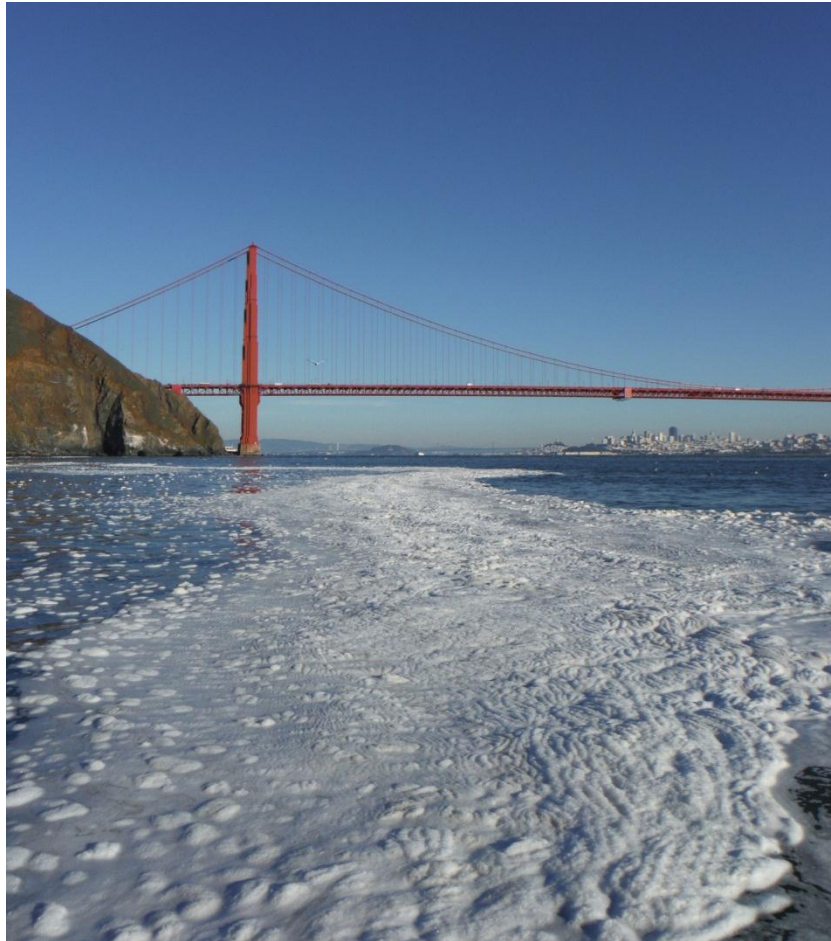


Summary of the 2014-15 Pacific Herring Spawning Population and Commercial Fisheries in San Francisco Bay



CDFW Photo

September 2015
Final Report



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Aquaculture and Bay Management Project
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INTRODUCTION

The California Department of Fish and Wildlife (Department) has conducted herring research in San Francisco Bay as part of its ongoing monitoring and management of the commercial fishery since 1972. The Department uses annual dive surveys and individual spawn deposition surveys to calculate a spawning biomass estimate each year. It also uses mid-water trawl survey data to estimate the age class structure, sex composition, and general condition of the San Francisco Bay spawning population each season. The Department also collects commercial fishery data to determine the age class structure of the commercial catch. The annual biomass estimate, age class structure, condition indices, commercial catch analysis, along with various environmental indicators all serve as the basis for establishing fishing quotas for the next season and are used by the Department to make recommendations to the Fish and Game Commission who has regulatory authority over the fishery. Specific information on commercial herring fishing regulations can be found in Title 14, California Code of Regulations, Sections 163 and 164. In addition, the Department prepares an Environmental Document to outline observed trends in the California Pacific herring population and to analyze potential environmental impacts associated with the fishery and proposed annual regulation changes.

More information on the life history of Pacific herring, the Department's management objectives, and the review and analysis of proposed commercial herring harvest regulations can be found in the 1998 Final Environmental Document and the most recent Final Supplemental Environmental Document (FSED)
<https://www.wildlife.ca.gov/Fishing/Commercial/Herring/CEQA>.

POPULATION SUMMARY

Spawning Biomass Estimate

The spawning biomass estimate for the 2014-15 season was 16,674 tons, which is below the historical average (1979-80 to present) of 51,300 tons. This was a substantial decrease in spawning biomass from the previous season's estimate of 60,600 tons, and is the fourth-lowest estimated biomass on record since the 1979-80 season (Figure 1).

Twelve spawning events were recorded during the 2014-15 season, primarily in the northern areas of San Francisco Bay and along the San Francisco waterfront (Table 1). Spawning events occurred as far north as Point San Pablo and south to Coyote Point (Figure 2). The first recorded spawn of the season occurred October 19-20, 2014, and the last recorded spawn occurred from February 25-March 1, 2015. There were several spawning events in Richardson Bay and along the Marin county shore. The largest spawn event was at Point Richmond with 6,716 tons of herring estimated. The second largest was the Richardson Bay to Point Diablo spawn with 3,947 tons, followed by the San Francisco waterfront spawn, estimated at 3,458 tons.



