

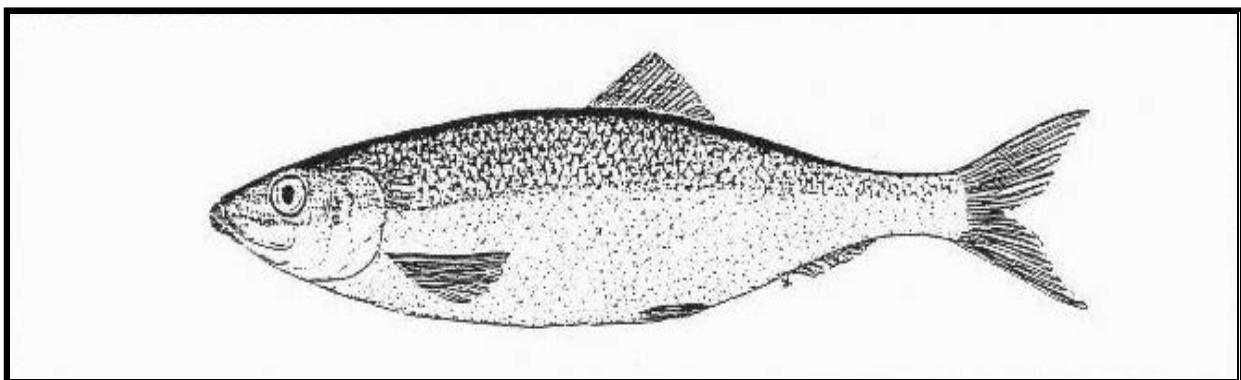
SCH No. 98052052

FINAL

SUPPLEMENTAL ENVIRONMENTAL DOCUMENT

**PACIFIC HERRING
COMMERCIAL FISHING REGULATIONS**

(Sections 163, 163.1, 163.5, and 164, Title 14, California Code of
Regulations)



**2010
STATE OF CALIFORNIA
THE NATURAL RESOURCES AGENCY
DEPARTMENT OF FISH AND GAME**

**FINAL SUPPLEMENTAL ENVIRONMENTAL DOCUMENT
PACIFIC HERRING COMMERCIAL FISHING REGULATIONS**

Table of Contents

SUMMARY	S-1
S.1 Introduction	S-2
S.2 Proposed Project.....	S-2
S.3 Project Alternatives	S-2
S.4 Existing Environment	S-3
S.5 Environmental Impacts.....	S-3
S.5.1 Proposed Project	S-3
S.5.2 Alternatives	S-3
S.5.3 Cumulative.....	S-5
S.6 Areas of Controversy	S-5
S.7 Issues to be Resolved.....	S-5
Chapter 1. INTRODUCTION	1-1
1.1 Background	1-1
1.2 The Functional Equivalent	1-2
1.3 Scoping Process.....	1-3
1.4 Report Availability	1-5
1.5 Authorities and Responsibilities.....	1-5
Chapter 2. PROJECT DESCRIPTION	2-1
2.1 Project Objectives.....	2-1
2.2 Project Locations	2-2
2.2.1 San Francisco Bay	2-3
2.2.1.1 Roe Herring Fishery.....	2-3
2.2.1.2 Herring Eggs on Kelp (HEOK) Fishery.....	2-5
2.2.1.3 Fresh Fish Market Fishery (not for roe purposes) San Francisco Bay	2-5
2.2.2 Tomales Bay	2-6
2.2.2.1 Roe Herring Fishery.....	2-6
2.2.2.2 Fresh Fish Market Fishery (not for roe purposes) Tomales Bay ..	2-6
2.2.3 Open Ocean.....	2-6
2.2.3.1 Open Waters Fishery	2-6
2.3 Project Characteristics.....	2-7
2.3.1 Roe Herring Fisheries	2-9
2.3.1.1 San Francisco Bay 2010-11 Quota	2-9
2.3.1.2 Tomales Bay, Humboldt Bay, and Crescent City Harbor 2010-11 Quota	2-11
2.3.1.3 Season Dates	2-11
2.4 Project Alternatives.....	2-11
2.4.1 Alternative 1 (no project)	2-12
2.4.2 Alternative 2 (existing regulations)	2-12
2.4.3 Alternative 3 (individual vessel quota).....	2-13

Chapter 3. ENVIRONMENTAL SETTING	3-1
3.1 General.....	3-1
3.2 Spawning Population Estimation Methods	3-2
3.3 Status of the San Francisco Spawning Population	3-3
3.3.1 San Francisco Bay Herring Young of the Year (YOY).....	3-11
3.3.2 <i>Cosco Busan</i> Oil Spill and Potential Impacts to San Francisco Bay Herring	3-12
3.3.3 Importance of Herring as a Forage Species.....	3-13
Chapter 4. ENVIRONMENTAL IMPACT ANALYSIS AND CUMULATIVE EFFECTS ..	4-1
Chapter 5. ANALYSIS OF ALTERNATIVES	5- 1 -
5.1 Alternative 1 (no project).....	5- 1 -
5.2 Alternative 2 (existing regulations).....	5- 2 -
Chapter 6. CONSULTATION	6-1
Literature Cited.....	L-1
Appendix A. Summary of Changes	

SUMMARY

S.1 Introduction

This Final Supplemental Environmental Document (FSED) to the Final Environmental Document (FED), Pacific Herring Commercial Fishing Regulations, 1998, provides the review and analysis required by California Environmental Quality Act (CEQA) Guidelines (Section 15000 et seq., Title 14, California Code of Regulations [CCR]). The review and analysis will assist the California Fish and Game Commission (Commission) in regulating the commercial harvest of herring throughout the State's ocean and estuarine waters. Specifically, the FSED reviews and evaluates proposed regulatory changes for the 2010-11 fishing season, supplementing, and in some cases replacing, aspects of the proposed project described in the 1998 FED and the FSEDs of 1999, 2000, 2001, 2002, 2004, 2005, 2006, 2007, 2008, 2009 and 2010. A Notice of Preparation (NOP) identified and incorporated concerns and recommendations of the public, resource and regulatory agencies, and the fishing industry into the review and analysis of the proposed changes contained in these documents.

The FSED includes seven chapters. Chapter 1 discusses the authorities and responsibilities under which the Final Supplemental Environmental Document (FSED) was developed and describes its intended use. Chapter 2 describes the proposed project and alternatives, and options for regulating the commercial harvest of herring. Chapter 3 describes the existing environment where the California herring fisheries occur. Chapter 4 addresses the impacts of the proposed project and cumulative effects. Chapter 5 describes the impacts of the alternatives to the proposed project. Chapter 6 identifies consultations with other agencies, professionals, and the public. Chapter 7 responds to public comments regarding the proposed project.

The proposed project has been selected as the preferred alternative based on the analysis of this FSED. The proposed project is identified as the preferred alternative because it provides a set of regulations most likely to achieve the CEQA requirements with respect to the conservation, sustainability, maintenance, and utilization of the herring resource.

S.2 Proposed Project

The proposed project is a body of regulations governing the commercial harvest of herring for roe products, bait, pet food, as fresh fish, and the harvest of herring eggs-on-kelp. The proposed project takes the form of recommendations for continuation, amendment, or change to an existing body of regulations in effect since November 18, 2009 (Sections 163, and 164, Title 14, CCR). It also includes regulations from Section 163.1 (herring permit transfers) and 163.5 (penalties in lieu of suspension or revocation-herring permittees), Title 14, CCR that were adopted by the Commission on March 2006 and October 2002, respectively.

The proposed regulatory changes will establish fishing quotas for San Francisco Bay for the 2010-11 herring fishing season, based on the most recent assessments of the spawning populations. Previously established quotas for Tomales Bay, Humboldt Bay, and Crescent City Harbor fisheries are not affected by these regulatory changes.

The specific regulatory changes proposed for the 2010-11 season will: (1) provide the Commission the option to consider a quota equal to zero to 10 percent of the most recent San Francisco Bay spawning biomass estimate; (2) set the dates of the gill net roe herring fishery in San Francisco Bay from 5:00 p.m. on January 2 until noon on March 11, 2011; (3) revise permitting to redistribute the December fishery to the odd and even platoons; and (4) set the dates of the roe herring fishery in Tomales Bay from noon on December 26, 2010, until noon on February 25, 2011. No quota changes were made for the Crescent City Harbor area, Humboldt Bay, and Tomales Bay fisheries.

S.3 Project Alternatives

Three alternatives to the proposed project are considered in this FSED. These alternatives include: (1) a no-fishery alternative; (2) a no change alternative, which uses existing regulations; and (3) establishing individual vessel quotas for gill net vessels in the roe herring fishery. Refer to Section 2.4, Project Alternatives, and Chapter 5 of this FSED, and Chapter 6 of the 1998 FED, Analysis of Alternatives, for a thorough description of alternatives and analysis of their impacts.

S.4 Existing Environment

The environments most likely to be affected by the regulatory revisions outlined in this FSED are San Francisco Bay and Tomales Bay. Although the proposed project consists primarily of regulatory changes for San Francisco Bay fisheries, the existing environment potentially affected by the proposed project and alternatives also includes the open ocean and other bays in which herring occur. Herring fisheries occur in the Crescent City Harbor area and Humboldt Bay. Refer to Section 3.3 of the FED, Specific Biological and Environmental Descriptions, for a thorough description of these environments and Chapter 3 of this document for a description of the environmental setting for these areas.

S.5 Environmental Impacts

S.5.1 Proposed Project

An analysis of the potential impacts of the proposed project is described by this FSED. The FED identified the area with the highest potential for adverse impacts associated with the proposed regulatory changes as the San Francisco Bay area, which supports the largest roe herring fishery in the State. The following localized, short-term, and less than significant impacts were identified in the FED for several areas of potential concern including: (1) boat and vehicle traffic circulation; (2) water and air quality; (3) housing and utilities; (4) geology, scenic quality, recreation; and (5) noise. The FED found biological impacts to have the greatest potential for significant environmental impact, but found these impacts to be localized, short-term, and less than significant, with mitigation provided by the current management strategy and herring population monitoring. Refer to Chapter 4 of the FED for a thorough environmental impact analysis of the proposed project. Any adverse impacts associated with the regulatory changes proposed by this FSED are addressed within this document.

S.5.2 Alternatives

The alternatives proposed in this FSED are the same as those described in the FED. A thorough analysis of the impacts of these alternatives is provided in Chapter 6

of the FED. A summary of impacts associated with these alternatives is provided below.

Alternative 1 (no project)

Localized, short-term, and less than significant impacts to vessel and vehicle traffic circulation, water quality, air quality, housing and utilities, scenic quality, recreational opportunities, and noise levels identified for the proposed project would be eliminated or redistributed in an unpredictable manner.

Alternative 2 (existing regulations)

In most regards, the environmental impacts associated with this alternative would be comparable to those of the proposed project. Although this alternative does provide for an adjustment of quotas and season dates, it does not address certain fishery-related problems considered in amendments or changes to existing regulations. The existing regulation alternative would maintain the herring fishery regulations as amended through 2009 and would not provide for the consistent adaptive management of the State's resources.

Alternative 3 (individual vessel quota)

As addressed in detail within the FED, individual vessel quotas, rather than the platoon-based quota system currently used in the roe herring gill net fishery, could potentially increase impacts due to an increase in the number of days fished. However, these impacts are still expected to be short-term, localized, and less than significant for most environmental categories.

Misuse of the resource could result from sorting catches to remove males from the catch or discarding unripe fish to achieve higher roe content, and therefore, higher ex-vessel prices. However, the competition between permittees, for a share of the quota, is greatly lessened under an individual quota system and may result in fewer nets likely to be lost, thus reducing impacts from "ghost" net fishing as explained in Section 4.2.6.1 of the FED.

S.5.3 Cumulative

An analysis of the cumulative impacts of the proposed project revealed no additional impacts to those addressed in the FED. The proposed regulatory changes addressed by this FSED are for an existing ongoing project. An analysis of cumulative impacts is provided in Chapter 5 of the FED.

A variety of factors have the capacity to influence the herring population status in California, in addition to the proposed project including: (1) biological events; (2) competitive interactions with other pelagic fish and fisheries; (3) oceanographic events; (4) habitat loss; and (5) water quality. However, as with potential impacts from the ongoing commercial harvest of herring, continued monitoring of the herring resource and oceanographic conditions should help identify any trends that would signal that the stock's reproductive potential is in jeopardy.

S.6 Areas of Controversy

Status of the herring population in San Francisco Bay has been identified as the only area of controversy regarding commercial herring fishing and is addressed in Chapter 3 of this FSED.

