

Summary of 2003-2004 Pacific Herring Spawning-Ground Surveys and Commercial Catch in Humboldt Bay and Crescent City

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Humboldt Bay

Project Location

Humboldt Bay is located approximately 260 miles north of San Francisco and is California's second largest estuary. The bay is 14 miles long, 4.5 miles wide at its widest point, and approximately 25 square miles in size excluding its tributaries and sloughs. Humboldt Bay consists of two wide and, shallow northern and southern arms connected by a relatively narrow channel (Figure 1). Both the north and south segments, called North Bay and South Bay, are extremely shallow with large, mostly vegetated, mudflats exposed during minus tides. The channel connecting the north and south sections and the entrance channel to the open ocean is referred to in this report as the Middle Bay. The Middle Bay is periodically dredged to allow for large vessel traffic, and its shoreline has most of the bay's commercial development. The herring roe fishery is restricted by regulations to the waters of districts 8 and 9 which encompass the entire waters of Humboldt Bay. Because herring schools will hold in the deeper channels during low tide and move toward the mudflats during flood tides, most fishing activity takes place in the tidal channels within North and South Bays.

Description of Fishery

The herring roe fishery in Humboldt Bay began in 1974 with a quota set by the state legislature at 20 tons. The quota was raised to 50 tons for the 1976 season by the Fish and Game Commission which was delegated management authority for all herring fisheries the same year. In 1983 the Commission raised the quota to 60 tons per season where it remains today. There are four herring permits issued for the Humboldt Bay fishery. All four permits are current, however only two permittees have been actively fishing in the last few years. Gill nets have been used exclusively for the take of herring for roe in Humboldt Bay since the 1976 season. For several years, at the request of Humboldt Bay permittees, the minimum gill net mesh size has been 2 ¼ inch with no meshes greater than 2 ½ inch. The season in Humboldt Bay is from noon on January 2 until noon on March 9.

Monitoring and Assessment

Prior to the current spawn assessment program, which was started with the 2000-01 spawning season, surveys were conducted for the 1974-75, 1975-76, 1990-91, and 1991-92 seasons (Rabin and Barnhart, 1986; Spratt, et. al., 1991). Historic and current spawn surveys employ the same basic survey methods developed for use by the Department in San Francisco and Tomales Bays (Spratt, 1981). The spawn survey was designed to estimate the total number of eggs spawned in a season and to convert that estimate to the total tons of adult spawners, using a conversion factor based on fecundity. The area of the

spawn is measured and samples are collected from which the density (number of eggs/m²) of eggs is calculated. This is expanded to the total area of the spawn to estimate the total number of eggs spawned. The total number of eggs spawned is then converted to tons of adult spawners. The accuracy of spawn area estimates has improved in recent years with the availability Global Positioning System (GPS) and Geographic Information System (GIS) technology. These tools allow biologists to record the geographic location of a spawn while on the bay and later transfer this information to digitized maps on office computers. Historically, a hydroacoustic survey has not been used in Humboldt Bay to assess biomass.

Humboldt Bay Spawn Assessment

Herring appear to spawn almost exclusively on the vast eelgrass beds found in both the North and South Bays of Humboldt Bay. During a typical spawn event, herring schools may deposit eggs in low density over 300 acres of eelgrass. The spawn escapement estimate for the 2004 herring spawning season is 505 tons (Table 1). This is close to a three-fold increase over last season's estimate of 167 tons and 158 tons higher than the 8-year average from seasons when spawn assessments were conducted in Humboldt Bay. There were four separate spawn events found in the bay this year. The first spawn detected was in the North Bay on January 4th and was estimated at 155 tons (Table 2). The next spawn took place in the South Bay on or near January 22nd. Empty egg cases, along with soon-to-emerge larval herring, were found over a large area of eelgrass on the west side of the bay. Because this spawn event was discovered too late for Department biologists to obtain an accurate estimate of egg density, spawn escapement estimates from this event are not included in the season total. Therefore, this season's spawn escapement estimate of 505 tons should be considered a low estimate by several tons. The next spawn event occurred on February 2nd in the North Bay and was estimated at 187 tons. The last spawn detected this season occurred in the South Bay on February 4th and was estimated at 155 tons.

