial Issuance of Market Squid Fleet Permits

Establishing limited entry qualifying criteria is a first step in reducing fleet size from the 165 squid vessels and 40 light boats currently permitted to achieve the selected capacity goal. A capacity goal is a target value that may be disruptive if implemented immediately. Providing initial qualifying criteria, implementing provisions for permit transferability, and encouraging additional attrition are mechanisms to help reduce the number of vessels in order to achieve the capacity goal in a less disruptive manner. Senate Bill 364 (1997) served as an initial notice of intent that a restricted access program was to be considered for the market squid fishery. This legislation established a squid fishery permit system; the system issued vessel-owner permits, and permit renewal required possession of a permit the previous season (moratorium). This moratorium of squid permits further served to alert squid fishermen of the potential for a restricted access program.

The Commission's policy to determine qualification for an initial permit has three elements. First, the policy for all restricted access fisheries assumes that initiating a restricted access program will not increase the recent level of fishing effort. Second, initial issuance of permits will only be to the current owners of qualifying vessels. Third, in order to meet the needs of a particular fishery, it may be desirable to modify the approach of giving permits only to current owners of qualifying vessels.

FGC §8101 permits any licensed fisherman to participate during the initial year of a limited entry program regardless of the prescribed conditions for entry if the fisherman presents to the Department satisfactory evidence that he or she has been licensed as

~~a California commercial fisherman for at least 20 years and has participated in the specific fishery. Further, the fisherman must demonstrate qualifying participation in the fishery through landings or other appropriate criteria determined by the Commission.~~

~~Developing light boat initial issuance criteria based on historical participation is particularly problematic given that light boat participation was not formally documented prior to the logbook program. When the permit program was initiated, light boats could possess either a market squid vessel permit or a squid light boat owner's permit to use attracting lights. A number of currently active light boats hold market squid vessel permits rather than light boat owner permit's based on the design of the permit structure during the 1998-2004 moratorium period. Beginning in 2000, the Department has operated a market squid logbook program, which documents light boat activity, and used these submitted logbooks as documented participation in the squid fishery.~~

~~The Commission adopted a limited entry program for the California market squid fishery following the Commission's own established guidelines and policies for restricted access commercial fisheries. Limited entry was widely supported by most members of the SRSC, the SFAC, and other squid fishing industry and conservation groups, with some processors and fishermen initially in opposition. During the adoption process, a group of both fishermen and processors got together and decided which elements to support as a group, which the Commission adopted.~~

Five major squid fishery permit categories ~~were adopted for initial issuance criteria~~have been established: 1) transferable market squid vessel owner permits, 2) non-transferable market squid vessel owner permits, 3) transferable ~~market squid brail permits~~Market Squid Brail Permits, 4) non-transferable ~~market squid brail permits~~Market Squid Brail Permits, and 5) ~~market squid light boat owner permits. Initial issuance of these permits was set under the following criteria:~~

~~Transferable Permits:~~

- Market Squid ~~Vessel Permit: possession of a current market squid vessel permit (2004-2005) and a minimum of 50 landings in window period 1 January 2000 through 31 March 2003;~~
- ~~Brail Permit: Possession of a current market squid vessel permit (2004-2005) and a minimum of 10 landings made with brail gear in window period 1 January 2000 through 31 March 2003;~~

Light Boat ~~Permit: Possession of a current market squid permit (either vessel or light for 2004-2005) and have submitted one light boat log by 31 December 2000.~~ 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.

Capacity Goal~~Non-Transferable Permits:~~

- ~~Market Squid Vessel Permit: possession of a current market squid vessel permit (2004-2005), possessed a California commercial fishing license for at least 20 years and made a minimum of 33 squid landings at any time prior to August 27, 2004;~~
- ~~Brail Permit: Possession of a current market squid vessel permit (2004-2005), possessed a California commercial fishing license for at least 20 years and made a minimum of 10 landings with brail gear during one fishing season in a window period from 1 January 2000 through 31 March 2003. Only receipts that demonstrate catch aboard a vessel that does not already qualify for issuance of a transferable permit of any permit class are eligible.~~

3.2.9. ~~The adopted option (Option I.1) for initial issuance establishes a fleet, (Table 3-3), that is in proximity with~~

As directed under the ~~adopted capacity goal for the market squid fishery (Option H.3). Further, the adopted transferability options (Options K.3, L.3, and M.4) provide a mechanism to achieve the adopted capacity goal.~~

~~Table 3-3. Summary of adopted project initial issuance limited entry criteria. Source: CDFG Landing Receipts~~

~~Permit Type~~	~~Initial issuance criteria~~	~~Anticipated number of qualifiers~~
~~Market squid vessel permit (transferable)~~	~~Possession of a valid 2004-2005 market squid permit; 50 market squid landings between 1 January 2000, and 31 March 2003.~~	~~68~~
~~Market squid brail permit (transferable)~~	~~Possession of a valid 2004-2005 market squid vessel permit; a minimum of 10 landings made with brail gear in window period 1 January 2000 and 31 March 2003.~~	~~5~~ ~~(11 qualify less 6 that also qualify for vessel permit)~~

Table 3-3. Summary of adopted project initial issuance limited entry criteria. Source: CDFG Landing Receipts		
Permit Type	Initial issuance criteria	Anticipated number of qualifiers
Market squid light boat owner's permit (transferable)	Possession of a 2004-2005 market squid permit (either vessel or light); submission of one light boat log by 31 December 2000.	45 (57 qualify less 8 that qualify for a vessel permit and 11 that qualify for a brail permit)
Market squid vessel permit (non-transferable)	A 20-year CA commercial fishermen possessing a valid 2004-2005 market squid permit; a minimum of 33 landings prior to 27 August 2004	12-25
Market squid brail permit (non-transferable)	Possession of a 2004-2005 market squid vessel permit; possession of a California commercial fishing license for at least 20 years; made a minimum of 10 landings with brail gear during one fishing season in a window period from 1 January 2000 and 31 March 2003. Only receipts that demonstrate catch aboard a vessel that does not already qualify for issuance of a transferable permit of any permit class are eligible.	5

3.3.4 Permit Fees

The adopted project requires that an appropriate annual fee for market squid vessel, market squid brail, and light boat owner's permits be established to: 1) cover the cost of squid research and management programs, and 2) provide adequate monitoring and implementation of aMSFMP limited entry program. Revenue is also generated from taxes 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. , the Any permit fee established needs to be reevaluated periodically.

The Commission adopted the following annual permit fees:

a vessel-based capacity goal of 55 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~~

~~Permits, 34~~ Market Squid Light Boat ~~Permit - Transferable = $600~~Permits, and 18 Market Squid Brail Permits, with the intent for non-transferable permits to decline through attrition.

~~Limited entry guidelines require an appropriate fee to implement a limited entry program, while also providing funds for management and research. The current baseline costs for maintaining existing Department programs that deal directly with market squid research, monitoring, enforcement, and license sales exceeds $964,000 annually (see Section 1, Chapter 5). Under the Commission's adopted program for initial issue of permits, the number of permits issued would be 111 transferable (68 vessel, 13 brail, 38 light boat). Assuming a minimum of 17 20-year nontransferable permits issued, there would be 135 permits initially issued (Table 3-4).~~

The Commission ~~has~~initially adopted the following transfer criteria:

- Establish full transferability of ~~market squid vessel permits~~Market Squid Vessel Permits based on comparable capacity (within 10%).
- Establish transferability of ~~market squid vessel permits~~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~~Market Squid Vessel Permit and surrender it to the Department for retirement.
- Once the ~~Capacity Goal~~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 owner permits~~Squid Light Boat Permits cannot be used to secure a ~~market squid vessel permit.~~ Market Squid Vessel Permit.

~~Table 3-4. Range of fees for transferable and non-transferable market squid vessel, brail and light boat owner permits. The current baseline costs for maintaining existing Department programs that deal directly with market squid research, monitoring, enforcement, and license sales exceeds $964,000 annually (see MSFMP Section 1, Chapter 5).~~

~~Permit type~~	~~Initial issuance~~	~~Permit Fee~~	~~Total~~
~~Market squid transferable permits~~			
~~Vessel~~	~~68~~	~~$2,000~~	~~$136,000~~
~~Brail~~	~~5~~	~~$2,000~~	~~$10,000~~
~~Light~~	~~45~~	~~$600~~	~~$27,000~~
~~Market squid non-transferable permits~~			
~~Vessel~~	~~12-25~~	~~$1,000~~	~~$12,000-25,000~~
~~Brail~~	~~5~~	~~$1,000~~	~~$5,000~~
~~Totals~~	~~135~~		~~$178,000~~
~~Program fees offset by fees (%):~~		~~Full Implementation ($964,000)~~ ~~Current Monitoring Only ($533,000)~~	~~18.5%~~ ~~33.4%~~

For ~~market squid vessel permits~~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.

~~3.3.6. Transferability of~~ For Market Squid Brail Permits~~.~~

~~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%). ~~Given they are a minor component of the fleet and the number of currently active brail vessels is less than the suggested capacity goal, there is little concern regarding overcapitalization at this time.~~

~~3.3.7 Transferability of Market Squid Light Boat Owner's Permits~~

The Commission ~~has~~also decided to establish full transferability of ~~light boat owner's permits.~~ Market Squid Light Boat Permits. This ~~would be~~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 ~~light boat owner's permit~~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.~~ Market Squid Brail Permit. The change reflects the ~~Fish and Game~~ Commission's decision to allow the holder of a ~~Transferable~~transferable Market Squid Light Boat Permit to upgrade that ~~Permit~~permit to a Transferable Market Squid Brail Permit, without the surrender of any additional permits (one-for-one upgrade).

~~3.2.8.~~3.2.10. ~~3.3.8~~ Permit ~~Transfer~~ Fees~~.~~

~~The Commission chose to set the permit transfer fee at $500.~~ The adopted project ~~establishes~~required that an appropriate annual fee ~~to transfer~~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.

~~light boat owner's~~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 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.

~~3.2.9.~~3.2.11. ~~3.3.9~~ Experimental Market Squid Vessel Permits

~~The~~In 2005, the Commission ~~has~~ established 3 experimental market squid vessel non-transferable permits~~. This allows~~, which allowed the Commission to issue 3 non-transferable ~~market squid vessel permits~~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 ~~would be~~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 ~~count towards~~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).

~~3.4~~ 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 ~~californicus~~*), State-listed threatened ~~Xantus's~~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 ~~14~~15 seabird species that breed on Santa Barbara, Anacapa and San Miguel islands (including ~~one~~two endangered species, one threatened species and five SSC) while 12 seabird species breed at the Farallon Islands (including four SSC) (Table 3-~~5).~~ 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.

~~Table 3-5 Seabird species that breed (indicated by an X) in the Channel Islands and the Farallon Islands~~.

Diurnal Species	**ANA**	**SBI**	**SMI**	**SRI**	**SCR**	**CAT**	**SCL**	**SNI**	**Farallon Is.**
~~**Diurnal Species**~~									
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 ~~‡,**~~, **	--	--	~~----~~ x	X	--	--	--	--	--
Black Oystercatcher	X	X	X	X	X	--	X	X	X
Common Murre	--	--	--	--	--	--	--	--	X
~~**Nocturnal Species**~~									
~~Ashy Storm-Petrel**~~	~~P~~	~~X~~	~~X~~		~~X~~	~~X~~	~~X~~		~~X~~
~~Black Storm-Petrel**~~		~~X~~	~~X~~			~~X~~	~~X~~		
~~Leach's Storm-Petrel~~		~~X~~	~~X~~						~~X~~
~~Xantus's Murrelet**, ***~~	~~X~~	~~X~~	~~X~~		~~X~~	~~X~~	~~X~~		
~~Rhinoceros Auklet**~~			~~X~~						~~X~~

~~Cassin's Auklet~~	~~X~~	~~X~~	~~X~~		~~X~~				~~X~~

*Federally and State listed as endangered
~~, ‡ Federally listed as threatened,~~ ** Department Species of Special Concern (SSC~~), ---- x = not seen since 1991~~)
‡ Federally listed as threatened~~*** State listed as threatened~~

~~P= probable nesting, R= Roost site~~

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

~~3.4.1 Area and Time Closures to Address Seabird Issues~~

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 ~~Gulf of 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.

~~3.5~~ 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. ~~3.5.1~~ 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. ~~Chapter 4.~~ Research to Support the Market Squid Fishery Management Plan

At the core of the ~~Marine Life Management Act (~~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)]. ~~With this in mind, the~~The MLMA includes, as a broad objective, promotion of marine ecosystem research that will enable better management decisions [FGC §7050(b)(5)]. Within ~~this~~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 ~~Essential Fishery Information (EFI).~~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]. ~~**These protocols**~~

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.

~~In these ways, the~~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 ~~30~~50 years, EFI is lacking in many areas for ~~this~~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, ~~this~~ chapter 4 describes fishery research protocols designed to advance the MSFMP. Additionally, ~~it~~chapter 4 identifies gaps in the current

knowledge of market squid stocks and the fishery, and the steps needed to obtain ~~this~~ information for implementation to be successful. ~~This chapter~~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 Grouping Essential Fishery Information~~

~~Besides requiring a description of current and past monitoring of the fishery, the MLMA also requires that research protocols in FMPs include a description of EFI for the fishery. All EFI categories are important or essential; however, resources required to obtain this information will always be finite. Essential fishery information has been categorized below to identify areas that are necessary to management. It is important to emphasize that these groups are not mutually exclusive since one group may include components that fall under another.~~

~~4.1.1 Age and Growth Characteristics~~

~~Age and growth studies typically measure how long a species lives, the age at which it reproduces, and how fast individuals grow. This information is very important to determine a population's ability to replenish itself, at what rate it might be harvested, and when individuals will reach a harvestable size. Changes in the age structure and growth rate of a population also serve as indicators of the population's health. This information is often essential for stock assessments and models that guide management strategies. Specific EFI includes length/weight ratios, longevity, age/length ratios, age at size at sexual maturity, and age at length at recruitment into the fishery.~~

~~4.1.2 Distribution of Stocks~~

~~A stock is a population unit that is selected for management purposes. It may be defined based on its ecology, genetics, and/or geographic separation. Discrete stocks of a given species may have very different growth rates, reproductive schedules and capacity, and ecological relationships. Stock distribution refers to where a stock is found and is important in addressing jurisdictional issues. Specific EFI includes the depth and geographic range of a species, the amount of gene flow and genetic structure of the stock, and helps to determine whether stocks are separate or continuous.~~

~~4.1.3 Ecological Interactions~~

~~This information identifies the interaction of fishes within the environment, habitat, and ecological community. The MLMA recognizes that fisheries are part of a larger system~~

~~and calls for conserving the health and diversity of marine ecosystems and living marine resources (FGC §7050)]. Fisheries are embedded in a web of ecological relationships that include the effects of oceanographic regimes and human disturbances on physiological, energetic, or behavioral aspects of organisms, relationships with prey and predators, interrelationships among species due to relative density of different populations, and the distribution and quality of habitat that is key to reproduction and recruitment. Estimation of any ecological relationship demands a species-specific, within-habitat approach due to environment and organism cross correlations.~~

~~4.1.4 Estimates of Abundance~~

~~This information helps to determine how many individuals comprise the population and the number available to the fishery. This information is essential for all predictive modeling of marine resources. Estimates of stock size can be determined through direct (e.g., surveys) or indirect (e.g., examination of the exploitation history) means. Specific EFI includes relative densities of target species, habitat-specific absolute densities, length frequency distributions, relative density estimates of life stages (i.e., eggs, larvae, young-of-the-year, juveniles, or adults), recapture rates of tagged fish, and catch-per-unit-effort information.~~

~~4.1.5 Movement Patterns~~

~~This information identifies the spatial distribution of fish and their residence time in specific habitats. Many species may exhibit movement patterns that are associated with specific oceanographic conditions. Certain species may aggregate in specific areas for spawning, move in predictable patterns, or move to certain locales that make them especially vulnerable to harvest. Insights into the movement patterns of fish are important to the development of management strategies based on regional catch quotas or marine protected areas. Specific EFI includes the home range, homing ability, seasonal migrations, environmental cues, and spawning grounds of a species.~~

~~4.1.6 Recruitment~~

~~Recruitment refers to the number of a species that survive to a particular life stage. It is often used to predict the population size in the future. In this context, recruitment refers to both recruitment to the fishery and recruitment to the population. Many species depend on successful recruitment events for replenishment of the stock. Recruitment success can be highly variable because it depends on the proper combination of many factors. As a result, sustainable harvest of the fishery may depend on only a few strong cohorts (born the same year) to provide harvestable stocks until the next successful recruitment event. Resource managers must consider this variable recruitment success when setting harvest levels by allowing sufficient portions of stocks to "escape" harvest and providing spawning biomass for future~~

~~recruitment successes. Specific EFI includes the duration and distribution of eggs and larvae, size and timing of recruitment events, and annual cohort success. In addition, information on habitat availability and levels of predators and prey items is also important.~~

~~4.1.7 Reproductive Characteristics~~

~~Understanding key reproductive characteristics allows managers to set appropriate open and closed seasons and protect valuable spawning habitats.~~

~~Specific EFI for a species includes the number of eggs released, size at maturity, fertilization and spawning period, geographic spawning area, multiple spawning periods, and the nature of mating systems. These data describe the reproductive potential of a fish stock and its ability to replenish itself.~~

~~4.1.8 Total Mortality~~

~~Total mortality of market squid refers to all removals of squid from the biomass and is traditionally separated into natural as well as fishing mortality. Natural and fishing mortality rates comprise the sum of all individuals removed from a population over a fixed time. Fishing mortality is the number of animals that are removed from the population by fishing. Natural mortality refers to all other forms of removal of squid from the population such as predation, starvation, disease or age. Fishing mortality and natural mortality are estimated in setting the current threshold of egg escapement. Mortality figures are essential for stock assessments and models to determine the number or weight (biomass) that may be safely harvested from a population or stock. Specific EFI includes catch data location, amount and sizes of discarded catch, landings by gear type, and survivability of fish that are released.~~

~~4.1.9 Market Squid Fishery Social and Economic Factors~~

~~The economic stability of coastal communities and quality of life may be affected by changes in activities related to recreational fishing or commercial fishing and processing. These changes may be caused by indirect factors or regulatory changes that directly affect fishing activities. Indirect factors include triggers from consumer or financial markets, such as 1) changes in consumer demand due to the favorable pricing and supply of a substitute item for a fishery product(s), 2) inflation, and, 3) tax changes that affect business investments or activities. These effects may be manifested locally through resultant changes in business output, employment, population, and public service demand. Four factors regarding social and economic information for the market squid fishery (employment, expenditures, market demand and revenue) are discussed below.~~

~~4.1.9.1 Employment~~

~~Overall, impacts to local community earnings and employment can be gauged using input-output multipliers to project the changes to local personal income and the number of local jobs. This procedure takes the direct change in final demand for an industry product or service in revenue or sales dollars and multiplies this direct change by a total income coefficient to estimate total change in local personal income. Similarly, multiplying the direct change by an employment coefficient will yield an estimate of changes in the number of local jobs.~~

~~4.1.9.2 Expenditures~~

~~Regulatory changes that directly affect recreational or commercial fishing revenues in local economies have a downstream effect on other economic sectors, which receive and re-spend those revenues. Output multipliers are used to describe the turnover effect (number of times a dollar is exchanged within a community) and interrelationships between the basic-sector and downstream business sectors in the local economy.~~

~~Additionally, changes that directly affect end-user demand for recreational fishing activities or commercial fisheries products may change end-user spending patterns. Depending on the nature of end-user demand for a given service or product, end-users may spend less if the quantity or quality of the service or product is decreased. Conversely, we would expect end-users to spend more if the quantity or quality was improved. These changes in spending patterns may also affect purchases of related or ancillary goods or services provided in the local economy.~~

~~Lastly, the costs (usually expenditures) of production of a good, a service, or an activity provide a means to compare the relationship between resources used to benefits derived. Often, this is expressed as the benefits-to-cost comparison. In the case of commercial fishing activities, by monitoring costs of production at various levels of output, we can define production where we have maximum economic benefit (or "profits"). This is important in creating harvest guidelines which foster optimum economic yield and economic efficiency in the fishing fleet. Economic efficiency equates to cost and waste minimizing practices.~~

~~4.1.9.3 Market Demand~~

~~Changes in the quantity or quality of available fishery-related goods or services affect the individual end-user's demand for those goods or services. How much this demand may be affected depends on individual income, tastes, preferences, and the accessibility to substitute goods or services. The aggregate demand, based on the combined responses of individuals to changes in a good or service, yields an overall demand function for a good or service. This demand function is used to predict the reactions of end-users to changes in the quantity or quality of goods or services, and~~

~~to estimate the relative value and benefits end-users derive from a good. Consequently, the effects of in-season adjustments to harvest limits can be projected in terms of the anticipated response of the target group of end-users, as well as changes in the corresponding revenue streams.~~

~~4.1.9.4 Revenue~~

~~This category includes revenue from the sale of local goods or services within the community and those goods or services which are exported out of the community. Revenue information allows resource managers to assess how changes in resources or regulations may affect industry sector revenues and ultimately, the local community's economic output and vitality. Revenue generated by fishery-dependent activities (e.g., by commercial landings, recreational direct expenditures, or end-user consumption of commercial products) provides basic information for calculating contributions to local economies and a means to compare relative values of goods and services derived from the fishery.~~

4.1. ~~4.2~~ Past and Ongoing Monitoring of the Commercial Fishery

4.1.1. ~~4.2.1~~ Sustainable Fishery Control Rules

~~Fishery~~ 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. ~~These gaps need to be a priority in research.~~

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 ~~destruction of~~impacts to egg beds by fishing gear should be investigated as they are not quantified in the egg escapement threshold~~; and~~

- 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. ~~4.2.2~~ Fishery-Dependent Monitoring

4.1.2.1. ~~**4.2.2.1**~~ Past Fishery-Dependent Monitoring

~~Fishery~~Landing receipts were the earliest form of fishery-dependent data ~~for~~collected from the commercial market squid fishery ~~have been collected since 1927. Commercial data in the form of landing receipts, which are filled out when the catch is sold to fish businesses or by fishermen selling directly to the public, are the primary source of information on the~~. 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, ~~gear~~gears used, and value of the catch. ~~Landing receipts to date have provided a general knowledge of when and where fishing activity occurs and amount of squid landed. Logbooks are another useful tool for tracking fishing activity that supplements data gathered from landing receipts. In the case of market squid, logbook information is gathered from fishing vessels and light boats. These records provide a measure of fishing effort and may prove helpful for population modeling.~~

~~Additionally, the Department has actively collected fishery-dependent biological data on market squid through a dockside sampling program since October 1998. The typical data collected are species identification, size, weight, sex, age from statoliths, maturity through gonad and mantle tissue collection, and fecundity.~~

~~4.2.2.2 Problems with Past and Ongoing Fishery-Dependent Monitoring~~

~~Currently, some fishery-dependent data are of limited use. Fishery-dependent monitoring, using landing receipts, does not provide adequate information about fishing location. Fishing blocks used by the~~ The Department ~~are 10 nautical miles (nm) by 10 nm representing an area of 100 square nautical miles. The size of the blocks is too large to identify specific fishing locations. Logbooks, which have been in operation since May 2000, will provide a more spatially explicit understanding of fishing activity, which is important for proper fishery management.~~

~~Generally, finfish stock fishery-dependent data have performed poorly in predicting stock decline when used alone (National Research Council 2001). However, because squid are pelagic and fishery-independent data are limited, the use of fishery-dependent data are the only source of stock information. Further, squid are short-lived (six-nine months) invertebrates, rather than longer-lived finfish, therefore, using fishery-dependent data presents additional challenges to an already problematic method of predicting abundance.~~

4.2.3 actively Fishery-Independent Research

4.2. 4.2.3.1 Past Fishery-Independent Research

There have been few fishery-independent studies on market squid. The Department sponsored several research projects beginning in 1998. These studies have provided necessary information on paralarval and market squid distribution when not on the spawning grounds, characterization of spawning habitat, and reproductive potential.

Fishery-independent data can: 1) provide measures of the relative abundance, trends, and estimates of the size and age structure of fish stocks which are not affected by fishing practices or management regulations; 2) calibrate trends in fishery-dependent estimates and tune assessment models; and 3) encompass a broad suite of information on the biological community, the physical environment and the ecosystem as a whole, which cannot be obtained directly via fishery-dependent measures.

4.2.3.2 Problems with Past and Ongoing Fishery-Independent Research

Fishery-independent research has, and continues to be, conducted by a few organizations through a diverse set of funding sources. Unfortunately, the bulk of the research suffers from:

- Limited spatial coverage;
- Non-standardized research that prevents comparison with other data sets; and
- High costs.

However, the Department market squid research program was funded primarily through substantial permit fees and has been coordinated for comparability throughout California. Further, the Department has collaborated with agencies, squid fishermen, and universities to conduct the research. This collaborative research approach is effective and should be advanced. A reduction in permit fees to $400 by the Legislature in the 2001-2002 season coincided with a reduction in Department sponsored research.

4.3 Current Knowledge of Essential Fishery Information

Currently, EFI for market squid is limited for management purposes. Additional data would be desirable to assess the biomass of the stock, life history, ecological interactions, and socioeconomics. A description of the data currently available on market squid is outlined below.

4.3.1 Age and Growth Characteristics

The lifespan of market squid has been calculated based on recent research. Preliminary results indicate that market squid harvested are between four and ten

~~months in age with new cohorts entering the fishery at least seven times a year. Length-at-age and length-weight relationships have been calculated, but need to be verified by further age and growth studies. In addition, daily ring deposition on statoliths needs to be validated throughout the lifespan of market squid.~~

~~4.3.2 Distribution of Stocks~~

~~The distribution of the market squid population is from the southern tip of Baja California, Mexico to southeastern Alaska. It is not known whether the population is made up of one or more stocks.~~

~~4.3.3 Ecological Interactions~~

~~No statewide coordination exists for studies of ecological interactions of market squid. Consequently, little is known about the region-specific effects of oceanographic regimes and human effects on the physiological, energetic, and behavioral characteristics of market squid, or the species that they interact with as prey, predators, or competitors.~~

~~4.3.4 Estimates of Abundance~~

~~No defensible estimates of abundance exist for market squid.~~

~~4.3.5 Movement Patterns~~

~~Paralarval research (Zeidberg and Hamner 2002) provides preliminary information of movement of paralarval squid, including movement offshore within currents and vertical migration.~~

~~4.3.6 Recruitment~~

~~Paralarval studies (Zeidberg and Hamner 2002) may provide information to predict recruitment into the fishery and identify spawning areas not targeted by the fishery.~~

~~4.3.7 Reproductive Characteristics~~

~~Some reproductive characteristics of market squid have been identified (Macewicz et al. 2001b). The potential fecundity has been characterized and is utilized in the egg escapement method. While monitoring continues, preliminary data indicate that the rate of eggs spawned prior to harvest varies between seasons. The temperature range for spawning squid has been identified using a remotely operated vehicle (ROV) and is most often in the range of 50 to 57° F. These current fishery-independent data collection methods need to be continued.~~

~~4.3.8 Total Mortality~~

~~The current rate of natural and fishing mortality for market squid, on either a daily or a monthly basis, is largely unknown. Ageing studies have started to produce better estimates and need to be continued on spatial (throughout its range) and temporal (within and between seasonal) scales.~~

~~4.3.9 Social and Economic~~

~~Adequate information on employment, expenditures, and revenues for certain basic sector industries are readily available or can be derived from existing sources. Such sources include the periodic surveys and reports prepared by the Bureau of the Census, the Bureau of Labor and Statistics, the Bureau of Economic Analyses, the USFWS, the Department, and local institutions and academic affiliates. Combined information from these sources allows analyses of impacts or contributions to local economies by commercial fishing activities. However, these sources do not provide adequate information relevant for a thorough analysis of the California market squid fishery.~~

~~4.4 Research to Obtain Essential Fishery Information~~

~~The Department is currently monitoring the market squid fishery through fishery-dependent programs and fishery-independent research. The fishery-dependent port sampling program allows the Department to determine the characteristics of harvested squid and shifts in the fishery, as well as estimate egg escapement. Another fishery-dependent program is the logbook program, which allows an estimate of fishery effort and provides exact locations of fishing activity. The egg escapement method is based on female squid collected independent of the fishery. Current fishery-independent research is focused on increasing the sample size of female squid to refine the egg escapement model as well as the characterization and location of squid spawning beds.~~

~~The following research needs are necessary to fill market squid EFI gaps identified above. The overall goal is to expand our knowledge of market squid. Data-poor management using a MSY proxy should be considered a temporary solution while an accurate method to assess market squid biomass is pursued.~~

~~4.4.1 Fishery-Dependent Data Research~~

~~Current efforts to collect fishery-dependent data rely heavily on port sampling, landing receipts, and logbook data. Landing receipts and logbooks record fishing effort and allow managers to track fishing trends. Port samples provide valuable environmental and biological information on squid taken in the fishery. When using the egg escapement method (as a proxy for MSY), it is important to be aware of shifts in the fishery that may make this method less effective. These data can be used to detect changes in the fishery including potential shifts (such as a shift to pre-spawning adults), which may have detrimental effects on the population.~~

~~4.4.2 Fishery-Independent Data Research~~

~~The most important fishery-independent research need is to develop a model to estimate market squid biomass. Since direct population counts cannot be made, it is necessary to develop models or proxies to estimate population parameters (e.g., mortality, fishing pressure).~~

~~Currently, market squid fecundity estimates, based on the egg escapement model, are used as a proxy for MSY. However, it is important to improve and enhance these estimates by increasing the sample size of female market squid used in the histological studies upon which the egg escapement model is based. In addition, mantle condition, especially the rate of mantle thinning, will provide insight into the health of squid caught in the fishery. Further, it is necessary to obtain a more complete understanding of squid spawning including the number of times spawning occurs in a lifetime, spawning rate, and the duration of time spent on spawning grounds.~~

~~Like other cephalopod species, the age of market squid can be determined by counting growth rings on the statoliths; however, this technique needs to be verified and validated for all stages of market squid development. In addition, current research is aimed at identifying possible differences of growth and/or fecundity rates between squid caught in the northern and southern California fisheries.~~

~~A common problem in most fisheries is bycatch. The potential take of both commercially and recreationally important fish species, such as salmon, should be further evaluated. The current port sampling program only~~ monitors the ~~frequency of incidental catch observed at the squid processing facilities. The use of at sea observers should be evaluated to determine if bycatch is an important issue to this fishery by documenting any impacts to~~ commercial ~~and recreationally important fish species such as salmon and rockfish, in addition to marine mammals and seabirds. In addition, squid egg cases can be disturbed during fishing operations. Therefore, it is important~~ 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 MSFMP fishery control rules in 2004. The primary goal of collecting these data is to monitor ~~bycatch to determine how squid eggs are being impacted. ROV and visual surveys may provide information on fishery impact to squid egg cases. These data may be applicable to future~~changes in the biological characteristics and to characterize California's commercial market squid fishery for development of population models.

~~Larval squid abundance from California Cooperative Ocean Fisheries Investigations (CalCOFI) cruises from 1978-1998 needs to be analyzed and if possible used as an~~

~~index of abundance for modeling purposes. Studies on natural mortality rates, dietary requirements, and spawning behavior could also fill in life history gaps. Other identified studies involve examining the distribution and migration of squid, including the determination of squid stock structure using genetic analyses.~~

~~Future research also needs to include explorations of spawning areas other than the traditional locations and an examination of egg densities and egg dynamics. Studies on the effects of sound and light disturbance on seabird populations should be continued. The possible interaction of predators (i.e., sea lions) and squid attracted to night lighting also should be addressed. Furthermore, it is recommended that monies and efforts be invested into archiving data and samples, expanding socioeconomic data collection, and maintaining a database on spawning areas.~~

~~4.4.3~~ 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 ~~Fishery Sponsored Research~~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.

Fishery-Independent Research

~~Collaboration between government researchers and various fishing industries has been promoted in recent years to defray increasing costs of management as well as to increase awareness of the targeted resource. As recognized by the market squid legislation, information on this resource is limited, and the FMP addresses this with a research and monitoring component. As knowledge increases or additional management needs become apparent, the FMP allows for adaptive management to occur. The Department supports and encourages efforts by the squid fishing industry to become involved and address appropriate research questions.~~

~~A preliminary meeting in April 2004 between an industry sponsored group of fishermen and processors and Department, NOAA Fisheries and university researchers was held with the goal to identify and prioritize research needs and design a plan for cooperative field research. Some of the proposed projects that industry could participate included:~~

- ~~Identifying potential spawning areas from anecdotal and existing fishery data;~~
- ~~Collecting representative samples of the missing age class of virgin female squid;~~

- ~~Testing the effectiveness of squid light boats at estimating squid abundance using lights for set periods of time (a catch per unit of effort concept); and,~~
- ~~Testing the effectiveness of light boats and fishing vessels to perform bongo net tows which would augment CalCOFI data with nearshore and additional stations between and outside the CalCOFI stations.~~

4.1.3. ~~4.4.4 Steps to Monitor the Fishery and Obtain~~

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

~~The Department will need more resources than are currently available in order to begin some of the research needed to address EFI issues. The research objectives should be based on data necessary to model the market squid biomass. The Department is encouraging collaboration with other state and federal agencies, academia, and the user groups to conduct EFI research and address squid management needs. Some of these needs include:~~

- ~~Further analysis and evaluation of particular components of the egg escapement method for the market squid population off the coast of California. This modeling work should focus on developing a better understanding of squid biology and population-level responses to exploitation strategies;~~
- ~~Developing an infra-structure to facilitate communication, logistical support, standardization of data collection methods, preliminary analysis, and reporting;~~
- ~~Addressing the effects of fishing gear (nets, bottom lines and shackles) on squid egg beds;~~
- ~~Assess relevance of previously collected data, publish for peer review, and use in management decisions;~~
- ~~Addressing the effects of squid lighting gear on nesting seabird rookeries;~~
- ~~Assessing the effectiveness of enforcement and adjust as necessary to better manage the resource (i.e., increasing penalties and/or enforcement);~~
- ~~Obtaining recommendations from advisory committees of the best data collection activities and models for market squid stock assessment; and,~~
- ~~Initiating educational outreach programs.~~

~~4.4.5 Social and Economic Dimensions of the Fishery~~

~~The relationship between fishermen and the markets plays a vital role in the survival and sustainability of a fishery (Pomeroy and FitzSimmons 2001). Many squid fishermen have close social and economic ties to local fishing communities. As a result, the economic stability of coastal communities can be greatly impacted by local fisheries. Therefore, comprehensive analyses of the socioeconomic dimensions of the squid fishery should be considered. Due to the instability of the market squid fishery, the~~

~~socioeconomic components can change frequently; thus, it is important to continually re-examine these conditions.~~

~~These recommendations work toward providing needed EFI and bringing the Department closer to an ecosystem-based approach to the management of market squid.~~

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 (wildlife.ca.gov/marine) 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 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. ~~Generally, these cost projections are underestimated because there is no way to determine how difficult some issues may be. Nevertheless, estimates are useful for projecting costs and for comparing different options. These cost estimates include expenditures that are incurred regardless of whether or not the MSFMP is partially or fully adopted. These expenses are termed "sunk" costs and equate to the costs of enforcement, data collection, research and monitoring that the Department must perform as part of its resource stewardship charge~~Annual management costs of the market squid fishery have increased since implementation of the original 2005 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 (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.

~~Enforcement activities within the Department are coded to programs, such as the Marine Life Management Act (MLMA) and Marine Life Protection Act (MLPA) rather than a specific species or fishery. This makes it difficult to determine the accurately estimate enforcement in any individual fishery.~~

~~Although no enforcement officers are strictly assigned to the squid fishery, it is estimated that 8% of an officer's time is spent on squid enforcement (J. Gross pers. comm.). The majority of the enforcement takes place at the peak times of the fishery. Within the major squid landing ports (Moss Landing, Monterey Bay, Port Hueneme, Ventura, San Pedro, and Terminal Island) there are nine lieutenants and 20 wardens. Enforcement takes place on land, at the point of landing and at squid processors, and at sea using the Department's five patrol boats and nine patrol skiffs.~~

> ~~The 8% estimate is further supported by landings data. In 2001 and 2002, the number of squid landings, as compared to all landings, was 8.3%~~ for the ~~major squid ports (identified above). This is assumed to equal an estimated 8% of enforcement time spent on squid (squid landings: 6,100; total commercial landings: 73,200 commercial landings for the major squid landing ports).~~ MSFMP (2025 baseline).