S.7 Issues to be Resolved

At issue is whether or not to provide for commercial fishing as an element of herring management in California. If commercial herring fishing is authorized, decisions to specify the areas, seasons, fishing quotas and other appropriate special conditions under which fishing operations may be conducted are required. As discussed, one aspect of managing this and other fishery resources is the understanding that a no project alternative is considered a management tool. This document, the 1998 FED, the 1999 FSED, the 2000 FSED, the 2001 FSED, the 2002 FSED, the 2004 FSED, the 2005 FSED, the 2006 FSED, the 2007 FSED, the 2008 FSED, and the 2009 FSED include a review and discussion of the proposed project as well as alternatives.

Chapter 1. INTRODUCTION

1.1 Background

This Final Supplemental Environmental Document (FSED) presents the review and analysis necessary to assist the California Fish and Game Commission (Commission), the lead agency pursuant to the California Environmental Quality Act (CEQA), in taking action regarding the regulation of the commercial harvest of Pacific herring (herring), *Clupea pallasii*, in California. It was prepared by the Department of Fish and Game (Department) for the Commission following CEQA Guidelines (Section 15000 et seq., Title 14, California Code of Regulations [CCR]). The project being considered consists of proposed changes to the regulations for the 2010-11 herring commercial fishing season.

This FSED was prepared as a supplement to: (1) the Final Environmental Document (FED), Pacific Herring Commercial Fishing Regulations, certified by the Commission in August 1998; (2) the Final Supplemental Environmental Document (FSED), certified by the Commission in August 1999; (3) the FSED, certified by the Commission in August 2000; (4) the FSED, certified by the Commission in August 2001; (5) the FSED, certified by the Commission in August 2002; (6) the FSED, certified by the Commission in August 2004; (7) the FSED, certified by the Commission in September 2005; (8) the FSED certified by the Commission in October 2006; (9) the FSED certified by the Commission in October 2007; (10) the FSED certified by the Commission in September 2008; and (11) the FSED certified by the Commission in September 2009. The FED outlines the full proposed project consisting of the operation and management of California's herring commercial fisheries and can be found on the Department's website at: <http://www.dfg.ca.gov/marine/herring/ceqa.asp>.

The FSEDs of 1999, 2000, 2001, 2002, 2004, 2005, 2006, 2007, 2008, and 2009 provide for revisions of the proposed project contained in the FED and regulatory revisions necessary for the 1999-2000, 2000-01, 2001-02, 2002-03, 2004-05, 2005-06, 2006-07, 2007-08, 2008-09, and 2009-10 herring commercial fishing seasons, respectively. Environmental documents (DSED and FSED) were not prepared for the 2003-04 season. This FSED supplements the existing certified environmental

documents and provides revisions to the regulations for the 2010-11 herring commercial fishing season.

The Department and Commission hold the public trust for managing the State's fish and wildlife populations, including herring. That responsibility is fulfilled by a staff of experts in marine resource management and enforcement issues related to California's herring resource. The knowledge and training represented by that expertise qualifies them to perform the review and analysis of the proposed revisions of the commercial herring harvest regulations that are contained in this document.

1.2 The Functional Equivalent

CEQA requires all public agencies in the State to evaluate the environmental impacts of projects that they approve or carry out. Most agencies satisfy this requirement by preparing an Environmental Impact Report (EIR) if there are potentially significant environmental impacts. If no potentially significant impacts exist, a Negative Declaration (ND) is prepared. However, an alternative to the EIR/ND requirement exists for State agencies for activities that include protection of the environment as part of their regulatory program. Under this alternative, an agency may request certification of its regulatory program from the Secretary for Resources. With certification, an agency may prepare functional equivalent environmental documents in lieu of EIRs or NDs.

The regulatory program of the Commission has been certified by the Secretary for Resources. A functional equivalent, Final Environmental Document for Pacific Herring Commercial Fishing Regulations, was certified by the Commission on August 28, 1998. A new FED is required: (1) when subsequent changes are proposed in the project requiring important revisions of the previous FED due to new significant environmental impacts not considered in a previous FED; or (2) when new information of substantial importance to the project becomes available (Section 15162, Title 14, CCR and Public Resources Code (PRC) Section 21166).

The CEQA lead agency may choose to prepare a supplement to a FED instead of a new FED, if only minor additions or changes are necessary, to make the previous FED adequately apply to the project in the changed situation. The final supplemental document is given the same notice and public review given to a final environmental

document, and may be circulated by itself without the previous FED. The lead agency when deciding whether to approve the proposed project, considers the previous FED as revised by the supplemental environmental document (Section 15163, Title 14, CCR). A Notice of Preparation (NOP) for the DSED was circulated to interested parties on April 26, 2010. Following the release of the NOP, the 30-day public comment period pursuant to CEQA for the DSED ended May 26, 2010. Pursuant to CEQA regulations, a 45-day public comment period for reviewing the DSED was held from June 16, 2010, to July 30, 2010.

This FSED is the eleventh Final Supplemental Environmental Document (FSED) to the FED prepared by the Department. The first FSED was certified by the Commission in August 1999; the second FSED was certified by the Commission in August 2000, the third FSED was certified by the Commission in August 2001, the fourth FSED was certified by the Commission in August 2002, the fifth was certified by the Commission in August 2004, the sixth was certified by the Commission in September 2005, the seventh was certified by the Commission in October 2006, the eighth was certified by the Commission in October 2007, the ninth was certified by the Commission in September 2008, and the tenth was certified by the Commission in September 2009. As provided for by CEQA, the Department will continue to use this method of revising Sections 163, 163.1 (the new section added in December 2005), 163.5, and 164, Title 14, CCR, for a period of approximately five to ten years. After this period, or sooner if deemed necessary, the Department will prepare a new environmental document or a fishery management plan (FMP).

1.3 Scoping Process

Pursuant to CEQA, the Department distributed, for the Commission, a NOP to interested parties on April 26, 2010. The Department received input on the proposed project at a Director's Herring Advisory Committee (DHAC) meeting held on April 21, 2010, in San Rafael, County of Marin. The DHAC consists of 26 representatives from the herring fishery, including buyers and fishermen. They are appointed by the Director and serve at his or her pleasure.

During the scoping process in past years, several issues were raised that are not included in this FSED including; developing a threshold, harvesting only the fishable biomass, a complete history of the fishery, genetic comparisons of the Tomales and San Francisco populations, the cost of management of the fishery, and establishing a limited voluntary individual quota herring fishery. All of these issues would be better addressed in a Fishery Management Plan (FMP). FMPs are required for all marine fisheries pursuant to the Marine Life Management Act. FMPs contain a comprehensive environmental and economic analysis of the fishery along with clear objectives and measures to ensure sustainability of that fishery. In addition to the primary requirements below, the Department seeks advice and assistance in developing FMPs from participants in the affected fishery, marine scientists, marine conservationists, and other interested parties. The primary requirements of an FMP pursuant to Fish and Game Code (FGC) Section 7072 are as follows:

- To the extent practical, each sport and commercial marine fishery under the jurisdiction of other states shall be managed under an FMP. Fishery management plans will be developed in priority order.
- Each FMP shall be based on the best scientific information and other relevant information that is available, or that can be obtained, without substantially delaying the preparation of the plan.
- To the extent that conservation and management measures in an FMP provide guidelines for overall harvest, FMPs shall allocate those increases or restrictions of harvest fairly among sport and commercial fishing interests participating in the fishery.

Specifically, each FMP shall include:

- A summary of the fishery which includes historical data, economic and social information related to the fishery, habitat and ecosystem role of the species, natural history and population dynamics, number of participants, and a history of conservation and management measures affecting the fishery.
- A fishery research protocol that includes past and ongoing monitoring, essential fishery information, identification of additional information, resources and time needed, and procedures for monitoring the fishery and for obtaining essential

fishery information.

- Measures necessary for the conservation and management of the fishery which includes limitations of the fishery, creation or modification of a restricted access program that contributes to a more orderly and sustainable fishery, procedures to establish, review and revise a catch quota, and requirements for permits.
- Measures to minimize adverse effects on habitat caused by fishing.
- Information and analysis of amount and type of bycatch if associated with the fishery and measures taken to minimize bycatch and mortality of discards.
- Criteria for identifying when the stock is overfished and measures to address overfishing if occurring.
- A procedure for review and amendment of the plan.

When an FMP is completed, it is subject to CEQA and is considered functionally equivalent to an EIR. The current 1998 FED and subsequent FSEDs serve as an interim FMP for herring until an FMP can be developed.

1.4 Report Availability

This FSED Document is available at depository libraries for each of the counties in the affected areas, at the California Fish and Game Commission office, and California Department of Fish and Game Marine Region offices. It will also be posted on the Department of Fish and Game website at www.dfg.ca.gov/marine/herring/ceqa.asp.

1.5 Authorities and Responsibilities

The California State Legislature formulates the laws and policies regulating the management of fish and wildlife in California. It is the policy of the State to ensure the conservation, sustainable use, and where feasible, the restoration of California's living marine resources for the benefit of all the citizens of the State (FGC Section 7050). It is also the State's policy to promote the development of local 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 Section 1700, Appendix 1 of the FED).

The Legislature provides further policy direction regarding herring management in FGC Sections 8550 et seq. FGC Section 8553, delegated authority from the Legislature to the Commission, whose members are appointed by the Governor, to regulate the commercial harvest and possession of herring. The remaining FGC sections relative to herring provide for a limited entry fishery and require periodic review of regulations and policies.

The Commission holds public meetings at its discretion to consider and adopt revisions to these regulations. Recommendations and comments from the Department, other agencies, and the public are typically received at two public Commission meetings each year prior to the herring commercial fishing season. Due to the state budget crisis, only one meeting will be held for discussion and potential adoption of proposed regulations for the 2010-11 season on September 16, 2010, in McClellan, California. The authority to prepare a supplemental environmental document is given in PRC Section 21166.

Chapter 2. PROJECT DESCRIPTION

2.1 Project Objectives

The proposed project, as defined in the Final Environmental Document (FED) certified by the California Fish and Game Commission (Commission) on August 28, 1998, is the regulation of Pacific herring (herring), *Clupea pallasi*, fisheries under the State's jurisdiction. The regulations are considered for inclusion in the California Code of Regulations (CCR) to implement the State's policies for managing the commercial use of herring (Sections 163, 163.1, 163.5, and 164, Title 14, CCR). The proposed project and alternatives addressed in this Final Supplemental Environmental Document (FSED) take the form of recommendations for amendment or change to the existing body of regulations. The recommendations and alternatives are based on biological assessments of existing stock conditions and comments received from interested individuals, commercial fishermen, and from the Director's Herring Advisory Committee (DHAC). The Commission has legislatively delegated authority to act on these recommendations.