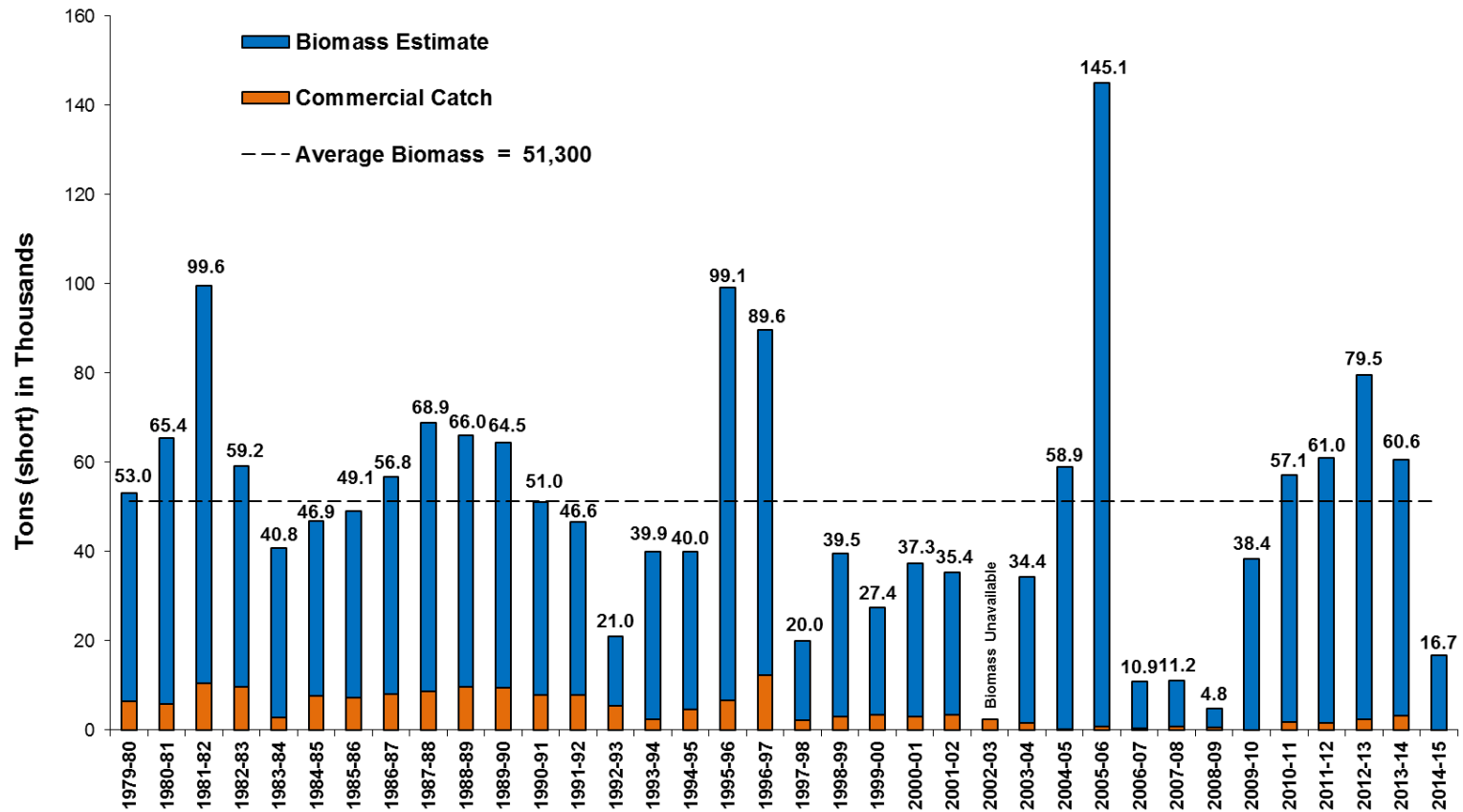


Figure 1. San Francisco Bay Pacific herring biomass estimates and commercial catch.



Table 1. San Francisco Bay Pacific herring spawning biomass estimate by event with commercial catch totals, 2014-15.

#	Approximate Spawn/Catch Date	Location	Submerged Areas	Shore Areas	Spawn Total	Gill-Net HEOK	Biomass Total	
1	October 19-20, 2014	Richardson Bay	Trace				Trace	
2	November 25-26, 2014	Richardson Bay	375		375		375	
3	December 12-14, 2014	Richardson Bay	18		18		18	
4	December 20-23, 2014	Richardson Bay	499	11	509		509	
5	December 27-30, 2014	San Francisco Waterfront		3,458	3,458		3,458	
6	January 3-4, 2015	Coyote Point		166	166		166	
7	January 5-8, 2015	Richardson Bay	1,016		1,016		1,016	
8	January 10-13, 2015	Paradise Cove-Belvedere Cove	163	197	360		360	
9	January 19-21, 2015	Richardson Bay-Point Diablo	1,596	2,312	3,909	38.0	3,947	
10	January 29-February 1, 2015	Point Richmond-Point San Pablo	4,206	2,502	6,708	7.6	6,716	
11	February 1-2, 2015	Tiburon (Keil Cove-Belvedere Cove)	23	58	81		81	
12	February 25-March 1, 2015	Richardson Bay	30		30		30	
Spawn Events (n) = 12		Totals in short tons	7,925	8,703	16,628	46	0	16,674