~~Using this value (8%), the estimated annual costs for enforcement in the squid fishery was determined as follows:~~

~~Staffing summary: 9 lieutenants, 20 wardens~~

~~Annual enforcement costs~~

~~(including operating expenses): $2,500,000~~

~~Percent estimate of squid enforcement x 8%~~

~~---~~

~~Total annual enforcement cost: $ 200,000~~

~~5.2 Ongoing Management and Research~~

~~In 1998, fishery managers, researchers, and statisticians from the Department and NOAA Fisheries met to develop both fishery-dependent and fishery-independent sampling and monitoring programs for market squid. During this meeting, goals were identified and a series of sampling protocols were developed to attain data necessary to expand existing knowledge of basic~~

~~market squid biology, life history, and commercial fishing activity (CDFG 2001c).~~

~~To acquire better information on squid taken in the California fishery, the Department developed a monitoring system to track variations over the season in squid length, weight, sex and maturity, and to accurately profile the State's commercial market squid fishery by tabulating catch data on a daily basis. Additional efforts to improve identification of the vessels participating in the fishery, characterize the use of gear to take squid, and determine the number of vessels using each gear type, fishing and landing patterns, market value, and product distribution, were undertaken as well.~~

~~Efforts to achieve these goals and to better manage the market squid fishery required the implementation of different programs. As part of the development of the monitoring system, a port sampling program was established in 1998 to collect fishery and biological data. Research cruises conducted by the Department and by outside contractors since 1998 have provided vital information about spawning habitats and egg production. In 1999, a logbook program designed to collect information on effort in the fishery was developed and implemented, where both roundhaul and light vessels provide information on their catch and effort during each day of fishing activity. The purpose of this program was to increase the amount and accuracy of data collected and to supplement the landing receipt program already in place. The estimated costs of these programs are separated into fishery-dependent monitoring and fishery-independent research.~~

~~Additional management tasks include the Department's responsibility to communicate fishery information to stakeholders on a timely basis. This may require preparation and mailing of newsletters or letters and the creation and maintenance of internet web pages. Also, the Department needs to communicate with an advisory committee (if formed), the Commission, and the general public.~~

~~5.2.1 Fishery-Dependent Monitoring~~

~~Collection of fishery-dependent biological data is authorized under FGC §8010. Written fishing records (logbooks) are required under FGC §8026, and CCR Title 14 §140 and §149. The use of landing receipts is required under FGC §8043. The costs of fishery-dependent monitoring can be broken down into two parts: 1) the port sampling program and 2) the logbook and the landing receipt program.~~

- ~~Fishery-dependent samples are taken from squid landings at the three major port areas (Monterey/Moss Landing, Santa Barbara/Ventura/Port Hueneme, and San Pedro/Terminal Island). There is a monthly goal of 25 samples from each southern port and 20 samples from Monterey. One sample is taken every day each week, and an additional sample is required on two randomly chosen days of the week. A sample consists of 30 squid randomly selected from one vessel. Samplers observe at least half of the load and collect squid throughout the observation time. Samplers also interview the captain to learn where the vessel fished, how many sets were made, if a light boat was used, size of the catch, and any anecdotal information. Samples are not collected when there are no landings.~~
  ~~The samples are processed in the lab to collect information on length, weight, sex, and gonadal condition. Statoliths and a sample of mantle tissue are taken from the first male and first five females of every sample. Gonads are preserved from the first five females of every sample. The estimated annual costs for these activities are as follows:~~
  ~~Staffing Summary: 2 Personnel Year (PY) Laboratory Assistants, 3.5 PY Temporary Help~~

  ~~Staff: $160,000~~

  ~~Annual operating expenditures: 69,000~~

  ~~Total annual costs: $229,000~~

- ~~The Department's statistical database and landing receipt and logbook programs provide vital information about the squid fishery. The estimated annual costs associated with the collection and maintenance of this information are as follows:~~
  ~~Staffing Summary: 1 PY Marine Biologist, 1 PY Temporary Help~~

  ~~Staff: $ 85,000~~

~~Annual operating expenditures: $19,000~~

~~Total annual costs: $104,000~~

~~5.2.2 Fishery-Independent Research~~

~~As part of the legislatively directed initial three year study (April 1998-2001, SB 364), approximately $240,000 annually was directed toward scientific research efforts outside the Department via contracts with the University of California. The objectives of these projects were to develop and evaluate applications of escapement and depletion modeling strategies to the California market squid fishery, obtain better information on squid life history, explore the stock structure of the squid population, and improve understanding of the relationships between age, growth, maturity, and fecundity. Some of the contract efforts required fishery-independent sampling aboard fishery research vessels, which provided a valuable basis for future science-based management strategies that may be used in lieu of proposed regulatory measures developed from catch information alone.~~

~~Within the Department, research cruises focused on collecting fishery-independent data have been undertaken. Annual trawl cruises from 1998 to 2001 have been used in development of egg escapement models, specifically to capture female squid to increase the robustness of the current model. Other research cruises have utilized a remotely operated vehicle (ROV) to characterize market squid spawning habitat, including the depth and temperature where egg cases are deposited as well as to develop an index of egg case abundance. The ROV cruises have been conducted twice a year to coincide with peak squid fishing activity. The estimated annual costs for continuing the Department fishery-independent research are as follows:~~

~~Staffing Summary: 1 Personnel Year (PY) Associate Biologist, 2 PY Marine Biologists, 0.25 PY Senior Biologist~~

~~Staff: $219,000~~

~~Annual operating expenditures: 215,000~~

~~Total annual costs: $434,000~~

~~5.3 Summary of Estimated Annual Costs of Implementation~~

~~Managing the fishery and developing an estimation of optimum yield will require continued monitoring and collection of fishery-dependent and fishery-independent data. Fishery-dependent biological data and fishery-independent biological data are necessary to estimate population size and reproductive success. Edited logbook and landing receipt data can be used to monitor trends in the fishery and estimate fishery effort.~~

~~The estimated annual cost of market squid enforcement is $200,000. Additional regulations for the squid fishery presented through this management plan are expected to require additional enforcement effort and cost that has not been estimated. Presently, there is no funding specified to offset these costs. Monies should be designated to properly fund the enforcement of the market squid fishery management plan. The estimated annual cost for ongoing and future research in the market squid project, including statistical data, fishery-dependent, and fishery-independent sampling is approximately $964,000. Current levels of funding are estimated at $533,000, which excludes all research that the Department was previously conducting. The funding for these operations is from the Fish and Game Preservation Fund.~~

~~The following is a summary of the estimated annual costs of full and partial implementation:~~

~~Description~~	~~Full Program~~	~~Partial Program~~
~~Enforcement~~	~~$200,000~~	~~$200,000~~
~~Fishery-dependent monitoring:~~		
~~Port sampling~~	~~$229,000~~	~~$229,000~~
~~Logbooks/landing receipts~~	~~$101,000~~	~~$104,000~~

~~Ongoing management and research~~

~~Research surveys $ 434,000~~

~~Total Implementation Expenses $964,000 $533,000~~

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., ~~L.B.~~ Spear, ~~S.G.~~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 ~~K~~, D.M. and ~~J~~G. V. Morejohn. 1977. Food habits and niche overlap of seabirds wintering on Monterey Bay, California. The Auk~~.~~, 94~~:~~ (3):526~~–~~543.

~~Bargmann, G., D. Hanan, S.F. Herrick, K. Hill, L. Jacobson, J. Morgan, R. Parrish, J. Spratt, and J. Walker. 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.~~

~~Benjamins, S. (2000). Cephalopod predators. *The Cephalopod Page*. http://www.nhm.ac.uk/hosted_sites/tcp/pred4.html (28 Nov. 2001)~~

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., ~~L.~~ Coelho, ~~J.P.~~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. ~~J. Moll. Stud.~~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

~~Bower, J. 2000. The dark side of light. Audubon. 102(2):92-97.~~

.

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*. ~~Pacific Fisheries Management Council~~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

~~CDFG:~~ . Accessed on July 9, 2024.

California Department of Fish and Game~~. 2001b. Draft, Constituent involvement plan for the nearshore fishery management plan (08 January 2001). Resources Agency,~~ (CDFG). March 19, 2001. Status of the Market Squid fishery with Recommendations for a Conservation and Management Plan. California Department of Fish and Game~~. 11 pp.~~ 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~~Game. 2001c. Status of the~~ .

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 ~~with recommendations for a conservation and management plan. Calif. Dept. of Fish and Game Marine Region Report to the Legislature. 73 pp.~~ (*Doryteuthis opalescens*). Conservation Genetics 22:97-110.

~~Carretta, J.V., M.M. Muto, J. Barlow, and J. Baker. 2002. U.S. Pacific Marine Mammal Stock Assessments: 2002.U.S. Department of Commerce, NOAA Technical Memorandum NOAA Fisheries -SWFSC-346. 286p.~~

~~Carter, H.R., G.J. McChesney, D.L. Jaques, G.S. Strong, M.W. Parker, J.E. Takekawa, D.L. Jory, and D.L. Whitworth. 1992. Breeding populations of seabirds in California, 1989-1991. Volume 1 - populations estimates, and Volume 2 - colony maps and appendices. Unpublished draft final report, U.S. Fish and Wildlife Service, Northern Prairie Wildlife Research Center, Dixon, California.~~

~~Carter, H.R., A. L. Sowls, M.S. Rodway, U.W. Wilson, R.W. Lowe, G.J. McChesney, F. Gress, and D.W. Anderson. 1995. Population size, trends, and conservation problems of the double-crested cormorant on the pacific coast of North America. Colonial Waterbirds. 18(Special Publication 1): 189-215.~~

~~Carter, H.R., D.L. Whitworth, J.Y. Takekawa, T.W. Keeney, and P.R. Kelly. 2000. At-sea threats to Xantus' murrelets (*Synthliboramphus hypoleucus*) in the Southern California Bight. *In* D.R. Browne, K.K. Mitchell, and H.W. Chaney (Eds.), Proceedings of the fifth California Islands symposium, 29 March to 1 April 1999, U.S. Minerals Management Service, Camarillo, California, pp. 435-447.~~

~~Carter, H.R., D. S. Gilmer, J. E. Takekawa, R. W. Lowe and U. W. Wilson. 2001a. Breeding Seabirds in California, Oregon, and Washington. Found at:~~

~~Carter, H.R., U.W. Wilson, R.W. Lowe, M.S. Rodway, D.A. Manuwal, J.E. Takekawa, and J.L. Yee. 2001b. Population trends of the common murre (Uria aalge californica). *In* D. A. Manuwal, H.R. Carter, T.S. Zimmerman, and D.L. Orthmeyer (Eds.), Biology and conservation of the common murre in California, Oregon, Washington, and British Columbia. Volume 1: Natural history and population trends. U.S. Geological Survey, Biological Resources Division, Information and Technology Report USDS/BRD/ITR2000-0012, Washington, D.C., pp. 33 – 128.~~

~~Claritas. 1996. 1996 Proprietary Estimates for all Census Tracts, Counties, and Minor Civil Divisions in the US. Claritas Data Services.~~

~~CTTCA: California Technology Trade and Commerce Agency. 2000. Labor force and occupations. http://. (02/01).~~

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

~~Dayton, P.K., S. Thrush, and F.C. Coleman. 2002. *Ecological Effects of Fishing in Marine Ecosystems of the United States*. Pew Oceans Commission. Arlington, Virginia. 44pp.~~

~~Dick, M.H. and W. Donaldson. 1978. Fishing vessel endangered by crested auklet landings. Condor. 80: 235-236.~~

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

~~Dohl, T.~~Dorval, E., Crone, P~~., K. S. Norris, .~~R~~. C. Guess, J. D. Bryant,.,~~ and ~~M. W. Honig. 1980. Summary~~J.D. McDaniel. 2013. Variability of ~~marine mammal~~egg escapement, fishing mortality and ~~seabird surveys of~~

spawning population in the ~~Southern~~ market squid fishery in the California ~~Bight area, 1975-1978. Part II. Cetacea of the Southern~~ 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 ~~Bight. Final Report~~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~~the Bureau~~.

Fiechter, J., Huckstadt, L.A., Rose, K.A., and D.P. Costa. 2016. A fully coupled ecosystem model to predict foraging ecology of ~~Land Management, NTIS Rep. No. PB81248189. 414p~~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., ~~N~~ 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. ~~Fish. Bull.~~Fishery Bulletin 102:389-392.

~~Furness, R.W. and M.L. Tasker. 2000. Seabird-fishery interactions: quantifying the sensitivity of seabirds to reductions in sandeel abundance, and the identification of key areas for sensitive birds in the north sea. Mar. Ecol. Prog. Ser. 202:253-264.~~

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

Gilly, W., ~~M.~~ 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. ~~Calif. Dept.~~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. ~~500p~~500 pp.

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

Hanlon, R.T., ~~N.~~ 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, ~~National Oceanic and Atmospheric Administration~~NOAA, Marine Sanctuaries Division, Silver Spring, MD. 24 pp.

~~Henry, A. E., 1997. Prey Dynamics of Pacific Harbor Seals and California Sea Lion foraging near San Nicolas Island. MS Thesis, San Diego State University, San Diego, California. pp. 115.~~

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 ~~California Cooperative Fisheries Investigations~~CalCOFI Program, 28-30 October 1997 at Lake Arrowhead, California.

~~Hunter, J.R., and N.C.H. Lo. 1997. The daily egg production method of biomass estimation: some problems and potential improvements. Ozeanografika 2: 41-67.~~

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. ~~Strondium~~Strontium labelling for verifying daily growth increments in the statoliths of the short-finned squid (*Illex illecebrosus*). ~~Can.J. Fish. Aquat. Sci.,~~Canadian Journal of Fisheries and Aquatic Sciences 42: 380-383.

Isaac, G., ~~H.~~ Neumeister, H., and W.F. Gilly. 2001. The effects of temperature on early life stages of California squid (*Loligo opalescens*). ~~Pacific Fisheries Management Council~~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. ~~Bull. Mar. Sci.~~Bulletin of Marine Science 54: 554-557.

Jackson, G~~.~~., D. 1998. Research into the life history of *Loligo opalescens*: where to from here? ~~Calif. Coop. Oceanic Fish. Invest. Rep.~~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.

~~Karpov, K.A.~~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*. ~~Calif. Dept.~~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 ~~Rep.~~Reports 20:51-57.

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

~~Kudroshoff, T. C., A. E. Henry, and M. L.~~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.

~~Yaremko. 2000. Frequency and distribution of market squid egg cases off California. Abstract. Fifty-first California Cooperative Fisheries Investigations Conference. Lake Arrowhead, CA. October 2000.~~

Lipinski, M. 1986. Methods for the validation of squid age from statoliths. ~~J. Mar. Biol. Assoc. U.K. 66:~~ 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 (*~~Salophus~~Zalophus californianus*) in southern California (1981-1995). CalCOFI ~~Rep~~Reports. 40:196-202.

~~Lowry, M.S., C.W. Oliver, C. Macky, and J.B. Wexler. 1990. Food habits of California sea lions *Zalophus californianus* at San Clemente Island, California, 1981-86. Fishery Bulletin, U.S. 88: 509-521.~~

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. ~~USCFISH.~~ Coastal Community Research, Wrigley Institute for Environmental Studies, University of Southern California. Los Angeles, CA. 39 pp

Macewicz, B.J., ~~J.R.~~ Hunter, J.R. and N.C.H. Lo. 2001a. Validation and monitoring of the escapement fecundity of market squid. Project report to ~~Calif. Dept.~~California Department of Fish and Game. Document #2, ~~Pacific Fisheries Management Council~~PFMC Squid ~~stock assessment review.~~ Stock Assessment Review. 8 pp.

Macewicz, B.J., ~~J.R.~~ Hunter, J.R., Lo, N.C.H~~. Lo,.~~, and E.L. LaCasella. 2001b. Lifetime fecundity of the market squid, *Loligo opalescens*. Document #1,

~~Pacific Fisheries Management Council~~PFMC Squid ~~stock assessment review.~~ Stock Assessment Review. 19 pp.

Macewicz, B.J., ~~J.R.~~ Hunter, J.R., Lo, N.C.H~~. Lo,.~~ and E.L. LaCasella. ~~2003~~2004. Fecundity, egg deposition, and mortality of market squid (*Loligo opalescens*). Fishery Bulletin 102(2):306-327.

~~MacGinite, G.E. and N. MacGinite. 1949. Natural History of Marine Mammals. New York: McGraw Hill. P. 473.~~

Maxwell~~,~~ M.R~~. 2001. Stock assessment models~~., Jacobson, L.D., and R.J. Conser. 2005. Eggs-per-recruit model for management of the California market squid~~, (*Loligo opalescens*~~. Document #7, Pacific~~) fishery. Canadian Journal of Fisheries ~~Management Council Squid stock assessment review. 53 pp.~~

~~May, R.M., J.R. Beddington, C.W. Clark, S.J. Holt,~~ and ~~R.W. Laws. 1979. Management of multi-species fisheries. Science. 205:267-277~~Aquatic Sciences 62(7):1640-1650.

~~McGowan, J.A. 1954. Observations on the sexual behavior and spawning of the squid, *Loligo opalescens*, at La Jolla, California. Calif. Fish Game Fish Bulletin 40(1): 47-55.~~

~~Miller D.J., M.J. Herder, and J.P. Scholl. 1983. California marine mammal/fishery~~

~~interaction study, 1979 to 1981. NOAA Fisheries - SWFSC Admin. Rep. LJ8313C. 234pp.~~

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

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

~~NMFS:National Marine Fisheries Service (NOAA Fisheries). 2001b. Alaska groundfish fisheries, draft programmatic environmental impact statement. United States Department of Commerce, National Oceanic and Atmospheric Administration, Alaska Region.~~

~~NMFS/NOAA 2001. National Oceanic and Atmospheric Administration, National Marine Fisheries Service~~

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.

~~NMFS/NOAA/OPR (2001) Commercial Fishery Interactions. .~~

~~NOAA /NCCOS. 2003. A Biogeographic Assessment off North/Central California: To Support the Joint Management Plan Review for Cordell Bank, Gulf of the Farallones, and Monterey Bay National Marine Sanctuaries: Phase I - Marine Fishes, Birds and Mammals. National Centers for Coastal Ocean Science. Silver Spring, MD 145 pp.~~

~~NOAA/NOS 2003a. Socioeconomic Impact Analysis of Marine Reserve Alternatives for the Channel Islands National Marine Sanctuary. April 8, 2003. Dr. Vernon R. Leeworthy and Peter C. Wiley. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service.~~

~~NOAA/NOS. 2003b. Gulf of the Farallones National Marine Sanctuary State of the Sanctuary Report. National Ocean Service. Silver Springs, MD. 32pp.~~

~~NOAA/NMFS (2003). Commercial fisheries dependent data. http://www.st.nmfs.gov/st1/econ/data.html.~~

~~National Research Council. 2001. Marine protected areas; Tools for sustaining ocean ecosystems. Nat. Acad. Press. Washington DC. 272 pp.~~

O'Dor, R.K. and D.M. Webber 1986. The constraints on cephalopods: why squid aren't fish. ~~Can. J. Zool.~~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. ~~Bull.~~Bulletin of Scripps ~~Inst. of Oceanogr. Univ. Calif. 14~~Institute of Oceanography University of California14: 1-90.

~~Oliphant, M.S. 1971. Pacific bonito food habits. Calif. Dept. Fish Game, Fish Bulletin 152: 64-82.~~

~~PFMC:~~ 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 ~~draft amendment eight. Pp. A78-A90~~. December 1998, p. D-9.

~~PFMC: Pacific Fisheries Management Council. 2002.~~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~~. 48~~, Stock Assessment and Fishery Evaluation. 79 pp.

~~PFMC: Pacific Fishery Management Council. 1998. The coastal pelagic species fishery management plan draft amendment eight. Pp. A78-A90.~~

~~PFMC Pacific Fishery Management Council Strategic Plan Development Committee. 2000. Groundfish Fishery Strategic Plan "Transition to Sustainability". Pacific Fishery Management Council. 65 pp.~~

~~PFMC. 2002. Limited entry fleet capacity and market squid maximum sustainable yield control rule. Amendment 10 to the~~PMFC. 2023. Coastal Pelagic Species Fishery Management Plan. ~~Pacific Fishery Management Council. July 2002. 224 pp.~~ As amended through Amendment 21.

~~PFMC. 2003. Status of the Pacific Coast coastal pelagic species fishery and recommended acceptable biological catches. Stock assessment and fishery evaluation - 2003. Pacific Fishery Management Council. June 2003. 120pp.~~

Pomeroy, C~~.,~~. and M. ~~Hunter.~~ FitzSimmons. 2001. ~~The Channel Islands~~Socio-economic organization of the California Market Squid Fishery~~. Summary prepared~~: Assessment for ~~the March 21,2001 Channel Islands Marine Reserves Working Group Meeting~~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.

~~Pomeroy, C., M. Hunter, and M. Los Huertos. 2002. Socioeconomic profile of the California wetfish industry. *In* D. Pleschner-Steele (ed.) California's wetfish industry: It's importance past, present and future. Santa Barbara, CA: California Seafood Council (CD-ROM).~~

~~Preuss, T.~~Biological, oceanographic, and acoustic aspects of the market squid, *Loligo opalescens* Berry. California Department of Fish and Game, Fish Bulletin 169:67-98.

~~and W.F. Gilly.~~ ~~2000. Role of prey-capture experience in the development of the escape response in the squid *Loligo opalescens*: A physiological correlate in an identified neuron. Journal of Experimental Biology 203 (3): 559-565.~~

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.

~~Reiss, C.S. M. Maxwell, J.R. Hunter, and A. Henry. In Submission. Environmental effects on population dynamics of *Loligo opalescens* in the southern California Bight. Submitted to California Cooperative Oceanic Fisheries Investigations Reports. 25pp.~~

Restrepo, V.R., ~~W.L.~~ Gabriel, W.L~~.L.~~, Low, ~~A.D.~~L.L., MacCall, ~~P.M.~~A.D., Mace, ~~R.D.~~P.M., Methot, ~~J.E.~~R.D., Powers, ~~B.L.~~J.E., Taylor, ~~G.G.~~B.L., Thompson, ~~P.R.~~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, ~~National Oceanic and Atmospheric Administration~~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 ~~Fish. Synop.~~ 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. ~~Calif. Dep.~~ California Department of Fish and Game, Fish Bulletin 169:35-44.

~~Telfer, T. C., J. L. Sincock, G. V. Byrd, and J. R. Reed. 1987. Attraction of Hawaiian seabirds to lights: conservation efforts and effects of moon phase. Wildlife Society Bulletin. 15: 406-413.~~

~~Tricas, Timothy C. 1979. Relationships of the blue shark, *Prionace glauca*, and its prey species near Santa Catalina Island, California. Fishery Bulletin 77 (1): 175-182.~~

~~United States Dept. of Comm. 1999. Trends in United States coastal regions 1970-1998. (12/11/00).~~

~~U.S. Bureau of Labor Statistics. 2003. . http://www.bls.gov/data/home.htm.~~

~~U.S. Department of Commerce.1997.RIMS II Regional Input-Output Modeling System multipliers. Regional Economic Analysis Division, Bureau of Economic Analysis, Washington, DC.~~

~~U.S. Fish and Wildlife Service. 1983. The California Brown Pelican Recovery Plan. Prepared by the USFWS under contract to Franklin Gress and Daniel W. Anderson (University of California, Davis). Published by USFWS, Portland, Oregon, pp. 50-52.~~

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. ~~California Cooperative Oceanic Fisheries Investigations~~CalCOFI Reports. ~~Pp.~~ 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.

~~Personal Communications~~

~~Amoroso, Orlando. President Southern California Commercial Fishing Association. San Pedro, CA~~

~~Gross, Jorge. Warden. CDFG. Ventura, CA.~~

~~Henry, Annette. Survey Coordinator, NOAA Fisheries - SWFSC, La Jolla, CA (formerly Marine Biologist, CDFG, La Jolla, CA)~~

~~Hochberg, F. G. Curator of Invertebrate Zoology. Santa Barbara Museum of Natural History, Santa Barbara, CA~~

~~Monterey Coast Guard. Monterey, CA~~

~~Naughton, Maura, Seabird Biologist, USFWS, Migratory Bird and Habitats~~

~~Program, Portland, Oregon~~

~~Olivas, Tim. Patrol Captain. CDFG. Monterey, CA~~

~~Pomeroy, Caroline. Ph.D. Economist. Institute of Marine Sciences, University of California at Santa Cruz. Santa Cruz, CA~~

~~Reid, Tim, Seabird Biologist, Tasmanian Government, Tasmania~~

~~Scheiblauer, Steve. Harbor Master. Monterey, CA~~

~~Smith, Sgt. Orange County Harbor Department. Newport Beach, CA~~

~~Steers, Nick. Captain, Los Angeles County Fire Department, Lifeguard Operations. Zuma Beach, CA~~

~~Strasser, Paul. Owner, 22nd Street Sportfishing and MCIP. San Pedro, CA~~

~~Sumpter, Gail. City of Malibu Code Enforcement. Malibu, CA~~

~~Trapp, John, Biologist, USFWS, Div. Migratory Bird Management, Arlington,~~

~~Virginia~~

~~Williams, Jeff, Seabird Biologist, USFWS, Alaska Maritime National Wildlife~~

~~Refuge, Homer, Alaska~~

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~~

~~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.

~~**Altricial** - A term used to describe the developmental pattern in birds in which newly hatched young are relatively immobile, have closed eyes, lack down, and~~

~~must be cared for by the adults. Altricial young are born helpless and stay in the nest for a comparatively long time.~~

~~**Allowable 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).~~

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.

~~**Catchability** - A value that modifies a unit of fishing effort in the calculation of fishing~~

~~mortality which usually will depend on the habits of the fish, its abundance, and the type and deployment of fishing gear.~~

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.

~~**Compensatory Mechanism** - A process by which the effect of one factor on a population tends to be compensated for by a change in another factor. For example, a reduction in the egg production (spawning) may be compensated for by an increase in the survival rate of eggs.~~

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

~~**Density Dependence** - When the density of a population of organisms directly affects other processes, which can then affect the abundance of that population. For example, a reduction in the numbers of a population might lead to increased growth per individual (because of earlier maturity).~~

Department - California Department of Fish and ~~Game~~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.

~~**Direct Enumeration** - The counting of individuals in a population through direct visual observations, or through the use of such aids as sonar or video. Typically involves estimating species density along sampling transects, and applying the result to an entire survey area in order to estimate abundance. These methods have only limited value for the marine resource manager. Their usefulness has generally been limited to enclosed (freshwater) or anadromous (e.g., salmon) resources, where direct observations and subsequent counts can result in estimates of abundance.~~

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 Production Method** - While this method is very expensive, it can provide a real-time, fishery independent estimate of spawning biomass, that is directly calculated from population reproductive values that are measured by extensive at-sea sampling of eggs and adults on the spawning grounds.~~

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.

~~**Equilibrium Yield** - The yield in weight taken from a fish stock when it is in equilibrium with fishing at a given intensity and its abundance is not changing from year to year. Also called **sustainable yield**.~~

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) ~~(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) ~~(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.

~~G~~

~~**Growth Overfishing –** A reduction in the proportion of fish caught that is not compensated for by a corresponding increase in their average size. This is more likely to occur when a fishery is taking too many younger individuals.~~

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 ~~it is~~ 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 ~~nonfishing~~non-fishing, artificial causes (e.g., pollution, seismic surveys).

MSFCMA - Magnuson-Stevens Fishery Conservation and Management Act.

MSFMP – Market Squid Fisheries Management Plan.

N

NOAA - National Oceanic and Atmospheric Administration

NOP - Notice of Preparation.

NMFS - National Marine Fisheries Service or NOAA Fisheries.

O

~~**Optimal Sustainable Yield** - A sustainable yield that takes into account biological,~~

~~social, and political values, and the effect of harvesting on dependent or associated species, in an attempt to produce the maximum benefit to society from a stock of fish.~~

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

(a) ~~(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) ~~(b)~~ Is the maximum sustainable yield of the fishery, as reduced by relevant economic, social, or ecological factors.
(c) ~~(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)~~ A depressed fishery.
(b) ~~(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 ~~sport~~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.

~~**Performance Standard** - A qualitative and/or quantitative standard used to judge whether the performance of a particular individual, tool, or process is functioning properly. The standard used must be objective and readily detectable. In fisheries biology, a performance standard used to gauge a specific management process could be the long-term recruitment success of a particular species as measured through a standard biological survey method.~~

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 ~~lead~~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.

~~**Survival Rate** - Number of fish alive after a specified time interval (usually a year) divided by the initial number.~~

Sustainable, Sustainable Use, and Sustainability - with regard to a marine fishery, both of the following:
(a) ~~(a)~~ Continuous replacement of resources, taking into account fluctuations in abundance and environmental variability.
(b) ~~(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.

~~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.

~~**Yield-Per-Recruit** - The expected lifetime yield per fish of a specific age. The yield is usually expressed in weight for each recruit. For a given species with a specific growth curve, and constant natural mortality, the yield-per-recruit will vary as a function of age at first capture and fishing mortality.~~

~~**Yield-Per-Recruit Model** - This model can be used to predict the yield from any given level of recruitment if just the natural mortality, present fishing mortality, and growth rates can be estimated. Furthermore, this model can be manipulated to estimate yields for any combination of natural mortality, fishing mortality, and age at first capture. This information could then allow management to adjust mesh sizes, and thus age at first capture, to provide for maximum or optimal yield per recruit regardless of population size.~~

~~Appendix B Existing Regulations Prior to Adoption of the MSFMP~~

~~(FGC and CCR Title 14)~~

~~Appendix B. Existing Regulations Prior to Adoption of the MSFMP~~

~~FISH AND GAME CODE~~

~~Article 9. Salt-water and Anadromous Fish Generally~~

~~§8399. Squid - restrictions.~~

~~North of Point Conception, squid may be taken the year around; however, the commission may adopt regulations specifying the days of the week and the times of the day when squid may be taken.~~

~~§8399.1. Squid taking restricted; seine skiff.~~

~~(a) In District 10, it is unlawful to engage in the following activities:~~

~~(1) Attract squid by a light displayed from any vessel, except a vessel deploying nets for the take, possession, and landing of squid or from the seine skiff of the vessel deploying nets for the take, possession, and landing of squid.~~

~~(2) Attract squid by a light displayed from any vessel whose primary purpose is not the deployment, or assisting in the deployment, of nets for the take, possession, and landing of squid.~~

~~(3) To encircle any vessel, other than by the seine skiff of a vessel deploying nets for the take, possession, and landing of squid, while that vessel is engaged in the taking of squid.~~

~~(b) For purposes of this section, "seine skiff" means a vessel that is not licensed by the federal government or registered by the Department of Motor Vehicles, that is used to assist a larger federally licensed or state registered fishing vessel by assisting in the deployment and retrieval of nets and the landing of fish, and that travels with that larger fishing vessel at all times, that is used solely at the direction of the operator of the larger fishing vessel, and that is owned by the owner of the larger fishing vessel.~~

~~Article 9.7. Market Squid~~

~~§8420. Legislative findings~~

~~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. 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. The legislature finds that the lack of research on market squid and the lack of annual at-sea surveys to determine the squid could result in over fishing of the resource, damaging the resource, and financially harming those persons engaged in the taking, landing, processing, and sale of market squid. The Legislature further finds that many 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. 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 limit the number of days of the week market squid may be taken and to develop a plan for a sustainable California market squid fishery.~~

~~§8420.5. Commercial taking of market squid.~~

~~North of a line extending due west magnetic from Point Conception, market squid may be taken for commercial purposes only between noon on Sunday and noon on Friday of each week.~~

~~§8421. Commercial market squid vessel permit.~~

~~(a) On or after April 1, 1998, no person shall use a vessel to take or land market squid with dip nets (commonly referred to as scoop nets), purse seine nets, or lampara nets for commercial purposes unless the owner of that vessel has been issued a commercial market squid vessel permit by the department that has not been suspended or revoked.~~

~~(b) A commercial market squid vessel permit shall be issued only for vessels employing dip, purse seine, or lampara nets for the taking of market squid for commercial purposes. No permit is required for any vessel taking or landing market squid for commercial purposes if the amount taken by the vessel does not exceed two tons landed in a calendar day or if the squid taken is used for live bait only. No other nets shall be used for the taking of market squid from a vessel for commercial purposes. Furthermore, it is unlawful to possess in excess of two tons of incidentally taken squid per trip.~~

~~(c) A commercial market squid vessel permit shall be issued to a person only if that person is the owner of record of the commercial fishing vessel for which the permit is issued and the vessel is registered with the department pursuant to Section 7881.~~

~~(d) A commercial market squid vessel permit shall be issued only to the person who~~

~~owns the vessel at the time of application for that permit. For purposes of this subdivision, an owner includes any person who has a lease-purchase agreement for the purchase of a vessel.~~

~~(e) No person who is issued a commercial market squid vessel permit shall sell, trade, or transfer the permit to another person.~~

~~(f) A commercial market squid vessel permit shall be issued annually, commencing with permit for the 1998-99 permit year.~~

~~(g) A violation of the section does not constitute a misdemeanor; however, pursuant to Section 7857, the commission may revoke or suspend the commercial market squid vessel permit or commercial fishing license held by any person who violates this section.~~

~~(h) Squid landed in excess of the limit specified in subdivision (b) of Section 8421 without a permit shall be forfeited to the department by the signing of an official release of property form. The squid shall be sold or disposed of in a manner to be determined by the department. The proceeds from all sales shall be paid into the Fish and Game Preservation Fund.~~

~~§8421.5. Permit holder of partnership or corporation.~~

~~If a commercial market squid vessel permit is issued for a vessel that is owned by a bonafide partnership or corporation, that partnership or corporation shall designate the individual who is the operator and shall provide that information to the department annually at the time of issuing the permit. If there is a dissolution of the partnership or the corporation, the partnership or corporation shall notify the department of the name of the partner or shareholder who is the successor permit holder and the department shall reissue the permit to that partner or shareholder.~~

~~§8422. Fees for permit; renewal.~~

~~(a) The fee for a commercial market squid vessel permit shall be four hundred dollars ($400).~~

~~(b) All applications for a commercial market squid vessel permit for the 1998-99 permit year shall be received by the department on or before April 30, 1998, or, if mailed, shall be postmarked by April 30, 1998. In order to renew a permit, an applicant shall have been issued a commercial market squid vessel permit in the immediately preceding year. Applications for renewal of the permit shall be received by the department on or before April 30 of each year, or, if mailed, shall be postmarked by April 30 of each year.~~

~~(c) Notwithstanding Section 7852.2, a penalty of two hundred fifty dollars ($250) shall~~

~~be paid in addition to the fee required under subdivision (a) for applications that do not meet the deadline specified in subdivision (b) but that are received by the department on or before May 31 of any year.~~

~~(d) The department shall deny all applications received after May 31 of each year, and the application shall be returned to the applicant who may appeal the denial to the commission. If the commission issues a permit following an appeal, it shall assess the late penalty prescribed by subdivision (c).~~

~~§8423. Commercial squid light boat owner's permit.~~

~~(a) No person shall operate a squid light boat unless the owner of the boat has been issued a commercial squid light boat owner's permit by the department and a permit number is affixed to the boat in the manner prescribed by the department.~~

~~(b) The department shall issue a commercial squid light boat owner's permit to a person who submits an application, pays the permit fee, and meets the other requirements of this section.~~

~~(c) The department may regulate the use of squid light boats consistent with the regulations established for commercial squid vessels.~~

~~(d) The fee for a commercial squid light boat owner's permit shall be four hundred dollars ($400).~~

~~(e) It is unlawful for a person to engage in the following activities, unless the vessel used for the activity has been issued a commercial market squid vessel permit or the person holds a commercial squid light boat owner's permit:~~

~~(1) Attracting squid by light displayed from a vessel, except from a vessel deploying nets for the take, possession, and landing of squid or except from the seine skiff of the vessel deploying nets for the take, possession, and landing of squid.~~

~~(2) Attracting squid by light displayed from a vessel whose primary purpose is other than deployment, or assistance in the deployment, of nets for the take, possession, and landing of squid.~~

~~(f) A commercial squid light boat owner's permit shall be issued to a person who is the owner of record of a vessel that is registered with the department pursuant to Section 7881. For purposes of this subdivision, an owner includes any person who has a lease-purchase agreement for the purchase of a vessel.~~

~~§8423.5 Fees for permit; renewal.~~

~~(a) All applications for a commercial squid light boat owner's permit for the 1998 permit year shall be received by the department on or before April 30, 1998, or, if~~

~~mailed, shall be postmarked by April 30, 1998. In order to renew a permit, an applicant shall have been issued a commercial squid light boat owner's permit in the immediately preceding year. Applications for renewal of the permit shall be received by the department on or before April 30 of each year, or, if mailed shall be postmarked by April 30 of each year.~~

~~(b) Notwithstanding Section 7852.2, a penalty of two hundred fifty dollars ($250) shall be paid in addition to the fee required under subdivision (a) for applications that do not meet the deadline specified in subdivision (b) but that are received by the department on or before May 31 of any year.~~

~~(c) The department shall deny all applications received after May 31 of each year, and the application shall be returned to the applicant who may appeal the denial to the commission. If the commission issues a license following an appeal, it shall assess the late penalty prescribed by subdivision (b).~~

~~§8424. Purchase of squid from vessel.~~

~~(a) No person shall purchase squid from a vessel or vessels unless that person holds a license issued pursuant to Section 8032 or 8033, employs a certified weigh master, and the facilities operated by the person are located on a permanent, fixed location.~~

~~(b) Notwithstanding any other provision of law, this section shall not apply to the transfer at sea of squid for live bait in an amount less than 200 pounds in a calendar day.~~

~~§8425. Annual squid management regulations.~~

~~On or after April 1, 1998, and annually thereafter, the commission, upon the recommendation of the director, after a public hearing at which findings are adopted, shall adopt regulations to protect the squid resource and mange the squid fishery at a sustainable level, taking into account the level of fishing effort and ecological factors, including but not limited to, the species' role in the marine ecosystem and oceanic conditions.~~

~~§8426. Fishery status report; recommendations for market squid conservation and management plan.~~

~~(a) The director shall be responsible for the development of research protocols and the development of recommendations for the management of the squid fishery as set forth in subdivision (c) and for the conduct of public hearings to receive information on the resource and the fishery. The director may establish a Squid Research Scientific Committee consisting of persons with scientific knowledge or expertise on the squid resource or fishery, who may be employed by academic institutions, public or private research institutions, or the private sector. The committee, if established, shall assist in~~

~~the development of research protocols and the preparation and review of the market squid conservation and management plan as described in subdivision (c). The department shall pay, from revenues derived pursuant to this article, the necessary costs of the committee, including a per diem to all members, as determined by the department.~~

~~(b) The director may establish a Squid Fishery Advisory Committee consisting of members representing licensed squid fishermen, squid processor, the recreational fishing industry, squid light boat owners, marine conservation organizations, and the Sea Grant Marine Advisory Program.~~

~~(c) The director shall hold public hearings to take testimony on interim measures, squid research needs, and the development of the management recommendations to be included in the report to the Legislature. Notwithstanding Section 7550.5 of the Government Code, on or before April 1, 2001, in consultation with the Squid Fishery Advisory Committee, if established, and following public hearings, the director shall submit to the Legislature a report on the status of the market squid fishery with recommendations for a market squid conservation and management plan, including, but not limited to, the following information:~~

~~(1) Whether a limited access plan to manage the amount of fishing effort in the market squid fishery is necessary and, if so, what criteria should be used to determine who may participate in the fishery, what the optimum number of vessels should be in the fishery, and the overall fleet capacity.~~

~~(2) Whether it is necessary or advisable to reduce the number of days of the week that market squid may be taken for commercial purposes in specified areas of the state to protect the squid resource.~~

~~(3) Whether there are areas, if any, that should be declared harvest replenishment areas for squid where the taking of squid would not be permitted.~~

~~(4) A research and monitoring program of the market squid resource as may be needed to assist in the management of the market squid fishery to assure sustainable harvest on an annual basis and funding for that program.~~

~~(5) The regulation of squid light boats.~~

~~(6) Coordination that may be necessary with a federal coastal pelagic species management plan, should one be adopted.~~

~~(7) Whether it is necessary or advisable to modify the method of take or the use of fishing gear.~~

~~§8427. Transfer of permit to replacement vessel.~~

~~(a) A commercial market squid vessel permit issued pursuant to Section 8422 or a commercial squid light boat owner's permit issued pursuant to Section 8423 may be transferred to another vessel owned by the permit holder, if the vessel is of comparable capacity as determined by United States Coast Guard documentation papers, and only if the permitted vessel was lost, stolen, destroyed, or suffered a major mechanical breakdown.~~

~~(b) The department shall not issue a permit for a replacement vessel if the permitted vessel was reported as lost, stolen, destroyed, or damaged for fraudulent purposes.~~

~~(c) Only the permit holder at the time of the loss, theft, destruction, or mechanical breakdown of the vessel may apply for the transfer of the vessel permit. Proof that a vessel is lost, stolen, or destroyed shall be in the form of a copy of the report filed with the United States Coast Guard or any other law enforcement agency or fire department investigating the loss.~~

~~(d) The vessel owner shall submit an application for the transfer to the department on a form provided by the department and shall pay a non-refundable transfer fee of two hundred fifty dollars ($250) for each transfer of a market squid vessel permit or a commercial squid light boat owner's permit.~~

~~(e) The permit for the permitted vessel shall be current, and the owner of the permitted vessel shall make assurances in the transfer application that any renewal of the permit which becomes due during the application processing period will be made.~~

~~(f) The owner of the permitted vessel shall submit evidence with the transfer application sufficient to establish that he or she is the owner of the permitted vessel and the owner of the replacement vessel at the time of the application for transfer.~~

~~(g) The vessel owner shall sign the transfer application under penalty of perjury and shall certify that the information included in the application is true to the best of his or her knowledge and belief.~~

~~§8428. Use of funds.~~

~~An amount not to exceed the sum collected annually from permit fees paid pursuant to Sections 8422 and 8423 may be used for the purposes of this article, including any research that may be necessary for the development of recommendations from the Legislature.~~

~~§8429. Material false statements-penalties.~~

~~Any statement made to the department, orally or in writing, relating to a permit issued under this article, shall be made under penalty of perjury. The commission shall revoke the commercial fishing license, the commercial boat registration of any vessel, and, if~~

~~applicable, any licenses issued pursuant to Section 8032, 8033, or 8034 that are held by any person submitting material false statements, as determined by the commission, for the purpose of obtaining a commercial market squid vessel permit.~~

~~§8429.5. Authority of director and commission.~~

~~Notwithstanding any other provision of law, nothing in this article shall prohibit or otherwise limit the authority of the director or the commission under any other law.~~

~~§8429.7. Repeal of article~~

~~Sections 8420.5 to 8423.5, inclusive, and Sections 8426 and 8427 shall become inoperative upon the adoption by the commission of a market squid fishery management plan and the adoption of implementing regulations pursuant to Section 8425, and are repealed six months thereafter.~~

~~CALIFORNIA CODE OF REGULATIONS~~

~~149. Commercial Taking of Market Squid.~~

~~(a) Fishing days. North of a westerly extension of the United States --Republic of Mexico boundary line, market squid may not be taken for commercial purposes between 1200 hours (noon) on Friday and 1200 hours (noon) on Sunday of each week. This regulation applies to vessels catching squid or attracting squid with lights for the purpose of catching. This regulation does not apply to vessels pursuing squid for live bait purposes only.~~

~~(b) Records. Pursuant to Section 190 of these regulations, any person who possesses a valid market squid vessel permit or squid light boat owners permit shall complete and submit an accurate record of his/her squid fishing/lighting activities on a form [Market Squid Vessel Logbook - DFG 149a (4/99), or Market Squid Light Boat Logbook - DFG 149b (4/99), which are incorporated by reference herein] provided by the department, as appropriate to the type of fishing activity.~~

~~(c) Maximum Wattage. Each vessel fishing for squid or lighting for squid will utilize a total of no more than 30,000 watts of lights to attract squid at any time.~~

~~(d) Light Shields. Each vessel fishing for squid or lighting for squid will reduce the light scatter of its fishing operations by shielding the entire filament of each light used to attract squid and orienting the illumination directly downward, or providing for the illumination to be completely below the surface of the water.~~

~~(e) Seasonal Harvest Guideline. For the period from April 1 through March 31 of the following year, a total of not more than 125,000 short tons of market squid may be taken by vessels permitted under Section 8421 of the Fish and Game Code, with the fishery closure implemented as follows:~~

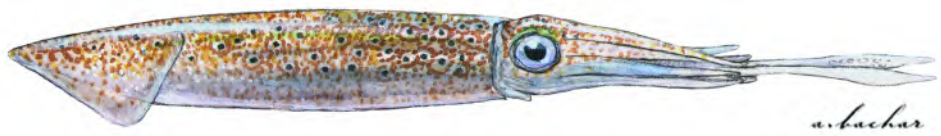
~~(1) The department shall estimate, from the current trend in landings, when the market squid harvest guideline will be reached, and will publicly announce the effective date of closure of the directed fishery on VHF/channel 16 between the hours of 10:00 p.m. and 12:00 a.m. (midnight). It shall be the responsibility of all operators of permitted market squid vessels to monitor VHF/channel 16 to determine when the harvest guideline is expected to be reached and the fishery closed. Any announcement issued or made by the department on VHF/channel 16 shall constitute official notice.~~

~~(2) Whenever the market squid harvest guideline has been reached, market squid may be taken for commercial purposes until April 1 only pursuant to Section 8421(b) of the Fish and Game Code.~~

Species-at-a-Glance

Scientific Name

Doryteuthis (Loligo) opalescens



Range

Market squid range from Baja California, Mexico to southeastern Alaska.