The project goal is to maintain healthy herring stocks in California. Objectives for achieving this goal include:

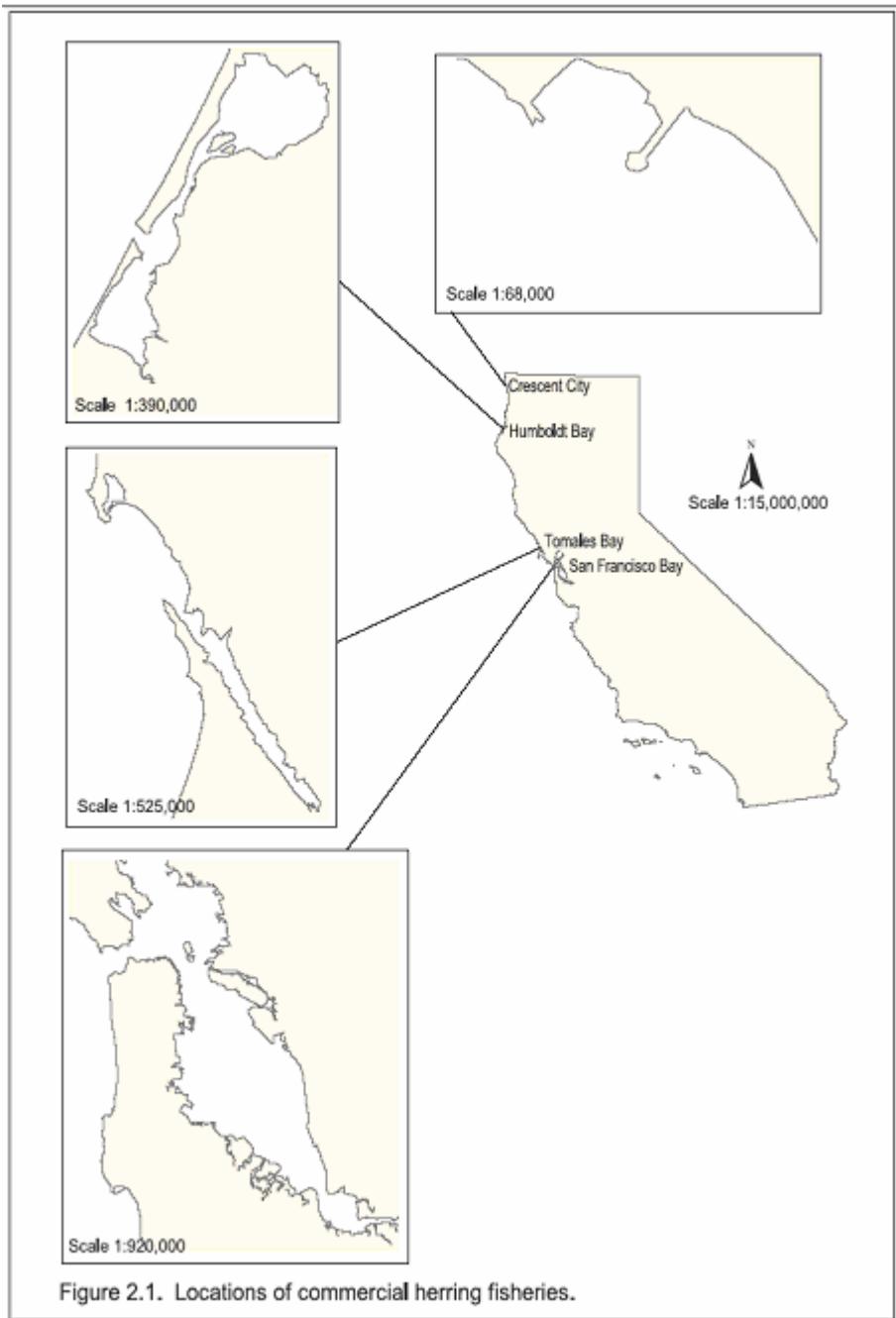
- Restore healthy age structures to stocks in need of rebuilding;
- Avoid and/or minimize the harvest of two and three-year-old herring, many of which are first-time spawners;
- Manage commercial harvest of herring to achieve a sustainable fishery;
- Provide sufficient herring to conserve living resources of the ocean that utilize herring as a food source;
- Provide sufficient herring to support recreational take.

Under existing law, herring may be taken for commercial purposes only under a revocable permit, subject to such regulations, as the Commission shall prescribe (Fish and Game Code Section 8550). Current regulations specify permit qualifications, permit validation requirements, permit limitations, permit areas, seasons, fishing quotas, gear restrictions, and landing and monitoring requirements.

The proposed project addressed by this FSED consists of amendments and changes to existing regulations for the 2010-11 commercial herring fishing season. The proposed project adjusts the fishing quota and season dates and times that fishing operations are allowed in San Francisco Bay and season dates and times for fishing operations for in Tomales Bay. Quota recommendations for San Francisco Bay are primarily based on the most recent assessments by the Department of Fish and Game (Department) of the size of the spawning population of herring in San Francisco Bay.

2.2 Project Locations

Permits are issued for commercial herring fishing in four geographically distinct areas of estuarine waters under the jurisdiction of the State of California (Figure 2.1). Many of the regulations considered by this document are specific to an area and type of fishing operation. This section describes each area in which regulatory changes are proposed, including current commercial fisheries for herring, and proposed seasons, quotas, and geographical restrictions for those fisheries. A complete description of commercial herring fishing areas is provided in Section 2.2 of the FED. The environmental setting for each geographical fishing area is detailed in Section 3.3 of the FED.



2.2.1 San Francisco Bay

The proposed commercial herring fishing dates and quotas for San Francisco Bay are as follows:

2.2.1.1 Roe Herring Fishery

Season: 5:00 p.m. on Sunday, January 2, 2011, until noon on Friday March 11, 2011.

Note: Herring fishing is not permitted after noon on each Friday until 5:00 p.m. on each Sunday (Section 163 (h)(5), Title 14, CCR).

Gill net permittees (Odd #) January 2-7, January 16-21, January 30-31, February 1-4, February 13-18, February 27-28, and March 1-4.

Gill net permittees (Even #) January 9-14, January 23-28, February 6-11, February 20-25, and March 6-11.

Note: Herring fishing is not permitted from noon on Friday through 5:00 p.m. on Sunday (Section 163 (h)(5), Title 14, CCR).

Quota: The total take of herring in San Francisco Bay for commercial purposes shall be set between zero to 10 percent of the most current biomass estimate for San Francisco Bay. This quota range is based on the determination of the Department's assessment of the stock status and utilizing the best science available. The best available science includes, but is not limited to, recent fishery-independent field surveys, commercial catches, age composition, and environmental data. The Department's recommendation for the 2010-11 season is 1,920 tons.

Note: The overall quota for the herring roe fishery will be reduced by transfers to the herring eggs-on-kelp fishery, and the fresh fish market quota (See Section 2.2.1.2 and 2.2.1.3).

Area: Waters of Districts 12 and 13 and that portion of District 11 lying south of a line extending from Peninsula Point (the most southerly extremity of Belvedere Island) to the easternmost point of the Sausalito ferry dock.

1) Regulations prohibit the setting or operating of nets within 300 feet of the following piers and recreation areas: Berkeley Pier, Paradise Pier, and San Francisco Municipal Pier (between the foot of Hyde Street and Van Ness Avenue), Pier 7 (San Francisco), Candlestick Point State Recreation Area, the jetties in Horseshoe Bay, and the fishing pier at Fort Baker. Regulations also prohibit the setting or operating of nets within 70 feet of Mission Rock Pier.

2) Regulations prohibit the setting or operating of nets in Belvedere Cove (north of a line drawn from the tip of Peninsula Point to the tip of Elephant Rock). Regulations also prohibit the setting or operating of gill nets from November 15 through March 17, in the area bounded by a line drawn from the middle anchorage of the western section of the Oakland Bay Bridge (Tower C) to the Lash Terminal buoy #5 to the easternmost point at Hunter's Point (Point Avisadero), from Point Avisadero to the Y "A" buoy to Alameda NAS entrance buoy #1

(entrance to Alameda Carrier Channel) to the Oakland Harbor Bar Channel buoy #1, and then from the first Bar Channel buoy to Tower C of the Bay Bridge.

3) Other closures affecting the fishery include United States Coast Guard enforced Homeland Security Zones: 25 yards around all Golden Gate and Bay Bridge abutments and piers; 100 yards around and under any High Interest Vessels; and Naval Vessel Protection Zones which extend 100 yards around all Naval Vessels at all times and a 500 yard slow zone surrounding all Naval Vessels. The United States Coast Guard will also enforce Rule 9 of the Code of Federal Regulations (CFR) regarding channel and harbor blockages.

2.2.1.2 Herring Eggs on Kelp (HEOK) Fishery

Season: December 1, 2010 to March 31, 2011

Quota: The Department recommends that the Commission adopt a five percent harvest for San Francisco Bay for the 2010-11 season. This would allow a 3.36-ton individual quota for transferred "CH" gill net permits and a 4.15-ton quota for individual gill net permits.

Note: The combined quota for harvest of herring eggs on kelp depends on the number of "CH" and gill net permits transferred to the herring eggs on kelp fishery.

Area: Waters of Districts 11, 12, and 13, and that portion of District 2 known as Richardson Bay.

Note: The area open to the herring eggs-on-kelp fishery is further restricted. Rafts and lines may not be placed in any waters or areas otherwise closed or restricted to the use of herring gill net operations, except the areas known as Belvedere Cove and Richardson Bay or except where written permission is granted by the owners or controlling agency (e.g., Navy, Coast Guard). When rafts or lines are placed in Belvedere Cove or Richardson Bay, they must be tied to a permanent structure (e.g., pier or dock).

2.2.1.3 Fresh Fish Market Fishery (not for roe purposes) San Francisco Bay

Season: November 2 through November 15, 2010, and April 1 through October 31, 2011.

Quota: If the Commission adopts a harvest rate greater than zero, 20 tons of the overall San Francisco Bay quota will be allotted to the fresh fish market fishery.

Note: No permittee may take or possess herring except in the amount specified on a current daily market order, not to exceed 500 pounds, from a licensed fish dealer.

Area: Same as specified in roe herring fishery.

2.2.2 Tomales Bay

The proposed Department commercial herring fishing dates for Tomales Bay are as follows:

2.2.2.1 Roe Herring Fishery

Season: Noon on Sunday, December 26, 2010, until noon Friday, February 25, 2011. Weekend fishing is allowed contingent on funds made available to the Department to cover biological staff time.

Quota: The total take of herring for roe purposes shall not exceed 350 tons for the season.

Area: Tomales Bay includes the waters of District 10 lying south of a line drawn west 252° magnetic, from the western tip of Tom's Point to the opposite shore.

2.2.2.2 Fresh Fish Market Fishery (not for roe purposes) Tomales Bay

Season: November 2 through November 15, 2010, and April 1 through October 31, 2011.

Quota: 20 tons, except that 10 tons total may be transferred to gill net permittees participating in research sponsored by the Department.

Note: No permittee may take or possess herring except in the amount specified on a current daily market order, not to exceed 500 pounds, from a licensed fish dealer.

Area: Same as the roe herring fishery.

2.2.3 Open Ocean

As of January 1, 2010, all commercial fishing for herring in ocean waters is prohibited, except as specified in Section 163 (f)(1), Title 14, CCR. An incidental take of no more than 10 percent herring by weight of any landing composed primarily of other coastal pelagic fish species or market squid may be landed.

2.2.3.1 Open Waters Fishery (closed)

Area: Ocean waters are limited to the waters of Districts 6 (excluding the Crescent City area), 7, 10 (excluding Tomales Bay), 16, and 17.

2.3 Project Characteristics

The proposed project recommends continuation of the existing regulations as modified by changes discussed below for the San Francisco Bay and Tomales Bay fisheries. No modifications are proposed for Crescent City Harbor area or Humboldt Bay. These regulations, as amended, will assist in the control of the commercial harvest of herring at a level that meets the State's policy with respect to the use of aquatic resources. This section states the specific purpose of the regulations and summarizes the factual basis for the regulation.

The commercial roe herring and HEOK fisheries are closely regulated through a catch-quota system to provide for adequate protection and utilization of the herring resource. The Department conducts annual assessments of the size of the spawning population of herring in San Francisco Bay (Section 3.2.2.1, FED). These data serve as the basis for establishing fishing quotas for the following season. The principal regulatory changes proposed for the 2010-11 season included: (1) provide the Commission the option to consider a quota of zero to 10 percent of the most recent San Francisco Bay spawning biomass estimate (the Department's recommendation is a five percent harvest for San Francisco Bay); (2) set the dates of the gill net roe herring fishery in San Francisco Bay from 5:00 p.m. on January 2 until noon on March 11, 2011; (3) integration of December "DH" platoon into Odd and Even groups, with a season beginning in January 2011; and (4) set the dates of the roe herring fishery in Tomales Bay from noon on December 26, 2010, until noon on February 25, 2011. No quota changes were made for the Crescent City Harbor area, Humboldt Bay, and Tomales Bay fisheries.

Annual herring spawning population estimates from biomass surveys in San Francisco and Tomales bays have been conducted by the Department since 1973, but were discontinued in Tomales Bay in 2006-07. Spawning ground surveys in Humboldt Bay were conducted during the 1974-75, 1975-76, 1990-91, and 2000-01 through 2006-07 seasons. Spawning ground surveys have been used to estimate spawning biomass in San Francisco, Tomales, and Humboldt bays. Spawning ground surveys assess the

total number of eggs spawned and these data are used to calculate the parental population size (Section 3.2.2.1.1 of the FED).

From 1990 through 2003, the Department derived the spawning biomass estimate in San Francisco Bay from a combination of the spawn deposition and hydroacoustic surveys. Beginning with the 2003-04 season, the Department conducted spawning deposition surveys as the primary assessment tool to estimate the spawning biomass. This is in conjunction with trawl surveys that are used to determine age and population structure of herring schools entering San Francisco Bay. Spawning biomass estimates for San Francisco Bay are shown in Figure 2.2. Currently, the Department does not conduct spawning biomass surveys in Tomales Bay, Humboldt Bay or the Crescent City Harbor area.