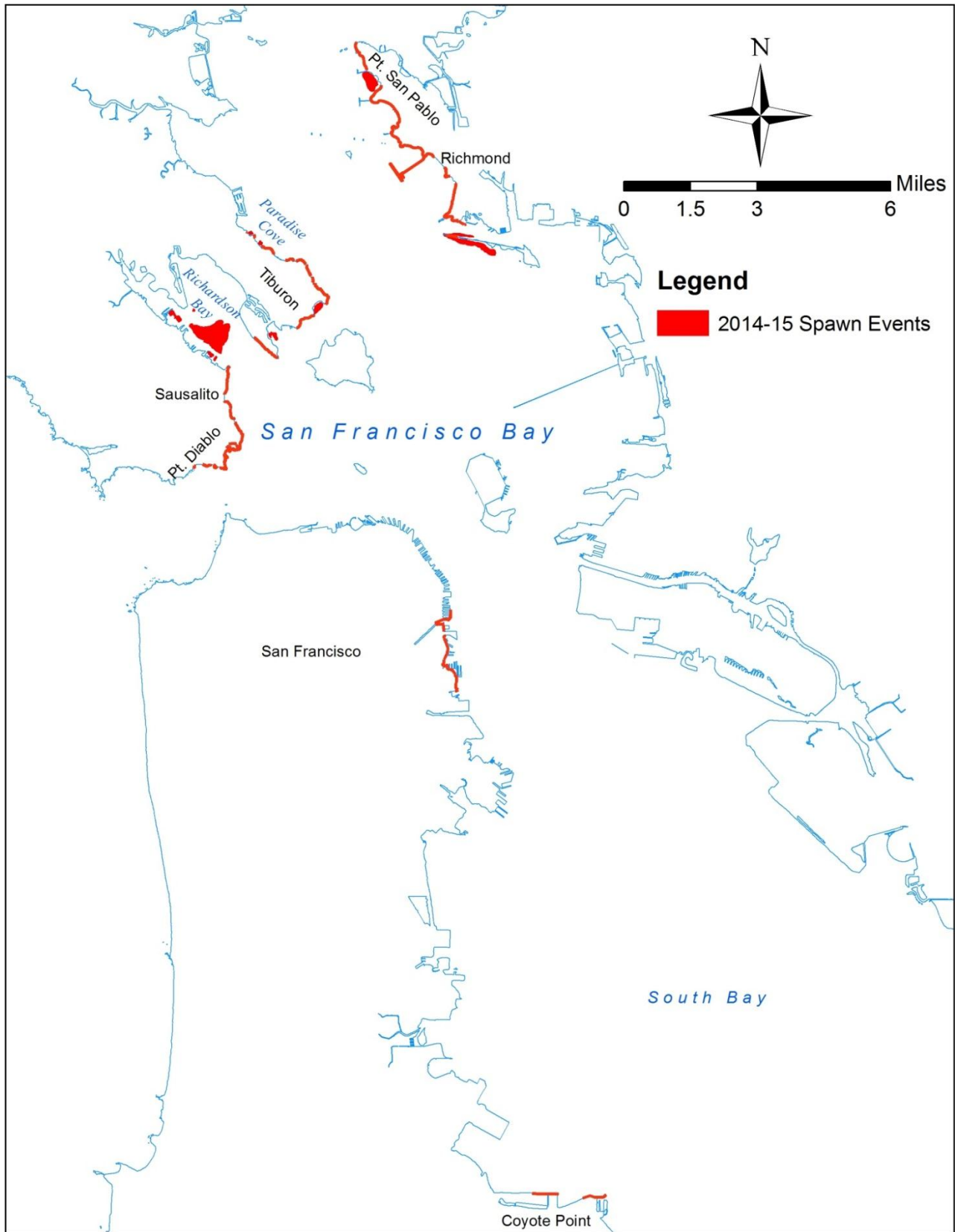


Figure 2. San Francisco Bay herring spawn event map 2014-15 season.



Herring from both the San Francisco Bay spawning population and commercial catch are aged each season using otolith surface readings. Spawning population age composition for 2014-15 shows that biomass declined from the previous season for individual age classes, except age 7 (Figure 3). The spawning biomass of age 2 and 3 herring was the lowest since the 2008-09 season and reduced numbers of young fish negatively affect recruitment to the San Francisco Bay fishery. The proportion of age six and older herring increased between 2013-14 and 2014-15 and age 7 herring were collected in both research samples and commercial samples for the first time since 1998-99 (Figures 4, and 5). Historically the commercial fishery has been supported by a greater proportion of older fish from the spawning population which may reduce the burden on younger cohorts to support the fishery.

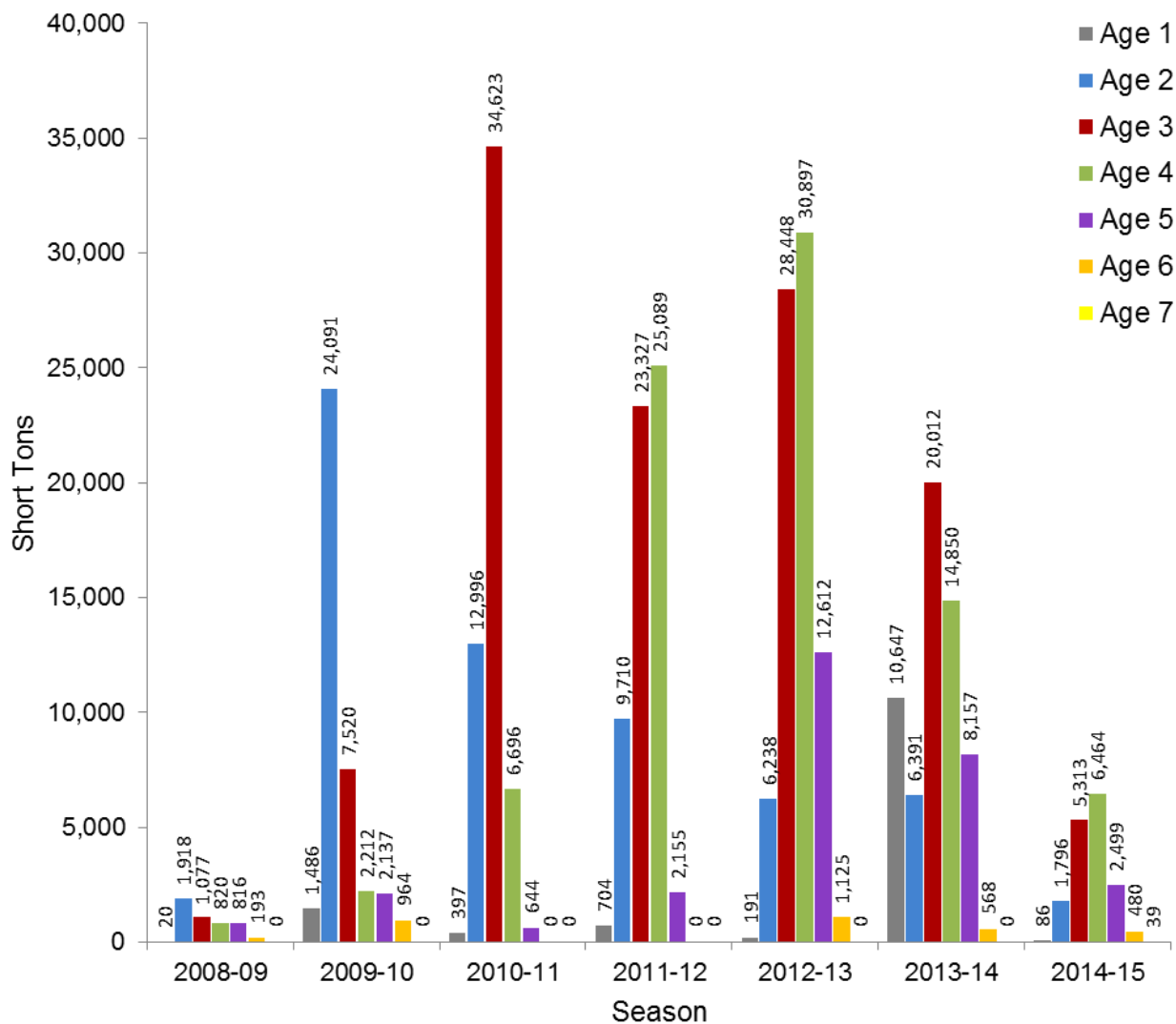


Figure 3. Estimated San Francisco Bay spawning biomass by age class for the 2008-09 to 2014-15 seasons based on research catch.