Habitat

Market squid inhabit inshore and offshore pelagic waters of the California Current Ecosystem but are also associated with bottom substrate during spawning events and egg development.

Size (length and weight)

Market squid are fast-growing. They are less than 3 millimeters at hatching and grow to an average mantle length of 152 millimeters at the time of spawning, approximately 6 months later. Individual growth rates vary.

Life Span

Market squid are short-lived with life spans of approximately 6-10 months.

Reproduction

Market squid are terminal spawners, and decease after reproducing. Spawning occurs year-round.

Prey

As larvae and juveniles, market squid consume copepods and euphausiids. As adults, they feed on fish, polychaete worms, squid (cannibalism), and crustaceans.

Predators

Market squid are forage for many fish and marine mammal predators in the California Current Ecosystem.

Fishery

Market squid primarily support a commercial fishery. In the 2023 calendar year, more than 52 million pounds of market squid were landed in California, generating roughly $33 million in revenue. The median ex-vessel price of market squid increased from $0.10 to $0.50 per pound since 2000 and remained at $0.50 per pound from 2016 to 2018. In 2020, the median ex-vessel price increased to $0.60 per pound and has remained at $0.60 per pound into July of 2024. Landing, processing, and distribution mostly occur in Monterey Bay, Ventura, and Los Angeles port areas.

Area Fished

The market squid fishery is centered in the nearshore waters of California, typically over sandy bottom habitats. In California, commercial effort is concentrated in central California around Monterey Bay and in southern California including the Channel Islands.

Fishing season

In California, the regulatory fishing season for market squid is year-round April 1 through March 31.

Fishing gear

Purse seine, drum seine, lampara, and brail gear are used in the market squid fishery.

Market(s)

Market squid are primarily exported with minimal domestic retention for processing. They also are used as bait or for consumption. Market Squid are typically shipped frozen to China, Japan, and Europe for processing prior to sale and exported to international markets from there.

Current Stock Status

No current estimates of population abundance in California exist for market squid. Recruitment varies substantially from year to year in response to environmental factors, causing natural fluctuations in abundance. Given the short lifespan of this species and based on estimates of reproductive output the status of the stock appears productive.

Management

Since 2005 the market squid fishery has been principally state-managed through the Market Squid Fishery Management Plan. Market squid is also included in the federal Coastal Pelagic Species Fishery Management Plan. From 2023-2024, a new Squid Fishery Advisory Committee (SFAC) reviewed California market squid fishery management and advised the California Department of Fish and Wildlife on potential management changes (CDFW 2024b). Recommendations on management changes from the SFAC will be provided to the California Fish and Game Commission in 2024-2025.

The Species →

Related Links

- California Market Squid Fishery Management Plan
- California Department of Fish and Wildlife Pelagic Fisheries and Ecosystem Program
- Marine Fisheries Data Explorer
- California Department of Fish and Wildlife License Statistics
- California Wetfish Producers Association
- California Cooperative Oceanic Fisheries Investigations
- California Current Integrated Ecosystem Assessment
- National Oceanic and Atmospheric Administration List of Fisheries

Last Updated: The Market Squid Enhanced Status Report was updated in 2024.

Contact Us: To contact CDFW regarding Market Squid, please email CDFW's Marine Region or call 831-649-2870.

Citation: California Department of Fish and Wildlife. 2024 Market Squid, *Doryteuthis (Loligo) opalescens*, Enhanced Status Report.

Contributor(s): Katie Grady, Sarah Valencia, Dianna Porzio

Acknowledgement(s):

Market Squid Enhanced Status Report 2024

Table of Contents

List of Acronyms

List of Figures

List of Tables

Literature Cited

California Department of Fish and Wildlife

Marine Region (Region 7)

Regional Manager: Dr. Craig Shuman

Main Office: 20 Lower Ragsdale Drive, Suite 100, Monterey, CA 93940

AskMarine@wildlife.ca.gov | (831) 649-2870

Office Locations| Marine Blog| Subscribe

Back to Top

1.5. Effects of Changing Oceanic Conditions

Collapse All

1. The Species

1.1. Natural History

1.1.1. Species Description

Market squid (Doryteuthis (Loligo) opalescens) or opalescent squid (Figure 1-1), are part of the class Cephalopoda and the phylum Mollusca (Berry 1911). There are approximately 750 recognized species of squids alive today and more than 10,000 fossil forms of cephalopods. Market squid belong to the family Loliginidae. These squid 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). This name change however was not formalized or published (CDFG 2005). The Department currently refers to Loligo opalescens as market squid in regulation (Fish and Game Code (FGC) §8420, §8045) and as market squid or Loligo opalescens throughout the Market Squid Fishery Management Plan (MSFMP, CDFW 2005).

Figure 1-1. Market squid (Photo Credit: Dane McDermott, CDFW).

1.1.2. Range, Distribution, and Movement

Market squid range from the southern tip of Baja California, Mexico to southeastern Alaska (Figure 1-2). 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) (Figure 1-3) 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). Their 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). They are found at depths of 30 meters (m) (98 feet (ft)) by day and 15 m (49 ft) at night, suggesting diel movement (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). They are found at depths of up to 600 m (1,969 ft) during the day, but move vertically to the upper 100 m (328 ft) of the water column at night to feed (Hunt et al. 2000; Zeidberg and Hamner 2002). 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. This allows them 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 unknown at this time 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 (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 southern California Bight (SCB) and no temporal differences between samples in the Monterey areas were evident.

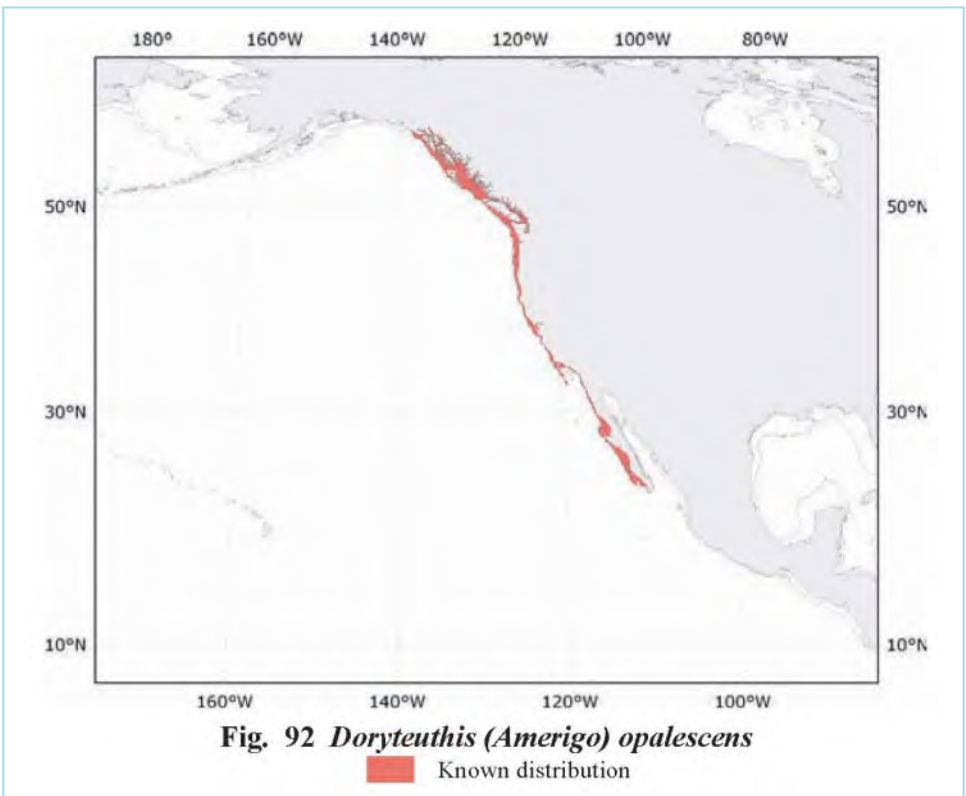


Figure 1-2. Range of market squid (Reproduced from Jereb et al. 2010).

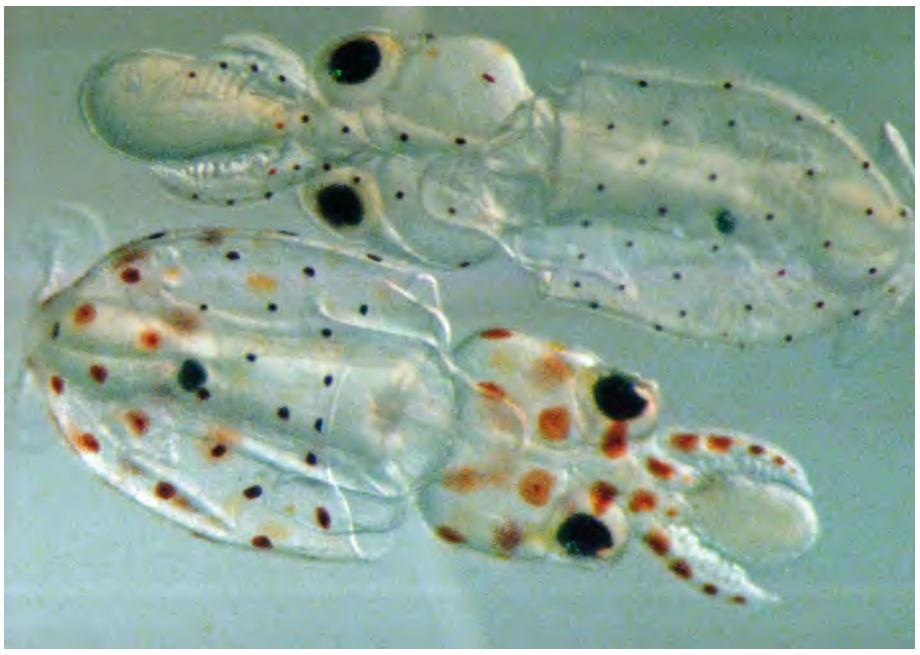


Figure 1-3. Market squid paralarvae (Photo Credit: Sonia Torres, CDFW).

1.1.3. Reproduction, Fecundity, and Spawning Season

Relatively little is known about the life history of spawning market squid. Generally, in central California, spawning activity starts around April and ends in October. In southern California, spawning tends to begin around October and ends 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 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. These interactions are 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 (m^2) may be formed and appear to carpet the sandy substrate.

After fertilization, embryonic development of egg cases in aquaria at 16.0 degree, Celsius (°C) (60.8 degree, Fahrenheit (°F)) 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 (*Doryteithis 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. (2001, 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 this 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.

1.1.4. Natural Mortality

Determining the natural mortality (M) 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 (F) result in the total mortality operating on the fish stock.

Based on their 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. These observations suggest 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 1-3). 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).

While there are no studies directly estimating the natural mortality rate of squid, 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)

1.1.5. Individual Growth

Individual growth of marine species can be quite variable, not only among different groups of species but also within the same species. Growth is often very rapid in young fish and invertebrates but slows as adults approach their maximum size. The von Bertalanffy Growth Model is most often used in fisheries management, but other growth functions may also be appropriate.

Market squid are less than 3.0 mm (0.1 in) at hatching and grow to an average mantle length of 152 mm (10 in) at the time of spawning. Butler et al.(2001) found that market squid growth increases with age and is best described with an exponential function (Figure 1-4):

$$DML = 0.001342 * Age^{2.132}$$

where DML is in millimeters and age is in days ($r^2 = 0.95$, $df = 275$, $P < 0.001$). Paralarvae growth is slow (0.05 (0.002 in) mm DML per day) during the first month but increases 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 (Figure 1-5). Because the body weight of squid declines as eggs are released, this function was fit to data for mature females that had not yet spawned (pre-ovulatory females).

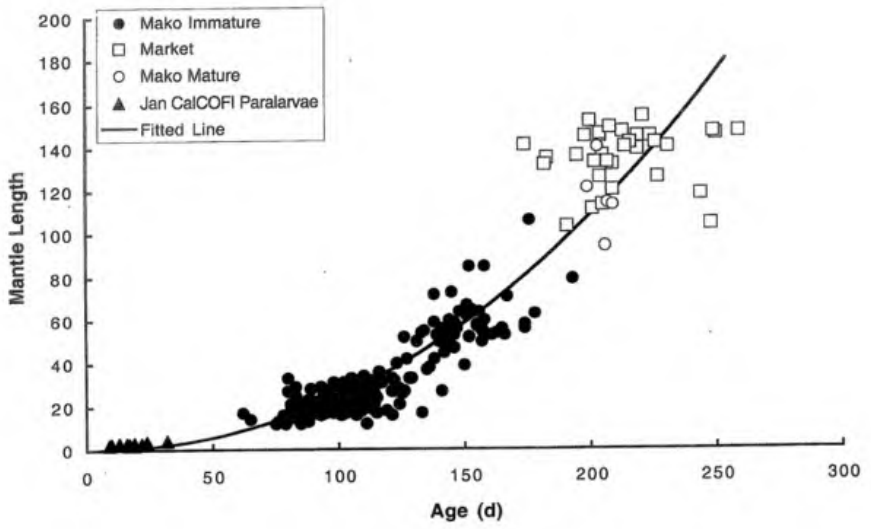


Figure 1-4. Relationship between age (in days) and DML (in mm) of market squid for a cohort hatched in November to December 1999 (Reproduced from Butler et al. 2001). In the figure legend, R/V "Mako" is the name of the vessel, "Market" indicates adult squid were collected from the commercial fishery, and "Jan CalCOFI Paralarvae" indicates paralarvae samples collected from a January CalCOFI cruise.

▸ View Detailed Description

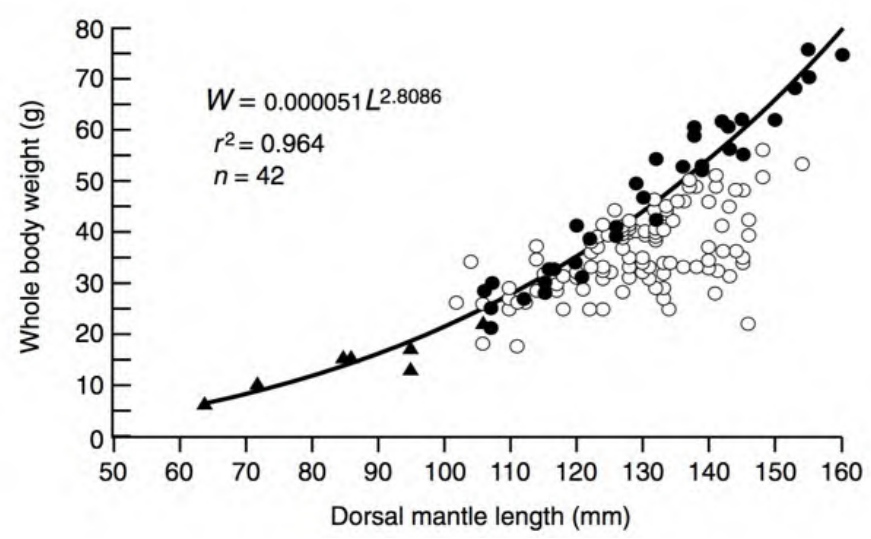


Figure 1-5. Female market squid whole body weight as a function of DML length prior to spawning (n=158). Solid triangles represent immature females, solid circles represent mature females that have not spawned, and open circles represent females that have spawned (Reproduced from Macewicz et al. 2004).

▸ View Detailed Description

1.1.6. Size and Age at Maturity

Market squid begin to reach sexual maturity 5 or 6 months after hatching (Butler et al. 1999; Butler et al. 2001). At this point they 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.

1.2. Population Status and Dynamics

The unique biology of cephalopods such as market squid requires a different management approach than other fisheries (Boyle 1990). Market squid exhibit very fast growth and short life spans. They are most vulnerable to fishing during mating, when males and females pair up to exchange gametes directly. Unlike other fish and invertebrates that spawn over multiple years and are often more fecund as they get older, because market squid die shortly after laying eggs, recruitment to the population is entirely dependent on the successful survival of the eggs. This may lead to concerns that a prolonged multiple-cohort failure would be highly detrimental to the population and the fishery (Boyle and Boletsky 1996; Hibberd and Pecl 2007; Zeidberg et al. 2011a).

Market squid exhibit large variability in year-to-year abundance. These fluctuations are attributed to environmental conditions influencing spawning activity and survival of recruits (Ralston et al. 2015; Van Noord, 2020; Chasco et al. 2022; Suca et al. 2022). However, these fluctuations may also reflect changes in the spatial distribution of the population, making them more available to fishermen or surveys in some years and less available in others. In addition, the central and southern California landings generally peak 6 months apart suggesting that two spawning events occur per year. The recruits from successful Monterey spawning activity may become the adults taken in the southern California fishery the following winter, and vice versa (Butler et al. 1999; Zeidberg et al. 2011b). Deeper (70.0 to 150.0 m (229.7 to 492.1 ft)) off-season or year-round spawning may exist with an annual harmonic of concentrated spawning in the spring in Monterey and in the winter in southern California due to favorable oceanographic conditions (Zeidberg et al. 2011b). Due to these life history characteristics, forecasting abundance or availability using traditional demographic models is impractical, and many squid fisheries such as the Argentine Shortfin Squid (*Illex argentinus*) fishery around the Falkland Islands and the Humboldt Squid (*Dosidicus gigas*) fishery in Mexico are managed based on the concept of “escapement” in which fishing is restricted in order to allow a certain proportion of the population to spawn successfully (Arkhipkin et al. 2015).

1.2.1. Abundance Estimates

There is information on the coast wide distribution and relative abundance of market squid from fishery-independent midwater rockfish trawl surveys that are conducted at night annually between San Diego, California and Gold Beach, Oregon in May and June by the National Marine Fisheries Service (NMFS). These surveys are part of the Southwest Fisheries Science Center (SWFSC) Rockfish Recruitment and Ecosystem Assessment Survey. Data are incorporated into the California Current Integrated Ecosystem Assessment (CCIEA) project available at the National Oceanic and Atmospheric Administration (NOAA) CCIEA website (CCIEA 2023). Due to the timing and location of these trawl surveys, as well as the ability of larger squid to avoid the trawl nets, these surveys only provide an index of relative abundance of juvenile squid (Figure 1-6) (Ralston et al. 2018). This index was paired with a model of egg escapement developed by Dorval et al. (2013) to develop an estimate of total abundance in three biogeographic regions (Tables 1-1, 1-2, and 1-2). These regions include (1) Bodega Bay to Point Piedras, (2) Santa Barbara, Los Angeles, and the northern Channel Islands, and (3) San Diego to the southern Channel Islands (Dorval et al. 2013). Because the three major fishing port complexes (Monterey, Ventura, and Los Angeles) do not always represent mutually exclusive fishing areas, these regions were used to distinguish spatially explicit spawning grounds. This represents the best available index of absolute abundance for the market squid population in California.

In 2019, more juvenile market squid were captured in the Juvenile Salmon and Ocean Ecosystem Survey (JSOES) off Oregon and Washington than any other year in the 22-year time series (Thompson et al. 2019). This marks a recent upward trend in the presence of market squid in these northern daytime surface trawls. JSOES has been conducted by the Northwest Fisheries Science Center in late June every year between 1998 and 2019.

A time series of the larval abundance (paralarvae) of market squid is also available from the California Cooperative Fisheries Investigation (CalCOFI) sampling program (Figure 1-7) (See section 4.2.2 for more information on CalCOFI sampling).

Zeidberg et al. (2006) found a significant linear relationship between a paralarvae density index collected in February in the SCB and Catch Per Unit Effort (CPUE) in southern California the following November from 2000 to 2003. This suggests that the number of paralarvae could be used to predict adult abundance and potentially be used as an indicator in management. Continued efforts to assess this paralarvae index as a potential management tool are on-going by the Department, the California Wetfish Producers Association (CWPA), and the SWFSC (Van Noord, 2020). Van Noord and Dorval (2017) found a strong relationship between paralarval density and distribution to local Sea Surface Temperature (SST) and ocean productivity (specifically a measurement of zooplankton abundance). Relative paralarval abundance and fishery landings remained high during cool and productive La Niña conditions. Conversely, a strong El Niño Southern Oscillation (ENSO) drove dramatic declines in relative paralarval abundance followed by a decline in fishery landings (Figure 1-8).

Some information on the status of market squid can be drawn from fishery-dependent indicators. Yearly catch in southern and central California can provide some information on recruitment from the previous season, but catches may provide a negatively biased estimate of the population strength unless economic factors are accounted for (Hardwick and Spratt 1979). Yearly catch may be influenced by availability, market demand, and processing capacity. In addition, because fishing occurs on shallow-water spawning aggregations, catches may not consistently reflect the overall stock size. Market squid embryos have been documented at greater depths than what the fishery targets (Navarro et al. 2018), and adults may spawn outside the temporal and spatial window of the fishing fleet (e.g., further offshore, deeper waters, further north, or further south). The fishery also closes once the seasonal catch limit is reached during episodes of high abundance. Thus, catch or CPUE alone may not be a suitable index of abundance.

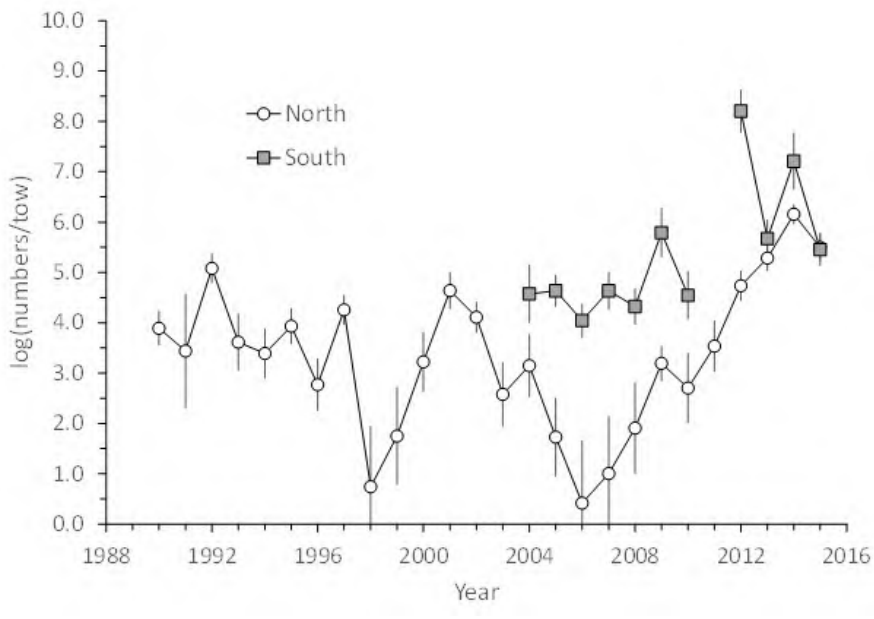


Figure 1-6. Annual variation in the abundance of market squid based on standardized midwater trawl survey data (logged numbers of squid per tow) for north and south of Point Conception (see Ralston et al. 2018 for methods). The error bars ± 1.0 standard error (Reproduced from Ralston et al. 2018).

▸ View Detailed Description

Table 1-1. Quarterly estimates of market squid spawning stock biomass (metric tons) by year in biogeographical region 1 (Dorval et al. 2013). Estimates based on the method of Dorval et al. (2013), assuming a natural mortality rate of 0.15 and an egg laying rate of 0.45 (Reproduced from Appendix II in Dorval et al. 2024).

Year	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
1999	-	-	-	-
2000	-	7,631	2,539	440
2001	-	1,447	6,473	982

Year	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
2002	1,876	19,523	6,438	2,864
2003	-	6,821	9,656	5,715
2004	-	6,319	2,766	-
2005	-	3,349	1,126	-
2006	-	1,446	163	-
2007	-	-	-	-
2008	-	-	-	-
2009	-	479	-	-
2010	-	15,985	9,696	6,138
2011	-	6,197	7,258	-
2012	-	-	12,039	26,123
2013	-	775	19,945	1,597
2014	-	20,223	32,330	-
2015	-	314	15,979	6,568
2016	-	-	12,295	-
2017	-	2,469	6,682	546
2018	-	9,299	2,382	2,607
2019	202	282	3,873	-
2020	-	9,763	5,060	312
2021	569	-	4,545	-
2022	-	-	1,568	-

Table 1-2. Quarterly estimates of market squid spawning stock biomass (metric tons) by year in biogeographical region 2 (Dorval et al. 2013). Estimates based on the method of Dorval et al. (2013), assuming a natural mortality rate of 0.15 and an egg laying rate of 0.45 (Reproduced from Appendix II in Dorval et al. 2024).

Year	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
1999	10,260	19,069	3,095	51,124
2000	29,523	11,019	3,187	127,275
2001	19,081	10,252	3,986	42,345
2002	12,302	1,030	2,458	14,738
2003	4,137	862	1,556	32,561
2004	18,905	13,775	-	36,702
2005	108,656	-	-	6,460
2006	5,686	-	656	9,557
2007	78,360	345	401	-
2008	13,038	-	4,371	-
2009	62,093	-	-	78,276
2010	-	-	-	77,716
2011	6,829	-	37,329	90,652
2012	5,623	2,105	45,029	123,901
2013	-	12,169	54,702	71,319
2014	-	4,530	38,365	38,273
2015	-	595	19,608	9,034
2016	-	4,291	13,311	-
2017	1,001	7,632	1,124	-
2018	-	178	961	40,716
2019	5,604	628	-	4,827

Year	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
2020	7,689	-	-	-
2021	-	3,827	1,453	25,499
2022	30,246	1,830	5,292	-

Table 1-3. Quarterly estimates of market squid spawning stock biomass (metric tons) by year in biogeographical region 3 (Dorval et al. 2013). Estimates based on the method of Dorval et al. (2013), assuming a natural mortality rate of 0.15 and an egg laying rate of 0.45 (Reproduced from Appendix II in Dorval et al. 2024).

Year	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
1999	2803	5704	276	9566
2000	11695	2,593	1,161	21114
2001	31831	701	1,048	51640
2002	70,594	964	135	523
2003	1067	727	1,904	2,281
2004	31635	401	-	377
2005	6952	1,120	1,992	29451
2006	70261	4,501	3797	-
2007	-	-	354	2903
2008	-	1382	2873	-
2009	-	2367	6909	-
2010	28469	-	2,460	107,789
2011	1648	-	11,536	61731
2012	10697	-	25,428	130,630
2013	2808	5765	34,171	39,074
2014	767	4,855	-	3017

Year	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
2015	-	-	-	348
2016	-	4387	-	-
2017	-	4,762	921	5642
2018	10153	122	-	3,877
2019	7833	178	-	-
2020	6271	-	-	1029
2021	3466	860	866	3542
2022	5414	1027	1,387	-

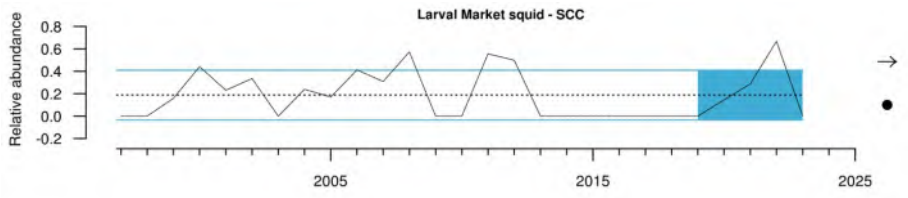


Figure 1-7. Index of larval abundance for market squid in southern California. These data were collected during spring CalCOFI surveys (CalCOFI 2021). Data are summed across all sampled stations, and units are in number under 10 square meters of surface area; ln (abundance+1). The dashed line represents the long-term mean, and the solid lines represent the mean +/- one standard deviation. The blue shading and arrow represent recent trends (Reproduced from CCIEA 2023).

▸ View Detailed Description

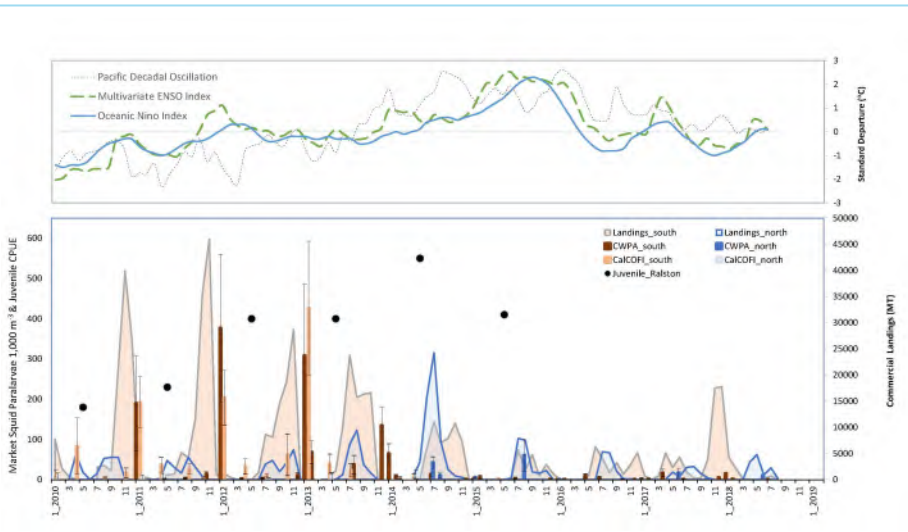


Figure 1-8. ENSO influences on market squid in the CCE. Top panel displays the trends and deviations from the average for three oceanographic and atmospheric indices. Bottom panel displays market squid paralarval abundance and juvenile CPUE from Ralston et al. 2018 on the left, and landings on the right y-axis. SCB information is displayed in warm colors and Monterey Bay Region data are shown in cool colors. Error bars indicate two standard error. All data span September 2010 through September 2018. (Figure reproduced from Van Noord and Dorval 2017).

▸ View Detailed Description

1.2.2. Age Structure of the Population

Market squid age can be determined using statoliths, which are hard calcified structures suspended in the balance or hearing receptor of some aquatic invertebrates. Similar structures called otoliths exist in fish. Rings are deposited daily on statoliths as the animal develops and may be used to determine life span (Figure 1-9). Daily ring deposition has been validated for several squid species including market squid and has been shown to be an accurate method for ageing squid (Jackson and Domeier 2003; Hurley et al. 1985; Lipinski 1986; Jackson 1990a, b, 1994, 1998; Bettencourt et al. 1996; Spratt 1979).

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. This strongly suggests that a new cohort enters the fishery almost monthly. Figure 1-10 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 2000-2019 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 in to 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, this cannot be determined at present. Future analyses of collected statoliths would provide useful information.

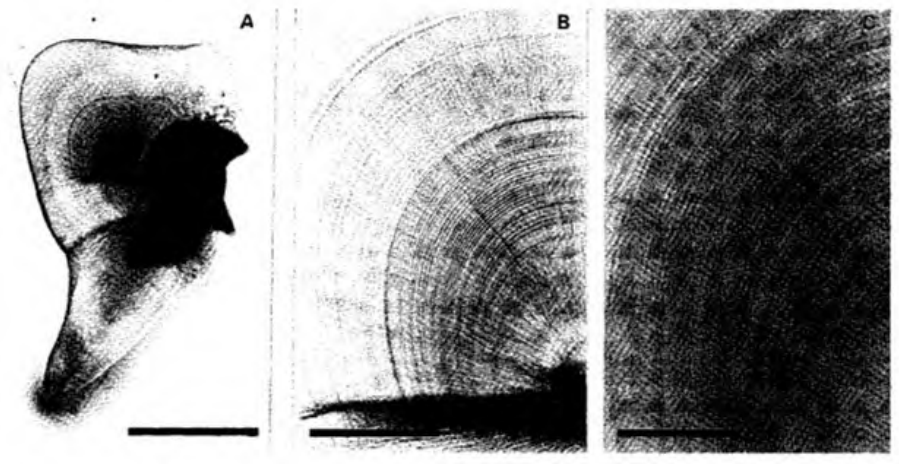


Figure 1-9. The ground and polished statolith from a female market squid caught off the coast of central California in 1990. Images include (A) a whole statolith (scale bar = 500 micrometers (μm)), (B) a close-up lateral region showing detail of increment structure (scale bar = 100 μm), and (C) close-up of individual increments in the lateral region (scale bar = 50 μm) (Reproduced from Jackson 1998).

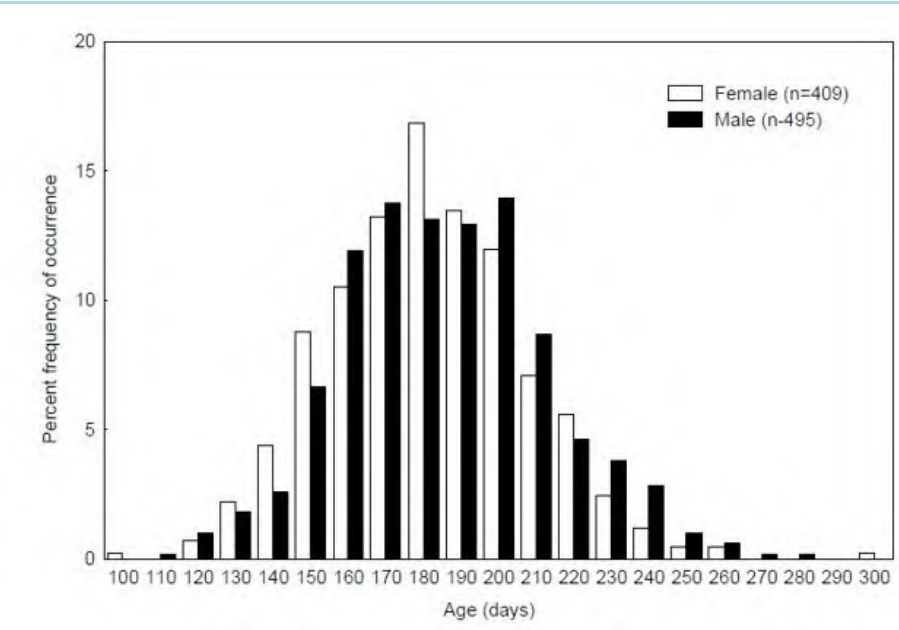


Figure 1-10. Market squid percent frequency of occurrence by age and sex. Port samples used to determine percent frequency of occurrence were collected from November 1998 through July 2000 (Reproduced from the MSFMP).