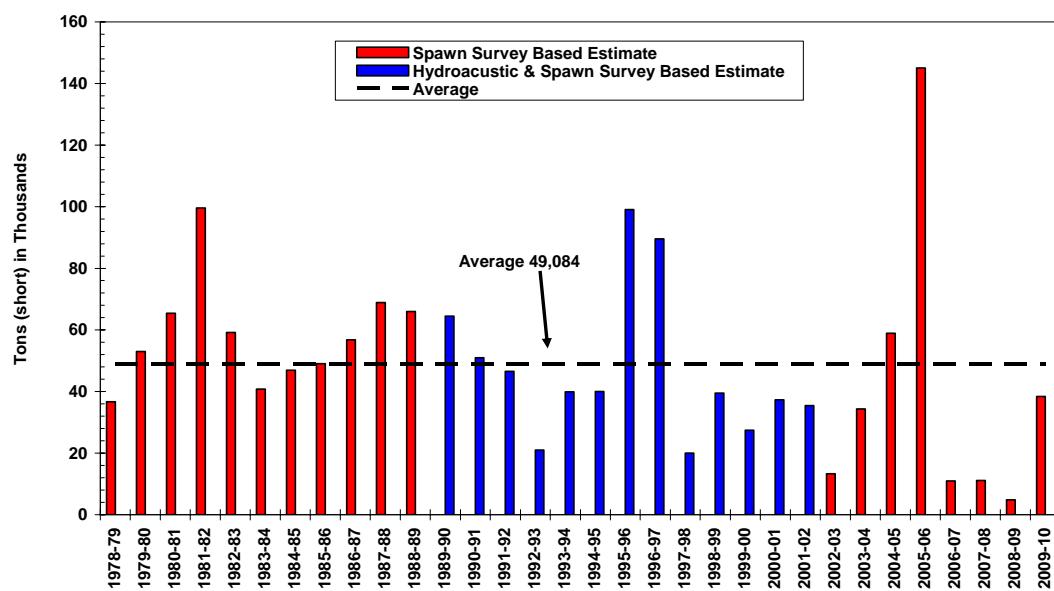


Figure 2.2 San Francisco Bay Pacific Herring Spawning Biomass Estimates for Seasons 1978 to 2010

Annual fishing quotas are intended to provide for a sustainable fishery and have been limited to a total catch, not to exceed 20 percent (harvest percentage) of the spawning biomass. This exploitation level was selected, based upon model simulations to help ensure adequate protection of the herring resource while taking into account accidental overages and other management uncertainties. This model assumes stable environmental and biological conditions.

Quotas are the principal regulatory tool to establish adequate protection of the herring resource and provide for the long-term yield of the fishery. Each year, the Department recommends a harvest percentage that is not determined by a fixed mathematical formula; rather, the recommendation is based upon the modeling results and takes into account additional data collected each season, such as oceanic conditions, growth rates of herring, strength of individual year-classes, and predicted size of incoming year-classes (*i.e.*, recruitment). In response to poor recruitment, or indication of population stress, and/or unfavorable oceanographic conditions, harvest percentages in previous years have been set below 15 percent. For example, a near record low spawning biomass was estimated for both the 2006-07 and 2007-08 seasons; therefore, a conservative harvest percentage of 10 percent was recommended for those two seasons. The Department recommended a zero ton quota or no fishery option for the 2009-10 season, when the herring spawning biomass in 2008-09 fell to a new historical low of 4,833 tons. The Commission adopted this recommendation and no commercial fishery was held in San Francisco Bay for the 2009-10 season. This was done to help safeguard the remaining population and allow for stock rebuilding

In addition to annual changes in quotas, management recommendations to improve or provide for the efficient harvest and orderly conduct of the herring fisheries are solicited from interested fishermen, individuals at public meetings, and DHAC. The proposed amendments to Sections 163 and 164, Title 14, CCR, addressed by this FSED, reflect both Department and the public recommendations.

2.3.1 Roe Herring Fisheries

2.3.1.1 San Francisco Bay 2010-11 Quota

The spawning biomass estimate for the 2009-10 season was 38,409 tons, which is below the historical average (1978-79 season to present) of 49,084 tons. This however, was a significant increase over the 2008-09 season estimate of 4,833 tons (Figure 2.2). The Department is providing the Commission the option to consider a quota range of zero to 10 percent of the 2009-10 spawning biomass estimate of 38,409 tons. Due to the apparent rebound of the herring population, the Department is recommending a conservative five percent harvest option for the 2010-11 season. The Department, however, remains concerned over the herring stocks age structure that is

heavily skewed towards younger fish, specifically the large increase in the percentage of 2-year old herring in the 2009-10 spawning population. The Department considers that a five percent harvest rate for 2010-11 will help reduce fishing mortality, which will be critical for continued stock recovery. This approach will also help maintain a sustainable fishery while continuing to ensure herring's integral role in both ocean and bay ecosystems.

Based on age estimates from the research data, the increase in spawning biomass appears to be due to the recruitment of 2-year old herring (2007-08 year class) to the spawning population. While the increase in biomass is encouraging, the Department remains concerned with the low estimated numbers of age four and older herring in the spawning population. The 2007-08 year class appears to be the strongest year class in recent seasons; however, this year class will be subjected to increased fishing pressure when it returns as 3-year olds in the 2010-11 season. With appropriate harvest controls the strong year classes can support a fishery for several seasons. For this reason one of the Department's longstanding management objectives has been to reduce the harvest of 2- and 3-year old herring, many of which are first-time spawners.

Though the 2009-10 season spawning biomass of 38,409 tons remains below the historical average of 49,084 tons, the Department considers that a limited quota will support a sustainable fishing opportunity while safeguarding sufficient numbers of herring for stock rebuilding. Additionally, fishing effort in the San Francisco herring fishery has decreased significantly during the past several years. During the 1990s the number of herring permits peaked at over 450, with over 120 vessels participating. In contrast, during the 2008-09 season permit renewals fell to 219 and only 31 vessels elected to participate. Given the decline in the number of participants, a 1,920 ton quota will provide for a fishery while minimizing the threat of overexploitation.

Within the overall quota for San Francisco Bay, separate quotas are established for each gill net platoon (i.e., Odd, and Even fishing groups). The overall quota is divided among the platoons in proportion to the number of permits assigned to each platoon. Adjustments to quota assignments for each fishing platoon are calculated annually to offset permittee attrition and the use of herring permits in the HEOK fishery. HEOK fishing occurs only in San Francisco Bay and the fishery is regulated under Section 164, Title 14, CCR. Individual HEOK quotas depend on the total herring fishery

quota for San Francisco Bay established by the Fish and Game Commission under Section 163, Title 14, CCR. In 1994, the Commission provided HEOK permittees possessing "CH" permits with a HEOK quota equal to approximately 0.79 percent of the overall quota. All HEOK permittees must hold a herring permit. To fish HEOK, permittees must waive herring fishing privileges under Section 163 and "exchange" their "share" of the herring quota for an equivalent HEOK quota. The current factor used to convert an equivalent amount of whole fish to the herring eggs on kelp fishery is 0.2237. This factor was derived from the round haul to gillnet conversion ratio allotted during the 1988-89 season.

2.3.1.2 Tomales Bay, Humboldt Bay, and Crescent City Harbor 2010-11 Quota

The previously set quota for Tomales Bay, Humboldt Bay and Crescent City Harbor area is 350 tons, 60 tons, and 30 tons, respectively.

2.3.1.3 Season Dates

Season opening and closing dates for San Francisco and Tomales bays, as well as the dates of various provisions of the regulations, are adjusted each year to account for annual changes in the calendar. The consensus of the DHAC, which met on April 21, 2010, was to recommend that the dates and times of the roe herring fisheries in San Francisco Bay be set from 5:00 p.m. on Sunday, January 2, 2011, until noon on Friday, March 11, 2011 (all gill net platoons; "DH", Odd and Even). The consensus among Tomales Bay permittees was to recommend opening at noon on Sunday, December 26, 2010, until noon Friday, February 25, 2011. The Department agrees with the DHAC recommendation for season dates for San Francisco and Tomales bays.

2.4 Project Alternatives

Three alternatives to the proposed project are considered. These alternatives were examined and detailed in the FED, 1998, and re-examined as they apply to this FSED. Two of these alternatives take the form of additional changes to the existing regulations that could feasibly be joined. The third alternative is a no project (no fishery) alternative. In evaluating alternatives, the comparative merits and impacts of individual

alternatives that could be logically and feasibly joined should be considered as so joined unless otherwise stated. The alternatives to be considered under this FSED are:

- Alternative 1 (no project, i.e. no fishery). Under this alternative, the commercial harvest of herring would be prohibited.
- Alternative 2. Under this alternative, existing regulations would be modified only by adjusting quotas to reflect current biomass estimates and by adjusting dates to reflect changes in the calendar.
- Alternative 3 (individual vessel quota for gill net vessels in herring roe fishery). Under this alternative, the proposed regulations would be modified by establishing an individual vessel quota for all gill net vessels. The proposed individual gill net vessel quota would equal the overall gill net quota divided by the number of permittees using gill net gear.

The following section states the specific purpose of the alternatives and summarizes the factual basis for determining that the alternatives are reasonably necessary.

2.4.1 Alternative 1 (no project)

This is a CEQA required alternative. It provides a reference for comparison to the proposed project and alternatives 2 and 3.

2.4.2 Alternative 2 (existing regulations)

The only amendment or change suggested relates to adjusting quotas to reflect current biomass estimates and adjusting dates to reflect annual changes in the calendar.

2.4.3 Alternative 3 (individual vessel quota)

This alternative would establish an individual herring quota for each San Francisco Bay gill net permittee. Under existing regulations [Section 163(g)(4)(C), Title 14, CCR] an overall herring quota is established for each of the three gill net groups (platoons) in San Francisco Bay, allowing individual permittees to take and land as much fish (tonnage) as they are capable of until the overall quota for their respective group is reached. An individual permit quota has been suggested each season for the

past several years. However, there has never been a clear consensus of support or opposition among industry members about this issue. The Department is concerned about the level of enforcement effort that would be necessary to effectively monitor and enforce this alternative. See Section 2.4.3 of the FED for a full description of this alternative.

Chapter 3. ENVIRONMENTAL SETTING

3.1 General

Pacific herring (herring), *Clupea pallasii*, are found throughout the coastal zone from northern Baja California on the North American coast, around the rim of the North Pacific Basin and Korea on the Asian coast (Hart 1973, Outram and Humphreys 1974). In California, herring are found offshore during the spring and summer months foraging in the open ocean. Beginning as early as October and continuing as late as April, schools of adult herring migrate inshore to bays and estuaries to spawn. Schools first appear in the deep water channels of bays to ripen (gonadal maturation) for up to two weeks, then gradually move into shallow areas to spawn. The largest spawning aggregations in California occur in San Francisco and Tomales bays. San Francisco Bay is also near the southern end of the range for herring (Miller and Schmidtke 1956).

Spawning occurs in the intertidal and shallow subtidal zones. Males release milt into the water column while females extrude adhesive eggs on a variety of surfaces including vegetation, rocks, and man-made structures such as pier pilings, boat bottoms, rock rip-rap, and breakwater structures. Embryos (fertilized eggs) typically hatch in about 10 days, determined mainly by water temperature. Larval herring metamorphose into juvenile herring in about 10 to 12 weeks. In San Francisco Bay, juvenile herring typically stay in the bay through summer, and then migrate out to sea. Research conducted on herring in Straits of Georgia, British Columbia (BC) suggests that 1- and 2-year old herring occupy inshore waters and older herring occupy shelf waters (Haegele 1997). In BC waters, juvenile herring during the summer were found in shallow nearshore waters of less than 50 meters, in shoals of similar-sized individuals. Based on the life history data of herring in BC waters there may be very little direct competition for food between age classes, and the first opportunity for direct interaction may be when herring sexually mature and join the spawning stock (Hay 2002).

Most herring fisheries occur during the spawning season. The roe herring gill net fisheries catch herring as they move into the shallows to spawn when the eggs are ripest. The primary product from this fishery, *kazunoko*, is the sac roe (eggs) removed from the females, which is processed and exported for sale to Japan. California's roe

herring fisheries occur in the Crescent City Harbor area, Humboldt Bay, Tomales Bay, and San Francisco Bay. Small fisheries for fresh fish are also permitted during the non-spawning season in Tomales and San Francisco bays.