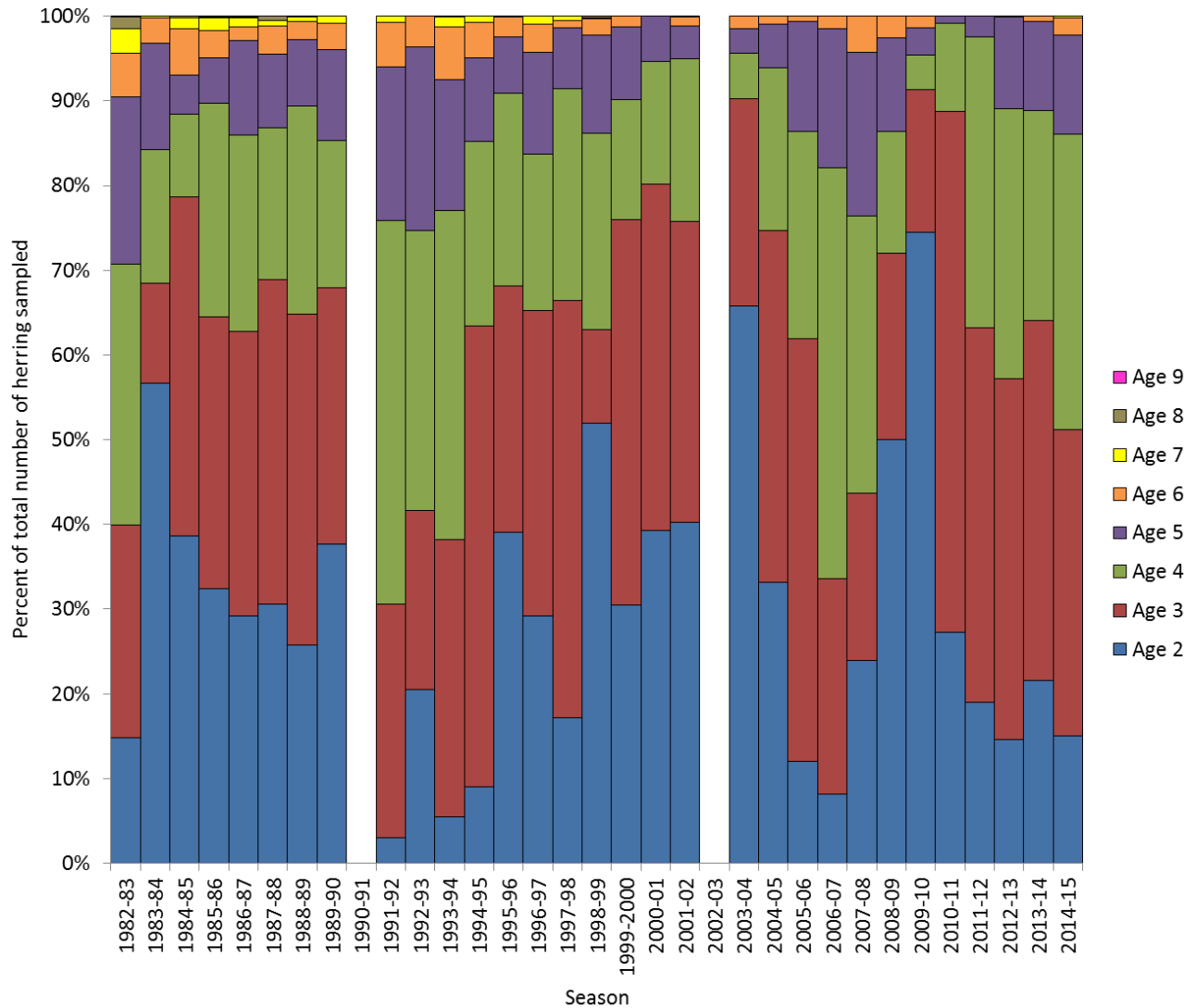


Figure 4. Age composition of the research catch (excluding age-1 fish). Percent by number of ripe fish for the San Francisco Bay herring spawning biomass. Note: Data unavailable for the 2002-03 season.