View Detailed Description

1.3. Habitat

The definition of Essential Fish Habitat (EFH) for Coastal Pelagic Species (CPS), such as market squid, Pacific sardine (*Sardinops sagax caerulea*), Pacific mackerel (*Scomber japonicus*), northern anchovy (*Engraulis mordax*), and jack mackerel (*Trachurus symmetricus*), is based on a temperature range bordered by the geographic area where CPS occurs at any life stage, have occurred historically, or where environmental conditions do not preclude colonization by CPS (PFMC 2023a). For the east-west geographic boundary, the EFH for CPS includes all marine and estuarine waters from the shoreline along the California, Oregon, and Washington coasts offshore to the limits of the Exclusive Economic Zone and above the thermocline, where SSTs range from 50 to 79 °F (10 to 26 °C), the upper tolerance of CPS finfish (PFMC 2023a). The southern boundary is the United States-Mexico maritime boundary. The northern boundary is more dynamic and is defined as the position of the 10°C isotherm, which varies seasonally and annually (PFMC 2023a).

Not much is known about the specific pelagic habitat requirements of adult market squid, but there is some evidence that their depth is limited by the Oxygen Minimum Zone (OMZ), which is a naturally occurring area ranging from a depth of 500.0 to 1,000.0 m (1,640.2 to 3,280.8 ft) where the amount of dissolved oxygen is less than that needed to support many marine species (Helly and Levin 2004; Stewart et al. 2014).

Some studies have mapped the spatial distribution and extent of egg beds using Remotely Operated Vehicles (ROVs) along portions of the California coast (Young et al. 2011; Zeidberg et al. 2011b). Major spawning grounds fished in California are located in Monterey Bay and the SCB. Zeidberg et al. (2011b) found that 95% of squid eggs surveyed were found on sandy benthic substrate in temperatures between 10.0 to 14.4 °C (50.0 to 57.9 °F) at depths between 20.0 and 70.0 m (65.6 to 229.7 ft). During spawning, egg capsules are inserted into sand with a thin anchoring strand, and wave surge ventilates the eggs (Zeidberg et al. 2011b). This depth may provide a range where the wave action is enough to provide oxygen, but not so strong that it dislodges the egg capsules. From in-situ observations, Navarro et al. (2018) found that market squid embryos require dissolved oxygen levels greater than 160 millimole and a pH greater than 7.8.

Squid eggs have been found significantly shallower in central California (13.0 to 61.0 m (42.7 to 200.1 ft)) than around the Channel Islands (20.0 to 93.0 m (65.6 to 305.1 ft)), in areas having a temperature of 10.0 to 12.0 °C (50 to 53.6 °F). This suggests that substrate and temperature, rather than depth, are the primary features of suitable spawning habitat (Zeidberg et al. 2011b). This temperature preference was also supported by laboratory studies that found that hatch rates are maximized when eggs are reared at temperatures between 9.0 and 14.0 °C (48.2 to 57.2 °F) (Zeidberg et al. 2011a). The upper and lower limits of viability appear to be 25 °C (77 °F) and below 7.0 °C (44.6 °F), respectively (Zeidberg et al. 2011a).

If temperature, rather than depth or substrate, is the primary determinant of suitable spawning habitat, then the amount of spawning habitat may vary from year to year, and this may impact egg survival rates. This may also explain the variability observed in the fishery, both seasonally and between years. The concentrated spawning aggregations targeted by the southern California fishery in December/January and the central California fishery in May/June, may be triggered by favorable ocean bottom temperatures (Young et al. 2011). Additionally, the year-to-year variation observed in the population and the low commercial landings seen during and after El Niño events may be due to a lack of suitable spawning habitat in warmer water years (Zeidberg et al. 2011b), a preference for deeper less accessible spawning grounds, or other unknown factors.

1.4. Ecosystem Role

Market squid are a key nearshore prey species in the CCE (Szoboszlai et al. 2015). The CCE is an eastern boundary current upwelling system off the West Coast of the United States, extending from the Strait of Juan de Fuca in the north to the Mexican border in the south. Market squid can play a fundamental role as a mid-trophic level species, in which they transfer energy up the food chain from zooplankton, crustaceans, and small fish (their prey) to large fish, marine mammals, and birds (their predators). Market squid are classified as a mid-energy taxa and are sometimes a central part of the prey assemblage in years in which the CCE experiences cooler waters, strong upwelling, and higher productivity (Harvey et al. 2018).

1.4.1. Associated Species

Several marine worms use squid as a host species. Larval nematodes (roundworms), cestodes (tapeworms) and polychaetes (bristleworms) have all 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 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. These 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). This 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 between these organisms (Zeidberg et al. 2011a).

1.4.2. Predator-prey Interactions

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 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, and reproductive status, as well as by depth and location (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.

Market Squid as Prey

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 (*Asterina 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 lineolate*), salmon, halibut,

and tuna (Figure 1-11) (Fields 1965; Morejohn et al. 1978). In fact, 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 (Tables 1-4, 1-5, and 1-6).

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.

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 lineolate*), salmon, halibut, and tuna (Figure 1-11) (Fields 1965; Morejohn et al. 1978). In fact, 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 (Tables 1-4, 1-5, and 1-6)

In terms of frequency-of-occurrence, the presence of squid 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 rhinocerous 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 lalandi*), kelp bass (*Paralabrax clathratus*), barred sand bass (*Paralabrax nebulifer*), California 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 3rdor 4th behind northern anchovy, euphausids, 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 3rdbehind 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 turbot (*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 alalonga*) (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).

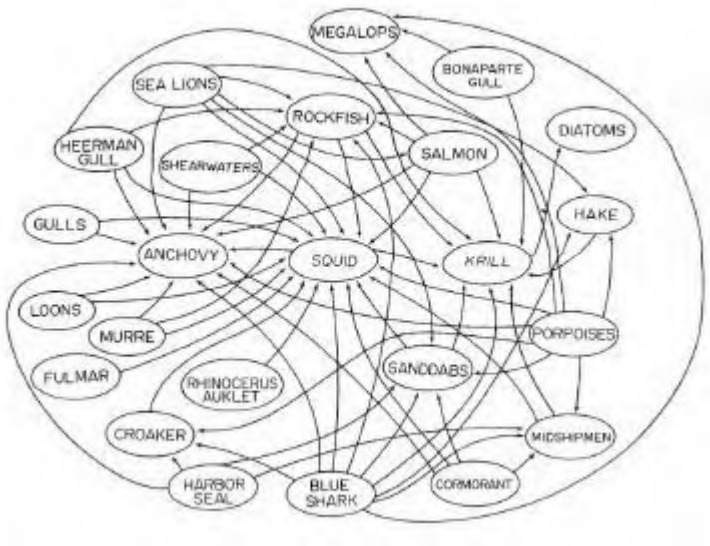


Figure 1-11. Food web for market squid involving commercially important or abundant fish, birds, and marine mammals (Reproduced from Morejohn et al. 1978).

Table 1-4. Known fish predators of CPS, including market squid (Reproduced from the MSFMP).

Common Name	***Species***	**Common Name**	***Species***
Northern anchovy	*Engraulis mordax*	Yellowtail	*Seriola dorsalis*
Pacific sardine	*Sardinops sagax*	White seabass	*Atractoscion nobilis*
Pacific whiting	*Merluccius productus*	Queenfish	*Seriphus politus*
Common thresher shark	*Alopias vulpinus*	California corbina	*Menticirrhus undulatu*
Bonito shark	*Isurus oxyrinchus*	White croaker	*Genyonemus lineatus*
Soupfin shark	*Galeorhinus zyopterus*	Surfperches (many species)	*Amphistichus* spp.
Blue shark	*Prionace galuca*	California barracuda	*Sphyraena argentea*
Pacific electric ray	*Tetronarce californica*	Pacific (chub) mackerel	*Scomber japonicus*
Silver (Coho) salmon	*Oncorhynchus kisutch*	Pacific bonito	*Sarda lineolata*
King (Chinook) salmon	*Oncorhynchus tshawytscha*	Albacore	*Thuunus alalunga*

Common Name	*Species*	Common Name	*Species*
Steelhead	*Oncorhynchus mykiss*	Bluefin tuna	*Thunnus orientalis*
Rockfish (many species)	*Sebastes* spp.	Swordfish	*Xiphias gladius*
Striped bass	*Morone saxatilis*	Striped marlin	*Kajikia audax*
Barred sand bass	*Paralabrax nebulifer*	Giant seabass	*Stereolepis gigas*
Kelp bass	*Paralabrax clathratus*	Lingcod	*Ophiodon elongatus*
Spotted sand bass	*Paralabrax maculatofasciatus*	California scorpionfish	*Scorpaena guttata*
Ocean whitefish	*Caulolatilus princeps*	Dogfish	*Squalus acanthias*
Jack mackerel	*Trachurus symmetricus*	--	

Table 1-5. Known bird predators of CPS, including market squid (Reproduced from the MSFMP).

Common Name	*Species*	Common Name	*Species*
Black-footed albatross	*Diomedia nigripes*	Black-legged kittiwake	*Rissa tridactyla*
Fulmar	*Fulmarus glacialis*	Common murre	*Uria aalge*
Sooty shearwater	*aleuticus Puffinus griseus*	Pigeon guillemot	*Cepphus columba*
	Puffinus puffinus		*Brachyramphus marmoratus*
Manx shearwater	*Puffinus tenuirostris*	Marbled murrelet	*Synthliboramphus craveri*

Common Name	*Species*	Common Name	*Species*
Short tailed shearwater	*Puffinus creatopus*	Craveri's murrelet	*Synthliboramphus scrippsi*
Pink footed shearwater	*Oceanodroma leucorhoa*	Scripps's murrelet	*Synthliboramphus hypoleucus*
Leach's storm petrel	*Oceanodroma homochroa*	Guadalupe murrelet	*Synthliboramphus antiquus*
Ashy storm petrel	*Oceanodroma melania*	Ancient murrelet	*Ptychoramphus aleuticus*
Black storm petrel	*Pelecanus occidentalis*	Cassin's auklet	*Cerorhinca monocerata*
Brown pelican	*Phalacrocorax auritus*	Rhinoceros auklet	*Fratercula corniculata*
Double-crested cormorant	*Phalacrocorax penicillatus*	Horned puffin	*Fratercula cirrhata*
Brandt's cormorant	*Phalacrocorax pelagicus*	Tufted puffin	*Haliaeetus leucocephalus*
Pelagic cormorant	*Larus glaucescens*	Bald eagle	*Pandion haliaetus*
Glaucous-winged gull	*Larus occidentalis*	Osprey	*Thalasseus elegans*
Western gull	*Larus heermanni*	Elegant tern	*Hydroprogne caspia*
Heerman's gull	*Larus delawarensis*	Caspian tern	*Sterna forsteri*
Ring-billed gull	*Larus californicus*	Forster's tern	*Sternula antillarum browni*

Table 1-6. Known mammal predators of CPS, including market squid (Reproduced from the MSFMP).

Common Name	*Species*	Common Name	*Species*

Common Name	*Species*	Common Name	*Species*
Northern fur seal	*Callorhinus ursus*	Bottlenose dolphin	*Tursiops truncatus*
Guadalupe fur seal	*Arctocephalus townsendi*	Pilot whale	*Globicephala* spp.
Steller sea lion	*Eumetopias jubatus*	Blue whale	*Balaenoptera musculus*
California sea lion	*Zalophus californianus*	Fin whale	*Balaenoptera physalus*
Northern elephant seal	*Mirounga angustirostris*	Sei whale	*Balaenoptera borealis*
Harbor seal	*Phoca vitulina*	Minke whale	*Balaenoptera acutorostrata*
Common dolphin	*Delphinus capensis*	North Pacific right whale	*Eubalaena japonica*
Harbor porpoise	*Phocoena phocoena*	Humpback whale	*Megaptera novaeangliae*
Dall's porpoise	*Phocoenoides dalli*	Eastern North Pacific gray whale	*Eschrichtius robustus*
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	--	

1.5. Effects of Changing Oceanic Conditions

The CCE is a highly variable ecosystem and is known to fluctuate significantly at annual, decadal, or longer time scales. At smaller time scales the ENSO is a short-term fluctuation between periods of cooler water, strong upwelling, and high nutrient availability and those characterized by warmer water, delayed or weak upwelling, and lower nutrient availability. Strong El Niño periods can produce considerable reductions in primary production in the CCE, which can alter the abundance and distribution of CPS such as market squid (Van Noord, 2020; Chasco et al. 2022; Suca et al. 2022).

Due to their short life span, market squid are likely very responsive to changing environmental conditions that affect juvenile survival and recruitment to the fishery. Squids and other cephalopods have high adaptive capacity and the propensity to modify their own physiology through protein-altering ribonucleic acid (RNA) editing, which could help with acclimating to variable ocean conditions and temperature changes (Voss and Rosenthal, 2023). These physiological advantages paired with a changing ocean environment may result in

shifts in suitable habitats for market squid, including an expansion or shift of fishable biomass to more northern latitudes north of Point Conception (Burford et al. 2020; Suca et al., 2022). For the southerly spawning grounds, research suggests that the larval abundance of Market Squid is lower during warmer periods (Koslow and Allen 2011). Similarly, landings of market squid in California's primary southern fishing grounds are also significantly lower during El Niño events (Zeidberg et al. 2006). The growth rate and size at maturity of market squid during warmer periods have also been found to be lower (Butler et al. 1999; Jackson and Domeier 2003; Reiss et al. 2004), and this may reduce the reproductive output of female squids (Henry et al. 2003). These lower growth rates are likely due to food limitations (Jackson and Domeier 2003). Climate change is expected to alter ENSO frequencies and duration, but the levels are still impossible to predict. The magnitude of variability in the system may increase, leading to more extreme conditions.

Climate change is also altering the physical and chemical properties of ocean water off the coast. Ocean warming, changes to the pH of ocean water via ocean acidification, and changes in the oxygen content of ocean water may expand or compress the availability of suitable habitat for market squid spawning (Zeidberg et al. 2011b; Navarro et al. 2018; Burford et al. 2022). It is hypothesized that this could lead to increasingly localized and dense spawning, resulting in potentially important changes for both the fishery and market squid ecology generally. Naturally occurring hypoxic OMZs off the coast of California have been getting shallower (Bograd et al. 2008) and could compress the depth range for adult market squid (Stewart et al. 2014).

← Species-at-a-Glance

The Fishery →

Related Links

- California Market Squid Fishery Management Plan
- California Department of Fish and Wildlife Pelagic Fisheries and Ecosystem Program
- Marine Fisheries Data Explorer
- California Department of Fish and Wildlife License Statistics
- California Wetfish Producers Association
- California Cooperative Oceanic Fisheries Investigations
- California Current Integrated Ecosystem Assessment
- National Oceanic and Atmospheric Administration List of Fisheries

Last Updated: The Market Squid Enhanced Status Report was updated in 2024.

Contact Us: To contact CDFW regarding Market Squid, please email CDFW's Marine Region or call 831-649-2870.

Citation: California Department of Fish and Wildlife. 2024 Market Squid, *Doryteuthis (Loligo) opalescens*, Enhanced Status Report.

Contributor(s): Katie Grady, Sarah Valencia, Dianna Porzio

Acknowledgement(s):

2.4. Social and Economic Factors Related to the Fishery

Collapse All

2. The Fishery

2.1. 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 §27, Title 14, California Code of Regulations (CCR), except where prohibited or restricted, as specified, in state Marine Protected Areas (MPAs) and round haul gear closure areas (FGC §8750-8757). Seasonal shifts in resource availability and timing of peak spawning has 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. Fishing effort in central California is focused around Monterey Bay and tends to occur between April and September, coinciding with the upwelling season (Figure 2-1) (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 commercial fishery was primarily focused in 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 2-1). Monterey, Ventura, and Los Angeles Counties are the principal counties where squid is offloaded and distributed (Figure 2-6). 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.

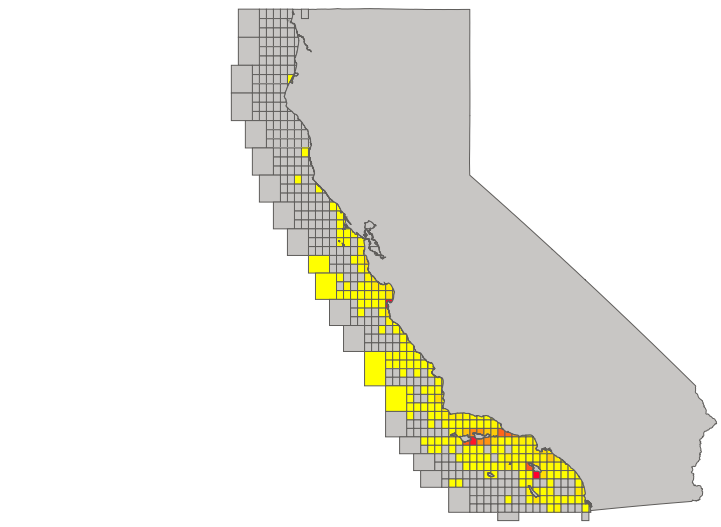


Figure 2-1. Map of California commercial market squid fishery landings (lbs) by CDFW fishing block from the 2000 to 2023 calendar year (CDFW MLDS 2024).

View Detailed Description

Block ID	Total Pounds	Total Value
100		Confidential
101	0	$0
102	0	$0
103	0	$0
104	0	$0
105	0	$0
106	0	$0
107	0	$0
108	0	$0
109		Confidential
110	0	$0
111	0	$0
112	0	$0
113	0	$0
114	0	$0
115	0	$0
116		Confidential
117	0	$0
118	0	$0
119	0	$0
Total	**4,443,990,952**	**$1,119,488,238**

2.2. Fishing Effort

2.2.1. Number of Vessels and Participants Over Time

The commercial market squid fishery operates under a restricted access program, also referred to as a limited entry program. In a limited entry fishery, the number of persons who may participate or the number of vessels that may be used in taking a specified species of fish is limited by statute or regulation (FGC §8100). Under the limited entry program of the Market Squid Fishery Management Plan (MSFMP), a permit is required to participate in the fishery. Qualification for different types of permits and transferability options were based on historical participation in the fishery. Market squid vessel permits allow a vessel to attract squid with lights and use large seine nets or brail to capture squid. Brail permits allow a vessel to attract squid with lights and use brail gear only to capture squid. Light boat permits only allow a vessel to attract squid with lights. In most cases, squid purse seine vessels work with light boats. A light boat is typically a smaller vessel with several high-powered lights located around the vessel. The light boat uses lights to aggregate squid in a small area around the boat (Figure 2-2). Once squid are aggregated, the light boat signals the seiner to deploy its net, encircling the light boat, in order to catch the squid located under the lights.

As of July 2024, there were 68 vessel permits (1 of which is non-transferable), 28 light boat permits (two of which are non-transferable), and 48 brail permits (all transferable) issued (CDFW Automated License Database System). Through permit transfers, upgrades, or attrition the number of permits issued has changed over time. When the MSFMP was implemented in 2005, there were 92 vessel permits (12 of which were non-transferable and 3 of which were experimental), 14 brail permits, and 61 light boat permits issued (CDFW 2019). Since 2005, there have been 34 upgrades from light boat to brail permits (Figure 2-3). This influx of brail permits, particularly from 2010 to 2013, was the direct result of light boat permit upgrades.

Of the 68 limited entry 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. This suggests that most brail-permitted vessels are solely acting as light boats or catching squid for sale as live bait.

As one of California's oldest fisheries, the market squid fishery began in 1863 when Chinese immigrants harvested small quantities of squid from Monterey Bay (Dickerson and Leos 1992; Fields 1965). Small skiffs were used to encircle a net around another skiff equipped with lit torches used to attract the squid (Walthers and Gillespie 2002). Italian immigrant fisherman introduced the more efficient lampara net for catching squid around 1905 (Vojkovich 1998). From 1916 to 1923, when the Department began keeping records, the fishery caught less than 1,000 short tons (tons) per year. From 1924 to 1932, landings averaged more than 2,000 tons per year. Most of this catch was dried and exported to China; some was used domestically as canned or frozen product (CDFG 2005).

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. 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. During the 1980s, California's squid fishery grew rapidly as international demand for squid increased, especially from Europe and China, due to declining squid fisheries in other parts of the world (CDFG 2001). During this time there was a shift in the fleet from mainly brail boats to larger purse seine vessels. Brailing involves a dip net sometimes using the assistance of the vessel's hydraulics. The larger vessels equipped with round-haul gear and a tender vessel more easily met the increasing demands for squid and continue to dominate today's fishery (Figure 2-2).

As squid availability fluctuates regionally throughout the season many vessels target other fisheries, typically lower-valued CPS (e.g., northern anchovy or Pacific mackerel), salmon, or tuna. When squid are readily available, fishing effort can be driven by market conditions. During "boom" years, if squid processors have full freezers or ex-vessel value drops too low, vessels may be subject to market-imposed limits and effort declines due to lower economic incentive to fish. Under current conditions there is little evidence of market-imposed limits as the international demand for market squid remains constant, though with a market preference for larger squid, buyers sometimes impose size-based limits to maintain a higher quality product (Diane Pleschner-Steele personal communication).

Figure 2-2. Vessels using seine gear, light boats, and tender vessels to target market squid during the daylight and at night (Photo Credit: CDFW).

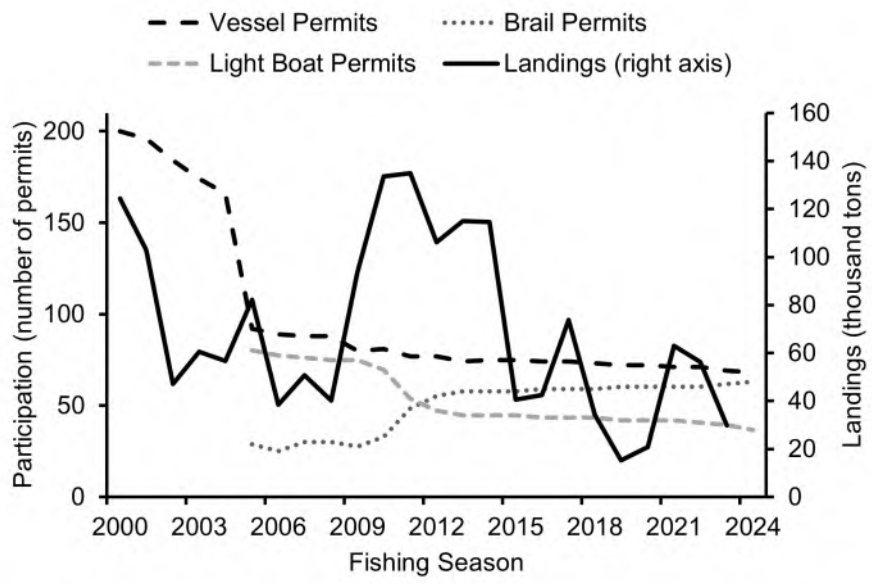


Figure 2-3. Market squid fishery participation (number of limited entry permits by type; left axis) and landings (thousand tons; right axis) from 2000 to 2023 fishing seasons (CDFW MLDS). The commercial Market Squid fishery runs on an April 1 through March 31 fishing season.

▸ View Detailed Description

2.2.2. Type, Amount, and Selectivity of Gear

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. Fishing occurs both during the day and at night. At night, light boats are used to aggregate squid to the surface. Nearly all vessels, brail boats, and light boats use side-scan sonar and fathometers (Lutz and Pendleton 2000). The purse seine, drum seine, and the less common lampara are encircling type nets (Figure 2-4). With the help of a tender vessel, the webbing of the seiner net is laid out to encircle a school of squid. When the school is surrounded, the bottom of the net may be closed, and drawn next to the boat (PFMC 2010). A purse seine net has metal rings sewn along its bottom edge and a cable is passed through the rings. When the cable is drawn tight, the net "purses." A centrifugal pump is lowered into the bagged school of squid, and water and squid are pumped through a separator and into the hold of the fishing vessel (Vojkovich 1998). With brail gear, fisherman lift the fish out of the net with netted scoops.

According to Department records during the drafting of the MSFMP, the average purse seine was 18.9 m (62.0 ft) in length with an average gross tonnage (GT) of 81 tons and an average hold capacity of 84 tons (CDFG 2005). The average light boat length was 11.8 m (39.0 ft) in length with an average GT of 19 tons (CDFG 2005). Gross tonnage 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 lampara net was the only legal form of round haul gear in the southern bight of Monterey Bay until 1989. Once the purse and drum seines were legalized for use in this district, the market squid commercial fleet switched gear types and the lampara became mostly obsolete. 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). By the early 1990s, the purse seine became the dominant gear for the entire coast, with the drum seine gaining popularity by the mid-1990s (CDFG 2005).

Figure 2-4. Vessels equipped with (A) purse seine gear (B) drum seine gear (C) lampara gear (D) brail/dip net gear (Photo Credit: CDFW).

2.3. Landings in the Recreational and Commercial Sectors

2.3.1. Recreational

Market squid is important in small volumes to the recreational fishery as either live or dead bait. The bait is caught primarily by commercial live bait haulers using seine or brail nets. There is no record of when recreational fisheries in California started using market squid as bait (CDFG 2005). This small volume of squid is a high value fishery, which supplies bait to recreational fisheries along the California coast, primarily in southern California. Live bait is sold from a harbor-based bait barge or from the catcher vessel at-sea. Sport fishing vessels and private skiffs also catch their own squid bait by using attracting lights and brail nets and/or rod and reel with jigs. Live and dead squid are ideal bait for a variety of California sport fisheries, particularly rockfish and white seabass. 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. New reporting requirements will provide data on live bait catch beginning in 2019.

There are insufficient data to accurately describe recreational fishing effort for market squid. Some operators record scooping live squid for sale as bait in market squid logbooks.

2.3.2. Commercial

The commercial fishery for market squid is routinely one of the largest in California in terms of volume and value. From 1997 to 2023, market squid represented the largest single species fishery by volume in the state for all but 4 years (yr). The fishery was also the largest by ex-vessel value for over half of those years. The 2009 to 2014 period was particularly productive, with landings and ex-vessel revenue averaging over 125,000 tons and $65 million per year, respectively (Figure 2-5). Landings in California prior to 1987 rarely exceeded 20,000 tons. In 2023 more than 52 million pounds of market squid were landed in California, generating roughly $33 million in revenue (Figure 2-5). The success of the California market squid fishery is due in large part to the role of international buyers. New markets, primarily in Europe and Asia, developed over the past three decades and were willing to pay higher prices for California squid. The vast majority of squid is now frozen for export to China, Japan, and Europe where it is mainly sold for consumption. Minor amounts are also sold fresh or canned.

The commercial fishing season for market squid lasts from April 1 through March 31 of the following year. The fishery exceeded the 118,000 ton catch limit in the 2010-2011 and 2011-2012 fishing seasons. As a precaution, the fishery was closed prior to reaching the catch limit in the following three fishing seasons:

2012-2013, 2013-2014, and 2014-2015. As part of a cooperative effort, the industry voluntarily stopped fishing for squid during both the 2013-2014 and 2014-2015 fishing seasons.

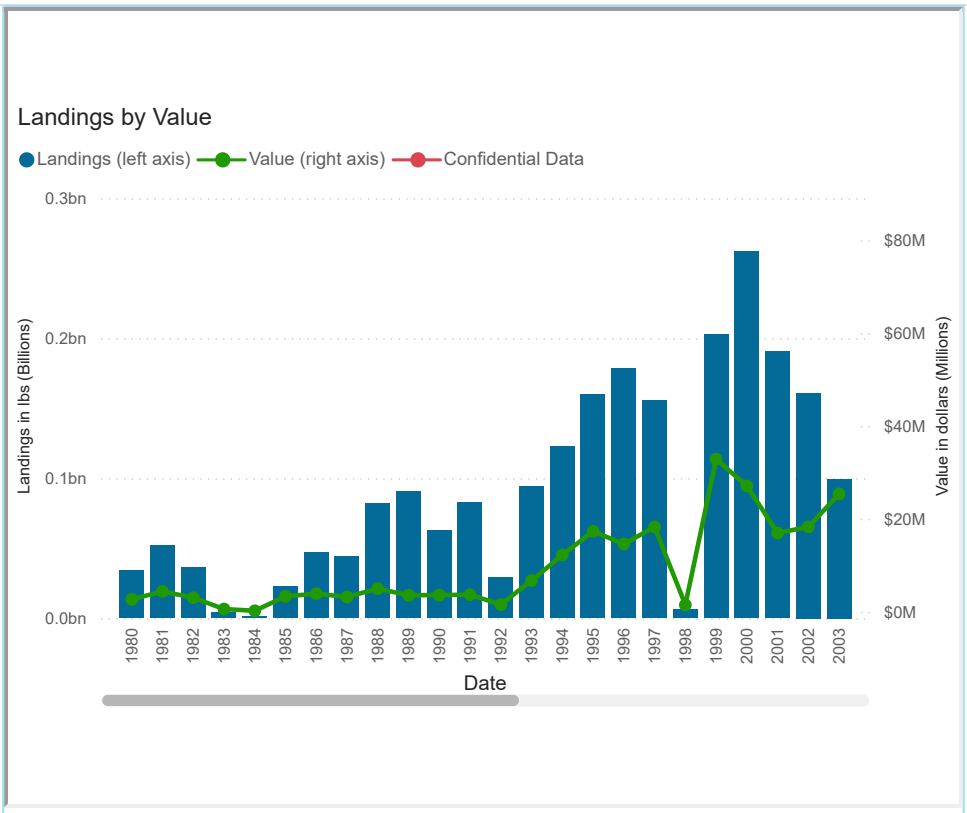


Figure 2-5. Market squid fishery landings (billion lbs) and value (million dollars) from the 1980 to 2023 calendar years (CDFW MLDS).

View Detailed Description

Year	Landings (lbs)	Value
1980	33,917,681	$2,656,171
1981	51,829,716	$4,383,650
1982	35,953,254	$3,014,499
1983	4,020,348	$581,319
1984	998,902	$202,119
1985	22,652,458	$3,314,407
1986	46,908,612	$3,887,269
1987	44,056,899	$3,182,040
1988	82,082,351	$4,973,508
1989	90,152,659	$3,547,291
1990	62,714,435	$3,584,777
1991	82,426,950	$3,676,275
1992	28,902,796	$1,532,615
1993	94,185,071	$6,730,612
1994	122,372,050	$12,214,104
1995	159,685,409	$17,317,091
1996	178,095,778	$14,587,217
1997	155,174,428	$18,269,800
1998	6,381,504	$1,475,732
1999	202,712,530	$32,854,240
Total	**4,914,233,091**	**$1,152,291,359**

2.4. Social and Economic Factors Related to the 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. There continues to be a substantial number of market squid vessels with home ports outside California likely due to declines in some of these other fisheries. Historically, there have been territorial disputes between “local” and out-of-state fisherman. Some light boats participate in other local fisheries that do not use attracting lights such as herring, hook and line, and live bait.

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 (Figure 2-6). 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, but 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 calendar year.

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.). In the early years of the limited entry access fishery, there were instances of concerted price wars where the fishing fleet would strike for a higher price (Dianna Porzio 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).

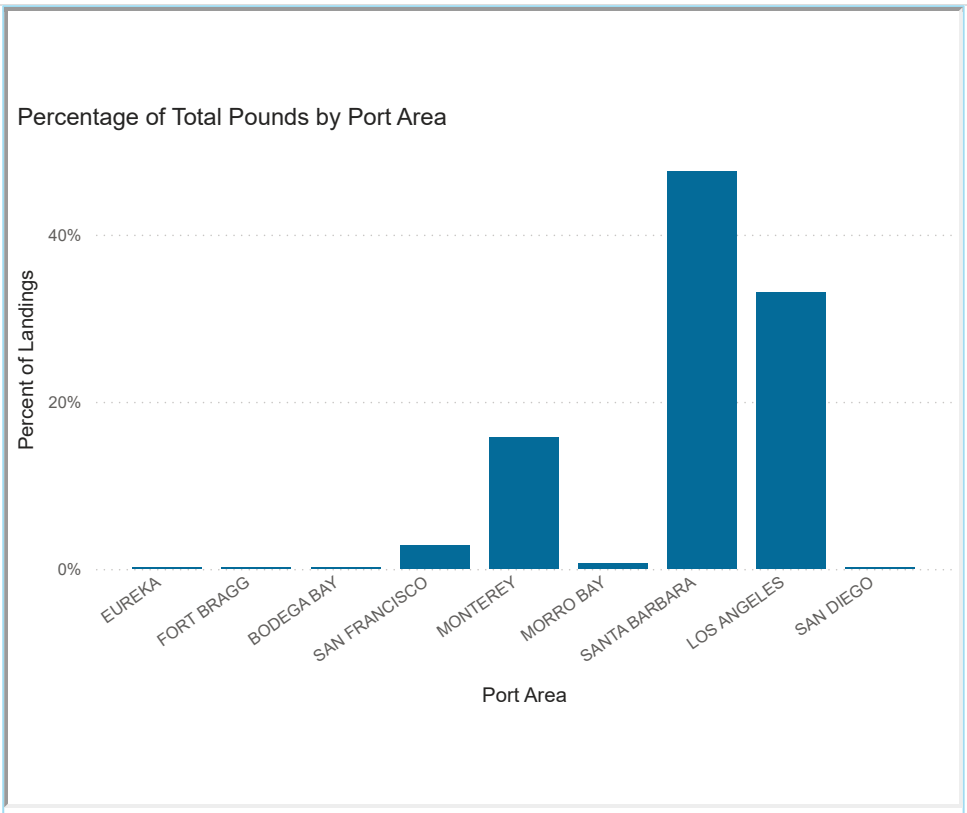


Figure 2-6. Market squid percentage (%) of total landings (by weight) by port complex from the 1980 to 2023 calendar years (CDFW MLDS).

View Detailed Description

Port Area	% Total Pounds
EUREKA	0.11%
FORT BRAGG	0.01%
BODEGA BAY	0.06%
SAN FRANCISCO	2.78%
MONTEREY	15.72%
MORRO BAY	0.61%
SANTA BARBARA	47.61%
LOS ANGELES	33.08%
SAN DIEGO	0.02%
Total	**100.00%**

← The Species

Management →

Related Links

3. Management

3.1. Past and Current Management

To describe management measures clearly, summaries of regulatory and statutory language are provided below. Information on current fishing regulations is available on our commercial regulations web page and ocean sport fishing web page. For the full text of all applicable laws and regulations, please refer directly to the relevant sections of the California Fish and Game Code and/or Title 14 of the California Code of Regulations.

The market squid fishery was primarily an open-access fishery prior to 1998. Concern over growing harvest rates and a rapid increase in the number of vessels entering the fishery prompted the implementation of industry sponsored legislation in 1997. The following year, the Legislature passed Senate Bill (SB) 364 (Sher), which was incorporated into Fish and Game Code (FGC) §8420-8429.7. The Legislature deemed it necessary to adopt and implement fishery management measures that sustain both the squid population and marine life that depends on squid. SB 364 required the purchase of an annual permit to land or to attract squid by using light for purposes of commercial harvest. It also placed a moratorium on the number of vessels in the fishery, established a permit for market squid vessels and light boats, and initiated a 3-year study to assess conservation and management of the fishery (CDFG 2005). During this study, researchers and the Department explored several science-based methods for developing fishery management strategies but determined that traditional assessment methods used to estimate biomass were not applicable to market squid.

In April 2001, the Department, in collaboration with scientists and stakeholders, submitted a status report with recommendations for market squid conservation and a future management plan (CDFG 2001). During this time, the Legislature delegated management authority for the squid fishery to the Commission and required the adoption of the MSFMP. The goals of the MSFMP as dictated by the MLMA are: (1) to manage the market squid resource to ensure long term resource conservation and sustainability; and (2) to develop a framework for management that will be responsive to environmental and socioeconomic change (CDFG 2005). The initial analysis and design phases for the MSFMP began in January 2001 with contributions from the Department, NOAA, university researchers, and industry representatives. Since its completion in 2005, the MSFMP has remained the primary management tool for the market squid fishery as directed by §149, Title 14, CCR (Table 3-1.).

Market squid is also included under federal management through the CPS FMP implemented in 2001, though management in the CPS FMP is delegated to the State. The CPS fishery includes market squid and four finfish species (Pacific sardine, Pacific mackerel, northern anchovy, and jack mackerel) as a fishery management unit. CPS finfish are pelagic because they generally occur or are harvested above the thermocline in the upper mixed layer (PFMC 2023a). Market squid are included in this complex because they are similarly fished as aggregations. The CPS FMP required that Maximum Sustainable Yield (MSY) be established for all species in

the plan (CDFG 2005). Setting MSY for market squid has proven problematic because an accurate biomass has yet to be determined. Hence, the Pacific Fishery Management Council (PFMC) approved the use of egg escapement as a proxy for MSY for the market squid fishery. Details of this method are summarized below and described in section 4.1 of the MSFMP. The CPS FMP requires Status Determination Criteria and management reference points (e.g., Acceptable Biological Catch (ABC) and Annual Catch Limit (ACLs)) for all fishery management unit species. Market squid are exempt from ACL requirements because their life cycle is less than 1 year.

Table 3-1. Summary of market squid regulations from 1959 to 2023 (Reproduced and updated from Table 2-13 in the MSFMP 2005). All information included in this table is summarized and not to be considered explicit language for each regulation.

Date	Bill # (Author) or Title 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.
1984	§149, Title 14, CCR	The Commission adds CCR Title 14 §149, to prohibit any vessel, using or possessing a roundhaul net in Districts 16 and 17, from taking Market Squid between noon Friday and midnight Sunday and between noon and midnight on any Monday through Thursday.
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 District 16, subject to the same area and season restrictions previously in effect for lampara nets.
1993	AB 14 (Houser)	Restricts the use of attracting lights in District 10.
1993	SB 1030 (Thompson)	A landing tax of $0.0019/pound (lb) is imposed.