The San Francisco Bay herring eggs-on-kelp fishery suspends giant kelp, *Macrocystis pyrifera*, from rafts for herring to spawn on in shallow water areas. The kelp is harvested near the Channel Islands and/or in Monterey Bay and then transported to San Francisco Bay. The product of this fishery is the egg-coated kelp blades that are processed and exported to Japan. This product, *komochi* or *kazunoko kombu*, is typically served as an appetizer during New Year's celebrations.

Herring are a food source for many species of birds, fish, invertebrates, and mammals. Predation is particularly high during spawning when adult fish and eggs are concentrated and available in shallow areas. Predation by birds and fish during the egg stage, when eggs are deposited in the intertidal and shallow subtidal zones, is a significant cause of natural mortality for herring.

The roe herring fishery in California has been intensively regulated since its inception in 1973, at first by the California State Legislature, then by the Fish and Game Commission (Commission). Department of Fish and Game (Department) estimates of the spawning population biomass have provided a critical source of information used for establishing fishery quotas to control the harvest of herring and provide for the long-term health of the herring resource. A thorough description of the environmental setting is provided in Chapter 3 of the 1998 Final Environmental Document (FED), which includes herring life history, ecology, status of stocks and fisheries at that time, and biological and environmental descriptions of herring fishery locations (Crescent City Harbor area, Humboldt Bay, Tomales Bay, San Francisco Bay, and Monterey Bay).

3.2 Spawning Population Estimation Methods

During the 1973-74 through 1988-89 seasons, Department estimates of San Francisco Bay herring spawning biomass were made using spawn deposition surveys (refer to Sections 3.4 and 3.5 below). From the 1990-91 through 2001-02 seasons, the Department estimated San Francisco Bay spawning biomass using a combination of spawn deposition and hydroacoustic surveys. In 2002-03, the Department was unable

to generate a spawning biomass due to a wide discrepancy between the two survey methods.

The Department assessed the two methods using the Coleraine Model and an independent peer review conducted by California Sea Grant. The results indicated that the spawn deposition survey provided a better estimate of spawning biomass.

Beginning with the 2003-04 season, the Department reverted to using the spawn deposition surveys alone for biomass estimation. In addition to the spawning biomass estimates, the Department collects fishery independent age composition data from the population and fishery dependent age composition data from the commercial catch. All of the information collected by the Department, including ocean conditions, is used in annual population assessments.

3.3 Status of the San Francisco Spawning Population

The spawning biomass estimate for the 2009-10 season was 38,409 tons, which is below the historical average (1978-79 season to present) of 49,084 tons. However, this was a significant increase over the 2008-09 season estimate of 4,833 tons (Figure 2.2). The increase in spawning biomass was due to a strong recruitment of the 2-year old herring to the spawning population (Figure 3.1), as well as improved physical condition of fish in the population. The increase in recruitment and improved physical condition is likely due to more favorable biological and environmental conditions.

Improving oceanic conditions as reported by the El Niño Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), and Upwelling Indices (UI), may aid in herring stock recovery. These indices can be used as predictors of favorable environmental conditions for herring. Many studies have shown correlations between the amount of coastal upwelling and production of various fisheries including herring. When indices show weak or no El Niño events, cool sea surface temperatures and offshore winds often prevail, resulting in strong coastal upwelling events affecting plankton production. The cool nutrient laden waters result in increased availability of plankton, fueling the marine food web of which herring are an integral part.

Hydrographic conditions also improved over the previous three seasons for San Francisco Bay with near average rainfall reported for the current water year (October

2009-September 2010). During average or above average rainfall years, winter storms supply sufficient freshwater to San Francisco Bay to create lowered bay salinity and ideal spawning conditions for herring. Since 2006, California has experienced a statewide drought with below normal precipitation levels. If the drought subsides, improved bay conditions can be expected to further aid in stock recovery.

There were nine recorded spawning events during the 2009-10 season, primarily within the central and northern areas of San Francisco Bay. Spawning events were recorded from as far north as Pt. Molate and south to Coyote Point. The first recorded spawn of the season occurred on December 14, 2009, and the last recorded spawn occurred on April 1, 2010 (Table 3.1). There were several protracted spawning events during the season. Intermittent spawning events occurred in Richardson Bay. Of particular interest was the utilization of Point Richmond as a spawning area given the last recorded spawn event occurred 24 years prior on January 19, 1986. A single spawn event accounted for 68 percent of the escapement, comprising a total of 26,289 tons. This is the third consecutive season in which relatively few spawn events made up a large proportion of the overall spawn escapement. This is an important consideration when making management decisions for the herring fishery in order to avoid over exploitation of a single spawning wave.

The Department uses the spawning stock biomass and age class structure to assess the spawning population and determine an appropriate harvest level from the available stock. Herring were captured with research nets to estimate the age class structure of the San Francisco Bay spawning population this season. The age of herring is determined from a surface reading of the otoliths (ear bones) of herring. Samples used to estimate the age structure are sorted into age classes or groups of fish the same age. The age class structure helps assess cohorts (year classes) of herring born in a given year or season which compose the spawning population.

The age composition estimate for the 2009-10 season shows a rebuilding of the spawning stock through a strong recruitment of 2-year old herring (2007-08 year class) and an improvement in the number of 4-year old and older fish (Table 3.2). During the last several seasons, the herring population structure has experienced a truncation of age classes which continued through the 2009-10 season. The numbers and proportion

of older herring remain well below historical averages and these older fish historically supported the commercial fishery. The data indicate that the successive cohorts that would support a commercial fishery next season, from the 2006-07, 2005-06, 2004-05, and 2003-04 seasons (herring age three, four, five, and six respectively), have shown poor recruitment and survival. Low survival of these older age classes places additional burden on abundant cohorts like the 2007-08 year class to support the sustainability of the San Francisco Bay fishery and to fulfill the ecosystem function of herring.

Table 3.1 2009-10 San Francisco Bay Herring Biomass Estimate							
(weights in short tons)							
#	Approximate Spawn/Catch Date	Location	Submerged Vegetation	Shoreline	Spawn Total	Gill Net*	HEOK*
1	December 14, 2009	<i>Richardson Bay</i>	206.5		206.5		206.5
2	December 17, 2009	<i>San Leandro Channel</i>	2.1		2.1		2.1
3	January 4, 2010	<i>Richardson Bay</i>	4,667.9	20.6	46,88.6		4,688.6
4	January 22-25, 2010	<i>Coyote Point</i>		1,191.2	1,191.2		1,191.2
5	January 25-29, 2010	<i>Paradise to Lime Point (includes Richardson Bay)</i>	23,185.8	3,102.8	26,288.6		26,288.6
6	February 13-20, 2010	<i>Richardson Bay</i>	4,674.4		4,674.4		4,674.4
7	February 12-22, 2010	<i>Point Richmond</i>	978.7	76.1	1,054.9		1,054.9
8	February 27-March 6, 2010	<i>Richardson Bay (includes Belvedere)</i>	302.6	0.6	303.1		303.1
9	April 1, 2010	<i>Richardson Bay</i>	<i>Trace</i>		<i>Trace</i>		<i>Trace</i>
n	spawn events = 9	Total in Tons	3,4018.0	4,391.4	38,409.4	0.0	0.0
							38,409

* There was a zero quota for the 2009-10 season in San Francisco Bay.

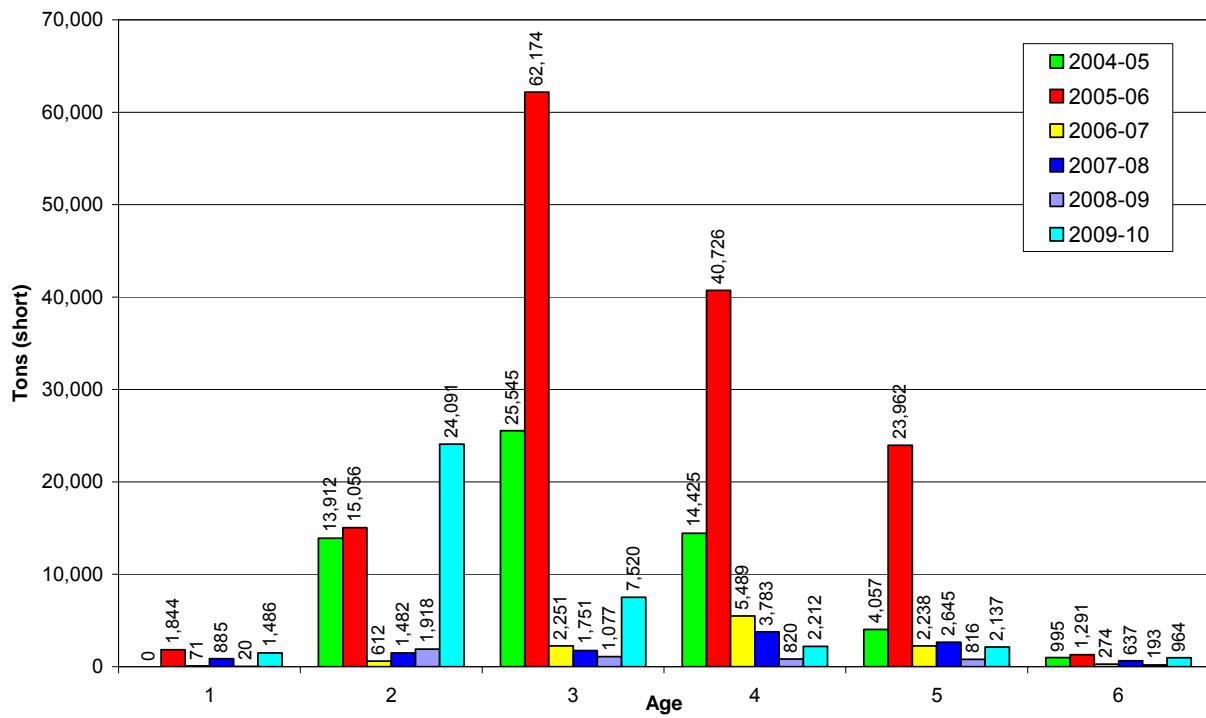


Figure 3.1 San Francisco spawning biomass by age class for the 2004-05 to 2009-10 seasons

The length-weight relationship for herring in spawning condition sampled by Department research nets in the 2009-10 season indicates that herring below 186 millimeters (mm) were heavier in weight for a given body length (BL) compared to the previous season, particularly toward the lower end which was composed of younger fish (Figure 3.2). The length-weight relationship of herring can also be used to develop a condition factor index, which is used to describe the health of a population. The San Francisco Bay herring condition factor index improved for mature herring when compared to last season and showed the best indices since the 2002-03 season (Figure 3.3). Both female and male herring returned in a more robust condition which may be an indicator of better growth, and reproductive potential for the 2010-11 season.

In summary, the 38,409 tons of spawning biomass estimated for the 2009-10 season was below the historical average (1978-79 season to present) of 49,084 tons, but was nearly an eight-fold increase over the 2008-09 season estimate of 4,833 tons. The increased spawning biomass, due to strong recruitment of the 2-year old herring to the spawning population and as the improved physical condition of fish, indicate that

favorable biological and environmental conditions are aiding the rebuilding of the San Francisco Bay herring stock. Early reports for spring 2010 by the ENSO, PDO, and UI indices indicate favorable oceanic conditions for continued herring stock recovery. In addition, hydrographic conditions within San Francisco Bay have improved over the previous three seasons with near average rainfall reported for the current water year, which may aid in spawning success and survival of young herring in the bay.

Since the 2002-03 season, the Department has expressed concern regarding the health, specifically the age structure, of the San Francisco Bay herring population. Following the 1997-98 El Niño, the estimated number of age four and older herring, which has historically supported the gill net fishery, declined and these older age classes have yet to recover based upon the 2009-10 season age data. In contrast, the large recruitment of 2-year old fish (2007-08 year class) into the spawning population demonstrates the potential for stock recovery. The 2007-08 year class appears to be the strongest in recent seasons; however, this year class will be subjected to a high level of fishing mortality this coming season, due to its strength in numbers in comparison to the numbers of age four and older herring which normally support the commercial fishery. The potential to take young herring (under 4-years old) could rise as seen between 2000-04 when there was a low proportion of harvestable 4-year old and older herring (Figure 3.4). Continued monitoring of the commercial catch will ensure that the Department's management goals are maintained and younger fish are not harvested at unacceptable levels. For this reason one of the Department's longstanding management objectives has been to reduce the harvest of 2- and 3-year old herring, many of which are first-time spawners. With an appropriate harvest rate strong year classes can support a fishery for several seasons.