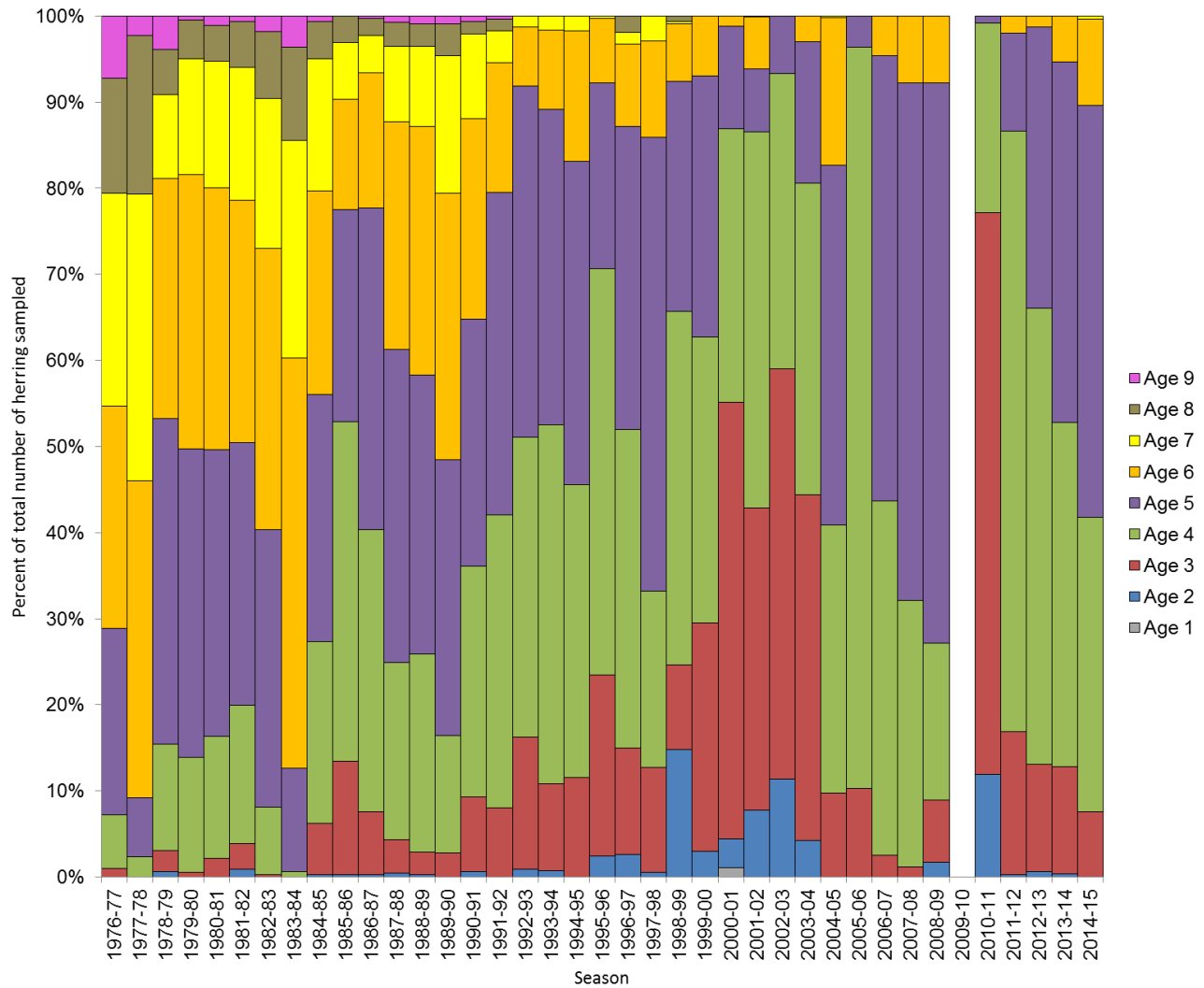


Figure 5. Age composition of the commercial gill net catch; based on fish lengths. Percent by number of fish for the San Francisco Bay herring fishery. Note: The fishery was closed during the 2009-10 season.

The length-weight relationships for herring in spawning condition are used to develop a condition factor index (CI), which is derived from a fish's weight divided by the cube of its length, and used to describe the health of a population. The San Francisco Bay herring CI for mature 2014-15 fish was near average and showed a slight increase relative to the 2013-14 season (Figure 6).



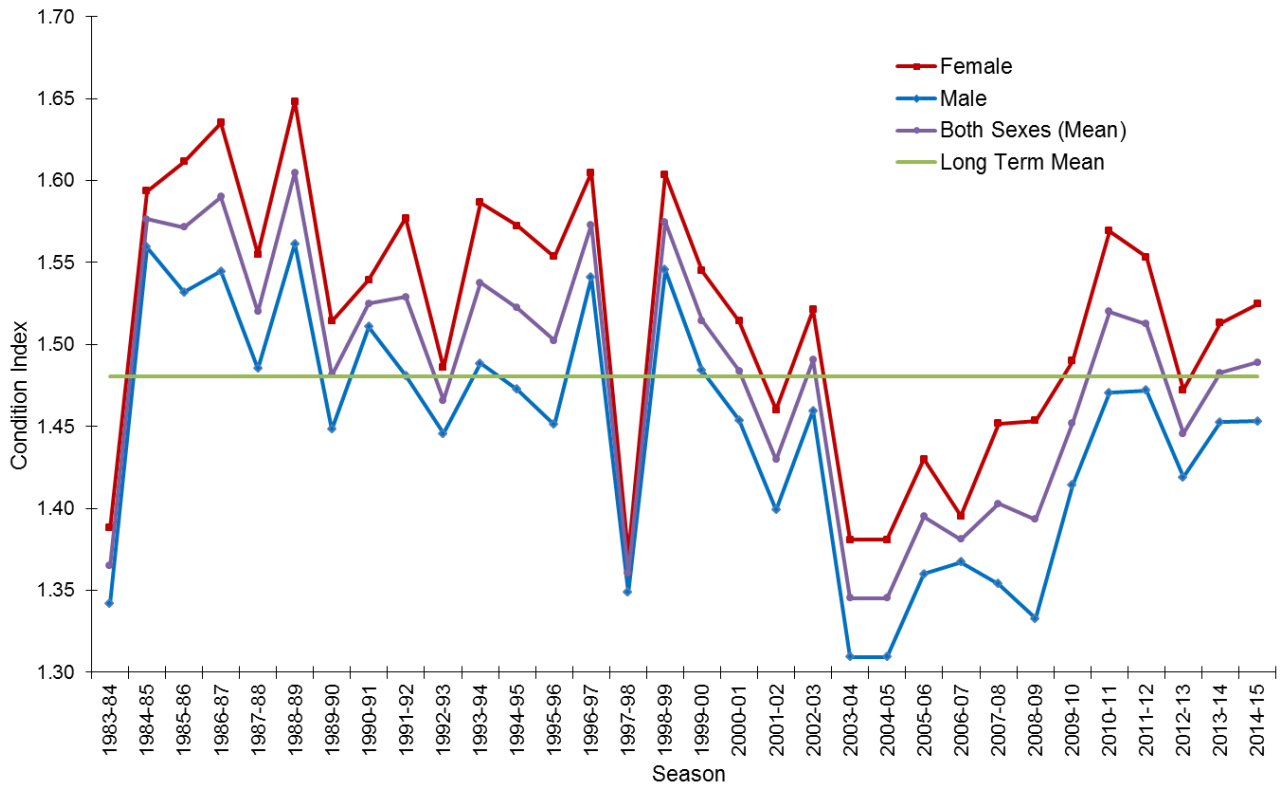


Figure 6. Average Condition Index (CI) and CI for ripe male and female fish based on research catch from the San Francisco Bay herring spawning population.