Date	Bill # (Author) or Title Section	Management Action
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 light boat owner's permit. Allows for transfer of vessel or light boat owner's permits under certain conditions. A 3-yr 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 tax 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)	MLMA passes.
2000	§149, Title 14, CCR	Amendment – Prohibits commercial take of Market Squid between noon on Friday and noon on Sunday from Pt. Conception south to the US-Mexico border. Requires commercial squid vessels and light boats to maintain logbooks detailing fishing/lighting activities.
2000	§149, Title 14, CCR	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 January 1, 2004. Extends existing duties imposed on the Department and the Commission and makes an appropriation.

Date	Bill # (Author) or Title Section	Management Action
2001	SB 209 (Sher)	Requires the Commission to adopt the MSFMP by 31 Dec 2002, after consideration and public hearings. Requires the Commission to establish fees for commercial Market Squid vessel permits and commercial squid light boat owner's permits annually commencing April 1, 2003. Prohibits each person who is issued a commercial squid light boat owner's 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 a MSFMP and the adoption of implementing regulations and will be repealed 6 months thereafter.
2001	§149, Title 14, CCR	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	§159, Title 14, CCR	Market Squid is included under Commercial Fishing for CPS.
2003	§1.39, Title 14, CCR	Market Squid is included in CPS under General Provisions and Definitions.
2004	§149, Title 14, CCR	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.
2004	§149, Title 14, CCR	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.
2004	§149, Title 14, CCR	Prohibits take of Market Squid for commercial purposes using attracting lights in all waters of the Gulf of the Farallones National Marine Sanctuary. This regulation also applies to vessels pursuing squid for live bait purposes.
2004	§149, Title 14, CCR	Requires any operator of a commercial Market Squid vessel or permit holder of a 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.

Date	Bill # (Author) or Title Section	Management Action
2004	§149, Title 14, CCR	Prohibits attracting squid by light except as authorized by RA 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.
2004	§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.
2004	§149, Title 14, CCR	Prohibits the take of live bait for purposes other than use as live bait or sale as live bait.
2005	§149.1, Title 14, CCR	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.
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.

3.1.1. Overview and Rationale for the Current Management Framework

The MSFMP was designed to allow the Commission to make changes to regulations without the need for a full amendment to the FMP and provides the Commission specific guidelines for making management decisions. The MSFMP framework structure is consistent with management of market squid by the PFMC outlined in the CPS FMP. To meet the standards of the MLMA for adaptive management, the MSFMP establishes a hierarchical framework within which adjustments to the management of the market squid fishery can be made in a responsible and timely manner. The Commission may take four general types of actions within the framework of the MSFMP: (1) FMP amendment, (2) full rulemaking, (3) notice action, and (4) prescribed action. A Full Rulemaking process, pursuant to the Administrative Procedures Act, is required for any changes to management measures that are discretionary in nature. This typically requires at least three Commission meetings. The first meeting includes commission review of the issues and publication of a notice for public comment with the intent to adopt regulations at a later meeting. At the second meeting, the Commission reviews the proposed measures and alternatives in detail and receives public comments. At the third meeting, the commission adopts the final rules and submits this to the Office of Administrative Law for procedural review prior to publication and implementation.

The market squid fishery operates through a limited entry program that includes provisions for initial entry into the fleet, types of permits, permit fees, and the potential for permit transferability. The intent of restricting access to the fishery for the market squid resource was to balance the need for viable economic harvest with the need to protect the squid resource. Additional fishery control rules were established to promote a more sustainable fishery, prevent overfishing, provide a protocol for managing market squid fishing, and reduce impacts to seabirds. These include a seasonal-catch limit to prevent the fishery from over-expanding; weekend closures to provide for periods of uninterrupted spawning; gear regulations regarding light shields and wattage; monitoring programs designed to evaluate the impact of the fishery on the resource; and establishment of a seabird closure restriction the use of attracting lights for commercial purposes in any water of the Gulf of the Farallones National Marine Sanctuary (§149, Title 14, CCR). Setting a seasonal-catch limitation was intended to curtail growth of the fishery should market demand allow for such expansion. Catch trends indicate that the market squid resource is quite robust and able to sustain historic catch levels (CDFG 2005). Since the implementation of the MSFMP, additional spatial closures have been established through the Marine Life Protection Act (MLPA) process of developing an MPA network (see section 3.1.2.1.8).

An MSY model is often used to determine catch limits, but a proxy or substitute for MSY may be used where scientific information is inadequate. Due to a lack of adequate data to make a mathematical MSY determination, the MSFMP uses a proxy for MSY based on historical landings. This guidance was taken from NOAA Fisheries (Restrepo et al. 1998). Restrepo et al. (1998) proposed that in data-poor situations, such as the market squid fishery, it is reasonable to use historical average catch from a period when there is no qualitative or quantitative evidence of declining abundance. Using this methodology, the Commission established a statewide seasonal catch limit of 118,000 tons using a 3-year average catch from the 1999-2000 to 2001-2002 fishing seasons (CDFG 2005). 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 this level of landings (CDFG 2005).

This approach assumes that the stock is above the average spawning biomass to sustain MSY and uses a multiplier of 1.0. A multiplier of 1.0 was chosen to be most appropriate for market squid as opposed to more precautionary Optimum Yield (OY) multipliers due to its short lifespan. This approach to risk management reduces the chance of inadvertent overfishing when little is known about the status of the stock (CDFG 2005). Because exploitation rates are strongly influenced by availability, market demand, and processing capacity, standardized catch-effort data are not reliable proxies for market squid population abundance (Dorval et al. 2013).

3.1.1.1. Criteria to Identify When Fisheries Are Overfished or Subject to Overfishing, and Measures to Rebuild

Because no biomass estimate exists for market squid, it is not possible to define an overfished condition for this species. Setting a mathematical MSY for market squid is impractical for the squid fishery because biological data are inadequate, and landings are strongly influenced by availability and market demand rather than effort. Overfishing is defined as harvest of squid occurring at a time when either the egg escapement threshold is not being met, or when catches are exceeding specified allowable levels and that these catches may not be sustainable (CDFG 2005).

Consequently, the egg escapement method is used as a proxy for MSY/OY. 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 2023a).

The egg escapement approach can be used to evaluate the effects of fishing mortality on the spawning potential of the stock, and to examine the relation between the stock's reproductive output and candidate proxies for the fishing mortality that results in MSY (F_{MSY}). The egg escapement model is not used as a real-time tool for management, but rather a method of assessing the effectiveness of management, which is an appropriate use in regard to the accuracy of the model (Emmanis Dorval pers. comm).

This threshold is currently set to a level of egg escapement of at least 30%. Therefore, the Overfishing Fishing Limit and ABC for market squid are a F_{MSY} proxy resulting in egg escapement ≥ 30% (Table 3-2). 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).

Table 3-2. Summary of statewide market squid proportional egg escapement from the 2014-2015 to 2023-2024 fishing seasons. Means are computed across three regions and weighted based on the number of samples collected per region across four quarters (Section 1.2.1). Fishing mortality rates are based on a natural mortality of 0.15 and a constant egg laying rate of 0.45 (Dorval et al. 2013). An "*" indicates that sampling was impacted by the COVID-19 pandemic and/or staffing shortages, and thus statewide mean proportional egg escapement could not be computed adequately. Former results were modified due to additional data cleaning (Dorval et al. 2024).

Fishing Season	Number of Samples	Proportion of Vessel Landings Sampled	Mean Proportional Egg Escapement
2014 - 2015	94	0.026	0.302
2015 - 2016	97	0.066	0.320
2016 - 2017	52	0.020	0.266
2017 - 2018	134	0.035	0.223
2018 - 2019	130	0.062	0.359
2019 - 2020	72	0.050	0.449
2020 - 2021	*67	*0.032	*0.196
2021 - 2022	121	0.034	0.292
2022 - 2023	*46	*0.018	*0.238
2023 - 2024	71	0.04	0.310

Summary of statewide market squid proportional egg escapement from the 2014-2015 to 2022-2023 fishing seasons.

3.1.1.2. Past and Current Stakeholder Involvement

The Department's initial status report, submitted in 2001, was developed through cooperative efforts of scientists, fishing industry representatives, and stakeholders (CDFG 2001). As part of this process, The Squid Fishery Advisory Committee (SFAC), made up of resource stakeholders, and a Squid Research Scientific Committee (SRSC), consisting of many of the world's leading squid fishery scientists, were established to advise the Department Director (Director) on recommendations for squid conservation and management and to provide input on the development of research protocols. These committees were disbanded after the final MSFMP was implemented.

In 2004, the non-profit CWPA was established with the mission to "(1) protect and maintain access to wetfish resources in California; (2) promote sustainable production of wetfish resources, with a focus on supporting collaborative research, and (3) facilitate communication within and outside California's wetfish industry (CWPA 2019)." The CWPA Board of Directors consists of processors, vessel owners, and vessel operators. Some of these individuals act as representatives on the CPS Advisory Subpanel to the PFMC. CWPA has partnered with the SWFSC and the Department on multiple research projects including, but not limited to, chartering vessels to tow bongo nets near spawning grounds to collect paralarvae and mapping local squid concentrations in relation to environmental indices.

3.1.2. Target Species

3.1.2.1. Limitations on Fishing for Target Species

3.1.2.1.1. Catch

The seasonal-catch limit for market squid is 118,000 tons. The squid fishery runs year-round on an April 1 through March 31 fishing season. The Department actively tracks landings for the fishery to determine if and when the seasonal-catch limit will be reached. Effective closure dates are publicly announced by the United States Coast Guard on very high frequency radio channel 16 between the hours of 2200 and 2400 (midnight). When the seasonal-catch limit has been reached and 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. The incidental allowance is restricted to 2 tons per trip and 10% of the total volume by weight of all fish landed or possessed on a vessel (§149, Title 14, CCR). market squid will school with CPS finfish and mixed landings are fairly common. An incidental allowance following a seasonal closure prevents squid and target species from being discarded under these circumstances.

3.1.2.1.2. Effort

Limiting entry to the commercial fishery is the major effort restriction. This includes provisions for initial entry into the fleet, types of permits, permit fees, and permit transferability. Prior to 2014, vessels landing less than 2 tons of squid on a per trip basis were not required to possess a limited entry market squid permit. This directed allowance was removed in 2014 to prevent directed fishing without a market squid permit and continued fishing after the fishing season was closed (§149, Title 14, CCR). Landing of market squid beyond the jurisdiction of the state of California is not affected by limited entry access requirements. Recreational fishing for market squid does not require a limited entry permit, nor does fishing for squid for use as live bait.

A weekend closure prevents fishing activity from occurring from noon on Friday to noon on Sunday. There are no additional restrictions on number of trips, tonnage per trip, or days at-sea, other than those self-imposed by markets.

3.1.2.1.3. Gear

Major gear regulations control the use of lights in the market squid commercial fishery. Regulations require that each vessel fishing for squid or lighting for squid will use a maximum of 30,000 watts at any time (§149, Title 14, CCR). As part of these restrictions, each vessel must reduce the light scatter of its fishing operations by shielding the entire filament of each light used to attract squid. The illumination must also orient directly downward, and the lower edges of shields are required to be parallel to the deck of the vessel.

3.1.2.1.4. Time

The sole time restriction for the market squid commercial fishery is a weekend closure. Market squid may not be taken for commercial purposes from 1200 hours (noon) Friday to 1200 hours (noon) Sunday of each week (§149, Title 14, CCR). This extends from the U.S.-Mexico border to the California-Oregon border. The weekend closure allows for 2 days of uninterrupted spawning in areas where squid are being harvested. This provides protection to the resource by allowing spawning and ensuring egg cases are deposited without disturbance from the fishery. The use of attracting lights for commercial harvest is also prohibited on weekends. This measure spreads the spawning escapement throughout the year, unlike a seasonal quota or closure. Prohibiting fishing activity on the weekends was also intended to alleviate conflict with other interest groups (e.g., divers, recreational fishermen, or commercial passenger fishing vessels) operating in the same area (CDFG 2005).

3.1.2.1.5. Sex

There are no limitations on the sex of market squid taken commercially or recreationally.

3.1.2.1.6. Size

There are no size restrictions on market squid taken commercially or recreationally.

3.1.2.1.7. Area

Squid may not be taken using attracting lights in all waters of the Gulf of the Farallones National Marine Sanctuary at any time. This restriction was established in 2004 and designed to protect not only seabirds that breed and rear on the Farallon Islands, but also protect a large forage area (3,250 square kilometers (km^2) (1,255 square miles (mi^2) in the waters surrounding the islands from light disturbance and interactions with squid vessels.

Additionally, there are area restrictions for round haul vessels, those that employ the use of purse seine, drum seine, and lampara net gear to commercially harvest squid. In the inland waters of Districts 1, 2, and 3 which encompass much of the land mass of California, round haul nets may not be possessed on any boat except in that part of District 3 lying within the boundaries of the Moss Landing Harbor District, where round haul or any other type of nets may be possessed on any boat, and except in that part of District 2 lying within Marin County (FGC §8751).

Purse and round haul nets may not be used at any time from June 1 to September 10 each year, in that portion of District 20 from a line extending 3 nautical mi east magnetically from the extreme easterly end of Santa Catalina Island southerly to a line extending 3 nautical mi southeasterly magnetically from the United States government light on the southeasterly end of Santa Catalina Island (FGC §8755). District 20 encompasses Santa Catalina Island and the portion of state waters within 3 nautical mi of the island's coastline on the northerly, easterly, and southerly side of the island, lying between a line extending 3 nautical mi west magnetically from the extreme westerly end of Santa Catalina Island to a line extending 3 nautical mi southwest magnetically from the most southerly promontory of China Point (FGC §11030). These regulations exclude fishing for use or sale of squid for live bait, though in Districts 19A and 19B, round haul nets may not be used within 750.0 ft (228.6 m) of any public pier (FGC §8757). District 19A includes ocean water and tidelands to highwater mark between Malibu Point and Rocky Point (Palos Verdes Pt.), excluding all rivers, streams, and lagoons (FGC §11028). District 19B includes ocean waters and tidelands northerly of the following line: beginning at the west end of the San Pedro Breakwater, thence in an extended line following the axis of the San Pedro, the middle, and Long Beach breakwaters to the east end of the latter, then to the outer end of the west jetty of Anaheim Bay (FGC §11029).

3.1.2.1.8. Marine Protected Areas

Pursuant to the mandates of the Marine Life Protection Act (Fish and Game Code (FGC) §2850), the Department redesigned and expanded a network of regional MPAs in state waters from 2004 to 2012. The resulting network increased total MPA coverage from 2.7% to 16.1% of state waters. Along with the MPAs created in 2002 for waters surrounding the Santa Barbara Channel Islands, California now has a statewide scientifically-based, ecologically-connected network of 124 MPAs. The MPAs contain a wide variety of habitats and depth ranges.

MPAs function as areas of uninterrupted spawning for market squid and as forage reserves for the many species that consume market squid. When designing the current MPA Network, the Department and advisory bodies considered both squid spawning habitat and historic ecological reserves where squid spawning was known to occur. Approximately 13% of documented market squid spawning grounds (e.g., soft bottom or unknown habitat up to 100 m (328.1 ft) deep (Zeidberg et al. 2011b)) in California are now within no-take MPAs (CDFW unpublished data). This habitat estimate is singularly based on bathymetry models and does not consider other environmental factors related to EFH for market squid such as temperature ranges documented by Zeidberg et al. 2011b. The relative contribution of these MPAs to market squid spawning success and recruitment is not known (Van Diggelen 2017).

In addition to the no-take MPAs, limited take State Marine Conservation Areas (SMCAs) also protect squid. Fishing for squid using round haul net is allowed in the Bodega Head SMCA, the Pillar Point State SMCA, Point Dume SMCA, Abalone Cove SMCA, Farnsworth Offshore SMCA, and Dana Point SMCA, but not more than 5% by weight of any commercial pelagic finfish or market squid catch landed or possessed shall be other incidentally taken species in this SMCA (§632, Title 14, CCR). In the Point Dume SMCA, Abalone Cove SMCA, Farnsworth Offshore SMCA, and Dana Point SMCA, specifically, commercial take with brail gear and light boat is also allowed (§632, Title 14, CCR).

3.1.2.2. Description of and Rationale for Any Restricted Access Approach

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 vessel 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 (CDFG 2005). At the time of its conception, the limited entry program for the market squid fishery was widely supported by most members of the SRSC, the SFAC, and other squid fishing industry and conservation groups, with some processors and fisherman in opposition.

As directed under the MSFMP limited entry program, the Commission adopted a vessel-based capacity goal of 55 market squid vessel permits, 34 light boat permits, and 18 market squid brail permits, with the intent for non-transferable permits to decline through attrition. The fleet size at this time was 165 squid vessels and 40 light boats. The MSFMP defines the fleet capacity goal as an optimal number of vessels where the number of vessels matches the available squid resource (CDFG 2005). 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 yr 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 (CDFG 2005).

3.1.3. Bycatch

3.1.3.1. Amount and Type of Bycatch (Including Discards)

Bycatch is defined as "fish or other marine life that are taken in a fishery but which are not the target of the fishery" (FGC §90.5). Bycatch includes "discards," defined as "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 not to be retained" (FGC §91). The bycatch also may include species that, while not the target, are desirable and thus are retained as incidental catch. The term "Bycatch" does not always imply a negative impact.

Bycatch is minimal in the commercial market squid fishery, although it cannot be avoided entirely (Table 3-2). Salmon (*Oncorhynchus* spp.), steelhead (*Oncorhynchus mykiss*), striped bass (*Morone saxatilis*), or American shad (*Alosa sapidissima*) may not be taken with purse or round haul nets (FGC §8756). It is also unlawful to use any purse seine or round haul net to take yellowtail, barracuda, or white seabass (FGC §8623). Pacific bonito may not be smaller than 24 in (61 centimeters (cm)) fork length or five pounds (lb) by weight except that round haul loads may contain 18% or less by number of Pacific bonito smaller than the minimum size (FGC §8377).

There have been very few interactions identified between the California market squid fishery and threatened or endangered marine species of birds and mammals (Table 3-2). The market squid fishery is classified as a Marine Mammal Protection Act Category III fishery in terms of impact on marine mammal stocks. This means annual mortality and serious injury of a stock in a given fishery 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 3-3). 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 3-3). 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).

Table 3-3. Preliminary catch summary for vessels targeting market squid from NMFS-SWR CPS pilot observer program including live, dead, and unknown bycatch, 2004 to 2008 (Reproduced from PFMC 2011).

Species	Target Catch	Incidental Catch	Live	Dead	Unknown
Squid	**1274 mt**	**--**	**28 mt**	**350 lbs**	**2 mt**
Anchovy	--	100 lbs	120 lbs	--	--
Jack Mackerel	--	2 mt	18 lbs	2 lbs	--
Pacific Mackerel	--	20 mt	20 mt	180 lbs	1 lb
Sardine	--	12 mt	13 mt	1077 lbs	3 lbs
Spanish Mackerel	--	20 lbs	--	--	--
Bat Ray	--	--	53	--	1
Bat Star	--	--	1	--	--
Blue Shark	--	--	2	--	--
Common Mola	--	--	1	--	--
Pelagic Stingray	--	--	60	--	--
Pacific Butterfish	--	19	--	--	1
Sunstar	--	30	4	--	--

Species	Target Catch	Incidental Catch	Live	Dead	Unknown
Squid Eggs	--	--		--	505 lbs
Lobster	--	--	3	--	--
Brittle Star	--	--	--	3000	--
Unid. Batfish	--	--	--	2 lbs	--
Unid. Crab	--	1	1	--	93
Unid. Croaker	--	3	2	16 lbs	
Unid. Flatfish	--	1	1	6	2
Unid. Jellyfish	--	4	--	--	--
Unid. Mackerel	--	2 lbs	102 lbs	--	--
Unid. Octopus	--	1	--	--	--
Unid. Rockfish	--	1	1	4	--
Unid. Ray	--	--	4	--	1
Unid. Sanddab	--	4	3	--	4
Unid. Sea star	--	1	--	--	--
Unid. Sea slug	--	--	--	--	21
Unid. Scorpionfish	--	1	--	--	--
Unid. Surfperch	--	--	--	3	--
Unid. Skate	--	3	--	1	--
Unid. Smelt	--	49	--	--	--
Unid. Stingray	--	9	17	--	--

Species	Target Catch	Incidental Catch	Live	Dead	Unknown
Unid. Shark	--	--	--	--	1
Thresher Shark	--	1	--	--	--
CA Sea Lion	--	--	98	--	--
Harbor Seal	--	--	3	--	--
Common Dolphin	--	--	--	1	--
Unid. Gull	--	--	16		

Table 3-4. 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. A "-" indicates that no individuals of that species were observed during that year. An "*" indicates data a currently under review (CDFW Market Squid Port Sampling Database).

Category and Common Name	*Scientific name*	2019	2020	2021	2022	2023
Finfish Anchovy, northern	*Engraulis mordax*	25.00	31.33	31.43	19.51	8.06
Barracuda, California	*Sphyraena argentea*	2.78	2.41	1.43	0.81	-
Bass, kelp	*Paralabrax clathratus*	1.85	1.20	0.71	-	1.61
Blacksmith	*Chromis punctipinnis*	-	-	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	6.00	5.70	6.50	-

Category and Common Name	*Scientific name*	2019	2020	2021	2022	2023
Fish, unspecified	--	-	1.20	7.10	1.60	1.60
Flatfish, unspecified	--	17.59	14.50	13.60	8.10	4.80
Flying fish, California	*Cheilopogon pinnatibarbatus californicus*	0.93	-	1.40	5.70	3.20
Halfmoon	*Medialuna californiensis*	-	2.40	0.70	-	6.50
Halibut, California	*Paralichthys californicus*	7.41	4.80	2.10	10.60	1.60
Herring, Pacific	*Clupea pallasii*	1.85	-	2.10	1.60	-
Herring, red-eye round	*Etrumeus teres*	11.11	1.20	2.90	4.10	4.80
Jacksmelt	*Atherinopsis californiensis*	18.52	37.4	30.00	24.40	16.00
Mackerel, jack	*Trachurus symmetricus*	47.22	33.70	27.90	49.60	37.10
Mackerel, Pacific (chub)	*Scomber japonicus*	52.78	48.20	21.40	53.70	58.10
Midshipman, unspecified	*Porichthys spp.*	2.78	-	-	1.60	1.60
Midshipman, plainfin	*Porichthys notatus*	3.70	14.50	11.40	6.50	-
Midshipman, specklefin	*Porichthys myriaster*	-	-	2.10	1.60	1.60
Pacific sardine	*Sardinops sagax*	74.07	71.10	58.60	67.50	54.80
Rockfish, unspecified	*Sebastes spp.*	2.78	1.20	3.60	3.30	1.60

Category and Common Name	*Scientific name*	2019	2020	2021	2022	2023
Rockfish, bocaccio	*Sebastes paucispinis*	0.93	3.60	2.10	1.60	-
Sablefish	*Anoplopoma fimbria*	-	1.20	0.70	4.90	-
Salmon, Chinook	*Oncorhynchus tshawytscha*	1.85	6.00	0.70	-	-
Sanddab, unspecified	*Citharichthys spp.*	6.48	1.20	3.60	3.30	-
Sanddab, longfin	*Citharichthys xanthostigma*	0.93	1.20	-	-	1.60
Sanddab, Pacific	*Citharichthys sordidus*	11.11	27.70	27.10	21.10	1.60
Sanddab, speckled	*Citharichthys stigmaeus*	4.63	3.60	4.30	4.90	1.60
Scorpionfish, California	*Scorpaena guttata*	9.26	9.60	2.90	16.30	17.70
Sculpin, staghorn	*Leptocottus armatus*	-	1.20	1.40	3.30	-
Smelt, night	*Spirinchus starksi*	-	3.60	2.10	-	-
Sole, English	*Pleuronectes vetulus*	4.63	6.00	7.90	8.90	-
Sole, sand	*Psettichthys melanostictus*	1.85	1.20	2.10	6.50	-
Sunfish, ocean	*Mola mola*	-	3.60	0.70	4.90	-
Topsmelt	*Atherinops affinis*	1.85	4.80	0.70	0.80	-
Turbot, unspecified	*Pleuronectidae*	1.85	-	2.10	1.60	-

Category and Common Name	*Scientific name*	2019	2020	2021	2022	2023
Turbot, hornyhead	*Pleuronichthys verticalis*	3.70	9.60	8.60	8.90	1.60
Wrasse, rock	*Halichoeres semicinctus*	-	-	-	0.80	1.60
Elasmobranchs Ray, bat	*Myliobatis californica*	3.70	-	2.90	10.60	9.70
Ray, Pacific electric	*Tetronarce californica*	8.33	13.30	9.30	8.90	-
Shark, horn	*Heterodontus francisci*	6.48	-	2.10	2.40	-
Skate, big	*Raja binoculata*	2.78	6.00	-	3.30	-
Skate, California	*Raja inornata*	2.78	1.20	1.40	0.80	-
Skate, unspecified	*Rajidae*	-	1.20	2.10	0.80	1.60
Stingray	*Dasyatidae*	0.93	1.20	2.10	-	-
Invertebrates Anemones, unspecified	*Anthozoa*	-	3.60	0.70	0.80	-
Crab, unspecified	*Cancer spp.*	6.48	12.10	7.90	7.30	3.20
Crab, claws	*Cancer spp.*	2.78	2.40	5.00	2.40	-
Crab, decorator	*Bivalvia*	0.93	2.40	-	0.80	-
Crab, Dungeness	*Metacarcinus magister*	5.56	9.60	17.10	7.30	-
Crab, red rock	*Cancer productus*	5.56	3.60	5.70	4.10	-
Crab, rock unspecified	*Cancer spp.*	0.93	2.40	1.40	2.40	-

Category and Common Name	*Scientific name*	2019	2020	2021	2022	2023
Crab, shells	--	8.33	15.70	12.10	8.90	-
Crab, swimming unspecified	--	12.04	7.20	2.10	0.80	-
Jellyfish, unspecified	*Hydrozoa*	35.19	49.4	37.9	26.80	9.70
Lobster, California spiny	*Panulirus interruptus*	1.85	6.0	0.70	1.60	1.60
Mussel, unspecified	*Mytilus spp.*	6.48	1.20	2.10	0.80	6.50
Octopus, unspecified	*Octopus spp.*	2.78	2.40	1.40	0.80	-
Prawn, spot	*Pandalus platyceros*	0.93	1.20	4.30	1.60	-
Pyrosome	*Pyrosoma atlanticum*	27.78	31.3	16.4	28.50	24.2
Salps	--	6.48	3.60	4.30	4.90	8.10
Sand dollar	*Dendraster excentricus*	0.93	1.20	1.40	-	-
Sea cucumber, unspecified	*Holothuroidea*	1.85	3.60	2.90	3.30	1.60
Shrimp, target	*Sicyonia penicillata*	3.7	7.20	2.10	4.10	6.50
Squid egg cases	--	31.48	45.80	30.00	35.00	*
Marine Plants	*Phycophyta*	21.30				
Algae, marine			13.30	20.00	9.80	9.70
Eelgrass	*Zostera spp.*	3.70	2.40	2.90	5.70	1.60
Kelp, unspecified	*Laminariales*	60.19	73.50	35.70	62.60	56.50

Category and Common Name	*Scientific name*	2019	2020	2021	2022	2023
Kelp, feather boa	*Egregia menziesii*	7.41	6.00	6.40	7.30	1.60
Kelp, giant	*Macrocystis pyrifera*	11.11	4.80	22.90	4.10	6.50
Surfgrass	*Phyllospadix spp.*	35.19	57.80	34.30	22.00	4.80

3.1.3.2. Assessment of Sustainability and Measures to Reduce Unacceptable Levels of Bycatch

Round-haul fishing seldom results in unintentionally caught fish, primarily because the vessels target specific single-species schools (PFMC 2010). Incidental catch in the CPS fishery is primarily other CPS (e.g., Pacific mackerel, Pacific sardine, or northern anchovy). If larger fish are in the net, they can be released alive before pumping or brailing by lowering a section of the cork-line or by using a dip net. Grates can be used to sort larger non-CPS from the catch (PFMC 2023b). The load is pumped out of the hold at the dock, where the catch is weighed and incidentally caught fish can be observed and sorted. Because pumping at-sea is so common, any incidental catch of small fish would not be sorted at-sea (PFMC 2023b). Most bycatch is caught when round haul nets fish in shallow water over rocky bottom (PFMC 2010). Operators try to avoid this to protect gear. Also, they may be specifically prohibited to fish these areas because of closures.

3.1.4. Habitat

3.1.4.1. Description Of Threats

During the implementation of the MSFMP, there was concern over the use of chains as a seine weight in the commercial fishery. Chains had the potential of digging deeper into the ocean floor than the suggested alternatives, such as small diameter cables. The squid fleet has moved away from the use of chains and now uses weighted lines. Net bottoms and weighted lines may also scrape the ocean floor and do harm to squid egg beds. Purse seines used for squid typically do not hang as deep as purse seines used for other species, so contact with the bottom is potentially reduced.

The extent to which market squid egg beds or soft bottom habitat are disturbed by non-directed commercial fishing gears is not known at this time. Market squid are not commonly caught as incidental species to other fisheries; the highest prevalence of incidental market squid is from trawl fisheries, at routinely less than 2 tons of market squid per year from landings made between 2010 and 2023 (CDFW MLDS).

3.1.4.2. Measures to Minimize Any Adverse Effects on Habitat Caused by Fishing

The MLMA requires the minimization of adverse effects on habitat from fishing activities. Beyond California's MPA network, which affords spawning and habitat protection, seabird closure and special closure areas reduce the potential for interactions between the squid fishery and seabirds that are sensitive to disturbance from lights and noise. The weekend closure provides statewide habitat protection from squid fishing throughout the year.

3.2. Requirements for Person or Vessel Permits and Reasonable Fees

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 transferrable 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. Brail permits are transferable based on comparable capacity (within 10%). Transferable light boat permits are transferable and permit holders can upgrade to a transferable brail permit on a "one for one" permit retirement (Table 3-4; Table 3-5).

Table 3-5. Annual permits fees and transfer fees as of April 2024 (Reproduced from California Commercial Fishing Regulations Digest, CDFW 2024a).

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

Table 3-6. Initial annual permit fees and transfer fees established by the MSFMP in March 2005 (CDFG 2005).

Permit Type:	Fee:
Market Squid Vessel (Transferable)	$2,000.00
Market Squid Vessel (Non-Transferable)	$1,000.00
Market Squid Brail (Transferable)	$2,000.00

Permit Type:	Fee:
Market Squid Brail (Non-Transferable)	$1,000.00
Market Squid Light Boat (Transferable)	$600.00
Market Squid Transfer Fee	$500.00
Market Squid Brail (Upgrade from light boat)	$1,500.00

← The Fishery

Monitoring & Essential Fishery Information →

Related Links

California Market Squid Fishery Management Plan

California Department of Fish and Wildlife Pelagic Fisheries and Ecosystem Program

Marine Fisheries Data Explorer

California Department of Fish and Wildlife License Statistics

California Wetfish Producers Association

California Cooperative Oceanic Fisheries Investigations

California Current Integrated Ecosystem Assessment

National Oceanic and Atmospheric Administration List of Fisheries

Last Updated: The Market Squid Enhanced Status Report was updated in 2024.

Contact Us: To contact CDFW regarding Market Squid, please email CDFW's Marine Region or call 831-649-2870.

Citation: California Department of Fish and Wildlife. 2024 Market Squid, *Doryteuthis (Loligo) opalescens*, Enhanced Status Report.

Contributor(s): Katie Grady, Sarah Valencia, Dianna Porzio

Acknowledgement(s):

Market Squid Enhanced Status Report 2024

Table of Contents

List of Acronyms

4. Monitoring and Essential Fishery Information

4.1. Description of Relevant Essential Fishery Information

Fishery-dependent Essential Fishery Information (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 ton) 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.

4.2. Past and Ongoing Monitoring of the Fishery

4.2.1. Fishery-dependent Data Collection

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 (CDFG, 2005). 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 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 (CDFG, 2005).

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 (Figure 4-1). 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 (SAFE) reports.

Vessel captains are interviewed during the offload in order to collect fishing effort information. Data collected by the interviews are:

- date of landing
- Department block location where fishing occurred
- how much was captured
- number of sets made
- gear used
- if a light boat was used
- location and market of landing
- landing receipt number
- anecdotal information given to help characterize the fishery

A squid sample consists of 30 individuals randomly collected throughout the offload (Figure 4-2). The samples are processed for:

- weight
- length
- sex
- presence of spermatophores or eggs
- gonad weights from the first five females to determine fecundity
- mantle punch samples from the first five females and first male used to determine condition and maturity
- statoliths (calcareous structure) from first five females and the first male used to determine age

Data pertaining to interactions with egg beds are also collected during the interview and sample collection process. This specific project was initiated during the 2007-2008 market squid fishing season. Data collected during the interview are:

- net type used
- net depth in fathometers
- mesh size (in)
- leadline type
- average fishing depth
- if the net touched the bottom

Samplers record egg case presence and if egg cases appeared to come from the bottom. Whenever possible, samplers collect market squid egg cases during the sample collection process. Samplers then determine and record maturity and embryo development stage.

When eggs are offloaded at the processor, there are two possibilities for egg presence: (1) the egg cases were laid in the net after the squid were seined and prior to returning to port, or (2) the egg cases, laid previously, were removed from the seafloor. If eggs were recently laid and are in the first few days of development, it is not possible to determine if they came from the seafloor or were laid in the net. If eggs are further developed and organogenesis is apparent (Figure 4-3) this indicates eggs were deposited on the seafloor as opposed to net-laid.

The earliest stage of development includes cleavage and gastrulation (Figure 4-3a) (Fields 1965). The second stage of development includes organogenesis (Figure 4-3b,c). On or around 8 days after fertilization organ formation begins and progresses quickly. Shortly after, the mantle ridge thickens, the eyes grow more prominent, and the first-forming ventral arms appear. The third stage of development (Figure 4-3d) includes growth of specific organ systems and apparent embryo development.

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 data gathered from landing receipts. Logbook data are used to monitor fishing locations, environmental conditions, fishing effort, catch amounts, use of catch, and fleet characterization and capacity.

Data collected from Market Squid Vessel and Light/Brail Boat Logbooks are included in Figures 4-4, 4-5, and 4-6.

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).

Figure 4-1. Photos of the market squid offloading process (Photo Credit: CDFW).

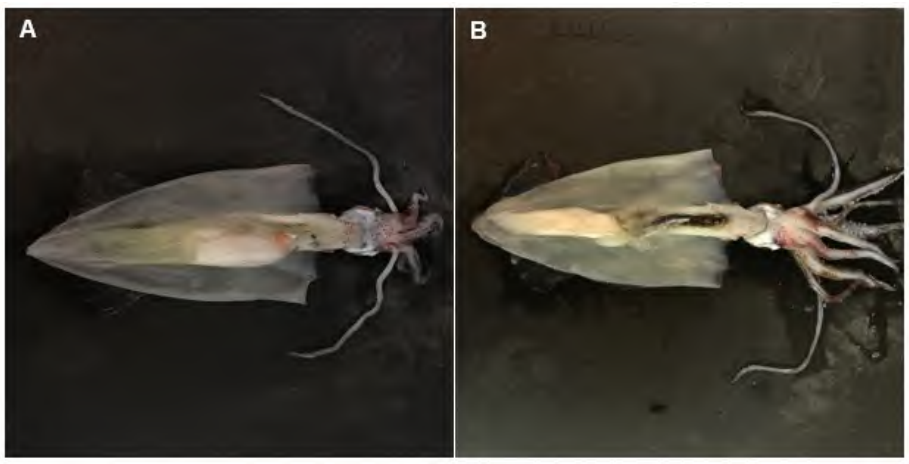


Figure 4-2. Photos of (A) a dissected female market squid and (B) a dissected male market squid. (Photo Credit: Kristen Ondrejko, CDFW).

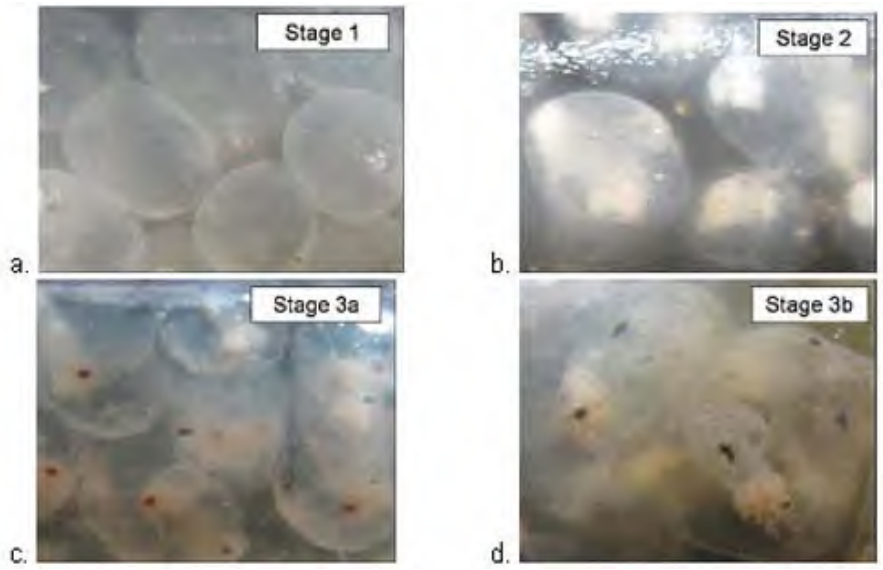
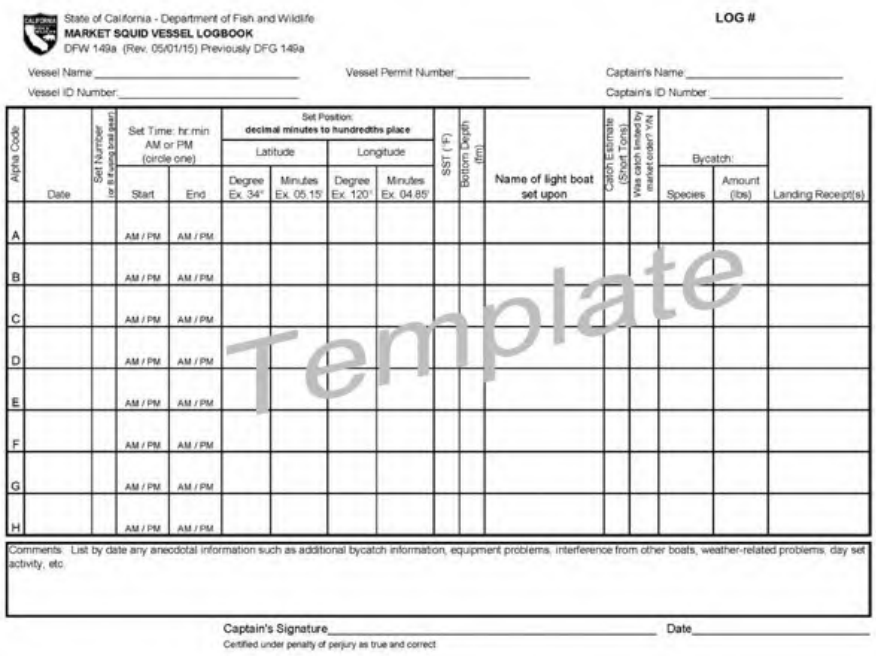


Figure 4-3. Photographs of market squid embryos at various stages of development: a. Beginning stage; cleavage and gastrulation b. Intermediate stage, organogenesis c. Intermediate stage; development of specific organ systems, red eyes present, and large yolk sac, and d. End of embryo development stage; close to hatching, black eyes, chromatophores and ink sac present, and yolk sac is highly reduced (Photo Credit: Mike Navarro, CDFW).