Table 3.2 Estimated numbers (x 1,000) of herring-at-age in the San Francisco Bay spawning population, 1982-83 to present

Season	Age and Percent Composition																	Total	
	1	%	2	%	3	%	4	%	5	%	6	%	7	%	8	%	9	%	
82-83	a	N/A	87,908	14.8	149,971	25.2	182,936	30.7	118,040	19.8	30,478	5.1	17,177	2.9	8,121	1.4	797	0.1	595,428
83-84	a	N/A	332,699	56.6	69,654	11.9	92,565	15.8	73,840	12.6	17,306	2.9	1,168	0.2	117	0	0	0	587,349
84-85	a	N/A	184,695	38.7	190,998	40	46,613	9.8	22,153	4.6	25,914	5.4	6,652	1.4	688	0.1	0	0	477,713
85-86	a	N/A	162,422	32.4	160,613	32.1	126,535	25.3	26,790	5.3	16,038	3.2	7,752	1.5	717	0.1	182	0	501,049
86-87	a	N/A	168,962	29.2	194,365	33.6	134,528	23.2	64,598	11.2	9,182	1.6	6,175	1.1	1,065	0.2	246	0	579,121
87-88	a	N/A	233,193	30.6	292,508	38.3	136,604	17.9	66,494	8.7	25,337	3.3	5,027	0.7	3,939	0.5	0	0	763,102
88-89	a	N/A	146,525	25.8	222,058	39	139,906	24.6	44,435	7.8	12,310	2.2	3,030	0.5	534	0.1	0	0	568,798
89-90	a	N/A	294,631	37.6	237,377	30.3	136,248	17.4	84,361	10.8	23,970	3.1	6,572	0.8	0	0	0	0	783,159
90-91																			
91-92	1,356	0.3	13,666	3.0	126,016	27.5	206,930	45.2	82,870	18.1	23,764	5.2	3,490	0.8	0	0	0	0	458,092
92-93	0	0	48,925	20.5	50,398	21.1	79,045	33.1	51,713	21.7	8,642	3.6	0	0	0	0	0	0	238,723
93-94	11,485	2.7	22,403	5.3	134,870	31.8	160,335	37.9	63,331	15	25,926	6.1	4,808	1.1	355	0.1	0	0	423,513
94-95	2,276	0.5	39,363	9.0	236,783	54.1	94,833	21.7	42,850	9.8	18,223	4.2	3,196	0.7	0	0	0	0	437,524
95-96	3,142	0.3	483,164	38.9	359,357	29	282,069	22.7	81,768	6.6	28,904	2.3	1,687	0.1	0	0	0	0	1,240,091
96-97	1,184	0.1	290,497	29.1	359,459	36	183,370	18.4	120,029	12	33,098	3.3	8,935	0.9	270	0	0	0	996,842
97-98	42	0	45,092	17.2	129,411	49.3	65,637	25	18,724	7.1	2,259	0.9	1,430	0.5	0	0	0	0	262,595
98-99	1,931	0.4	256,816	52.0	54,306	11	114,835	23.2	56,915	11.5	9,729	2	558	0.1	978	0.2	b	0	496,068
99-00	1,440	0.4	103,490	30.4	154,260	45.3	48,150	14.1	29,000	8.5	4,310	1.3	0	0	0	0	b	0	340,650
00-01	255,158	36	178,401	25.2	185,748	26.2	65,555	9.2	24,267	3.4	126	0	0	0	0	0	0	0	709,255
01-02	5,788	1.5	157,182	39.6	138,752	35	75,088	18.9	15,383	3.9	4,265	1.1	152	0	0	0	0	0	396,610
02-03																			
03-04 ^c	2,473	0.5	328,257	65.5	122,072	24.3	26,641	5.3	14,848	3	7,225	1.4	0	0	0	0	0	0	501,516
04-05 ^d	0	0	287,298	33.1	360,741	41.6	166,538	19.2	44,684	5.2	8,367	1	0	0	0	0	0	0	867,628
05-06	59,112	3.2	217,177	11.7	896,819	48.3	438,877	23.6	234,285	12.6	11,202	0.6	0	0	0	0	0	0	1,857,473
06-07	2,176	1.5	11,970	8.1	37,000	25.0	70,734	47.8	23,941	16.2	2,176	1.5	0	0	0	0	0	0	147,997
07-08	24,928	16.1	31,035	20.0	25,714	16.6	42,578	27.5	24,987	16.1	5,602	3.6	0	0	0	0	0	0	154,844
08-09	623	0.8	36,786	49.6	16,211	21.8	10,599	14.3	8,105	10.9	1,870	2.5	0	0	0	0	0	0	74,194
09-10	48,493	7.3	458,179	69.0	103,675	15.6	25,083	3.8	20,066	3.0	8,361	1.3	0	0	0	0	0	0	663,857
Mean	23,423	4.0	177,721	30.5	192,659	31.1	121,263	22.1	56,095	10.2	14,022	2.6	2,993	0.5	646	0.1	51	0.0	581,661

Note: The 1990-91 and 2002-03 seasons were not estimated due to incomplete or unresolved data sets. ^a 1-year-olds were not estimated, ^b 9-year-olds were not estimated, ^c includes corrected estimated number of two-year-olds, ^d no 1-year-olds were sampled in spawning condition

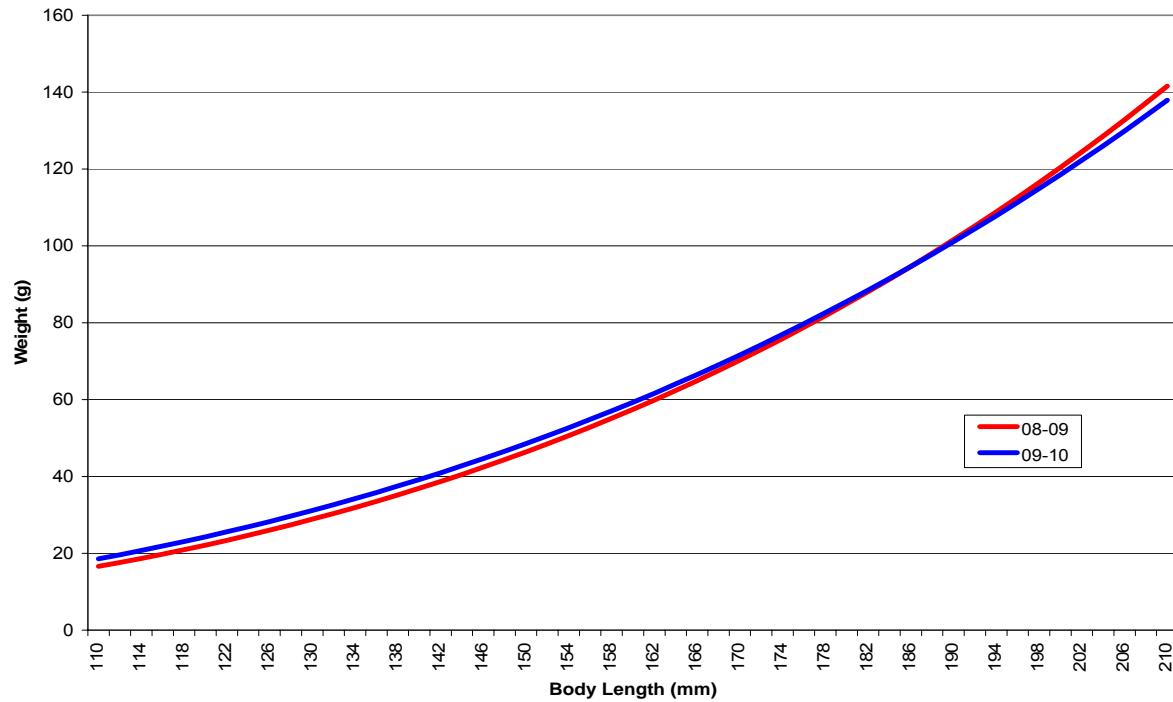


Figure 3.2 Length-weight relationship of ripe San Francisco Bay herring captured with research gear during the 2008-09 and 2009-10 seasons

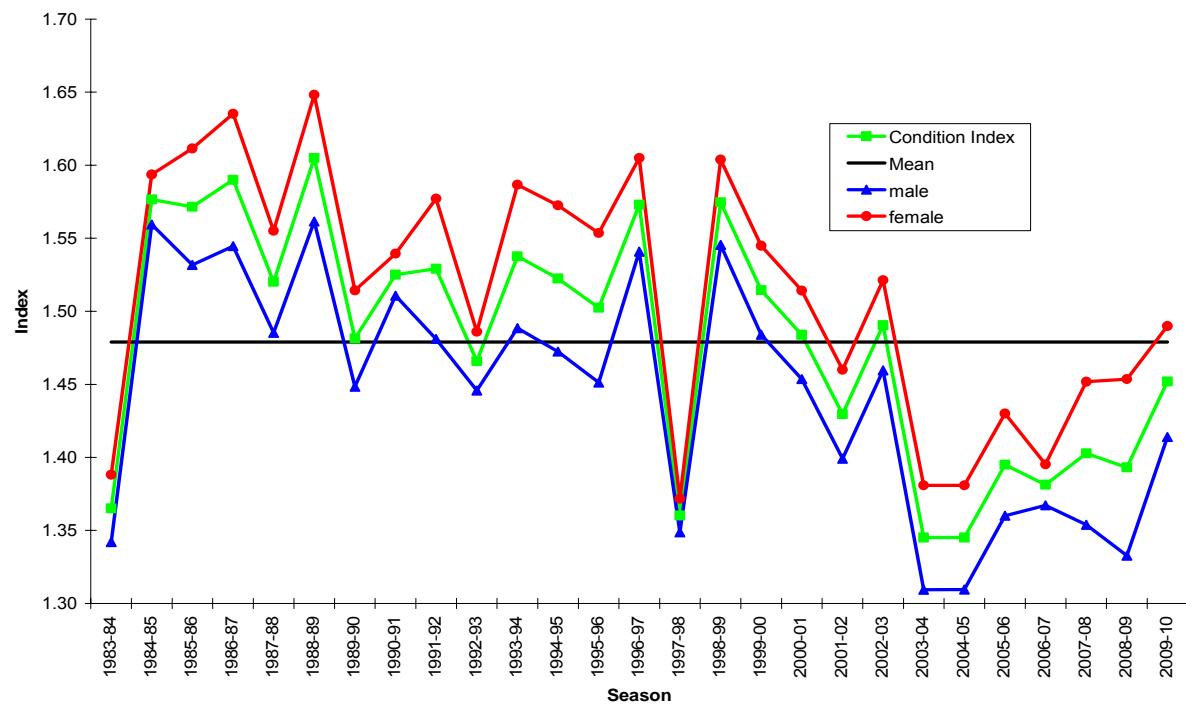


Figure 3.3 Historical condition factor indices for ripe San Francisco Bay herring