In summary, the spawning biomass estimate for the 2014-15 season was 16,674 tons, significantly lower than the historical average (1979-80 to present) of 51,300 tons. This decline is likely attributable to poor oceanic and estuarine conditions which adversely affect herring survival. Reports detailing sea surface temperature in the Northeast Pacific during the past year indicate persistently warm conditions (National Marine Fisheries Service 2015). Additionally, reduced freshwater influence in the San Francisco Estuary associated with the ongoing drought has resulted in atypical estuarine conditions, which may have negative impacts on both spawning herring and young herring in the estuary. See Chapter 3.3 of the 2015 FSED for more information.

Commercial Gill Net Fishery Summary

The herring gill net fisheries catch herring as they move into shallow areas to spawn. The traditional product from this fishery, *kazunoko*, is the sac roe (eggs) removed from the females, which is processed and exported for sale in Japan. California's roe fishery began in 1973 and a formal limited-entry permit system was implemented in 1977.

In San Francisco Bay, the fishery is separated into Odd and Even fishing groups



(platoons) based on permit numbers. Platoons rotate fishing weeks throughout the season and the season year determines which platoon begins fishing first. Thus, the Odd platoon was designated to fish first for the 2014-15 season. Generally, the opening date of the fishery is set for January 1 and the closing date is set for March 15 with minor adjustments each year to account for annual changes in the calendar. The DH fishery continued to be integrated into the Odd and Even platoons this season. The 2014-15 season opened at 5:00 p.m. on Thursday, January 1, 2015, and closed at 12:00 p.m. (noon) on Friday, March 13, 2015. Since 1974, the gill net fisheries are closed each week from noon on Friday until 5:00 p.m. on Sunday. This weekend closure was instituted to reduce conflicts with recreational users of the bay. Both Odd and Even platoons ceased fishing prior to reaching the quota in 2014-15.

The total fishery quota for San Francisco Bay was set at 2,500 short tons (tons) for the 2014-15 season. This was 4.1 percent of the previous season's (2013-14) spawning biomass estimate of 60,600 tons. The total quota for the gill net fishery was 2,302.5 tons (Tables 1 and 2). This quota was split between the Odd and Even platoons based on the number of permits in each platoon, with the Odd receiving 1,121.1 tons and the Even receiving 1,181.4 tons.

Commercial fishing effort was severely reduced this season. Only two commercial fishing vessels participated in the gill net fishery during the 2014-15 season. Approximately 2 percent (45.7 tons) of the San Francisco Bay gill net quota was landed by the combined platoons during the 2014-15 commercial herring season (Tables 2 and 3).

Fish landed by the gill net fishery during the 2014-15 season were similar in size to those landed in the three previous seasons, continuing the trend of reduced size of herring in the commercial catch (Figure 7). The commercial samples had the fourth lowest mean and third lowest maximum body lengths on record. However it should be noted that the samples used for this data represent 100 herring in only 2 landings for the season.

Odd Gill Net Fishery

The Odd platoon fishery opened on Thursday, January 1, 2015, at 5:00 p.m. A single fishing vessel participated and made all of their landings on Friday, January 30 (Table 4). Roe percentage was 15.5 percent (Figure 8). Only one percent of the permits assigned to this platoon fished this season.

Even Gill Net Fishery

The Even platoon fishery opened on Sunday, January 4, 2015, at 5:00 p.m. Two fishing vessels participated and made landings on January 20 and 21 (Table 5). The roe count was 13.4 percent (Figure 8). Only two percent of the permits assigned to this platoon fished this season.

Special Education Permits

No Special Education Permits were issued for the 2014-15 season.



Herring Eggs on Kelp (HEOK) Fishery Summary

The HEOK fishery occurs only in San Francisco Bay. The fishery suspends giant kelp, *Macrocystis pyrifera*, from rafts on which herring spawn. The product of this fishery, *komochi* or *kazunoko kombu*, is the egg-coated kelp blades that are processed and exported to Japan where it is consumed as a delicacy. All HEOK permittees must hold a current herring permit and request from the Department that the gill net permit be converted to a HEOK permit for the season. The herring eggs on kelp season began December 1, 2014, and ended March 31, 2015. The opening and closing dates for the herring eggs on kelp fishery are not adjusted to take into account annual changes in the calendar.

The total amount of HEOK that may be harvested is based on the previous season's spawning population estimate in San Francisco Bay and each HEOK permittee is currently allocated a quota equal to approximately 0.79 percent of the overall San Francisco Bay quota. In 2014-15, the total quota for the HEOK fishery was 44.2 tons of product, which was converted from 197.5 tons of whole fish from the total San Francisco Bay quota. Ten HEOK permits were renewed this season but there was no fishing effort and no HEOK product landed (Table 6).

TABLE 2. Herring quotas, landings, roe count, and fish count, for San Francisco Bay, 2014-2015 Season.

FISHERY	QUOTA (tons)	LANDINGS (tons)	HARVEST PERCENTAGE (%)	ROE COUNT	FISH COUNT
Odd gill net	1,121.1	7.6	0.7%	15.5	104.8
Even gill net	1,181.4	38.1	3.2%	13.4	106.0
TOTAL GILL NET	2,302.5	45.7	2.0%	13.8*	105.0*
HEOK (0 of 10 active)	197.5 (whole fish) = 44.2 tons product	0.0	0.0%		
SF BAY TOTAL	2,500	45.7	2.0%		

* Roe count and fish count are averages of information provided on receipts; therefore they may not equal the sum of platoon averages.



TABLE 3. Quotas and landings for the herring sac roe fisheries in San Francisco Bay, 1972-73 season through 2014-15 season.