State of California - Department of Fish and Wildlife
MARKET SQUID VESSEL LOGBOOK
DFW 149a (Rev. 05/01/15) Previously DFG 149a

LOG #

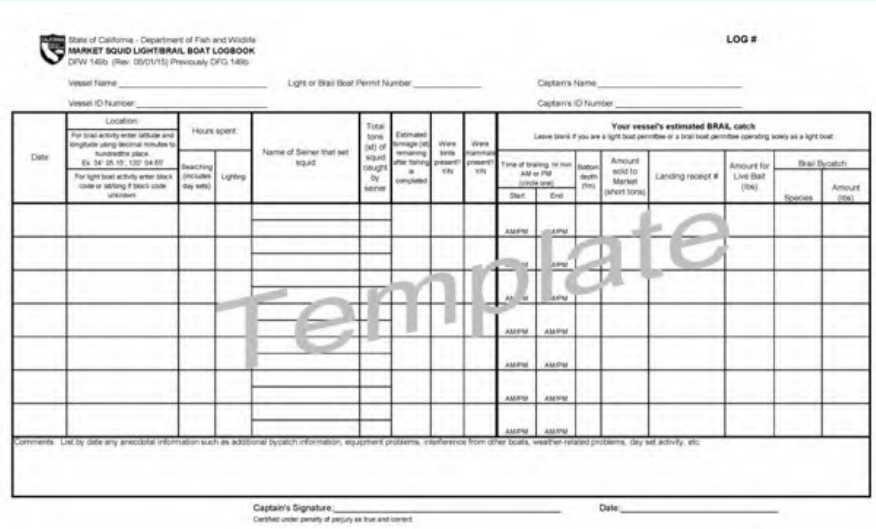
Vessel Name:_____ Vessel Permit Number:_____ Captain's Name:_____
Vessel ID Number:_____ Captain's ID Number:_____

Alpha Code	Date	Set Number (or if Current trap given)	Set Time: hr:min AM or PM (circle one) Start	Set Time: hr:min AM or PM (circle one) End	Set Position: decimal minutes to hundredths place Latitude Degree Ex. 34°	Latitude Minutes Ex. 05.15'	Longitude Degree Ex. 120°	Longitude Minutes Ex. 04.85'	SST (°F)	Bottom Depth (fm)	Name of light boat set upon	Catch Estimate (Short Tons)	Was catch limited by market order? Y/N	Bycatch: Species	Bycatch: Amount (lbs)	Landing Receipt(s)
A			AM / PM	AM / PM												
B			AM / PM	AM / PM												
C			AM / PM	AM / PM												
D			AM / PM	AM / PM												
E			AM / PM	AM / PM												
F			AM / PM	AM / PM												
G			AM / PM	AM / PM												
H			AM / PM	AM / PM												

Comments: List by date any anecdotal information such as additional bycatch information, equipment problems, interference from other boats, weather-related problems, day set activity, etc.

Captain's Signature_____ Date_____
Certified under penalty of perjury as true and correct

Figure 4-4. Market Squid Vessel Logbook template (§149, Title 14, CCR). DFW 149a. Revised March 1, 2015.


State of California - Department of Fish and Wildlife
MARKET SQUID LIGHT/BRAIL BOAT LOGBOOK
DFW 149b (Rev. 05/01/15) Previously DFG 149b

LOG #

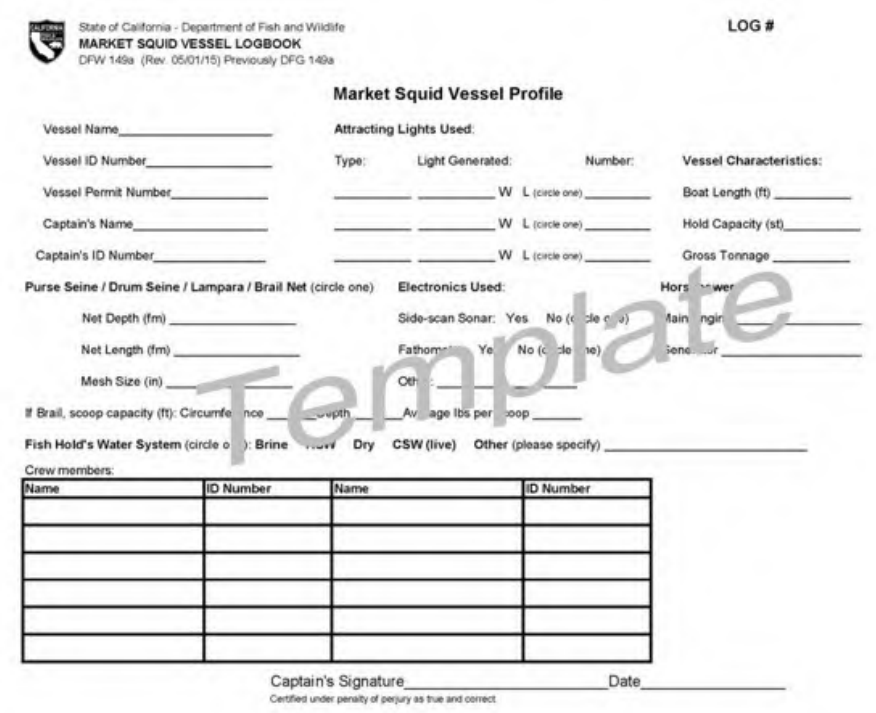
Vessel Name:_____ Light or Brail Boat Permit Number:_____ Captain's Name:_____
Vessel ID Number:_____ Captain's ID Number:_____

Date	Location: For brail activity enter latitude and longitude using decimal minutes to hundredths place Ex. 34° 05.15', 120° 04.85' / For light boat activity enter block code or latitude if block code unknown	Hours spent: Searching (includes day sets)	Hours spent: Lighting	Name of Seiner that set squid	Total tons (st) of squid caught by seiner	Estimated tonnage (st) remaining after fishing is completed	Were birds present? Y/N	Were mammals present? Y/N	Your vessel's estimated BRAIL catch (Leave blank if you are a light boat permittee or a brail boat permittee operating solely as a light boat) Time of brailing: hr:min AM or PM (circle one) Start	Time of brailing: hr:min AM or PM (circle one) End	Bottom depth (fm)	Amount sold to Market (short tons)	Landing receipt #	Amount for Live Bait (lbs)	Brail Bycatch: Species	Brail Bycatch: Amount (lbs)
									AM/PM	AM/PM						
									AM/PM	AM/PM						
									AM/PM	AM/PM						
									AM/PM	AM/PM						
									AM/PM	AM/PM						
									AM/PM	AM/PM						
									AM/PM	AM/PM						
									AM/PM	AM/PM						

Comments: List by date any anecdotal information such as additional bycatch information, equipment problems, interference from other boats, weather-related problems, day set activity, etc.

Captain's Signature:_____ Date:_____
Certified under penalty of perjury as true and correct

Figure 4-5. Market Squid Light/Brail Boat Logbook template. (§149, Title 14, CCR). DFW 149b. Revised March 1, 2015.


State of California - Department of Fish and Wildlife
MARKET SQUID VESSEL LOGBOOK
DFW 149a (Rev. 05/01/15) Previously DFG 149a

LOG #

Market Squid Vessel Profile

Vessel Name_____
Vessel ID Number_____
Vessel Permit Number_____
Captain's Name_____
Captain's ID Number_____

Attracting Lights Used:

Type: Light Generated: Number:
_____ _____ W L (circle one) _____
_____ _____ W L (circle one) _____
_____ _____ W L (circle one) _____

Vessel Characteristics:

Boat Length (ft) _____
Hold Capacity (st)_____
Gross Tonnage _____

Purse Seine / Drum Seine / Lampara / Brail Net (circle one)

Net Depth (fm) _____
Net Length (fm) _____
Mesh Size (in) _____

Electronics Used:

Side-scan Sonar: Yes No (circle one)
Fathometer: Yes No (circle one)
Other _____

If Brail, scoop capacity (ft): Circumference _____ Depth _____ Average lbs per scoop _____

Fish Hold's Water System (circle one): **Brine** **Flow** **Dry** **CSW (live)** **Other** (please specify) _____

Crew members:

Name	ID Number	Name	ID Number

Captain's Signature_____ Date_____
Certified under penalty of perjury as true and correct

Figure 4-6. Market Squid Vessel Logbook profile form template (§149, Title 14, CCR). DFW 149a. Revised March 1, 2015.

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

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.

Time Period	Principal Investigator	Resulting Publications	Samples Collected	General Purpose
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.

4.2.2. Fishery-independent Data Collection

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 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 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 2020).

Paralarvae abundance surveys makeup the largest fisheries-independent data series for the market squid fishery. Sampling was opportunistic prior to 2010, but since then 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 (Figure 4-7).

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 4 yr. 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 6 months (mo) after could indicate the degree of mixing of market squid populations on ecological timescales.

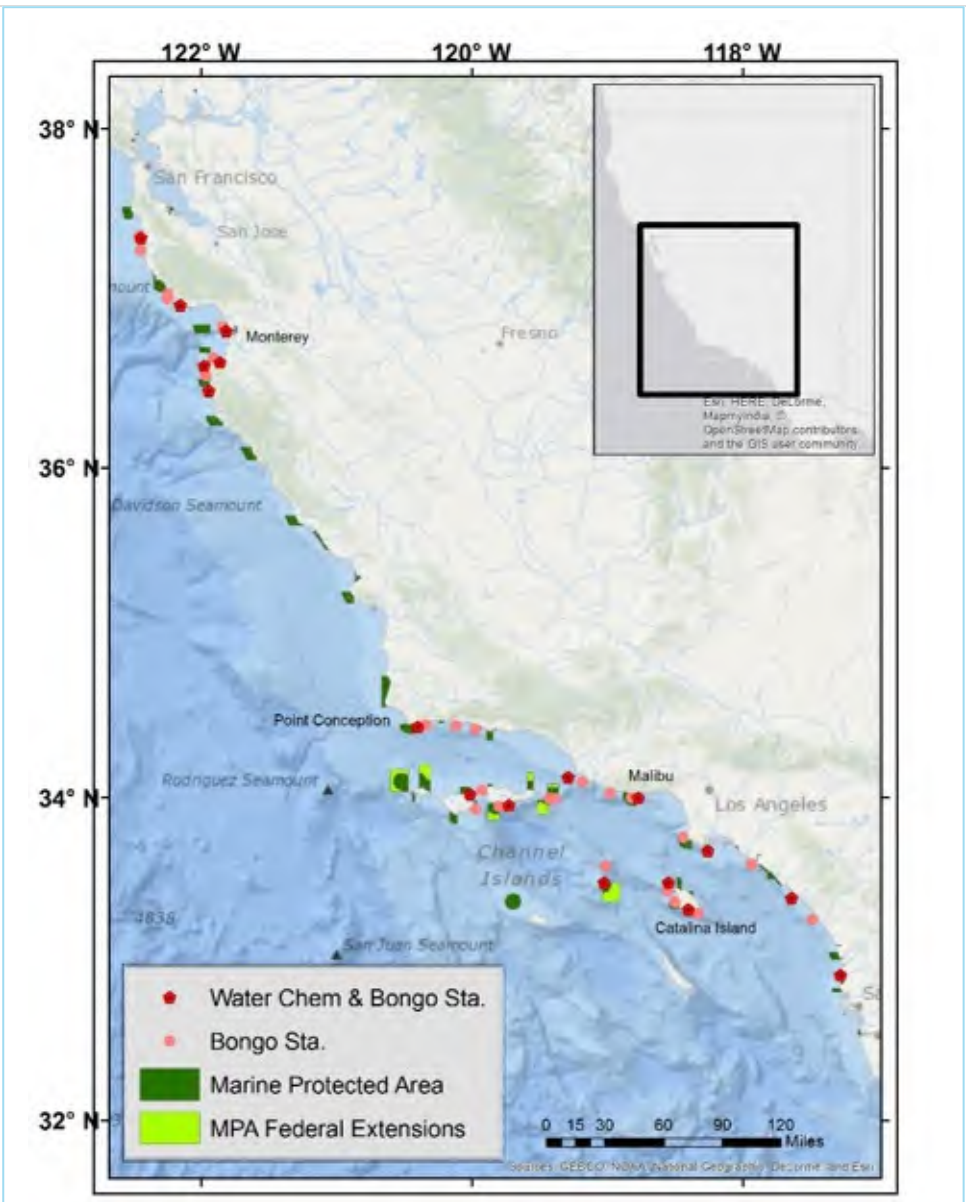


Figure 4-7. Paralarvae sampling areas off California are shown as pink circles. Five regions are identified across the sampling effort and include Monterey, the north Bight and south Bight of the SCB, and north and south Channel Islands (Reproduced from Van Noord and Dorval 2017).

← Management

Future Management Needs & Directions →

Related Links

California Market Squid Fishery Management Plan

California Department of Fish and Wildlife Pelagic Fisheries and Ecosystem Program

Marine Fisheries Data Explorer

California Department of Fish and Wildlife License Statistics

California Wetfish Producers Association

5. Future Management Needs and Directions

5.1. Identification of Information Gaps

The primary information gaps for the market squid fishery include the following: determine if changes in fishing behavior have altered traditional assumptions for egg escapement; explore spatial and temporal patterns in egg escapement; evaluate the effects of net contact with egg beds; improve understanding of spawning ground distribution and natural mortality; incorporate oceanographic data in multivariate approaches to investigating current fisheries-dependent data streams; and quantify age composition of the catch (Table 5-1).

Table 5-1. Informational needs for California market squid using available data streams and their priority for management.

Type of information	Priority for management	How essential fishery information would support future management
Number of juvenile squid caught by the fishery over time	High	Used to confirm assumption that catch is still mainly composed of adult squid as it pertains to the egg escapement method.
Differences in gonad weight based on timing of catch	High	Assess differences in spawning success in response to daytime fishing versus nighttime fishing.
Net contact with egg beds	Medium	Important for assessing disturbance to spawning beds.
Changes in fishing location and/or effort over time	Medium	Could indicate if regional management and/or managing by sectors would be appropriate.

Type of information	Priority for management	How essential fishery information would support future management
Fishing mortality in terms of egg escapement by gear type	Medium	Could indicate if certain gear types should be regulated differently.
Changes in type and quantity of incidental catch	Medium	Could indicate how changes in gear type, effort, location, or timing of fishing might correspond with catch composition.
Changes in net size	Low	Information would inform any necessary gear restrictions to ensure spawning success.
Changes in GT or average load size over time	Low	If the amount of squid caught in a single trip/set has changed over time, this could impact capacity goals and assumptions about effort or access.
Size composition of cohorts	Low	Used to determine if the size structure of the stock has changed over time and what variables might be driving that change.
Improved proxy for CPUE	Low	Finding a more suitable equivalent for CPUE could supplement fishing mortality and biomass estimates.

5.2. Research and Monitoring

5.2.1. Potential Strategies to Fill Information Gaps

As standardized fisheries-dependent data collection continues to shift to a digital platform, information gaps will be easier to fill. The Department is actively transitioning from paper submission to electronic submission, such as the recently implemented Marine Landings Database System (MLDS), which is populated by landing tickets entered through an electronic interface (E-tix). Should the market squid logbook program convert to electronic log submission (E-logs) this would substantially improve the timeliness of data collection and efforts to conduct QA/QC for incoming data, ultimately providing Staff more time to transform fishery-dependent data in to applied information.

Age data are needed to determine the degree to which changing environmental conditions may lead to changes in age at reproductive maturity. This question is best answered using egg escapement. Additionally, it is possible that long-term changes in the age or size structure of the stock are likely driven by environmental conditions either in addition to/or independent of fishing pressure (Jackson and Domeier

2003; Protasio et al. 2014). The Department currently lacks the staffing and resources to age squid statoliths. Visual ageing is time consuming, includes a lengthy training process, and introduces a high degree of variation/bias. Additionally, many staff are currently tasked with ageing otoliths for federally managed CPS finfish, which do have a year-class structure unlike squid. The Department is considering investments, such as the Fourier Transform Near-Infrared Spectroscopy Analyzer, a technology that is being developed for use in ageing otoliths and statoliths. This spectroscopic method uses the near-infrared region of the electromagnetic spectrum to elucidate overtones and bond vibrations in the molecules of a particular sample. By quantifying the spectral characteristics of otoliths or statoliths with reference-validated age estimates, this calibration allows for automatic ageing of remaining samples. This could substantially improve productivity and accuracy.

The Department could also greatly benefit from more long-term fisheries-independent data collection in the areas listed in Table 5-2. Direct strategies to fill information gaps may include using tools for nearshore and subtidal surveying such as juvenile trawl surveys, egg bed surveys using ROV technology or divers, and adult abundance surveys using aerial or drone technology. Because squid egg beds are often found deeper than 80.0 ft (24.4 m), a depth that becomes more difficult to survey with divers, ROV technology could facilitate more regular egg bed monitoring. ROV video and mechanical collection components could be used to help determine location and spatial extent of egg beds, egg densities, and changes in spawning potential. With improved side-scan sonar and drones equipped with spectral imaging technology, the Department and collaborators could conduct population surveys of adult spawning aggregations, particularly in unfished spawning grounds. Information gained from these surveys would be beneficial for determining distributional shifts in response to climate change.

Table 5-2. Informational needs for California market squid not attainable from existing data streams and their priority for management.

Type of information	Priority for management	How essential fishery information would support future management
Increase sample size of pre-ovulatory females	High	These samples could improve estimates of standing stock of oocytes for the egg escapement model.
Location and spatial extent of spawning grounds, specifically in unfished areas	High	Important for directing fishery independent survey efforts and determining the distribution/quality of essential fish habitat (Navarro et al. 2018).
Improved estimates of natural mortality	High	Could improve indices for the egg escapement model and determination of more accurate MSY/OY proxies
Age composition of cohorts	High	Need to age statolith collection to understand the role that age plays in maturity and if the age structure of the stock has changed over time

Type of information	Priority for management	How essential fishery information would support future management
Statolith elemental signatures of egg, larval, and adult samples	Medium	Could identify source populations for stocks and determine the relative value of spawning sites to recruitment
Effects of oceanographic conditions on spatial distribution and range expansion	Medium	Provides insight to where fishing effort is likely to be focused in the future and on potential new fishing grounds and communities
Effects of attracting lights on natural spawning behavior	Medium	Improved understanding of these impacts could provide for the necessity of alternative or more appropriate lighting regulations
Egg densities and dynamics	Low	Understanding how egg densities vary based on bed size can help to characterize the value of key spawning grounds
Direct biomass estimates	Low	Could set a more dynamic SCL using more robust reference points (Ralston et al. 2018)
At-sea bycatch observations	Low	Used to confirm that changes in fishing behavior have not increased the likelihood of at-sea bycatch

5.2.2. Opportunities for Collaborative Fisheries Research

The Department has collaborated in the past and will continue to work with outside entities such as academic organizations, non-governmental organizations, citizen scientists, and both commercial and recreational fishery participants to help fill information gaps related to the management of state fisheries. The Department will also reach out to outside persons and agencies when appropriate while conducting or seeking new fisheries research required for the management of each fishery.

The ROV and drone surveys described above could be conducted collaboratively with academia and scientists with existing technical capacity and equipment. Additionally, there are many unanswered questions surrounding market squid biology, distribution, and abundance, particularly in projecting how populations respond to environmental and abiotic changes independent of fishing pressure. Efforts could be aimed at expanding the inflow of fishery-independent data. Making ecosystem level connections between how shifting oceanographic conditions govern changes in market squid physiology, behavior, and spawning success may help to inform management.

Citizen science could be a useful avenue for compiling information on market squid egg bed distribution. If recreational, working, or scientific scuba divers had an avenue, such as a social media platform, to post photos of and spatial information on squid egg begs, this photo log could provide clues to shifts in ideal spawning habitat, independent of fishing efforts. This public interface could include photos submission or details on the date and Global Positioning System location of the sighting. Existing subtidal monitoring programs and citizen science groups could incorporate egg bed sightings into surveys or provide incidental observations.

5.3. Opportunities for Future Management Changes

This section is intended to provide information on changes to the management of the fishery that may be appropriate but does not represent a formal commitment by the Department to address those recommendations. ESRs are one of several tools designed to assist the Department in prioritizing efforts and the need for management changes in each fishery will be assessed in light of the current management system, risk posed to the stock and ecosystem, needs of other fisheries, existing and emerging priorities, as well as the availability of capacity and resources.

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. This decision is based on market demand, squid availability, and population fluctuations. The nature of this dynamic is somewhat unique in fisheries management and stems from the life-cycle characteristics common to market squid such as short lifespan, rapid growth, and little overlap of generations resulting in large natural fluctuations in abundance.

While market squid is currently considered a sustainable fishery with an adequate regulatory framework, there may be opportunities to improve fishery control rules, particularly in terms of clarifying language and rectifying potential loopholes. Other, more substantive changes to regulations could include altering gear, temporal, spatial, or effort restrictions and implementation of electronic monitoring.

Review of the Egg Escapement Method

The egg escapement Method is considered an “informal” management tool and the model is not currently intended for use in real-time management (PFMC 2011). The MSFMP sets a threshold value of 30% or greater egg escapement (e.g., an FMSY proxy resulting in egg escapement ≥ 30%). This spawning stock biomass per recruit ratio of 30% was based on fishery data from a vertebrate species, Georges Bank haddock (Melanogrammus aeglefinus), whose life history may vary from those of a pelagic invertebrate such as market squid (Gabriel et al. 1989). Furthermore, fishery control rules allow for additional escapement not represented in the model, such as excess spawning afforded by weekend closures and spawning grounds provided by the state’s MPA network.

As an assessment tool, the model has potentially unexplored utility in evaluating population dynamics and biological reference points related to MSY (PFMC 2011). The egg escapement Method is based on several assumptions: (1) immature squid are not harvested; (2) potential fecundity and standing stock of eggs are accurately measured; (3) life history parameters are accurately estimated (e.g., natural mortality and egg laying rate); and (4) instantaneous fishing mortality is translated into meaningful management units (PFMC 2011).

While annual statewide egg escapement goals are routinely met with current fishery control rules, there are instances where relative escapement falls below 30% on quarterly and regional scales. Historically, the fishery saw high catch within and among regions following some of these instances suggesting that recruitment is highly sporadic, and that one region of the state may provide recruits to a different region. Because fishing effort often peaks six months apart between central California and southern California, it is possible that recruits from successful central California spawning activity may become the adults taken in the southern California area, and vice versa (Butler et al. 1999). Improving understanding of these spawning patterns at finer scales will help to guide management response under a changing climate. A rise in concentrated fishing pressure coupled with contraction of suitable spawning habitat during El Niño events could affect localized

spawning potential, abundance, and recruitment (Cheng et al. 2020). The Department and NOAA affiliates are actively exploring the utility of the egg escapement model and spatial and temporal patterns of escapement that may better inform management. Extending temporal closures or dispersing effort on a region-specific basis are potential options to ensure adequate spawning.

Lighting

Lighting regulations are in effect to minimize light emissions, and ensure lights are not directed onto nearshore cliff areas with human populations or where birds are nesting. The light shield regulations may need to be evaluated in relation to modern equipment. For example, §149, Title 14, CCR states that lights cannot total more than 30,000 watts; however, light emitting diode bulb output is measured in lumens.

Additional lighting regulations may also be directed at restricting use of submerged lights. There is currently no prohibition on lowering lights into the water column. Because squid may spawn at depths where surface lights have no effect it could be prudent to prevent lighting at depth. Prohibiting the use of submerged lights not permanently attached to the hull of the vessel or lowering the lights to a specified distance below the water surface are potential solutions.

Egg Beds

Dockside sampling and logbook records can be used to attempt to gauge the frequency of: (1) impacts to substrate where eggs may be deposited; (2) damage or mortality to egg masses from contact with gear itself (PFMC 2011). When market squid egg cases are observed at offloading sites, there are two potential reasons that egg cases may be in the net: (1) squid released eggs in the net after being captured, or (2) egg cases were taken from the ocean floor during fishing activity. From July 2010 to July 2020, market squid egg cases were identified in 26.2% of observed landings (CDFW, unpublished data). Because market squid can exude egg cases while in a seine net, the observed egg cases were collected and aged. If eggs are more than one day old, then egg cases were likely removed from the bottom (Figure 4-3). It was found that 43.5 % of sampled eggs were not spawned in the net, suggesting that at least 10.1% of total sampled landings included interaction with egg beds. There are no records of egg cases observed in landings made using brail gear.

Options to mitigate interactions with egg beds were discussed during the 2023-2024 SFAC process, which resulted in a recommendation for vessels to use riblines. Additionally, further research could include looking at potential patterns of net contact with egg beds and how that information could be applied to management. Research using divers or ROV's could be conducted to monitor sites immediately following fishing activity.

Effort

There are currently no bounds as to how much squid can be returned in a single trip, which could impact the rate at which the SCL is met. Evaluating changes in GT, CPUE, set size, or load size over time could help determine if changes to capacity management are merited. If needed, limiting either GT, the size of the landing returned to port, or the number of trips in a given time period are potential methods to slow down the rate of catch. This would allow for a longer fishing season in "booming" years when the SCL is met and reduce competition on the water. Alternatively, there could be benefits to ensuring certain school sizes are targeted to correspond with trends in spawning behavior.

Access

The intent of restricting access to the market squid fishery was to produce a moderately productive and specialized fleet, and to limit the extent of fishing pressure on the resource. The evolution of permit transfers, the sustained international demand for squid, and the substantial increase in the cost of a market squid permit over the past two decades has made access to the fishery increasingly difficult, and this has subsequently altered the socioeconomic landscape. Considering the current scale of operations, these factors could impede the existence of small-scale, artisanal fishing opportunities, which may provide additional economic and employment opportunities to existing coastal fishing communities in the state of California. While prioritizing the need to fill the information gaps provided in Table 5-1 and 5-2, these socioeconomic factors also need to be considered.

Experimental Permits

Section 149.3, Title 14, CCR, allowed the Commission to issue up to three Non-Transferrable Market Squid Vessel Permits for the purpose of developing a squid fishery in areas previously not utilized for squid production. Three experimental market squid vessel permits were discussed at the Commission in 2014 and 2015 but were not issued on the grounds that the window for issuing these types of permits had passed. A similar request was reviewed in 2018 and that discussion was postponed in part due to the preparation of this ESR and in part to the fact that vessels have shown the ability to move when squid are available. In 2022, the Fish and Game Commission adopted a broad Experimental Fishing Permit program, which resulted in the repeal of the market squid Experimental Fishing Permit (Title 14, Section 149.3). From 2023-2024, the Department's Squid Fishery Advisory Committee (SFAC) discussed the potential for new small-scale fishery access. The SFAC recommended that the new EFP program is an option for those interested in exploring potential fishing opportunities for market squid that would not compete with the already established restricted access fishery spatially or economically. The Department will recommend that EFPs be issued in limited circumstances to help test the possibility of new squid fishing opportunities.

Market Squid Logbook Evaluation

The data required in logbooks should be reviewed to ensure information submitted is useful for management and for monitoring long-term trends. In particular, estimated tonnage remaining after fishing is completed, SST, and evidence of market-order limits have either proven difficult for operators to determine or are consistently unreliable. Additionally, self-reported location and bycatch information are less accurate compared to alternatives like Vessel Monitoring Systems and at-sea observer programs. Any new logbook program should consider a transition to an electronic format and digital vessel tracking. Many operators and vessel owners reside out of state making paper communication increasingly difficult. Timeliness of data submission and compliance could be substantially improved under an electronic system. Specifically, for compliance, the ability to cross-reference log and landing records becomes much easier if both monitoring tools include timely submission in a digital format. Furthermore, there is currently no field for LE Permit Number when submitting a landing record through E-tix. Without that number and with intermittent LE permit transfers, cross-referencing becomes more difficult. The transition to an E-log program would require a full rulemaking and continued collaboration with industry representatives.

5.4. Climate Readiness

Market squid are highly responsive to changes in environmental conditions, with populations experiencing dramatic variability in abundance over time and space. This can present challenges to managers even under normal climate variability and is likely to be exacerbated by climate change. Landings of market squid in California have been significantly lower during El Niño events (Zeidberg et al. 2006), because warmer periods may reduce reproductive output of females (Henry et al. 2003), the amount of available spawning habitat (Zeidberg et al. 2011b), larval abundance (Koslow and Allen 2011), and growth rates (Jackson and Domeier 2003; Reiss et al. 2004). Historically, while catches have been extremely low during these periods, the market squid fishery has rebounded quickly when conditions improve. However, given the short life span of squid, extended warm water periods could impact the availability of the species to the fishery. Given the ecosystem role that market squid play in the CCE, abundance may also be suppressed by predation. These various factors may result in an extended period of low catches in this fishery.

Climate change may also result in shifts or expansion in suitable habitats for market squid. Research has shown that market squid recruitment may be influenced by the availability of sandy bottom habitat between 10 and 12 °C (50 and 53.6 °F) (Zeidberg et al. 2011b), and there may be a shift or expansion in these habitats to either deeper or more northerly areas (Burford et al. 2020; Chasco et al. 2022; Suca et al. 2022). Embryo habitats may be more limited by pH or oxygen availability than temperature (Navarro et al. 2018), and these factors are also expected to change in the future. Conversely, decreases in the oxygen content of deep ocean waters off the coast of California could compress the depth range for adult market squid (Bograd et al. 2008; Stewart et al. 2014). As a result of these changes there may be shifts in the locations where fishing and landings occur. Given the emerging research on the influence of environmental factors on CPS and the propensity for squids to modify their own physiology through RNA editing in response to their environment,

there may be a need to explore the incorporation of environmental variables into stock assessments, predictive models, or harvest control rules (Voss and Rosenthal, 2023).

← Monitoring & Essential Fishery Information

Related Links

- California Market Squid Fishery Management Plan
- California Department of Fish and Wildlife Pelagic Fisheries and Ecosystem Program
- Marine Fisheries Data Explorer
- California Department of Fish and Wildlife License Statistics
- California Wetfish Producers Association
- California Cooperative Oceanic Fisheries Investigations
- California Current Integrated Ecosystem Assessment
- National Oceanic and Atmospheric Administration List of Fisheries

Last Updated: The Market Squid Enhanced Status Report was updated in 2024.

Contact Us: To contact CDFW regarding Market Squid, please email CDFW's Marine Region or call 831-649-2870.

Citation: California Department of Fish and Wildlife. 2024 Market Squid, *Doryteuthis (Loligo) opalescens*, Enhanced Status Report.

Contributor(s): Katie Grady, Sarah Valencia, Dianna Porzio

Acknowledgement(s):

Market Squid Enhanced Status Report 2024

Table of Contents

List of Acronyms

List of Figures

List of Tables

Literature Cited

State of California
Department of Fish and Wildlife

M e m o r a n d u m

Date: April 8, 2025

Received 4/10/2025
Original signed copy on file

To: Melissa Miller-Henson
Executive Director
Fish and Game Commission

From: Charlton H. Bonham
Director

Subject: **Submission of Initial Statement of Reasons for the April 16-17, 2025 Fish and Game Commission Meeting to Amend Sections 53.01, 149, and 149.1, and Repeal Sections 53.02 and 53.03, Title 14, California Code of Regulations, re: Commercial Taking of Market Squid**

Please find attached the Initial Statement of Reasons to amend sections 53.01, 149, and 149.1, and repeal sections 53.02 and 53.03, Title 14, California Code of Regulations. The proposed amendments were developed through a multiyear constituent advisory group process and include scientific and enforcement input. Changes to market squid regulations reflect Department recommendations discussed and agreed upon during the multiyear Squid Fishery Advisory Committee process. The proposed amendments add definitions, require the use of a purse seine rib line placed above the purse seine leadline, update the name of the Greater Farallones National Marine Sanctuary, extend the current weekend market squid fishery closure, and establish a new method of informing market squid fishermen about closures. Additionally, the proposed amendments clarify the requirements of the use of lights to aggregate squid and repeal sections 53.02 and 53.03.

The Department recommends that the new regulations become effective January 1, 2026. The proposed management measures are necessary to reduce potential bycatch and impacts to the sea floor. These changes will benefit squid reproduction and spawning success and increase the likelihood of the fishery remaining sustainable in the face of future environmental uncertainty.

If you have any questions or need additional information, please contact Dr. Craig Shuman, Marine Regional Manager at R7RegionalMgr@wildlife.ca.gov. The notice for this rulemaking should identify the Department point of contact as Trung Nguyen, Environmental Scientist.

ec: **Department of Fish and Wildlife**

Chad Dibble, Deputy Director
Wildlife and Fisheries Division

Craig Shuman, D. Env., Region Manager
Marine Region

John Ugoretz, Env. Program Manager
Marine Region

Eric Kord, Assistant Chief
Law Enforcement Division

Crystal D'Souza, Attorney
Office of General Counsel

Ona Alminas, Env. Program Manager
Regulations Unit
Wildlife and Fisheries Division

Fish and Game Commission

David Thesell, Deputy Executive Director

Susan Ashcraft, Marine Adviser

Sherrie Fonbuena, Analyst

State of California
Fish and Game Commission
Initial Statement of Reasons for Regulatory Action

Amend Sections 53.01, 149 and 149.1,
Repeal Sections 53.02 and 53.03,
Title 14, California Code of Regulations
Re: Commercial Taking of Market Squid

I. Date of Initial Statement of Reasons: March 10, 2025

II. Dates and Locations of Scheduled Hearings

(a) Notice Hearing:

Date: April 16-17, 2025 Location: Sacramento

(b) Discussion Hearing:

Date: June 11-12, 2025 Location: Sacramento

(c) Adoption Hearing:

Date: August 13-14, 2025 Location: Sacramento

III. Description of Regulatory Action

(a) Statement of Specific Purpose of Regulatory Change and Factual Basis for Determining that Regulation Change is Reasonably Necessary

Unless otherwise specified, all section references in this document are to Title 14 of the California Code of Regulations (CCR), “Department” refers to the California Department of Fish and Wildlife, and “Commission” refers to the California Fish and Game Commission.

The Department recommends that the Commission adopt the following proposed changes focusing on the commercial take of market squid. The last time market squid regulations were subject to major amendment was at the adoption of the Market Squid Fishery Management Plan (FMP) in 2004. The proposed amendments here represent the results of a significant multi-year long constituent advisory group process as well as scientific and enforcement input. The proposed changes are necessary to reduce potential bycatch and increase the likelihood of the fishery remaining sustainable in the face of future environmental uncertainty.

Background

The market squid fishery is regularly the largest commercial fishery in California, in both volume and ex-vessel value. Managed under the Commission’s authority since 2001, the fishery operates within the framework of the Market Squid FMP. The FMP defines harvest control rules (i.e., rules to manage a fishery developed under provisions of the Marine Life Management Act), a restricted access program, environmental protections, and fishery administration.

While regulations have been periodically adopted to adaptively manage various aspects of the fishery, 2021 marked the initiation of the first comprehensive review of the Market Squid

FMP since its adoption in 2004. The Department developed a multi-phase management review, supported by the Commission, and anchored in a Squid Fishery Advisory Committee (SFAC). Established by the Department's Director according to Section 53.02, the SFAC played a crucial role in assisting with developing and reviewing fishery assessments, management options and proposals, and FMP amendments.

During the final SFAC meeting in May 2024, the Department presented draft recommendations and adjusted the recommendations to reflect discussion points and expression of support from SFAC members. The SFAC recommended regulation changes, as well as non-regulatory actions.

In addition, the Department recommends changes for administrative topics not discussed during SFAC meetings. The first addresses the notification method used for closing a fishing season. Additional administrative changes clarify that a purse seine skiff does not need its own market squid vessel permit, correct the name of the Greater Farallones National Marine Sanctuary to its present name, and modify the definition of light shields to reflect possible changes to the manner in which light is emitted.

The proposed regulations define rib line and will require the use of a purse seine rib line, which must be placed above the purse seine leadline. The proposed regulations will extend the current weekend market squid fishery closure from noon to 7am on Friday statewide as well as an additional extension from Sunday at noon to Sunday at 2359 hour in the Monterey Bay Area (between a line due west from Point Lobos [36º 31.461' North Latitude] and a line due west from Pigeon Point [37º 11.000' North Latitude]).

The proposed regulations clarify that using lights to attract squid is considered a form of take and that such lights generally may not be used during the weekend closures. The existing exemption for lighting on the weekend when taking market squid as live bait will be amended to make the provision clearer and more enforceable. The amendment will clarify that lighting on the weekend is only allowed when actively taking market squid for live bait. Revisions to the regulation will 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.

Current Regulations

Current regulations in Section 53.01 specify definitions related to the market squid fishery. Section 53.02 describes process and timing of the market squid fishery as it relates to implementing the Market Squid FMP, including monitoring and regular updates; establishment of an advisory committee by the Department director to aid in assessing and responding to fishery concerns; and development of management actions consistent with the Administrative Procedure Act. Section 53.03 describes the set of management actions described in the original Market Squid FMP (Department, 2005).