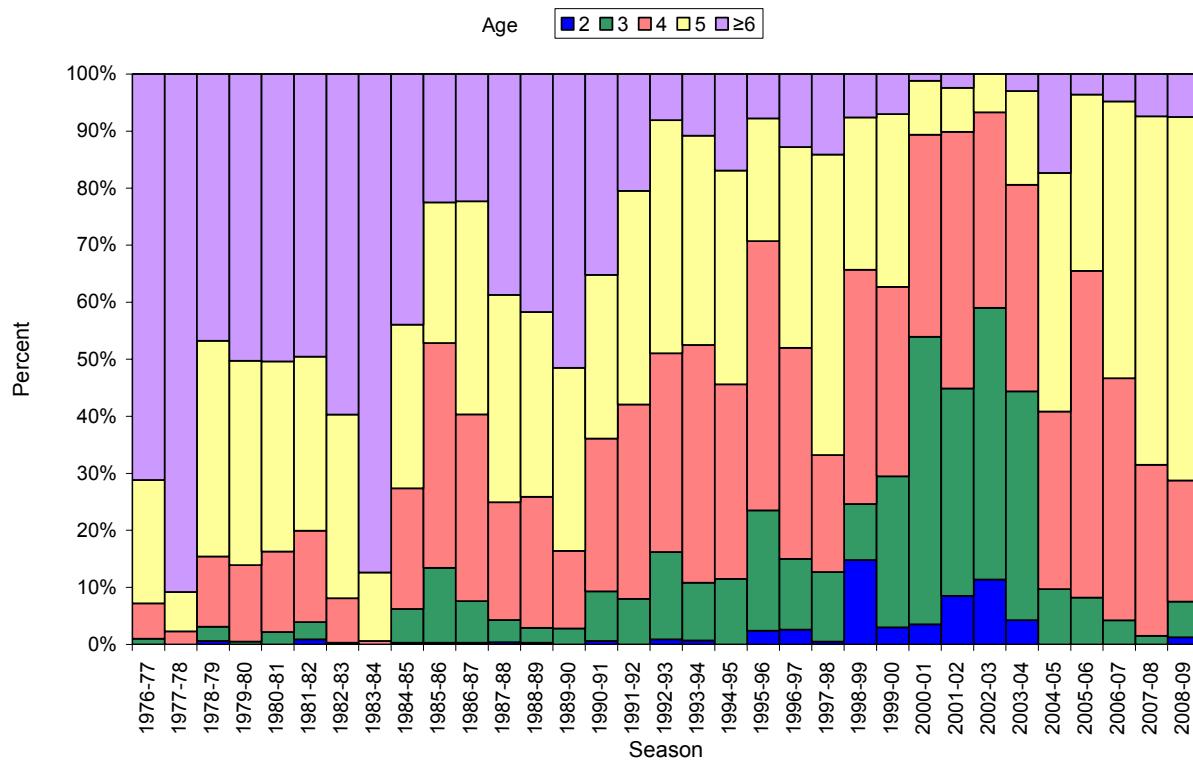


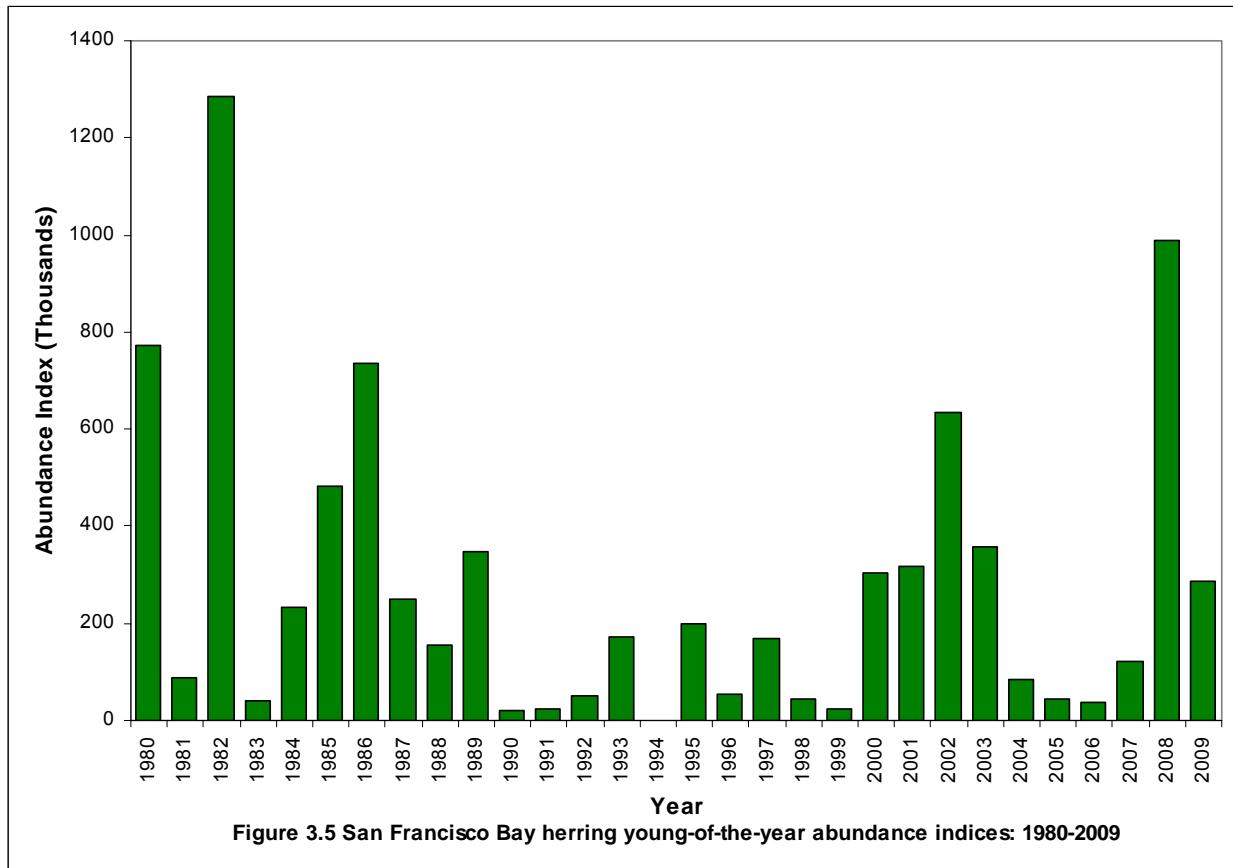
Figure 3.4 Age composition of the commercial gill net catch for the San Francisco Bay herring fishery.

3.3.1 San Francisco Bay Herring Young of the Year (YOY)

Herring young-of-the-year (YOY) are commonly caught for the Interagency Ecological Program for the San Francisco Estuary by the Department's San Francisco Bay Study (SFBS) during the spring and summer of each year. The SFBS conducts surveys to determine the abundance and distribution of invertebrates and fishes in the San Francisco Estuary from the western Sacramento-San Joaquin Delta to San Francisco Bay. Stations are sampled each month using a midwater trawl that is towed obliquely through the water column to capture species inhabiting varying depths. The catch from this net is used to calculate an index of abundance for YOY herring (Fleming 1999).

The herring YOY abundance index for 2009 was near the average for the period of record (Figure 3.4) which was greater than expected, considering the low spawning biomass estimate. The relatively high abundance of YOY indicated favorable environmental conditions for survival within San Francisco Bay (Hieb et al, in press). However, recruitment to the spawning stock is affected by a number of factors during

the first two to three years of life, including predation, food availability, competition, and environmental conditions.



3.3.2 Cosco Busan Oil Spill and Potential Impacts to San Francisco Bay Herring

On November 7, 2007, the container ship, *Cosco Busan* spilled an estimated 58,000 gallons of bunker fuel (IFO 380) into San Francisco Bay. Due to the timing of the oil spill, herring resources were potentially impacted. Since the spill occurred prior to the majority of spawning schools entering the bay, the most likely impact would be to spawning habitat and egg and larval development in contaminated areas. Previous studies, conducted after the *Exxon Valdez* oil spill, on herring egg and larval development exposed to weathered oil and polycyclic aromatic hydrocarbons (PAH) indicate impacts range from increased egg mortality to larval developmental abnormalities resulting in poor survival. Significantly higher herring egg and larval mortality was found in oiled versus non-oiled areas which supports the hypothesis that oil exposure decreases survival and hatching success in late stage embryos (McGurk

and Brown 1996). Norcross et al (1996) found herring larvae from oiled areas had low growth rate and high proportions of deformities such as craniofacial defects. Larvae from un-oiled areas in Prince William Sound had less severe abnormalities due to oil exposure through the water column or contaminated prey. PAH compounds found in oil selectively disrupt embryonic cardiac function and indirectly affect other tissues that are secondary to cardiovascular dysfunction (Incardona et al 2004). Sublethal effects resulting from oil exposure, such as developmental abnormalities can become lethal at later stages and environmental variables can alter the baseline of sublethal indicators (Hose et al 1996). Carls et al (2002) reviewed the toxicological impacts on herring from the *Exxon Valdez* oil spill found four to six percent of the spawn occurred within visibly oiled areas. However, elevated concentrations of biologically available oil were found in the water, providing evidence that the primary source of herring egg oil contamination was through the water. While crude oil and bunker fuel oil may have differing chemical properties, potential oil related impacts on herring are similar.

A Natural Resources Damage Assessment (NRDA) team conducted a study of egg and larval development in oiled and non-oiled areas in San Francisco Bay; however, the results are still under review. Field observations by Department staff indicated that key spawning areas were oiled during the spill. A review of existing literature indicates that potential impacts of oil exposure on herring may negatively affect year class strength, but similarly, other environmental conditions could also negatively affect year class strength. Herring have an evolved reproductive strategy to withstand predation, environmental uncertainties, and stochastic events. However, the current population level remains below average and significant increases in mortality at any life history stage will delay stock rebuilding. The findings of the NRDA report will assist in determining the immediate and long-term impacts to herring resources and assist in amending San Francisco Bay herring management strategies, if warranted.

3.3.3 Importance of Herring as a Forage Species

As referenced in the FED, herring are an integral component to a healthy functioning marine ecosystem, making up a large portion of the diet of marine organisms from California to Alaska. Herring are a mid-trophic level species that play

an important role linking the lower and higher trophic levels in the food web. As a key forage species, low biomass levels of herring could impact important recreational and commercial species as well as threatened and endangered fish, marine mammals, and sea birds that rely upon them as a food source.

Specifically, herring are a crucial part of the San Francisco Bay food web. Herring, at each life history stage from egg to adult, are utilized as forage within San Francisco Bay. Spawning herring are an important food source for marine mammals and birds residing within the bay during the winter, when many other fish leave the bay. Herring eggs are consumed by at least 20 species of birds (including several species of ducks and gulls) in addition to non-avian predators such as sturgeon, surfperch, smelt and crab. Invertebrates, small perch and young salmonids have all been documented as predators of herring larvae. Juvenile herring support a wide range of San Francisco Bay species, as a food source, from spring through fall. In offshore waters, adult herring are consumed by Pacific whiting, salmon (chinook and coho), sharks, sablefish, striped bass, steelhead, Pacific cod, rockfish, and walleye pollock. Herring are also consumed by marine mammals including harbor seals, northern fur seals, California sea lions, porpoises, dolphins, and whales.

Because herring play an important role as a forage species in ocean and bay ecosystems, it is vital that management concepts take into account these complex interactions. Herring occupy a crucial intermediate trophic level, between plankton and larger predators, which is usually comprised of only a few species (typically small pelagic fish). Changes in abundance of a forage species such as herring may lead to changes in the abundance of other species. Given the rebuilding status of the San Francisco Bay stock, the importance of protecting herring becomes vital to ensure long-term sustainability of the fishery while safeguarding its importance as a forage species in a functioning ecosystem.

Chapter 4. ENVIRONMENTAL IMPACT ANALYSIS AND CUMULATIVE EFFECTS

This chapter addresses the impacts and cumulative effects of the proposed project (changes to the commercial herring fishing regulations) on the existing environment described in Chapter 3 of this document and Chapter 3 of the Final Environmental Document (FED). The proposed project and two of the three alternatives will permit a continuation of the regulated commercial harvest of Pacific herring (herring), *Clupea pallasi*, in California. An analysis of the impacts of the proposed project is discussed in this Final Supplemental Environmental Document (FSED).

Existing regulations permit the commercial harvest of herring in four geographical areas: San Francisco Bay, Tomales Bay, Humboldt Bay, and the Crescent City Harbor area. Chapter 4 of the FED examined the environmental sensitivity of each of these areas at existing harvest levels. Thirteen environmental categories were considered, including; land use, traffic circulation, water quality, air quality, housing, public utilities, geological, biological, archaeological, scenic, recreation, noise, and growth inducement. Three categories (land use, archaeology, and growth inducement) were considered to have no environmental sensitivity to commercial herring fishery activity in any of the four geographical areas and were not considered in the impact analysis. Potential impacts relative to the above categories were re-examined annually and addressed in the Supplemental Environmental Document (SED). The basis for this assessment is provided in detail in Section 4.1 of the FED.

Section 4.2 of the FED provided a detailed impact analysis for the ten categories found to have environmental sensitivity to commercial herring fishery activity. Potential impacts to traffic circulation, water quality, air quality, housing and utilities, geology, scenic quality, recreational opportunities, and noise levels that were identified as an aspect of herring fisheries varied in degree with geographic area, but all were considered to be localized, short-term, and less than significant. Some of these potential impacts are mitigated by various existing regulations.

Section 4.2.6 of the FED provided a detailed analysis of the potential environmental impacts to biological resources that exist from commercial herring fisheries. The proposed project adds no new impacts to be analyzed.

The FED divided potential impacts into two categories: (1) direct harvest impacts, and (2) trophic level impacts. Short and long-term potential adverse impacts exist within each of these categories. Many of these potential impacts are mitigated by current management practices including annual stock assessments and regulations that control harvest and fishery impacts. Others are considered localized, short-term and less than significant.