Season	Quota (tons)	Landings (tons)	Season	Quota (tons)	Landings (tons)
1972-73*	1,500	436	1994-95	4,408	4,574
1973-74*	500	1,938	1995-96	5,524	6,165
1974-75*	600	514	1996-97	13,543	11,496
1975-76*	3,000	1,719	1997-98	9,793	1,981
1976-77*	4,000	4,201	1998-99	2,739	2,817
1977-78*	5,000	4,987	1999-2000	5,460	3,356
1978-79*	5,000	4,115	2000-01	2,499	2,991
1979-80*	6,000	6,430	2001-02	4,128	3,287
1980-81*	7,250	5,811	2002-03	3,262	2,097
1981-82*	10,000	10,415	2003-04	2,020	1,540
1982-83*	10,399	9,699	2004-05	3,169	145
1983-84*	10,399	2,828	2005-06	4,328	744
1984-85*	6,500	7,740	2006-07	4,328	292
1985-86*	7,530	7,278	2007-08	1,057	687
1986-87	7,470	8,098	2008-09	1,019	507
1987-88	8,432	8,741	2009-10	0	0
1988-89	9,238	9,736	2010-11	1,845	1,727
1989-90	9,057	8,962	2011-12	1,845	1,634
1990-91	8,858	7,741	2012-13	2,655	2,332
1991-92	7,134	7,417	2013-14	3,442	3,198
1992-93	5,175	5,151	2014-15	2,303	46
1993-94	1,996	2,302	Average	4,986	4,137

* Quotas and landings prior to the 1985-86 season include HEOK and fresh fish allocation and landings.

TABLE 4. Daily landings for the Odd gill net platoon.

Date	Pounds	Tons	# Receipts	Tons/Receipt	Roe Count
1/30/2015	15,252	7.63	2	3.81	15.5
Totals and averages	15,252	7.63	2	3.81	15.5

TABLE 5. Daily landings for the Even gill net platoon.

Date	Pounds	Tons	# Receipts	Tons/Receipt	Roe Count
1/20/2015	52,490	26.24	4	6.56	11.8
1/21/2015	23,700	11.85	4	2.96	14.9
Totals and averages	76,190	38.09	8	4.76*	13.4*

* Tons per receipt, fish count and roe count are averages of all receipts; therefore they may not equal the sum of daily averages.



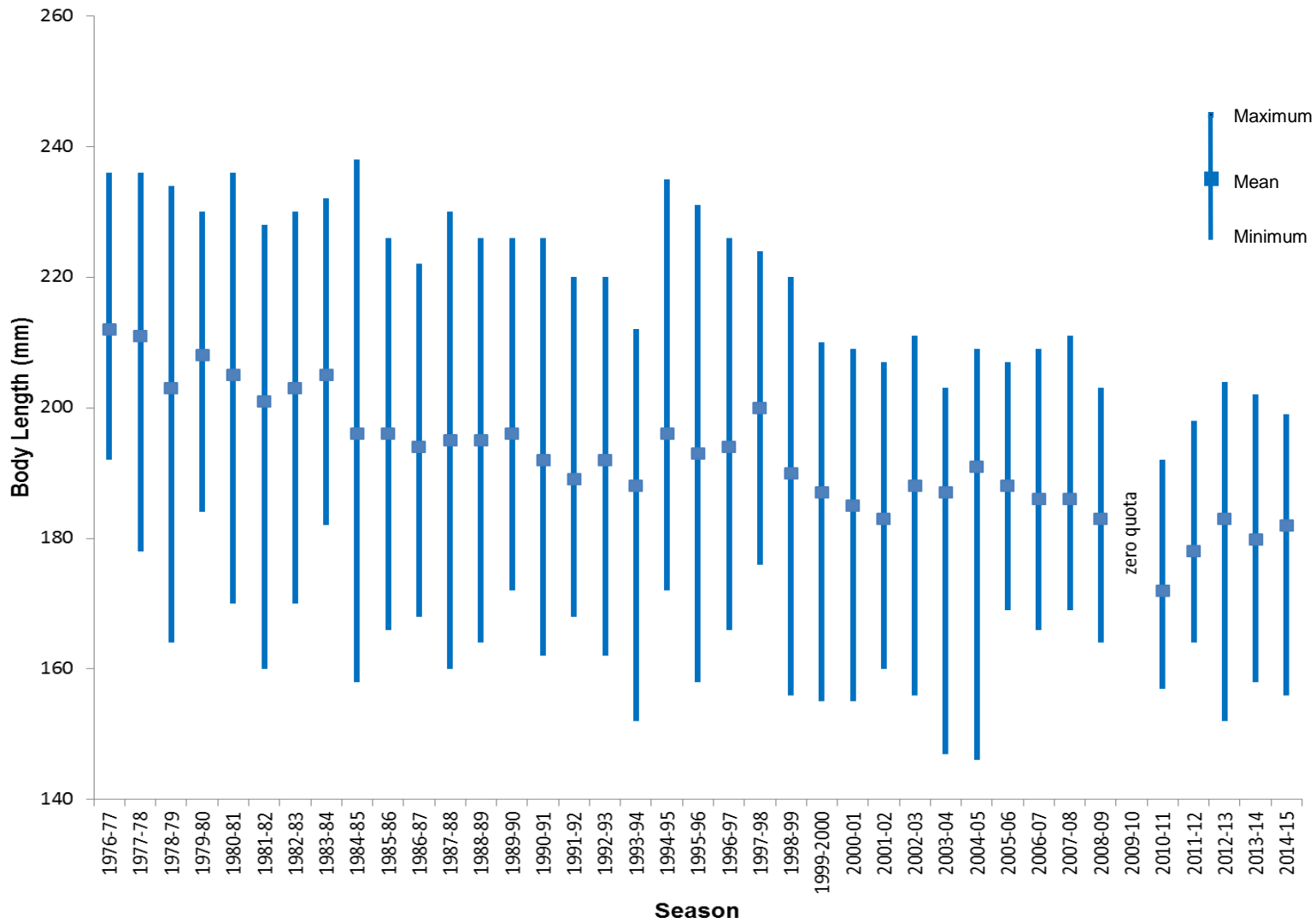


Figure 7. San Francisco Bay herring commercial minimum, mean and maximum body length from 1976-77 through 2014-15 seasons.