Current regulations in Section 149 specify requirements applicable to vessels taking squid and vessels attracting squid with lights for the purpose of commercial take. The regulations specify that a permit is required; set a seasonal catch limit of 118,000 short tons statewide;

specify the process to close the fishery when the seasonal catch limit is expected to be reached; provide a statewide closure between noon on Friday and noon on Sunday of each week; provide exemptions that allow the take of squid for live bait purposes and allow squid to be taken incidentally in other fisheries; prohibit use of attracting lights in the Greater Farallones National Marine Sanctuary for the protection of seabirds; require the completion and submittal of logbooks; prohibit the use of lights to attract squid except as authorized under permits described in subsection 149.1(b); prescribe maximum wattage and shielding requirements for attracting lights; specify that squid taken in violation of the regulations must be forfeited to the Department; specify to whom citations may be issued; and specify that operators and crewmembers of a commercial market squid vessel or lightboat operating under the provisions of a commercial market squid permit are not required to possess a Tidal Invertebrate Permit.

Proposed Regulations

The proposed regulations implement the amended Market Squid FMP.

Repeal subsection 53.01(m)

Subsection 53.01(m) is proposed to be repealed to remove the definition of Market Squid FMP. The Market Squid FMP does not require a definition, as it is described in Section 53.00. Furthermore, it is not necessary to incorporate the document by reference as the Market Squid FMP is not intended to have the force of law because it is an informational document, rather than a regulation.

Current subsections (n) through (u) are proposed to be renumbered as (m) through (t) to reflect the repeal of subsection (m).

Amend current subsection 53.01(t), renumbered as subsection (s)

The proposed regulations revise the definition of purse seine, specifying that the net is closed near the bottom instead of on the bottom. This change is necessary to correctly define the net. In addition, language is added to specify that purse seines used to take market squid or onboard vessels in possession of market squid are fitted with a rib line. This change is necessary to ensure that commercial fishermen are aware the seine configuration clearly includes a rib line.

Add new subsection 53.01(t), Rib line

The regulations in proposed subsection 149(f) will require the use of a purse seine rib line, which must be placed above the purse seine leadline. This amendment adds the definition of a rib line to read, “Rib line means a separate line made of soft rope or other non-metallic line that is a minimum of 36 inches above the leadline on a purse seine net. The rib line must encompass the purse seine net within 60 feet of both ends of the net.”

Department sampling data indicate that current purse seine fishing practices allow the net to scrape the seafloor in relatively shallow fishing areas and may increase benthic species bycatch or damage to squid egg beds. Requiring a rib line on purse seine nets will reduce contact with the seafloor. In addition, the proposed regulations will require

the use of a non-metallic rib line to purse the net instead of cables or chains (i.e., no metal lines), which will also reduce impacts to the sea floor. The requirement to use a rib line made of soft rope or other non-metallic line to purse the net mitigates potential impacts to seafloor habitats and enhances sustainability by protecting squid egg beds and other benthic species.

Repeal Section 53.02, Process and Timing, and repeal Section 53.03, Market Squid Fishery Management Plan (Market Squid FMP) Project.

These sections are proposed to be repealed, as they are either duplicative of existing authority, or are general policy statements rather than regulations, and therefore are not necessary. Existing statutory authority provides processes and purposes for development of an FMP, adopting regulations to implement an FMP, amending an FMP, convening stakeholders for advisory committees, and for monitoring and assessment of the fishery (e.g., Fish and Game Code sections 7070 *et seq.*). It is necessary to repeal these sections to reduce confusion of the regulated community and to conform to the clarity and non-duplication requirements of the Administrative Procedure Act

Amend subsection 149(a)

The proposed regulations add new subsection 149(a)(1), “A permit is not required for the seine skiff of a permitted vessel. For the purposes of this section, a seine skiff is a vessel that does not use lights to attract squid and its primary purpose is to assist the deployment of a net for a permitted vessel.”

This change is necessary to make it clear that a seine skiff vessel does not require a market squid permit because it is part of a purse seine vessel and its function to is help wrap the purse seine net and does not use lights to attract squid.

Amend subsection 149(b)(2), Closure Process.

The proposed regulations replace language in subsection 149(b)(2)(A) relating to public announcement of the effective date of squid closures on Very High Frequency (VHF) Channel 16 between the hours of 10:00 p.m. and 12:00 a.m. (midnight) with language specifying that the announcement will be posted on the Department’s website at wildlife.ca.gov/marine. The time of day of the announcement is repealed.

The proposed regulations replace language in subsection 149(b)(2)(B) related to the responsibility of operators to determine when the seasonal catch limit is expected to be reached and the fishery closed by monitoring VHF/channel 16 with language specifying they should monitor the Department’s website wildlife.ca.gov/marine. Additional proposed changes in this subsection regarding what constitutes official notice of the closure replace VHF/channel 16 with the Department’s website.

Current regulation (subsections 149 (b)(2)(A) and (B)) require the Department to notify the United States Coast Guard (USCG) to broadcast on VHF Channel 16 any upcoming closures to the market squid fishery. However, the USCG has indicated in a letter to the Department that it will no longer post notices via VHF 16 Broadcast Notice to Mariners because the “communication tools are reserved for important navigational safety information and deficiencies in aids to navigation.” The proposed regulation is

necessary to provide a revised communication tool that market squid operators can use to be informed about market squid fishery closure. The time of day of the announcement is no longer necessary as the website is accessible at any time of day.

Amend subsection 149(c), Time Closures. North of a westerly extension of the United States -- Republic of Mexico boundary line:

Current regulations specify that market squid may not be taken for commercial purposes between noon on Friday and noon on Sunday of each week. The proposed regulations change the start time of the closure to 0700 hours on Friday; the end time remains noon on Sunday in most of the State. The proposed changes further specify that market squid may not be taken for commercial purposes in the area between Point Lobos (36º 31.461' North Latitude) and Pigeon Point (37º 11.000' North Latitude) from 0700 hours on Friday through 2359 hours on Sunday of each week.

These changes are necessary for added conservation in squid fishery management and a buffer for sustainability at little expense, or potential improvement, to fishery yields and performance. The extension of the weekend closure will increase the uninterrupted spawning time for market squid, which will benefit squid reproduction and spawning success. Department analyses during the SFAC process showed a difference between the northern and southern fishery areas, supporting the difference in closure end time proposed for the Monterey Bay Area.

Amend subsection 149(d), Closed Areas for Seabirds.

The proposed regulations change "Gulf of Farallones National Marine Sanctuary" to "Greater Farallones National Marine Sanctuary" for consistency with the name of the national marine sanctuary changed in 2015 and currently in Code of Federal Regulations (CFR), Part 922, subpart H.

Add new subsection 149(f), Rib Line .

The proposed regulations add new subsection 149(f), "Rib line: After December 31, 2030, it is unlawful to take market squid for commercial purposes using a purse seine net that is not pursed using a rib line as defined in Section 53.01. All purse seine nets onboard any vessel taking or possessing market squid for commercial purposes must have a rib line attached and the rib line must be used to purse the net. A rib line must be made of soft rope or other non-metallic line. All rib lines must be made available for inspection upon demand by authorized Department personnel pursuant to Fish and Game Code Section 2012."

This addition for use of a soft rope or other non-metallic rib line to "purse" the seine net is necessary to mitigate potential impacts to sandy bottom habitat and enhances sustainability by protecting squid egg beds and other benthic species. The regulation will take into effect after December 31, 2030 in order to give the fishing community adequate time to retrofit fishing gear.

Amend current subsection 149(f), renumbered as subsection (g). Lights to Aggregate Squid.

The proposed regulations add subsection 149(g)(1). The first full sentence of current subsection 149(f) is moved to this subsection along with a new heading of “General Regulations”. Language specifying “of these regulations” is repealed due to redundancy.

The proposed regulations add subsection 149(g)(1)(A), “Lights used to aggregate squid are considered a form of take. Lights commonly used to aggregate squid that are turned on or in use are prima facie evidence that the vessel’s operator and crew are attempting to attract squid for commercial purposes.” The proposed language clarifies that use of lights to aggregate squid is considered a form of take consistent with Section 1.80 and informs the public how the Department considers the use of lights as it relates to the commercial take of market squid.

The proposed regulations add subsection 149(g)(1)(B), “Lights used to aggregate squid for commercial purposes shall not be turned on or in use during weekend closures as defined by subsection (c)(1) of this section.” This change is necessary to emphasize that “take” of market squid via attracting lights is prohibited during the weekend closure to allow for uninterrupted spawning time for market squid.

The proposed regulations add subsection 149(g)(2), Exceptions for Live Bait Purposes.

The proposed regulations add subsection 149(g)(2)(A), “Notwithstanding subsection (g)(1), vessels pursuing squid for live bait purposes only are not required to possess a permit described in subsection 149.1(b)”. This change restates and clarifies language in current subsection (f) that states, “This regulation does not apply to…vessels pursuing squid for live bait purposes only.” Language in current subsection (f) regarding seine skiffs is repealed as proposed subsection 149(a)(1) states that seine skiffs do not require a permit issued pursuant to Section 149.1 and do not use lights to attract squid.

The proposed regulations add subsection 149(g)(2)(B), “Subsection (g)(1)(B) does not apply to vessels pursuing squid for live bait purposes only during the weekend closure, if the following conditions are met:

1. Lights shall only be used to aggregate squid while actively taking or searching for squid and shall be turned off immediately upon completion of fishing for live bait.

2. All squid taken shall be maintained in a condition to be sold as live bait. Squid taken under this exemption shall not be used as live bait aboard the vessel that took it, and any squid not sold shall be returned to the water prior to the end of the weekend closure.

3. The operator of any vessel intending to utilize this live bait exemption shall provide prior notification via email to LEDMarineNotifications@wildlife.ca.gov prior to the vessel leaving port on that fishing trip. The notification shall include all of the following: operator’s name, vessel name, anticipated fishing date(s), port of departure, expected port of landing, fishing block(s) where live bait fishing activity will occur, live bait method

of take, description of how sales of live bait will occur, Dealer ID number, and, if applicable, Live Bait Dealer ID number."

This subsection is necessary to lay out the requirements for the commercial take of squid for live bait purposes during the weekend closure for the sustainable management of the fishery and to ensure vessels do not use lights for other purposes, while claiming to be engaged in the take of live bait. Minimizing the use of lights by only allowing their use while actively fishing is important for spawning and completion of life history requirements. Maintaining squid in a condition to be sold as live bait Is necessary to ensure freshness of live bait. Advance notification of take is necessary so that the Department has record of those taking market squid for live bait on the weekend.

Amend current subsection 149(h), renumbered as subsection (i), Light Shields.

Current regulation requires that the light scatter of fishing operations be reduced by shielding "the entire filament of each light." The proposed regulation replaces "of each light" with "or device capable of emitting light".

This change is necessary to address potential changes to lighting devices in the future.

Amend current subsection 149(l), renumbered as subsection (m), Incidental Take Allowance.

Current regulations specify that other requirements of this Section do not apply to incidental take. The proposed amendment states that other requirements of this Section, except subjection (g), do not apply to incidental take. This amendment was needed to clarify that vessels incidentally taking squid may not use lights.

Additional minor changes are proposed in Section 149 for clarity and consistency in re-numbering subsections, and updating pronouns and cross-references.

Amend Section 149.1. Market Squid Fishery Restricted Access Program.

Amendments are proposed to subsection 149.1(a) to update references to renumbered subsections in Section 149. No other amendments are proposed for Section 149.1.

(b) Goals and Benefits of the Regulation

The California Legislature has declared that the Pacific Ocean and its rich marine living resources are of great environmental, economic, aesthetic, recreational, educational, scientific, nutritional, social, and historic importance to the people of California.

It is the policy of the state to ensure the conservation, sustainable use, and, where feasible, restoration of California's marine living resources for the benefit of all the citizens of the state. The objectives of this policy include but are not limited to conserving the health and diversity of marine ecosystems and marine living resources; allowing and encouraging only those activities and uses of marine living resources that are sustainable; recognizing the importance to the economy and the culture of California of sustainable commercial fisheries; managing marine living resources on the basis of the best available scientific information and other relevant information that the Commission or Department possesses

or receives; and involving all interested parties in marine living resource management decisions.

Consistent with this policy, the proposed changes to weekend closure and requirement of rib line to the market squid regulations reflect what was discussed and agreed upon during the multiyear SFAC process. These changes will help to ensure long-term conservation and sustainability of the market squid resource.

(c) Authority and Reference Sections from Fish and Game Code for Regulation

Section 53.01

Authority: Sections 7071, 7078 and 8425, Fish and Game Code.
Reference: Sections 7071, 7075, 7078, 7083, 7086, 8420 and 8425, Fish and Game Code

Section 53.02

Authority cited: Section 7071, 7078 and 8425, Fish and Game Code.
Reference: Sections 7071, 7075, 7083, 7652, 8420 and 8425, Fish and Game Code.

Section 53.03

Authority cited: Section 7071, 7078 and 8425, Fish and Game Code.
Reference: Sections 7071, 7075, 7082, 7083, 8420 and 8425, Fish and Game Code.

Section 149

Authority: Sections 7078, 7701, 7708, 8026, 8425 and 8429.5, Fish and Game Code.
Reference: Sections 7701, 7708, 8026, 8425, 8429.5, 8429.7, 12159 and 12160, Fish and Game Code

Section 149.1

Authority: Sections 713, 1050, 7071, 7078, 7923, 8026, 8425, 8428 and 8429.5, Fish and Game Code.
Reference: Sections 1050, 7050, 7071, 7701, 7708, 7852.2, 7923, 8026, 8101, 8425, 8428, 8429.5 and 8429.7, Fish and Game Code.

(d) Specific Technology or Equipment Required by Regulatory Change

The proposed change to require a rib line to purse seine nets by December 31, 2030 does not specify a specific rib line that is needed. It must adhere to the specifications described in subsections 53.01(t) and 149(f), which state that the rib line must be rope or non-metallic, a minimum of 36 inches above the leadline, and encompass the purse seine net within 60 feet of both ends of the net.

(e) Identification of Reports or Documents Supporting Regulation Change

California Department of Fish and Wildlife. 2005. Final Market Squid Fishery Management Plan, dated March 25, 2025.

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

California Department of Fish and Wildlife. 2024. Squid Fishery Advisory Committee Review of California - Market Squid Fishery Management and Proposed Recommendations. Presented to the Marine Resources committee Meeting of the Fish and Game Commission, July 18, 2024.

(f) Identification of Reports or Documents Providing Background Information

Commission 2024, Staff Summary for July 17-18, 2024 Marine Resource Committee Meeting on Market Squid Fishery Management and Fishery Management Plan (FMP) Review.

Commission 2024, Staff Summary for November 6-7, 2024 Marine Resource Committee Meeting on Market Squid Fishery Management and Fishery Management Plan (FMP) Review.

(g) Public Discussions of Proposed Regulations Prior to Notice Publication

Ten public meetings of the SFAC were held, specifically focused on developing options for market squid fishery management updates. Following those meetings, two meetings of the Commission's Marine Resources Committee included discussions of the proposed recommendations as follows:

- Meeting 1 – February 9, 2023; Virtual
- Meeting 2 – April 18, 2023, Santa Cruz
- Meeting 3 – May 16, 2023, Virtual
- Meeting 4 – July 12, 2023, Virtual
- Meeting 5 – August 15, 2023, Seal Beach
- Meeting 6 – October 6, 2023, Virtual,
- Meeting 7 – November 15, 2023, Virtual
- Meeting 8 – January 26, 2024, Oakland
- Meeting 9 – March 21, 2024, Santa Barbara
- Meeting 10 – May 1-2, 2024, Long Beach
- Marine Resource Committee Meeting – July 18, 2024, Santa Rosa
- Marine Resource Committee Meeting – November 7, 2024, Sacramento

IV. Description of Reasonable Alternatives to Regulatory Action

(a) Alternatives to Regulation Change

No alternatives to changes to sections 53.01, 53.02, and 53.03 were identified.

No alternatives to the market squid fishery closure notification were identified by or brought to the attention of Commission staff.

Other alternatives to the extended weekend closure included extending the closure from Friday at 7am to Monday at 7am, statewide. However, the SFAC expressed that losing one

day of production each week is not cost effective because processors need to employ people five days a week. SFAC members also wanted a specific closure to the Monterey area due to greater concern about the impact on squid spawning and on-the-water conflicts with recreational users.

An alternative to the rib line requirement would be to require a net depth restriction. This would require fishing vessels to use a shallower net to reduce any bottom contact without the need for retrofitting of the purse seine net. This was discussed during the SFAC process, and it was determined that the Department does not have the ability to enforce a net depth restriction. Also, members of the SFAC have said that operators can own several different purse seine nets with varying depths and requiring shorter nets will reduce access to deeper water and will put more pressure on shallower fishing areas.

An alternative subsection (g) - Lights to Aggregate Squid would be to not allow squid lighting on the weekend while fishing for market squid as live bait. This was not considered because it would have a negative effect on the recreational fishing fleet purchasing market squid as live bait from the market squid fishing fleet.

An alternative to prohibit lighting around all or portions of the California Channel Islands was discussed during the SFAC process to additionally protect seabirds. Based on improved seabird breading and population status in the area, existing marine protected areas around seabird colonies, and potential impacts to the squid fishery, this alternative was determined to be unnecessary.

(b) No Change Alternative

Without the proposed changes, the outstanding issues concerning the regulations currently governing impacts to seafloor habitats, reduced spawning potential, weekend lighting for market squid exemption, and VHF channel 16 notifications would remain unaddressed.

V. Mitigation Measures Required by Regulatory Action

The proposed regulatory action will have no negative impact on the environment; therefore, no mitigation measures are needed.

VI. Impact of Regulatory Action

The potential for significant statewide adverse economic impacts that might result from the proposed regulatory action has been assessed, and the following initial determinations relative to the required statutory categories have been made:

(a) Significant Statewide Adverse Economic Impact Directly Affecting Businesses, Including the Ability of California Businesses to Compete with Businesses in Other States

The Commission anticipates that the proposed regulations will directly impact commercial market squid vessel permit holders and the market squid lighting boats that service those commercial fishing operations. The proposed live bait weekend light use reporting requirements are expected to have a direct economic impact of approximately $9,988, the total loss to light boats from the closures ($399,902), the proposed rib line requirements are expected to cost approximately $885,000, and estimated total economic effect of the proposed closures is $3,298,987. Combined, the total economic impact from the proposed

regulations is estimated to be $ 4,593,877, see the economic analysis in the addendum to the economic and fiscal impact statement (STD 399) for more information. The change in costs is not anticipated to affect the competitiveness of the California commercial market squid fishery with other states, as the regulations are intended to protect squid egg beds on the sea floor and preserve the sustainability of the fishery.

(b) Impact on the Creation or Elimination of Jobs Within the State, the Creation of New Businesses or the Elimination of Existing Businesses, or the Expansion of Businesses in California; Benefits of the Regulation to the Health and Welfare of California Residents, Worker Safety, and the State's Environment

The proposed weekend closures are expected to have a total economic effect of $3,298,987, which is expected to eliminate up to 19 jobs (3 from the statewide closure and 16 from the Monterey closure). The proposed regulations for rib lines and the reporting requirements for light boats participating in the live bait fishery are not anticipated to have any additional impacts to job creation or elimination.

The Commission does not anticipate that the proposed regulations will affect the creation of new businesses, the elimination of existing businesses, or the expansion of businesses within the state.

The Commission anticipates benefits to the state's environment including but not limited to the following: conserving the health and diversity of marine ecosystems and marine living resources; allowing and encouraging only those activities and uses of marine living resources that are sustainable; recognizing the importance to the economy and the culture of California of sustainable commercial fisheries; managing marine living resources on the basis of the best available scientific information and other relevant information that the Commission or Department possesses or receives; and involving all interested parties in marine living resource management decisions. No benefits to the health and welfare of California residents or to worker safety are anticipated as a result of these proposed regulations.

(c) Cost Impacts on a Representative Private Person or Business

The Commission anticipates that the per businesses costs for the proposed regulations is $46,736 per business using purse seines, with the light boat cost of $14,639 per vessel, a brail fisher cost of approximately $2,648 per vessel, and an average small business cost of approximately $17,746 per vessel. See the economic analysis in the addendum to the STD 399 for further details.

(d) Costs or Savings to State Agencies or Costs/Savings in Federal Funding to the State

The Commission anticipates that the proposed regulatory action will incur a fiscal impact on state government. Enforcement of the proposed regulations will require some of the Department's wildlife officers to undergo additional training to learn the new regulations, which is estimated to be $27,254.88.

(e) Nondiscretionary Costs/Savings to Local Agencies: None

(f) Programs Mandated on Local Agencies or School Districts: None

(g) Costs Imposed on Any Local Agency or School District that is Required to be Reimbursed Under Part 7 (commencing with Section 17500) of Division 4, Government Code: None

(h) Effect on Housing Costs: None

VII. Economic Impact Assessment

(a) Effects of the Regulation on the Creation or Elimination of Jobs Within the State

The Commission anticipates that the proposed regulations for a weekend closure may impact jobs within the state. The proposed weekend closures are expected to have a total economic effect of $3,298,987, which is expected to impact up to 19 jobs (3 from the statewide closure and 16 from the Monterey closure). Information for how these estimates were arrived at using the California Ocean Fish Harvester Economic (COFHE) model may be found in the addendum to the STD 399.

(b) Effects of the Regulation on the Creation of New Businesses or the Elimination of Existing Businesses Within the State

The Commission does not anticipate that the proposed regulations will affect the creation of new businesses or the elimination of existing businesses within the state. While the proposed regulations are anticipated to generate some economic impacts, none of the anticipated impacts are expected to make entry into the market squid fishery more difficult or continued activity less viable.

(c) Effects of the Regulation on the Expansion of Businesses Currently Doing Business Within the State

The Commission does not anticipate an expansion of businesses currently doing business within the state as a result of the proposed regulations.

(d) Benefits of the Regulation to the Health and Welfare of California Residents

The Commission does not anticipate impacts on the health and welfare of California residents.

(e) Benefits of the Regulation to Worker Safety

The Commission does not anticipate impacts to worker safety.

(f) Benefits of the Regulation to the State’s Environment

The Commission anticipates benefits to the state’s environment including but not limited to the following: conserving the health and diversity of marine ecosystems and marine living resources; allowing and encouraging only those activities and uses of marine living resources that are sustainable; recognizing the importance to the economy and the culture of California of sustainable commercial fisheries; managing marine living resources on the basis of the best available scientific information and other relevant information that the Commission or Department possesses or receives; and involving all interested parties in marine living resource management decisions.

(g) Other Benefits of the Regulation

None.

Unless otherwise specified, all section references in this document are to Title 14 of the California Code of Regulations (CCR).

The market squid fishery is regularly the largest commercial fishery in California, in both volume and ex-vessel value. Managed under the Commission's authority since 2001, the fishery operates within the framework of the Market Squid Fishery Management Plan (FMP) adopted by the Commission in 2004. The FMP defines harvest control rules, a restricted access program, environmental protections, and fishery administration.

While regulations have been periodically adopted to adaptively manage various aspects of the fishery, 2021 marked the initiation of the first comprehensive review of market squid FMP since its adoption. The Department developed a multi-phase management review, supported by the Commission, and anchored in a Squid Fishery Advisory Committee (SFAC). Established by the Department's Director according to Title 14, Section 53.02, the SFAC played a crucial role in assisting with developing and reviewing fishery assessments, management options and proposals, and FMP amendments.

The following proposed changes to market squid regulations reflect Department recommendations and include regulatory changes discussed and agreed upon during the multiyear Squid Fishery Advisory Committee process.

Proposed Amendments

The proposed regulations add a definition of a rib line and will require the use of a purse seine rib line which must be placed above the purse seine leadline after December 31, 2030..

Proposed regulations will extend the current weekend market squid fishery closure from noon to 7am on Friday statewide as well as an additional extension from Sunday at noon to Sunday at 11:59pm in the Monterey Bay Area (between a line due west from Point Lobos (36º 31.461' North Latitude) and a line due west from Pigeon Point (37º 11.000' North Latitude).

In addition, the Department is proposing changes for an administrative topic not discussed during SFAC meetings addressing the notification method used for closing a fishing season. The proposed regulations replace language in subsection 149(b)(2)(B) related to the responsibility of operators to determine when the seasonal catch limit is expected to be reached and the fishery closed by monitoring VHF/channel 16 with language specifying they should monitor the Department's website wildlife.ca.gov/marine. Additional proposed changes in this subsection regarding what constitutes official notice of the closure replace VHF/channel 16 with the Department's website.

Other changes not discussed during the SFAC process include cleaning up language for taking market squid for live bait during the weekend closure, updating lighting regulation in anticipation of changes in lighting technology, and clarify that a purse seine skiff does not need its own market squid vessel permit.

The proposed regulations clarify that using lights to attract squid is considered a form of take and that such lights generally may not be used during the weekend closures. The exemption for lighting on the weekend when taking market squid as live bait is proposed to be amended

to ensure vessels do not use lights for other purposes, while claiming to be engaged in the take of live bait. The amendment will clarify 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.

The “Gulf of Farallones National Marine Sanctuary” will be updated to “Greater Farallones National Marine Sanctuary”. This change updates the name of the national marine sanctuary currently in Code of Federal Regulations (CFR), Part 922, subpart H.

Proposed amendments also remove the definition the Market Squid FMP. The FMP does not require a definition, as it is described in Section 53.00. Furthermore, it is not necessary to incorporate the document by reference as the FMP is not intended to have the force of law, because it is an informational document rather than a regulation.

Amendments are proposed to subsection 149.1(a) to update references to renumbered subsections in Section 149.

Sections 53.02 and 53.03 are proposed to be repealed as they are either duplicative of existing authority or are general policy statements rather than regulations and therefore are not necessary.

Finally, other ,minor changes are proposed for clarity and consistency.

Benefit of the Regulations:

It is the policy of the state to ensure the conservation, sustainable use, and, where feasible, restoration of California’s marine living resources for the benefit of all the citizens of the state. The objectives of this policy include but are not limited to conserving the health and diversity of marine ecosystems and marine living resources; allowing and encouraging only those activities and uses of marine living resources that are sustainable; recognizing the importance to the economy and the culture of California of sustainable commercial fisheries; managing marine living resources on the basis of the best available scientific information and other relevant information that the Commission or Department possesses or receives; and involving all interested parties in marine living resource management decisions.

Consistent with this policy, the proposed changes to market squid regulations reflect what was discussed and agreed upon during the multiyear SFAC process. These changes will help to ensure long-term conservation and sustainability of the market squid resource.

Consistency and Compatibility with Existing Regulations:

The proposed regulations are neither inconsistent nor incompatible with existing state regulations. Section 20, Article IV, of the state Constitution specifies that the Legislature may delegate to the Commission such powers relating to the protection and propagation of fish and game as the Legislature sees fit. The Legislature has delegated to the Commission the power to adopt regulations governing market squid (California Fish and Game Code Section 8425). No other state agency has the authority to adopt regulations governing market squid. The

Commission has reviewed its own regulations and finds that the proposed regulations are neither inconsistent nor incompatible with existing state regulations. The Commission has searched the CCR for any regulations regarding the adoption of market squid regulations; therefore, the Commission has concluded that the proposed regulations are neither inconsistent nor incompatible with existing state regulations.

Proposed Regulatory Language

Section 53.01, Title 14, CCR, is amended to read:

§ 53.01 Definitions.

(a) *Brail gear, dip nets or scoop* nets means any net attached to a rigid frame operated by hand or mechanical device deployed from the vessel to scoop fish or invertebrates.

(b) *Daily trip limit* means a routine management measure which may be used to limit take of squid on a per-vessel basis within a calendar day.

(c) *Drum seine* means a purse seine net which is stored, deployed and retrieved with the aid of a mechanized drum (reel) mounted on the stern of the vessel.

(d) *Egg escapement* means the number or proportion of a female squid's lifetime supply of eggs that she is able to deposit, on average, before being taken in the fishery.

(e) *Egg escapement method* means 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.

(f) *Fishing year or fishing season* under the Market Squid FMP means the period April 1 through March 31.

(g) *Fishery Control Rules* means 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.

(h) *Fleet capacity goal* means an optimal number of vessels where the number of vessels matches the available squid resource.

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

(j) *Lampara* means a rectangular net constructed with graduated mesh sizes, a definite bunt (bag), and fitted with floats. It is laid out by the fishing vessel in a circle and closed at least partially on the bottom by pulling the leadline in advance of the float line.

(k) *Light boat* means 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.

(*l*) *Market squid* means Doryteuthis opalescens.

~~(m) *Market Squid Fishery Management Plan (Market Squid FMP)* means Chapters 1 through 5 of the Market Squid Fishery Management Plan approved by the Commission on August 27, 2004, hereby incorporated by reference.~~

~~(n)~~ (m) *National Marine Fisheries Service, NMFS or NOAA Fisheries* means the federal fisheries management agency which is contained in the United States Department of Commerce.

~~(o)~~ (n) *Overfished* is defined at Fish and Game Code Section 97.5, and in the Market Squid FMP also means a condition that may exist when either the egg escapement threshold is not met, or catches of squid exceed any specified allowable level.

~~(p)~~ (o) *Overfishing* is defined at Fish and Game Code Section 98, and in the Market Squid FMP also may mean that harvests of squid are occurring at times when either the egg escapement threshold is not being met, or catches are exceeding specified allowable levels. These catches may not be sustainable.

~~(q)~~ (p) *PFMC or Council* means the Pacific Fishery Management Council established pursuant to the Magnuson-Stevens Fishery Conservation and Management Act.

~~(r)~~ (q) *Point of concern* means one or more of the following conditions affecting market squid that, if found or are expected to exist, may trigger the application or adjustment of one or more management measures by the commission:

(1) Catch is projected to significantly exceed the current seasonal catch limitation.

(2) Any adverse or significant change in the biological characteristics of the market squid (age composition, size composition, age at maturity, or recruitment) is discovered.

(3) An overfished condition exists or is imminent (defined as when the egg-escapement method threshold is not realized in two consecutive years).

(4) Any adverse or significant change in the availability of market squid as forage or in the status of a dependent species is discovered.

(5) An error in data or a change to an indicator of stock status is detected that requires adjustment to fishery control rules to ensure sustainable resource management.

~~(s)~~ (r) *Points of concern process* means a process authorizing the commission to apply or adjust fishery management measures at any time during the year based on the confirmation of the existence of one or more resource-based points of concern identified in a fishery management plan pursuant subsection 50.03(a), Title 14, CCR.

~~(t)~~ (s) *Purse seine* means a rectangular net constructed with uniform mesh sizes, without a prominent bunt (bag), and fitted with floats. It is laid out with the end attached to a skiff while the deploying vessel encircles the squid. The end of the net is then brought up to the deploying vessel and is closed ~~on~~ near the bottom by pulling a purse line (draw string) threaded through rings along the leadline, preventing the catch from escaping. Purse seines used to take market squid or onboard vessels in possession of market squid are fitted with a rib line.

(t) *Rib line* means a separate line made of soft rope or other non-metallic line that is a minimum of 36 inches above the leadline on a purse seine net. The rib line must encompass the purse seine net within 60 feet of both ends of the net.

(u) *Round haul vessels* mean those that employ the use of lampara, purse seine, and drum seine net gear to commercially harvest squid.

(v) *Seasonal catch ~~limitation~~ limit* means 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.

(w) *Tons* means short tons, and is the standard unit of weight for purposes of describing catches and limits for the market squid fishery, notwithstanding subsection 50.00(c), Title 14, CCR.

(x) *Vessel capacity* means the gross registered tonnage, as listed on a federal Coastal Pelagic Species permit or calculated from length, breadth and depth measurements provided on United States Coast Guard documentation papers.

(y) *Weekend closures* mean a routine management measure which may be used to prohibit take of market squid during certain days of a week.

(z) Definitions contained in Chapter 1, and Article 1 of Chapter 5.5, of Subdivision 1, Division 1, Title 14, CCR, and Chapters 1 and 2 of Division 0.5 of the Fish and Game Code apply to the market squid fishery in addition to definitions of this Section.

Note: Authority cited: Sections 7071, 7078 and 8425, Fish and Game Code. Reference: Sections 7071, 7075, 7078, 7083, 7086, 8420 and 8425, Fish and Game Code.

Proposed Regulatory Language

Section 53.02, Title 14, CCR, is repealed:

~~**§ 53.02. Process and Timing.**~~

~~(a) Management of market squid stocks will conform to the goals, objectives, criteria, procedures, and Fishery Control Rule guidelines of the Market Squid FMP, and other applicable state and federal laws and regulations.~~

~~(b) Periodic monitoring and assessment of squid fisheries will be conducted, and, at a minimum, will include the collection and review of reported catches. The department will provide management recommendations to the commission as needed, and in-season if a need is identified.~~

~~(c) The director may establish and appoint members to an advisory committee to assist the department with development and review of fishery assessments, management options and proposals, and plan amendments.~~

~~(d) Management measures and actions may be developed, considered, and adopted in compliance with the Administrative Procedure Act and implemented at any time of year to achieve management plan goals and objectives, and may apply to any or all management areas, or portions of management areas at the discretion of the commission.~~

~~NOTE: Authority cited: Section 7071, 7078 and 8425, Fish and Game Code. Reference: Sections 7071, 7075, 7083, 7652, 8420 and 8425, Fish and Game Code.~~

Proposed Regulatory Language

Section 53.03, Title 14, CCR, is repealed:

~~**§ 53.03. Market Squid Fishery Management Plan (Market Squid FMP) Project.**~~

~~(a) The Department's Recommended Proposed Project in the Market Squid FMP involves a combination of limitations on total harvest, regulation on the use of squid fishing gear (including lights), use of time closures to allow for periods of uninterrupted spawning, restricted access and other limits on the commercial fleet capacity, mechanisms to allow for adequate squid escapement, and area closures designed to minimize impact to sensitive non-target species and habitat. These management measures described in the Market Squid FMP will be utilized in managing the squid fishery toward meeting goals and objectives of the Market Squid FMP.~~

~~(b) Other management measures as described in the Market Squid FMP, including but not limited to vessel trip limits, squid replenishment areas, seasonal closures, and marine protected areas may be used as needed to achieve the goals and objectives of the Market Squid FMP.~~

~~(c) A fishery management measure may be adopted by the commission instead of, or in addition to, measures included in the adopted Market Squid FMP Project where specified in statute or state or federal regulation.~~

~~(d) Consistent with the goals of the Restricted Access program, the Commission established a sixth permit class for Non-Transferable Market Squid Light Boat Permits in addition to the original five permit classes and an experimental permit class identified in the discussion of the program in the Market Squid Fishery Plan.~~

~~NOTE: Authority cited: Section 7071, 7078 and 8425, Fish and Game Code. Reference: Sections 7071, 7075, 7082, 7083, 8420 and 8425, Fish and Game Code.~~

Proposed Regulatory Language

Section 149, Title 14, CCR, is amended to read:

§ 149. Commercial Taking of Market Squid.

Requirements of this Section apply both to vessels taking squid and to vessels attracting squid with lights for the purpose of commercial take. Incidental commercial take of market squid that meets the criteria specified in subsection ~~(l)~~ (m) below, and commercial take of market squid for live bait as described in subsection ~~(m)~~ (n) below are not subject to the requirements of this Section, unless expressly specified.

(a) Permit Required. No person shall take, land, or attract squid by light for commercial purposes, except as provided in subsections (a)(1), ~~(l) and~~ (m), and (n) below, unless the owner of that vessel has a valid market squid permit issued pursuant to Section 149.1 of these regulations for use on that vessel that has not been suspended or revoked.

(1) A market squid permit is not required for the seine skiff of a permitted vessel. For the purposes of this section, a seine skiff is a vessel that does not use lights to attract squid and its primary purpose is to assist the deployment of a net for a permitted vessel.

(b) Seasonal Catch ~~Limitation~~ Limit.

(1) For the period from April 1 through March 31 of the following year, a total of not more than 118,000 short tons of market squid may be taken statewide for commercial purposes.

(2) Closure Process

(A) The department shall estimate, from the current trend in landings, when the Seasonal Catch Limit will be reached, and will publicly announce the effective date of closure of the directed commercial fishery on the department's website at: wildlife.ca.gov/marine. ~~VHF/channel 16 between the hours of 10:00 p.m. and 12:00 a.m. (midnight).~~

(B) It shall be the responsibility of all operators of permitted market squid vessels to monitor ~~VHF/channel 16~~ the department's website at: wildlife.ca.gov/marine to determine when the Seasonal Catch Limit is expected to be reached and the fishery closed. Any announcement issued or made by the department on ~~VHF/channel 16~~ its website shall constitute official notice.

(c) Time Closures. North of a westerly extension of the United States — Republic of Mexico boundary line:

(1) Fishing Days: Market squid may not be taken for commercial purposes ~~between 1200~~ from 0700 hours ~~(noon)~~ on Friday ~~and~~ through 1200 hours (noon) on Sunday of each week, except between a line due west from Point Lobos (36º 31.461'

North Latitude) and a line due west from Pigeon Point (37º 11.000' North Latitude) where market squid may not be taken for commercial purposes from 0700 hours on Friday through 2359 hours on Sunday of each week.

(2) Seasonal Closure: When the Seasonal Catch Limit defined in subsection (b) has been reached and the commercial fishery is closed, squid may be taken for commercial purposes only incidentally to the take of other target species and subject to the limitations defined in subsection ~~149(l)~~ (m) below or for live bait as defined in subsection ~~149(m)~~ (n) below through March 31.

(d) Closed Areas for Seabirds. Market squid may not be taken for commercial purposes utilizing attracting lights in all waters of the ~~Gulf of the~~ Greater Farallones National Marine Sanctuary. Boundaries of the Sanctuary are defined as those in effect on August 27, 2004, pursuant to Title 15, Code of Federal Regulations (CFR), Part 922, Subpart H. This regulation also applies to vessels pursuing squid for live bait purposes.

(e) Records. Pursuant to Section 190 of these regulations, any operator of a commercial market squid vessel, or person who possesses a valid Market Squid Vessel Permit, Market Squid Brail Permit, or Market Squid Light Boat Permit shall complete and submit an accurate record of ~~his/ her~~ their squid fishing, lighting, or brailing activities on a form (Market Squid Vessel Logbook — DFW 149a (Rev. 05/01/15), or Market Squid Light/ Brail Boat Logbook — DFW 149b (Rev. 05/01/15), which are located in Appendix A of Subdivision 1 of Division 1 of Title 14, CCR) provided by the department, as appropriate to the type of fishing activity. Logbook records shall be transmitted to the department on or before the 10th day of each month following the month that fishing activity occurred.

(f) Rib Line. After December 31, 2030, it is unlawful to take market squid for commercial purposes using a purse seine net that is not pursed using a rib line as defined in Section 53.01. All purse seine nets onboard any vessel taking or possessing market squid for commercial purposes must have a rib line attached and the rib line must be used to purse the net. A rib line must be made of soft rope or other non-metallic line. All rib lines must be made available for inspection upon demand by authorized Department personnel pursuant to Fish and Game Code Section 2012.