Chapter 5 of the FED provided a detailed analysis of the factors that have the capacity to influence future herring population status in California in addition to the existing herring fisheries or alternatives (cumulative effects). The proposed project introduces no new cumulative effects to those addressed by the FED. The FED discussed in detail the factors with greatest potential for cumulative effects, including continued commercial harvest of herring, unusual biological events, competitive interactions with other pelagic fish, unusual weather events, habitat loss, and water quality. Mitigation for these potential cumulative effects will be provided by annual stock assessments, annual changes in the level of harvest, or the selection of a no fishery alternative.

The Department of Fish and Game identified and addressed impacts and cumulative effects of the proposed project on the existing environment described in Chapter 3 of the FED, subsequent FSEDs, and this FSED. No impacts were identified that were not already addressed in the FED or prior FSEDs. Other impacts identified were determined to be localized, short-term, and less than significant.

Chapter 5. ANALYSIS OF ALTERNATIVES

An analysis of the potential environmental impacts of the three alternatives described in Section 2.4 is provided in Chapter 6 of the Final Environmental Document (FED). Three commercial harvest alternatives were selected for consideration by the California Fish and Game Commission (Commission) based on the Department of Fish and Game's (Department) recommendation, public comment received during the normal review process, or in response to the Notice of Preparation (NOP). These alternatives were selected to provide the Commission with a range of commercial harvest alternatives. The two commercial harvest alternatives contain common elements with only selected elements of the management framework considered as alternatives. A "no project" (no commercial harvest of herring within California state waters) alternative is also provided.

5.1 Alternative 1 (no project)

The "no project" alternative would eliminate the commercial harvest of Pacific herring (herring), *Clupea pallasi*, resources within California waters. Selection of this alternative would be expected to: (1) reduce total mortality and allow herring stocks to increase to carrying capacity; (2) increase competition between species (e.g., sardines and anchovies) occupying the same ecological niche as herring and potentially reduce standing crops of these species; (3) increase the availability of herring to predators by reducing search effort and increasing capture success; (4) eliminate the ethical concern of those opposed to the commercial harvest of herring and the scientific information on herring derived from sampling the commercial harvest; and (5) eliminate revenues to local and regional economies, and state and federal agencies derived from the commercial harvest of herring.

Localized, short-term, and less than significant impacts to traffic circulation, water quality, air quality, housing, utilities, scenic quality, recreational opportunities, and noise levels would also be eliminated under the no project alternative. Section 6.1 of the FED provides a full analysis of the potential impacts associated with this alternative.

5.2 Alternative 2 (existing regulations)

Existing regulations, adopted in 2009, were for the 2009-10 herring commercial fishing season. These regulations reflect the amendments as adopted by the Commission in September 2009. Under Alternative 2, changes would be made to revise the herring fishing seasons by location or adjust quotas to reflect the 2009-10 biomass estimate determined by the Department. In most regards, the environmental impacts of Alternative 2 will be similar to those of the proposed project. Alternative 2, however, does not address problems or conditions that are addressed by the proposed project.

Chapter 6. CONSULTATION

Chapter 6 of the Final Environmental Document (FED) explains the role that consultation with other agencies, professionals, and the public plays in the Department of Fish and Game (Department) marine resource management programs. Department staff, involved in Pacific herring (herring), *Clupea pallasii*, resource management, is in contact with other agencies, biologists and researchers involved in herring management on an ongoing basis. The U.S. Fish and Wildlife Service, NOAA-Fisheries Service, U.S. Environmental Protection Agency, and other state and federal agencies received all environmental documents that have been prepared regarding herring. To date, we have not received any comments from these agencies.

Consultations also occur during the annual review of regulations guiding the commercial harvest of herring. The process began this year when the Department presented the results of its annual population assessment and discussed possible regulatory changes for the 2010-11 season with the Director's Herring Advisory Committee (DHAC) on April 21, 2010.

Proposed changes to the regulations for the 2010-11 season were modified, as necessary, based on comments from the DHAC. These recommendations were presented to the California Fish and Game Commission (Commission) at their June 24, 2010, meeting.

Prior to preparation of the Draft Supplemental Environmental Document, the Department initiated a broader consultation by distributing a Notice of Preparation (NOP) that announced the intent to prepare the document dated April 26, 2010. In the NOP, the Department requested submission of views on the scope and content of the environmental information to be contained therein. The notice was distributed to members of the public and interested organizations that had expressed prior interest in herring management. The NOP was also provided to the State Clearinghouse for distribution to appropriate responsible and trustee agencies.

Literature Cited

- Carls, M.G., G.D. Marty, and J.E. Hose. 2002. Synthesis of the toxicological impacts of the *Exxon Valdez* oil spill on Pacific herring (*Clupea pallasii*) in Prince William Sound, Alaska, U.S.A. Can. J. Fish. Aquat. Sci. 59: 153-172.
- Climate Prediction Center National Centers for Environmental Prediction NOAA/National Weather Service. 2008. “El Niño/Southern Oscillation (ENSO) Diagnostic Discussion.” <http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.doc>
- Department of Fish and Game. 2010. Draft Supplemental Environmental Document (DSED), Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.
- Department of Fish and Game. 2009. Final Supplemental Environmental Document (FSED), Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.
- Department of Fish and Game. 2009. Draft Supplemental Environmental Document (DSED), Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.
- Department of Fish and Game. 2008. Final Supplemental Environmental Document (FSED), Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.
- Department of Fish and Game. 2008. Draft Supplemental Environmental Document (DSED), Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.
- Department of Fish and Game. 2007. Final Supplemental Environmental Document (FSED), Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.
- Department of Fish and Game. 2007. Draft Supplemental Environmental Document (DSED), Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.

Department of Fish and Game. 2006. Final Supplemental Environmental Document (FSED), Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.

Department of Fish and Game. 2006. Draft Supplemental Environmental Document (DSED), Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.

Department of Fish and Game. 2005. Final Supplemental Environmental Document, Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.

Department of Fish and Game. 2005. Draft Supplemental Environmental Document, Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.

Department of Fish and Game. 2004. Final Supplemental Environmental Document, Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.

Department of Fish and Game. 2004. Draft Supplemental Environmental Document, Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.

Department of Fish and Game. 2002. Final Supplemental Environmental Document, Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.

Department of Fish and Game. 2002. Draft Supplemental Environmental Document, Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.

Department of Fish and Game. 2001. Final Supplemental Environmental Document, Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.

Department of Fish and Game. 2001. Draft Supplemental Environmental Document, Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.

Department of Fish and Game. 2000. Final Supplemental Environmental Document, Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.

Department of Fish and Game. 2000. Draft Supplemental Environmental Document, Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.

Department of Fish and Game. 1999. Final Supplemental Environmental Document, Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.

Department of Fish and Game. 1999. Draft Supplemental Environmental Document, Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.

Department of Fish and Game. 1998. Final Environmental Document (FED), Pacific Herring Commercial Fishing Regulations (Sections 163, 163.5, and 164, Title 14, California Code of Regulations). State of California. The Resources Agency.

Fleming, K. 1999. Clupidae. In: Report on the 1980-1995 fish, shrimp and crab sampling in the San Francisco Estuary, California, J. Orsi, editor. The Interagency Ecological Program for San Francisco Estuary. Technical Report 63, 503 pp.

Haegele, C.W. 1997. The occurrence, abundance and food of juvenile herring and salmon in the Strait of Georgia, British Columbia in 1990 to 1994. Can. Man. Rep. Fish. Aquat. Sci. 2390: 124 pp.

Hart, J.L. 1973. Pacific fishes of Canada. Fish. Res. Board Can. Bull. 180, Ottawa. 740 pp.

Hay, D.E. 2002. Reflections of factors affecting size-at-age and strong year classes of herring in the North Pacific. In: PICES-GLOBEC International Program on Climate Change and Carrying Capacity Report of 2001 BASS/MODEL, Monitor and REX Workshops, and the 2002 MODEL/REX Workshop. PICES Scientific Report 20, 182 pp.

Hieb, K., D. Contreras, M. Fish, V. Afentoulis, and J. Messineo. In press. 2010. Fishes Annual Status and Trends Report for the San Francisco Estuary. IEP Newsletter.

Hose, J.E., M.D. McGurk, G.D. Marty, D.E. Hinton, E.D. Brown, and T.T. Baker. 1996. Sublethal effects of the *Exxon Valdez* oil spill on herring embryos and larvae morphological, cytogenetic, and histopathological assessments, 1989-1991. Can. J. Fish. Aquat. Sci. 53: 2355-2365.

Incardona, J.P., T.K. Collier, and N.L. Scholtz. 2004. Defects in cardiac function precede morphological abnormalities in fish embryos exposed to polycyclic aromatic hydrocarbons. Toxicology and Applied Pharmacology. 196: 191-205.

McGurk, M.D. and E.D. Brown. 1996. Egg-larval mortality of Pacific herring in Prince William Sound, Alaska, after the *Exxon Valdez* oil spill. Can. J. Fish. Aquat. Sci. 53: 2343-2354.

Miller, D.J. and J. Schmidtke. 1956. Report on the distribution and abundance of Pacific herring (*Clupea pallasii*) along the coast of central and southern California. Calif. Fish Game Bulletin 42: 163-187.

Norcross, B.L. J.E. Hose, M. Frandsen, and E.D. Brown. 1996. Distribution, abundance, morphological condition, and cytogenic abnormalities of larval herring in Prince William Sound, Alaska, following the *Exxon Valdez* oil spill. Can. J. Fish. Aquat. Sci. 53: 2376-2387.

Outram, D.N. and R.D. Humphreys. 1974. The Pacific herring in British Columbia waters. Fish. Mar. Serv., Pac. Biol. Stn. Circ., 100: 1-2

Appendix A

Summary of Changes

Summary of Changes to the 2010 Draft Supplemental Environmental Document for Pacific Herring Commercial Fishing Regulations

This appendix provides a summary of the changes made to the Draft Supplemental Environmental Document (DSED) based updated information on age data for San Francisco Bay, and minor grammatical changes for clarity.

General changes throughout the Document

- References to the DSED were changed to FSED (Final Supplemental Environmental Document) where applicable.
- Misspellings, grammatical errors, and errors in graph or table identification, were corrected.

Table of Contents

- The table of contents was revised to match any page numbers that changed during the process of finalizing the FSED document.
- Chapter 7, Responses to Comments Regarding the Proposed Project, was added.
- Appendix A, Summary of Changes was added.

Summary

- The following text was changed in S.1 Introduction, paragraph 2 to show the number of chapters in the FSED: The FSED includes seven chapters.
- The following text was added to S.1 Introduction, paragraph 2: Chapter 7 responds to public comments regarding the proposed project.
- The following sentence was revised for clarity in S.2 Proposed Project, paragraph 2: The specific regulatory changes proposed for the 2010-11 season will: (1) provide the Commission the option to consider a quota equal to zero to 10 percent of the most recent San Francisco Bay spawning biomass estimate and revise the permitting to redistribute the December fishery to the odd and even platoons, and (2) set the dates of the roe herring fishery in Tomales Bay from noon on December 26, 2010, until noon on February 25, 2011.
- Minor editorial changes were made.

Chapter 1. Introduction

- The following sentence in Section 1.5, paragraph 3 was replaced for clarification: These meetings will be held for the 2010-11 season on August 5, 2010, in Santa Barbara, California and on September 16, 2010, in McClellan, California.
- Minor editorial changes were made.

Chapter 2. Project Description

- The following sentence was revised for clarity in Section 2.3, paragraph 2: The principal regulatory changes proposed for the 2010-11 season included: (1) provide the Commission the option to consider a quota of zero to 10 percent of the most recent San Francisco Bay spawning biomass estimate. The Department's recommendation is a five percent harvest for San Francisco Bay;

(2) set the dates of the roe herring fishery in Tomales Bay from noon on December 26, 2010, until noon on February 25, 2011, and (3) the DHAC recommendation and with support by the Department for integration of December "DH" platoon into Odd and Even groups, with a season beginning in January 2011.

- Minor editorial changes were made.

Chapter 3. Environmental Setting

- The preliminary age data found in Figure 3.1 of the DSED was updated using final age data based on a more comprehensive analysis of herring otoliths.
- The preliminary age data found in Table 3.2 of the DSED was updated using final age data.
- The preliminary age data found in Figure 3.4 of the DSED was updated using final age data.
- Minor editorial changes were made.

Chapter 4. Environmental Impact Analysis and Cumulative Effects

- No changes

Chapter 5. Analysis of Alternatives

- No changes

Chapter 6. Consultation

- No changes

Chapter 7. Responses to Comments

- This chapter is added to all Final Supplemental Environmental Documents where comments are received.

Appendix A Summary of Changes

- Added