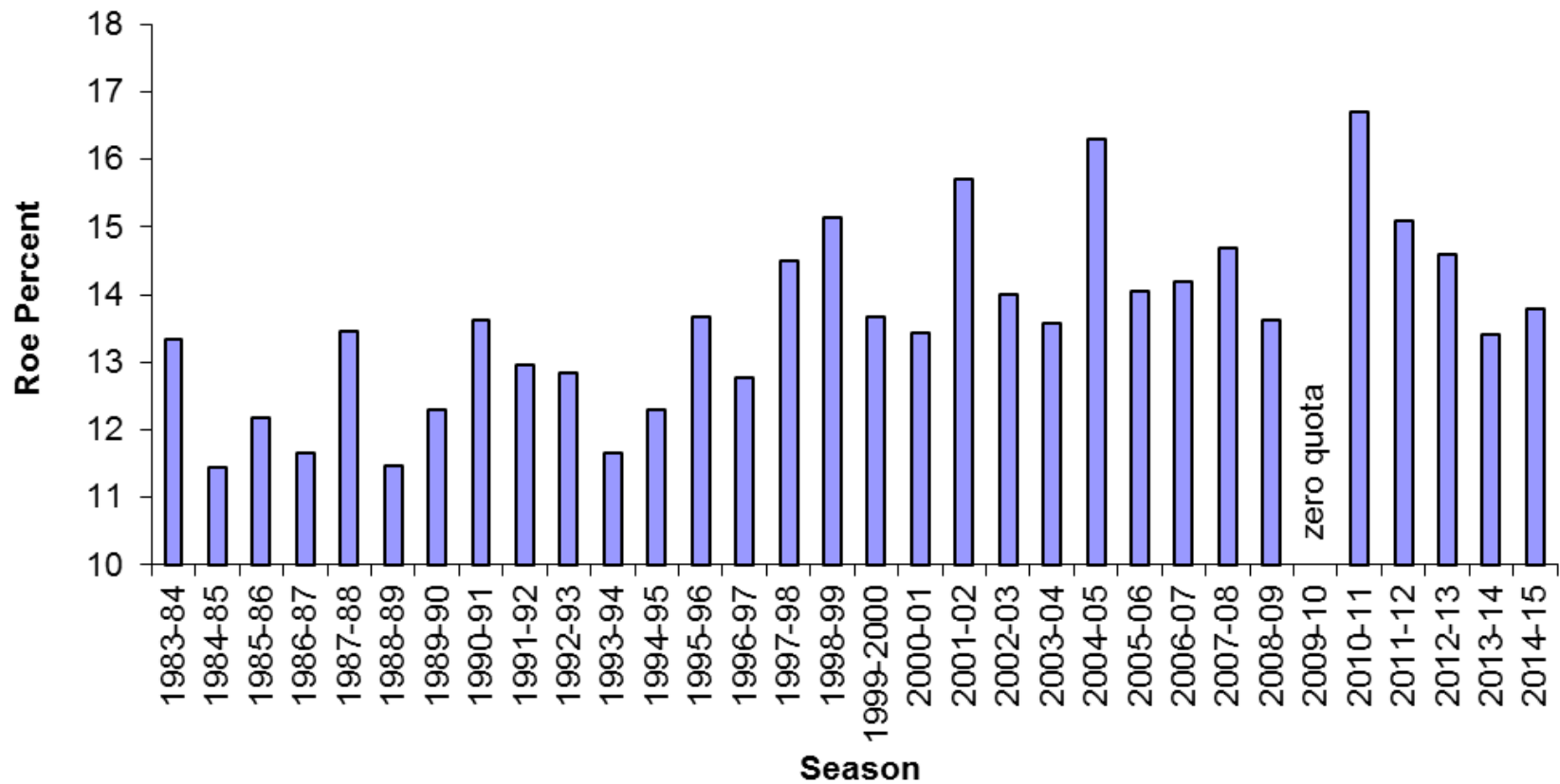


Figure 8. Average roe count in the San Francisco Bay gill net fisheries from 1983-84 through 2014-15 seasons.



Table 6. Quotas and landings of product for the HEOK fishery in San Francisco Bay, 1989-90 season through 2014-15 season.

Season	Quota (tons)	Landings (tons)
1989-90	110.0	107.1
1990-91	144.0	47.0
1991-92	114.0	84.2
1992-93	84.5	47.4
1993-94	35.1	35.0
1994-95	85.0	13.1
1995-96	106.5	106.8
1996-97	286.0	185.7
1997-98	209.0	36.4
1998-99	54.4	31.7
1999-2000	99.2	30.5
2000-01	49.3	27.2
2001-02	73.2	45.3
2002-03	57.6	53.3
2003-04	38.9	6.3
2004-05	55.7	0
2005-06	34.0	0
2006-07	34.0	3.9
2007-08	17.0	15.1
2008-09	17.6	3.3
2009-10	Fishery closed	0
2010-11	14.3	0
2011-12	12.3	0
2012-13	40.5	39.3
2013-14	66.0	0
2014-15	44.2	0
Average	72.4	35.3

CONCLUSION

The San Francisco Bay commercial Pacific herring fishery continued during the 2014-15 season at a reduced level of effort. This coincided with an estimated spawning biomass well below the historical average. The decline recorded during the 2014-15 season is likely attributable to poor oceanic and estuarine conditions which adversely affect herring. Despite the observed reduction in spawning biomass, the Department considers precautionary harvest percentages (at or below five percent) of the previous season's spawning biomass as the primary means of assuring a sustainable fishery even in years of unfavorable ecological conditions. Continued monitoring of both the herring spawning population and commercial catch will ensure that the Department's management objectives are achieved and younger fish are not harvested at unsustainable levels. The Department's management objectives include maintaining healthy Pacific herring stocks in California to conserve the living resources that depend on herring as forage, setting conservative harvest targets for the commercial fishery, and providing recreational fishing opportunities. Through the Fish and Game



Commission, and with the help of the fishing industry, the conservation community and the Director's Herring Advisory Committee, the Department will continue to manage the Pacific herring fishery with the primary goal of ensuring fishery sustainability.



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