~~(f)~~(g) Use of Lights to Aggregate Squid.

(1) General Regulations. It is unlawful to attract squid by light except as authorized under permits described in subsection 149.1(b) ~~of these regulations~~.

(A) Lights used to aggregate squid are considered a form of take. Lights commonly used to aggregate squid that are turned on or in use are prima facie evidence that the vessel's operator and crew are attempting to attract squid for commercial purposes.

(B) Lights used to aggregate squid for commercial purposes shall not be turned on or in use during weekend closures as defined by subsection (c)(1) of this section.

(2) Exceptions for Live Bait Purposes.

(A) Notwithstanding subsection (g)(1), ~~This regulation does not apply to seine skiffs of a permitted vessel, or to~~ vessels pursuing squid for live bait purposes only are not required to possess a permit described in subsection 149.1(b).

(B) Subsection (g)(1)(B) does not apply to vessels pursuing squid for live bait purposes only during the weekend closure, if the following conditions are met:

1. Lights shall only be used to aggregate squid while actively taking or searching for squid and shall be turned off immediately upon completion of fishing for live bait.

2. All squid taken shall be maintained in a condition to be sold as live bait. Squid taken under this exception shall not be used as live bait aboard the vessel that took it, and any squid not sold shall be returned to the water prior to the end of the weekend closure.

3. The operator of any vessel intending to utilize this live bait exception shall provide prior notification via email to LEDMarineNotifications@wildlife.ca.gov prior to the vessel leaving port on that fishing trip. The notification shall include all of the following: operator's name, vessel name, anticipated fishing date(s), port of departure, expected port of landing, fishing block(s) where live bait fishing activity will occur, live bait method of take, description of how sales of live bait will occur, Dealer ID number, and, if applicable, Live Bait Dealer ID number.

~~(g)~~(h) Maximum Wattage. Each vessel fishing for squid or lighting for squid shall utilize a total of no more than 30,000 watts of lights to attract squid at any time.

~~(h)~~(i) Light Shields. Each vessel fishing for squid or lighting for squid will reduce the light scatter of its fishing operations by shielding the entire filament ~~of each~~ or device capable of emitting light used to attract squid and orienting the illumination directly downward, or providing for the illumination to be completely below the surface of the water. The lower edges of the shields shall be parallel to the deck of the vessel.

~~(i)~~(j) Forfeiture. Squid landed or possessed in violation of this Section or any other provision of the Fish and Game Code or these regulations shall be forfeited to the department. The squid shall be sold or disposed of in a manner to be determined by the department. The proceeds from all sales shall be paid into the Fish and Game Preservation Fund.

~~(j)~~(k) Citations for violations of this Section may be issued to the vessel operator, crewmembers, and/or the holder of a market squid permit issued pursuant to Section 149.1~~ of these regulations~~.

~~(k)~~(l) Exemption from Tidal Invertebrate Permit. Operators and crewmembers of a commercial market squid vessel or light boat operating under the provisions of a commercial market squid permit are not required to possess a Tidal Invertebrate Permit, but are subject to the provisions of Section 123~~ of these regulations~~.

~~(l)~~(m) Incidental Take Allowance. Pursuant to this subsection, market squid may be taken for commercial purposes incidentally when engaged in fishing activities for other target species. Other requirements of this Section, except subsection (g), do not apply to incidental take. Incidentally-taken squid shall meet all of the following criteria:

(1) The volume of squid landed or possessed on a vessel shall not exceed 2 tons per trip.

(2) Market squid taken incidentally to other fisheries shall not exceed 10 percent of the total volume by weight of all fish landed or possessed on a vessel.

~~(m)~~(n) Exemption for Live Bait. Squid taken for live bait purposes shall only be possessed for use as live bait or sold as live bait. Other requirements of this Section do not apply to take of live squid for bait, unless expressly specified.

NOTE: Authority cited: Sections 7078, 7701, 7708, 8026, 8425 and 8429.5, Fish and Game Code.
Reference: Sections 7701, 7708, 8026, 8425, 8429.5, 8429.7, 12159 and 12160, Fish and Game Code.

Proposed Regulatory Language

Section 149.1, Title 14, CCR, is amended to read:

§ 149.1 Market Squid Fishery Restricted Access Program.

(a) Permit Required. On and after April 1, 2005, no person shall take, land, or attract squid by light for commercial purposes, except as provided in subsections ~~149(*l*) and 149(m)~~ 149(a)(1), 149(m) and 149(n), unless the owner of that vessel has a valid market squid permit for use on that vessel that has not been suspended or revoked.

[… No changes to subsections (b) through (r) …]

Authority cited: Sections 713, 1050, 7071, 7078, 7923, 8026, 8425, 8428 and 8429.5, Fish and Game Code. Reference: Sections 1050, 7050, 7071, 7701, 7708, 7852.2, 7923, 8026, 8101, 8425, 8428, 8429.5 and 8429.7, Fish and Game Code.

STD399 ADDENDUM

Amend Sections 53.01, 149 and 149.1,
Repeal Sections 53.02 and 53.03,
Title 14, California Code of Regulations
Re: Commercial Taking of Market Squid

Background

The market squid fishery is regularly the largest commercial fishery in California, in both volume and ex-vessel value. Managed under the Fish and Game Commission's (Commission) authority since 2001, the fishery operates within the framework of the market squid fishery management plan (FMP) adopted by the Commission in 2004. The FMP defines harvest control rules, a restricted access program, environmental protections, and fishery administration.

While regulations have been periodically adopted to adaptively manage various aspects of the fishery, 2021 marked the initiation of the first comprehensive review of the Market Squid FMP since its adoption. The Department of Fish and Wildlife (the Department) developed a multi-phase management review, supported by the Commission, anchored in a Squid Fishery Advisory Committee (SFAC). Established by the Department's Director according to Section 53.02, the SFAC played a crucial role in assisting with developing and reviewing fishery assessments, management options and proposals, and FMP amendments.

During the final SFAC meeting in May 2024, the Department presented draft recommendations to SFAC and adjusted the recommendations to reflect discussion points and expression of support from members. The SFAC recommended regulation changes, as well as non-regulatory actions.

In addition, the Department recommends changes for an administrative topic not discussed during SFAC meetings addressing the notification method used for closing a fishing season. As specified in current regulation (subsections 149 (b)(2)(A) and (B)), the Department is to notify the United States Coast Guard (USCG) to broadcast on VHF Channel 16 any upcoming closures to the market squid fishery. However, the USCG has indicated in a letter to the Department that it will no longer post notices via VHF 16 Broadcast Notice to Mariners because the "communication tools are reserved for important navigational safety information and deficiencies in aids to navigation". For market squid fishermen to be informed that there will be a closure, the proposed regulations specify that the Department will notify fishermen by posting to the Department's website.

The proposed regulations will require the use of a purse seine rib line which must be placed above the purse seine leadline. Department sampling data indicate that current purse seine fishing practices allow the net to scrape the seafloor in relatively shallow fishing areas and may increase benthic species bycatch. Requiring a rib line on purse seine nets will reduce contact with the seafloor. In addition, the proposed regulations will require the rib line to be made of non-metallic material instead of cable or chains (i.e., no metal lines), which will also reduce impacts to sea floor. This change mitigates

potential impacts to sandy bottom habitat and enhances sustainability by protecting squid egg beds and other benthic species.

The proposed regulations will extend by five hours the current weekend market squid fishery closure from noon to 7am on Friday statewide as well as an additional 12-hour extension from Sunday at noon to Sunday at 11:59 pm in the Monterey Bay Area (between a line due west from Point Lobos [36º 31.461' North Latitude] and a line due west from Pigeon Point [37º 11.000' North Latitude]). This change will increase the uninterrupted spawning time for market squid, which will benefit squid reproduction and spawning success. Department analyses during the SFAC process showed a difference between the northern and southern fishery areas, supporting the difference in closure end time proposed.

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. Vessels engaged in the take of market squid for live bait must also notify the Department in advance to indicate their intent to take live bait during a weekend closure.

ECONOMIC IMPACT STATEMENT

A. Estimated Private Sector Cost Impacts

Answer 1. a. Impacts businesses and/or employees **b.** Impacts small businesses e. Imposes reporting requirements:

The proposed regulations will require commercial fishers for squid to use a purse seine rib line which must be placed above the purse seine leadline, extend the current weekend market squid fishery closure, and require vessels engaged in the take of market squid for live bait to notify the Department in advance via email to indicate their intent to take live bait during a weekend closure.

Answer 3. Enter the total number of businesses impacted. Describe the types of businesses. Enter the number or percentage of total businesses impacted that are small businesses:

Department landing data indicates that 59 vessels landed squid using purse seines last year (2024), 28 of which had revenue under $1M and can be considered small businesses. Additionally, the 28 light boats affected by the closures in the proposed regulations are considered small businesses, and their revenue is generally estimated as about 20% of the landings value from the fishing vessels they assist. Finally, there were 48 vessels that fished for market squid using brail gear, all of which would be considered small businesses. In total, 104 out of the 135 businesses that the Commission anticipates will be affected by the proposed action can be considered small businesses.

Answer 6. Enter the number of jobs created and eliminated. Describe the types of jobs or occupations impacted.

The proposed expansion of statewide and Monterey closures may lead to the elimination of up to 19 jobs in the market squid commercial fishery. These jobs would mostly consist of deckhands and other support roles, see Tables 1 and 2 in Section B, Estimated Costs, for a complete description of how the value was estimated for the proposed closures.

B. Estimated Costs

Answer 1. What are the total statewide dollar costs that businesses and individuals may incur to comply with this regulation over its lifetime?

The immediate costs for installing the rib lines prescribed by these proposed regulations for purse seines are estimated by Marine Region staff to be approximately $10,000 if the owner bought materials and installed the rib lines themselves and $20,000 if they bought materials and hired someone to install rib lines. The cost across the 59 vessels that reported taking squid commercially by purse seines in 2024 is represented by the following:

Low estimate = $10,000 x 59 vessels = $590,000
High estimate = $20,000 x 59 vessels = $1,180,000
Average estimate = $15,000 x 59 vessels = $885,000

Currently the Department only possesses economic multipliers from the California Ocean Fish Harvester Economic (COFHE) model[1] for measuring the indirect and induced effects of the change in output (landings value) for commercial fisheries. The effects of a closure are measured in direct effects, indirect effects, and induced effects. The direct effects measure the response for a given industry per dollar of final demand for that same industry (in this case, income to lightboat or fishing vessels). Indirect effects measure the effect on other businesses that receive and distribute the harvest and are indirectly affected through changes in supply chain activity generated by the direct effects. Induced effects measure the effect on individuals who receive income from the above-mentioned business types who would also be affected should their income from the fishery and supporting businesses be reduced. These three impacts combine to give us the total economic effect.

Using the COFHE multipliers developed for the California commercial purse seine fisheries, the total statewide cost impacts (losses in total economic output) for the proposed five-hour expansion of the Friday closure of the market squid fishery are estimated to be $550,740, with an impact to approximately 3 jobs and direct impacts of approximately $283,326 to the 59 purse seine fishing vessels and the 48 brail fishing vessels affected by the proposed regulations, and is highlighted in Table 1. The total economic impacts for the proposed twelve-hour expansion of the Monterey Sunday

[1] Minnesota IMPLAN Group, Inc., 2014 with California Ocean Fish Harvester Economic (COFHE) Model multipliers. Available from: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=30738&inline

closure of the market squid fishery are estimated to be $2,748,247, with an impact to approximately 16 jobs, and is highlighted in Table 2. It should be noted that the Department's landing data indicates that only purse seine fishers are affected by the Monterey Sunday closure as there were no significant landings from brail fishers.

Table 1: Estimated 2025 Statewide Friday Closure Impacts – Purse Seine and Brail Vessels

COFHE Multipliers	Economic Output	Employment
Direct	$283,325.58	1.19
Indirect	$29,645.77	0.19
Induced	$237,768.81	1.75
Total Impact	$550,740.16	3.14

88,067.70	6,412.00	0.07

1,340,375.73	**267,485.80**	**0.20**
792,706.20	129,616.40	0.16
972,145.80	158,906.40	0.16
654,831.69	113,008.22	0.13

All of the 28 affected light boats are considered small businesses, and their revenue is generally estimated as about 20% of the landings value from the fishing vessels they assist, meaning that a fishery closure directly impacts their income. Based on the estimated value of landings for the proposed statewide and Monterey closures this represents a total value of approximately $399,902 in direct effects, as seen in Table 3. Dividing the combined value of the light boat income loss among the 28 light boats yields a cost of $14,282 per vessel.

Table 3: Estimated Light Boat Income Impact from Closures

	5-year Avg of Value	Est. Light Boat Income
Statewide Closure	$283,325.58	$56,665
Monterey Closure	$1,716,184.76	$343,237
Combined	$1,999,510.34	$399,902

Both the cost of rib line installation for commercial market squid vessels and the value

of lost income to light boats from the proposed closures represent direct effects to vessel income, and do not include the indirect effects or induced effects of those direct impacts because the COFHE model does not include multipliers for light boat activity, only for the effects related to landings.

Lastly, the reporting requirement for vessels targeting squid to notify the Department in advance prior to taking market squid for live bait during a weekend closure will impose a small reporting cost that is primarily expected to affect the 28 light boats. Program staff estimate that notifying the Department via email will require approximately 15 minutes of the vessel captain's time. Using California hourly wage estimates for First Line Supervisors of Farming, Fishing, and Forestry Workers from the U.S. Bureau of Labor Statistics [2] ($27.43/hour) yields a reporting cost of approximately $6.86 per vessel per weekend closure. If we overestimate the cost impact and assume that that up to 28 vessels will choose to participate during all of the weekend closures in a year, then the high-end of the total cost could be represented as the following:

28 vessels x 52 weekends x $6.86 = approximately $9,988 per year (approximately $357per vessel)

Combined with the light boat income loss of $14,282 per vessel, the cost to each light boat vessel is approximately $14,639.

Taking the value of the loss of landings from the proposed Friday closure (~ $283,326) and dividing it by the 107 vessels (59 purse seine and 48 brail) yields a per vessel cost of approximately $2,648 – this represents the only cost impact that brail fishers are likely to face. Doing the same with the Sunday closure (~ $1,716,185) and dividing it by the 59 affected purse seine vessels yields a per vessel cost of approximately $29,088. Combining this value with the estimated per vessel average cost of $15,000 for rib line installation for vessels using purse seines and the estimate for the statewide closure impact yields an estimated cost of approximately $46,736 per business that uses purse seine.

Approximately 28 of the vessels that fish for market squid using purse seines and all 48 of the vessels that fish using brail are considered small businesses, as well as the 28 light boats, for a combined 104 small businesses affected by the proposed regulations. Averaging out the cost of $46,736 per purse seine vessel with the light boat per vessel cost of $14,639 and the brail per vessel cost of $2,648 yields an average small business cost of approximately $17,746 per vessel using the following weighted average:

[($46,736 average cost per purse seine vessel x 28 purse seine vessels)+($14,639 average cost per light boat x 28 light boat vessels)+($2,648 average cost per brail vessel x 48 brail vessels)] / 104 small business vessels = $17,746 per small business vessel

A similar weighted average approach can be used for estimating the average among typical businesses:

[2] Farming, Fishing, and Forestry Occupations, U.S. Bureau of Labor Statistics

[($46,736 average cost per purse seine vessel x 59 purse seine vessels)+($14,639 average cost per light boat x 28 light boat vessels)+($2,648 average cost per brail vessel x 48 brail vessels)] / 135 vessels = $24,404 per vessel.

The combined cost of the total economic effects of the proposed Friday closure (~ $550,740) and Sunday Closure ($2,748,247), the estimate of the total annual reporting costs ($9,988), the total loss to light boats from the closures ($399,902), and the costs of rib line implementation ($885,000) is approximately $4,593,877.

C. Estimated Benefits

Answer 1. Briefly summarize the benefits of the regulation, which may include among others, the health and welfare of California residents, worker safety and the State's environment:

It is the policy of the state to ensure the conservation, sustainable use, and, where feasible, restoration of California's marine living resources for the benefit of all the citizens of the state. The objectives of this policy include but are not limited to conserving the health and diversity of marine ecosystems and marine living resources; allowing and encouraging only those activities and uses of marine living resources that are sustainable; recognizing the importance to the economy and the culture of California of sustainable commercial fisheries; managing marine living resources on the basis of the best available scientific information and other relevant information that the Commission or Department possesses or receives; and involving all interested parties in marine living resource management decisions.

Consistent with this policy, the proposed changes to market squid regulations reflect what was discussed and agreed upon during the multiyear SFAC process. These changes will help to ensure long-term conservation and sustainability of the market squid resource.

Benefits of the rib lines include reduced potential impact to sea floor habitats, including squid egg beds, which would lead to increased sustainability of market squid and potentially improved sea floor conditions.

Answer 3. What are the total statewide benefits from this regulation over its lifetime?

While the proposed regulations may not necessarily increase the value of the fishery, they may allow for sustainable conditions for the fishery to persist and preserve its continued use.

Without the proposed changes, the outstanding issues concerning the regulations currently governing impacts to seafloor habitats, reduced spawning potential, and VHF/channel 16 notifications would remain unaddressed. In particular, the potential of the rib line requirements to prevent damage to the sea floor may reduce the negative impact to squid beds, which would lead to increased sustainability of market squid and potentially improved sea floor conditions.

The proposed action will help to ensure long-term conservation and sustainability of the market squid fishery. The value of California's market squid landings is estimated to be

$42,981,272 based on the five-year average of annual landings data gathered by the Department, as seen in Table 4.

Table 4: Five-Year Value of Market Squid Fishery

Season	MLS catch estimate (pounds)	MLDS season total landed (Pounds)	MLDS season ex-vessel value
2019-2020	25,000	28,586,000	$15,202,556
2020-2021	380,700	36,562,500	$25,126,815
2021-2022	500,000	114,618,000	$75,117,998
2022-2023	39,600	100,825,500	$67,380,949
2023-2024	68,000	55,264,000	$32,078,042
5-year AVG	202,660	67,171,200	$42,981,272

Using the COFHE multipliers developed for the California commercial purse seine fisheries, the statewide value in total economic output for the market squid fishery is estimated to be $83,548,801.58, as seen in Table 5. Maintaining the sustainability for market squid fishery under the proposed regulations may not necessarily add to the value of the fishery but rather allow for its continued use.

Table 5: Estimated Value of CA Market Squid Fishery (5-year Avg)

OC-15 Multipliers	Economic Output
Direct	$42,981,272
Indirect	$4,497,345
Induced	$36,070,184
Total Impact	$83,548,802

D. Alternatives to The Regulation

Answer 2. Summarize the total statewide costs and benefits from this regulation and each alternative considered.

No alternatives to the market squid fishery closure notification were identified by or brought to the attention of Commission staff.

Other alternatives to the extended weekend closure included extending the closure from Friday at 7am to Monday at 7am, statewide. However, the SFAC expressed that losing one day of production each week is not cost effective because processors need to

employ people five days a week. SFAC members also wanted a specific closure to the Monterey area due to greater concern about the impact on squid spawning and on-the-water conflicts with recreational users.

An alternative to the rib line requirement would be to require a net depth restriction. This would require fishing vessels to use a shallower net to reduce any bottom contact without the need for retrofitting of the purse seine net. This was discussed during the SFAC process, and it was determined that the Department does not have the ability to enforce a net depth restriction. Also, members of the SFAC own several different purse seine nets with varying depths and requiring shorter nets will reduce access to deeper water and will put more pressure on shallower fishing areas.

FISCAL IMPACT STATEMENT

A. Fiscal Effect on Local Government

Answer 5. No fiscal impact.

The Department anticipates that the proposed regulatory action will have no fiscal effect on any local government entity or program.

B. Fiscal Effect on State Government

Answer 1. Additional expenditures in the current fiscal year. (Approximately)

$27,254.88

The Commission anticipates that the proposed regulatory action will incur a fiscal impact on state government. Enforcement of the proposed regulations will require some of the Department's wildlife officers to undergo additional training to learn the new regulations, learn what a rib line is, learn how to locate and inspect a rib line, understand how rib lines are used in the field by fishing boat operator and crew, and learn what it looks like if a boat operator or crewmember is not using the rib line to purse the net. The Department anticipates that 6 Lt. Specialists, 8 Lt. Supervisors, and 32 Wardens will need to go through approximately 8 hours of additional training, which will include a combination of online, classroom, and field training. The fiscal impact of the training is anticipated to be $27,254.88 (Table 6: Fiscal Impact of Additional Marine Enforcement Division [MED] Officer Training), and the Department anticipates that this cost will be absorbed within its existing budget.

Table 6: Fiscal Impact of Additional MED Wildlife Officer Training

Classification	Hours	Rate	# of Officers	Total
FISH AND GAME LIEUTENANT (SPECIALIST)	8	$91.05	6	$4,370.40
FISH AND GAME LIEUTENANT (SUPERVISOR)	8	$99.13	8	$6,344.32

FISH AND GAME WARDEN, DEPARTMENT OF FISH AND GAME	8	$64.61	32	$16,540.16
				$27,254.88

Source: CalHR CDFW Salary Data, October 3, 2024

The Commission does not anticipate that any other state agencies or programs will be affected by this regulatory action.

C. Fiscal Effect on Federal Funding of State Programs

Answer 3. No fiscal impact.

The proposed regulatory action will not have a fiscal effect on federal funding of state programs.

Market Squid Proposed Regulations and Fishery Management Plan Amendment

17 April 2025

Presented to:

CA Fish and Game Commission

Presented by:

Trung Nguyen

Environmental Scientist
Marine Region

Outline

- Current Market Squid Fishery Management Plan (FMP)
- Squid Fishery Advisory Commission (SFAC) Process
- SFAC and Department Recommendations
- Proposed Changes to Market Squid Regulations
- Proposed FMP Amendment 1

Market Squid FMP

- Market Squid FMP adopted by Commission 2004 – Implemented 2005
- Goals
  - Ensure long term conservation and sustainability
  - Reduce overfishing
  - Management responsive to environmental and socioeconomic changes

Original FMP Management Measures

- Established:
  - Fishery Control Rules
    - Seasonal catch limit
    - Weekend closures
    - Light shield requirements and wattage limits
    - Monitoring programs
  - A restricted access program
  - Lighting restrictions within the Greater Farallones National Marine Sanctuary.

Squid Fishery Advisory Committee

SFAC Charge

Review and advise the California Department of Fish and Wildlife on potential changes to California market squid fishery management

SFAC Members

Fishing Community

Conservation

Non-Consumptive

Research

Squid Fishery Management Web Page
https://wildlife.ca.gov/Conservation/Marine/MSFMP

SFAC Recommendations

- FMP amendment and regulatory changes
  - Extended weekend closures
  - Rib line and rope purse line requirement

Department Recommendations

- FMP amendment and regulatory changes
  - Extended weekend closures
  - Rib line and rope purse line requirement
  - Fishery closure notification change
  - Squid lighting clarity

Market Squid Regulation Changes

- **Definitions** (Section 53.01, Title 14, CCR)
  - Update and add new
- **Commercial Take of Market Squid** (Section 149)
  - Fishery closure notification
  - Weekend closure
  - Rib line and rope purse line
  - Use of lights to aggregate squid
- **Market Squid Fishery Restricted Access Program** (Section 149.1)
  - Update cross-references to Section 149
- **Process and Timing and Market Squid FMP Project** (Sections 53.02 and 53.03)
  - Repeal (outdated)

Weekend Closure Extension

Department Recommendation:

Current Closure

Proposed Closure

- Extend weekend closure
  - 7am Friday to noon Sunday, Statewide

  - Monterey Bay Area extends to Sunday at midnight
    - Area: Point Lobos (36° 31.461’ North Latitude) and Pigeon Point (37° 11.000’ North Latitude)

Monterey Bay Area Weekend Closure

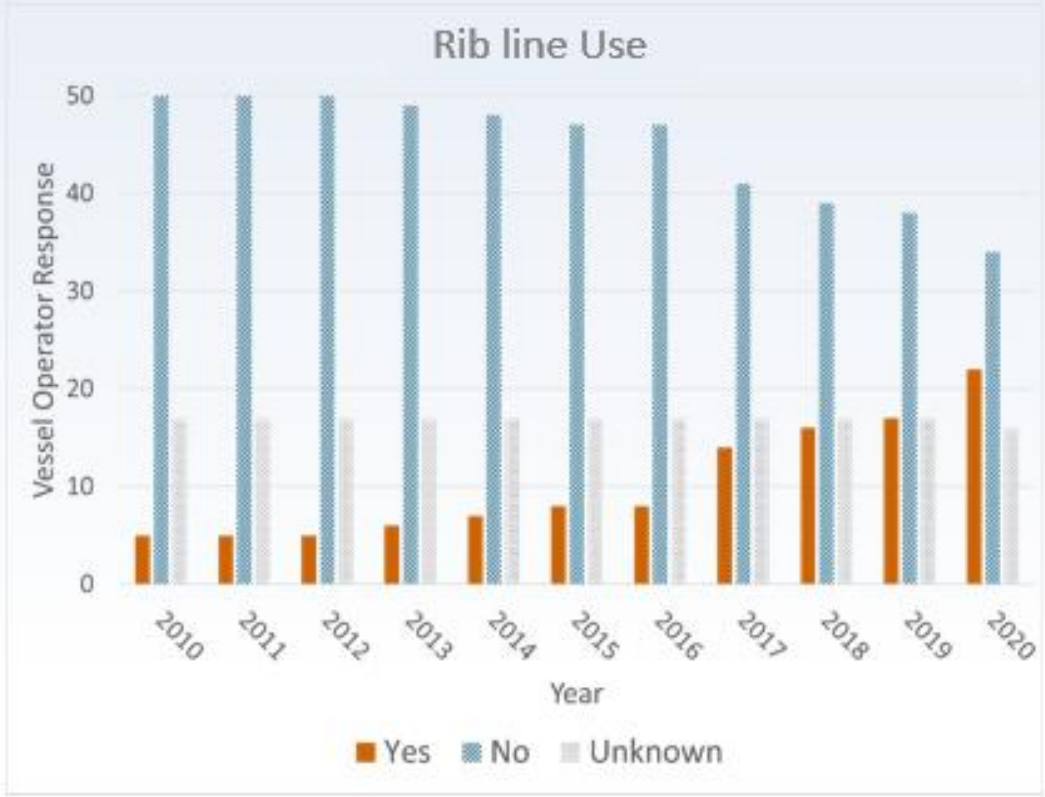
Monterey Bay Area

Area: Point Lobos (36º 31.467’ North Latitude) and Pigeon Point (37º 11.000’ North Latitude)

Rib line Requirement

Department Recommendation:

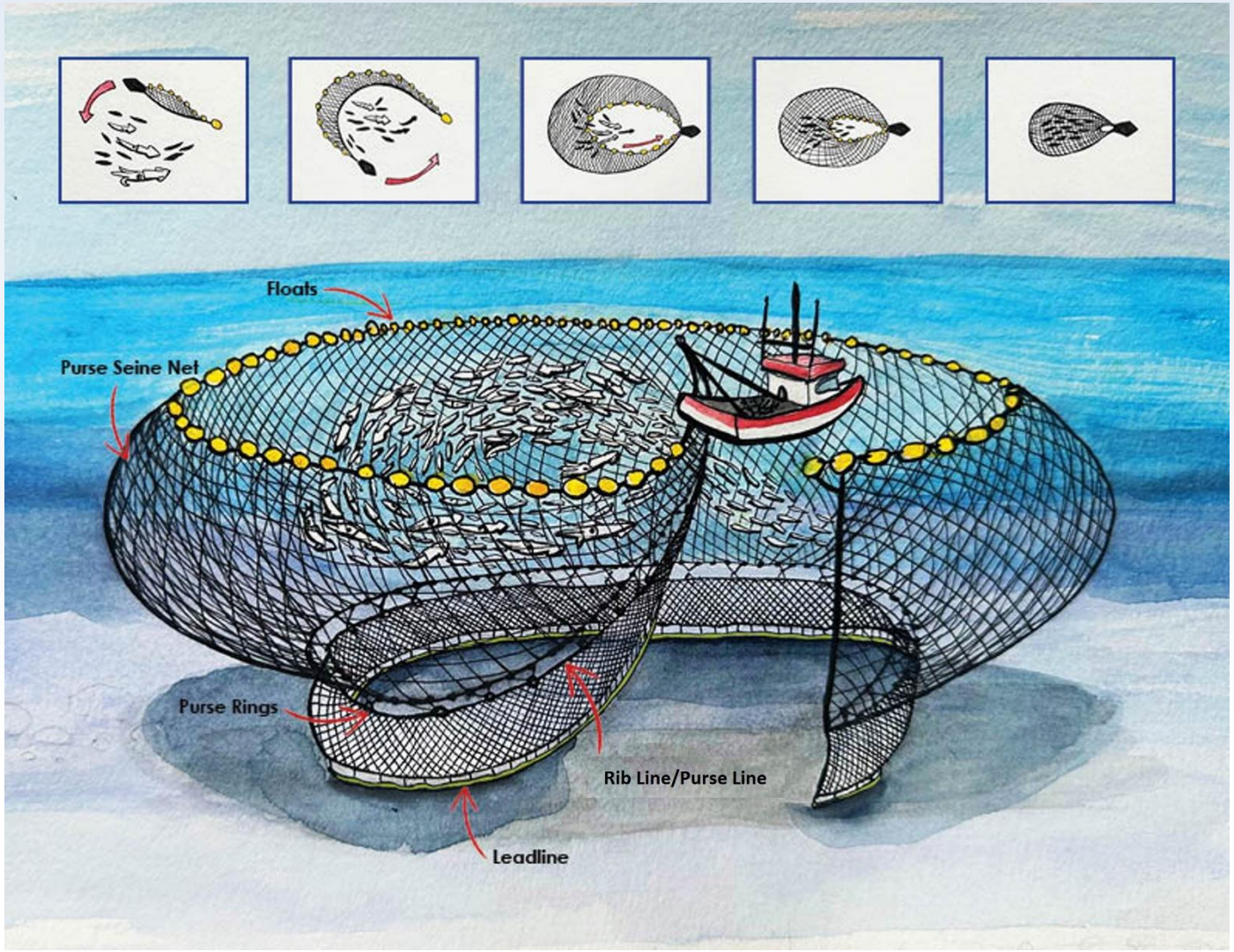
- Help protect seafloor habitat
- Require a non-metallic rib line
  - Rib line use continues to increase in the fleet
  - Dockside sampling indicates rib lines reduce bycatch for most benthic species

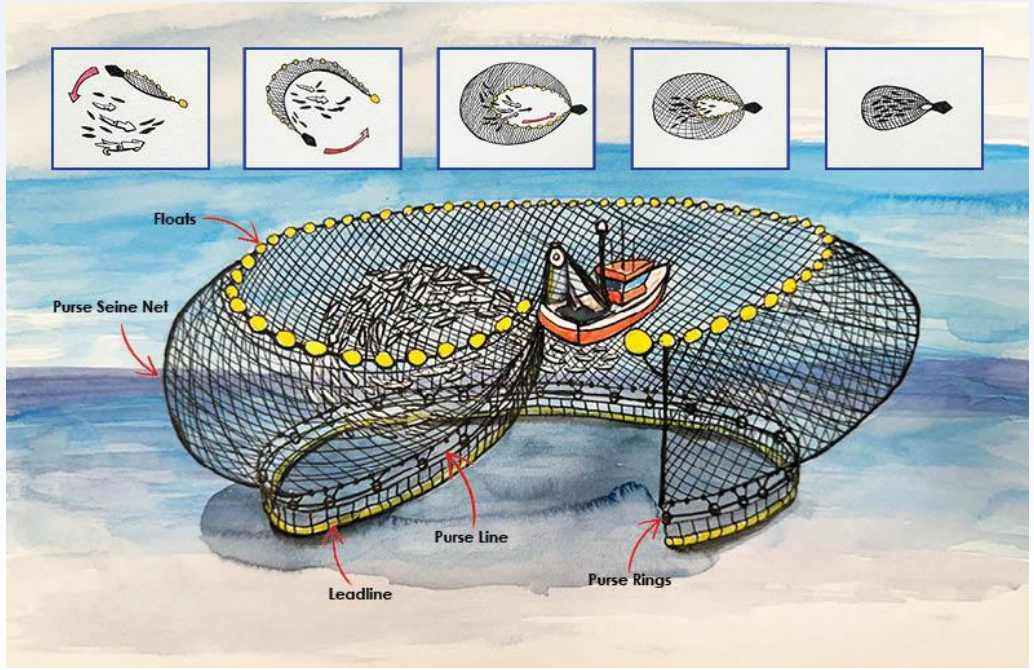


Rib Line Requirement

- Require a rib line
- Must be used to purse net
- Must be at least 36” above the leadline
- Must encompass purse seine net
- Rib line must be rope (no cable or chain)
- Required after December 31, 2030

Rib Line Diagram



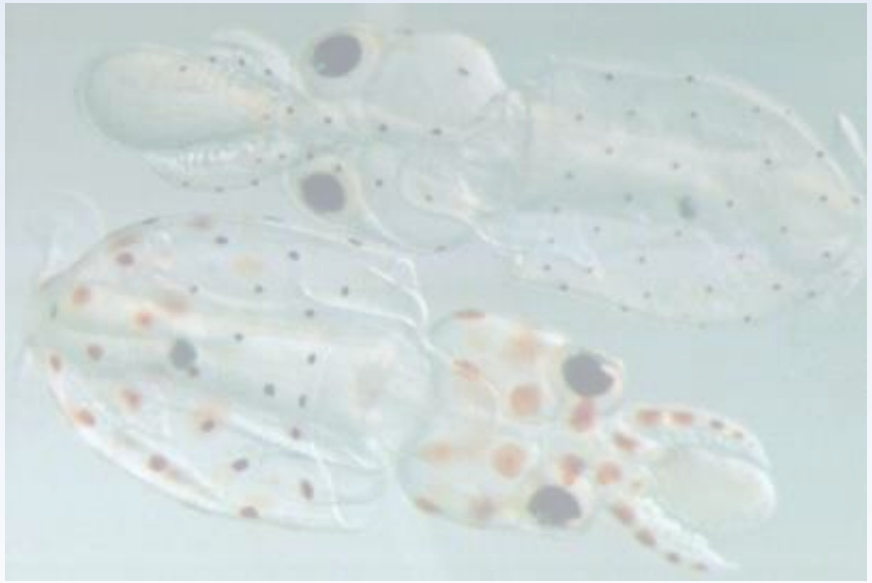


Use of Lights to Aggregate Squid

- Weekend lighting exemption amended for clarity
  - Only while actively taking market squid for live bait
  - Unsold squid must be released into water
  - Department notification via email before trip

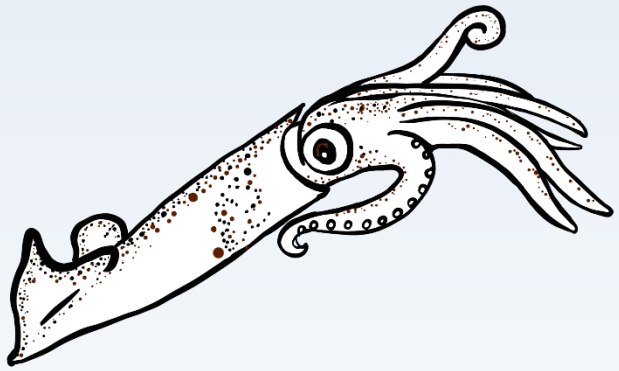
First Ever Commission FMP Amendment

- Section 1 (Chapters 1-5)
  - *Chapter 1* – Introduction
    - Rationale for Market Squid Fishery Management review
    - Added Marine Life Management Act and Enhanced Status Report information
  - *Chapter 2* – Background
    - Updated biological and ecological information
  - *Chapter 3* – Management measures
    - Rationale for extended weekend closure and new gear provisions
    - Ongoing Department monitoring programs, best practices for lighting
    - Removed experimental market squid vessel permits
    - Added proposed Experimental Fishing Permits



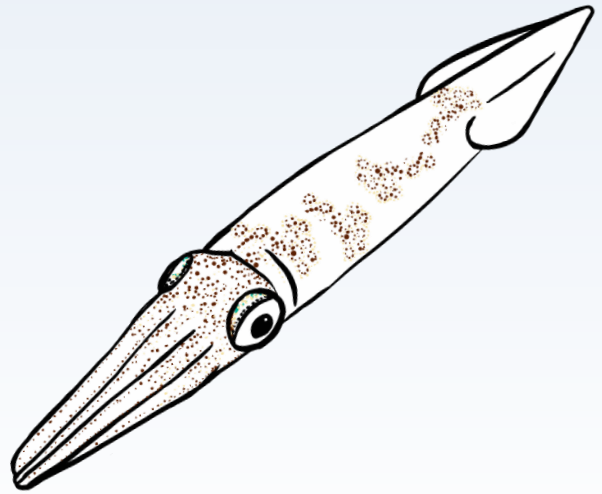
FMP Amendment Chapters 4 and 5

- Section 1 (Chapters 1-5), cont.
  - *Chapter 4* – Research
    - Updated past and ongoing monitoring information
    - Transition to electronic logs
    - Updated current knowledge of essential fishery information
    - Empirical dynamical modeling
  - *Chapter 5* – Future management needs and management costs
    - Added future management needs and potential changes
    - Updated estimated annual management costs



FMP Amendment Other Sections

- Section 2 - Original environmental analysis
  - Not included in FMP amendment
  - Remains unchanged in original FMP
- Section 3 - Original regulatory text
  - Not included in FMP amendment
  - Regulations found in Title 14
- Section 4 - Public Comment
  - Original response remain in original FMP
  - New section 2 in Amendment 1 with new public comment and responses



FMP Amendment - Management Components

- Changes to Fishery Control Rule and Environmental Considerations
  - Statewide weekend closure extension; Monterey Bay area extension
  - Rib line and rope purse line requirement
- No changes to Restricted Access Program and Administrative Items

Summary – Department Recommendations

- Extend weekend closure
  - Statewide to begin at 7am on Friday
  - Monterey Bay Area to Sunday midnight
- Require rib line and rope purse line
- Fishery closure notification change
- Squid lighting clarity

- First Amendment to Market Squid FMP

Amendment and Regulations Timeline

Proposed Timeline:

FGC Meeting
April 16-17, 2025

- Notice Hearing
  - Request regulatory notice and FMP Amendment process

FGC Meeting
June 18-19, 2025

- Discussion Hearing

FGC Meeting
August 13-14, 2025

- Adoption Hearing

Thank You

For questions please contact:
SFAC@wildlife.ca.gov