Commercial Fishery

The commercial Pacific herring landings were down again this season with just over 0.5 tons landed. This is the second lowest season on record for Humboldt Bay, and just a fraction of the average total landings per year of 39 tons since 1983 when the current quota of 60 tons was set (Figure 2). For the last five seasons the average total landings per year was close to 20 tons with a range of 0.1 tons in 2000 to 61.2 tons in 2001. The wide fluctuation in yearly landings is not easily explained. There appears to be little correlation between the size of the spawn escapement estimate and the commercial catch. In some years a drop in landings can be related directly to a strong El Nino event as was seen in 1983 and 1998; however, no such oceanic event was present this year. This is the second year in a row that large concentrations of herring were not seen by commercial fishermen or Department biologists prior to a spawning event. Herring appeared to stay in small, fast moving schools until they were ready to spawn. This behavior may have hindered fishermen's efforts to catch fish. There is also the possibility that this year's spawning population was composed of a large number of small 2 to 3 year-old fish that would not be available to the 2¼ inch mesh gill nets used in Humboldt Bay. Unfortunately, no herring were landed by Department research nets this season, thus we

are lacking biological information on this year's spawning population. However, 81% (by number) of the herring caught by the Department's research net last year were captured in meshes two inches or less suggesting that most fish in last season's spawning population were too small to be captured by commercial nets.

Cooperative Eelgrass Survey

The Department of Fish and Game continued to work with University of California Sea Grant, Humboldt State University, and Humboldt Bay Harbor District to monitor eelgrass, *Zostera marina*. Winter and summer eelgrass surveys were conducted throughout the bay to collect data on above-ground biomass, bed area, and density in Humboldt Bay. Above-ground eelgrass biomass for winter 2003-2004 had a mean of 0.48 kg/m² (range 0.29-0.97 g/m²), which is an increase of 24% from the winter 2002-2003 mean of .31 kg/m² (range 0.14-0.40 kg/m²). Eelgrass biomass is essential data for the calculation of spawn escapement estimates.

With the assistance of close to 25 volunteers on two separate Saturdays last spring, the eelgrass project was able to remove close to 300m² of the invasive eelgrass, *Z. japonica*, from Indian Island in Humboldt Bay. The Department will continue participating in the cooperative effort to eradicate this exotic seagrass from Humboldt Bay.

Crescent City

Project Description

The Crescent City area is approximately 15 miles south of the Oregon - California border. Approximately 11 miles of coastal waters south of Point Saint George and Crescent City harbor are open to commercial herring roe fishing. The majority of herring fishing takes place in Crescent City harbor.

Description of Fishery

The herring roe fishery in Crescent City began in 1973 when 12.1 tons were taken out of Crescent City harbor (see Figure 3). Since that time yearly landings have ranged from 0.12 to 60 tons with an average of 22 tons per year. The Fish and Game Commission established a set quota of 30 tons for Crescent City for the 1977-78 season which is still in effect today. All herring landed are to be taken by gill net only. Since the 1983-84 season only three permits have been issued annually. Although all permits are still active, no fishing effort has taken place for the last two seasons. The season begins on noon on January 14 and is open until noon on March 23.

Discussion

Although commercial landings in the Humboldt Bay herring fishery have been well below average the last two seasons, spawn assessments conducted by the Department during the same time period show that a significant number of herring were still entering the bay to spawn. This year's spawn escapement estimate of 505 tons, if used as a basis

for setting the Humboldt Bay fishery quota, would result in a conservative exploitation rate of 12 % with a quota set at 60 tons. The average yearly spawn escapement from the last four spawn assessment surveys conducted since the 2000-2001 season is 417 tons. A 60 ton quota based on this average would result in a 14% exploitation rate, which is still considered a conservative rate of harvest.

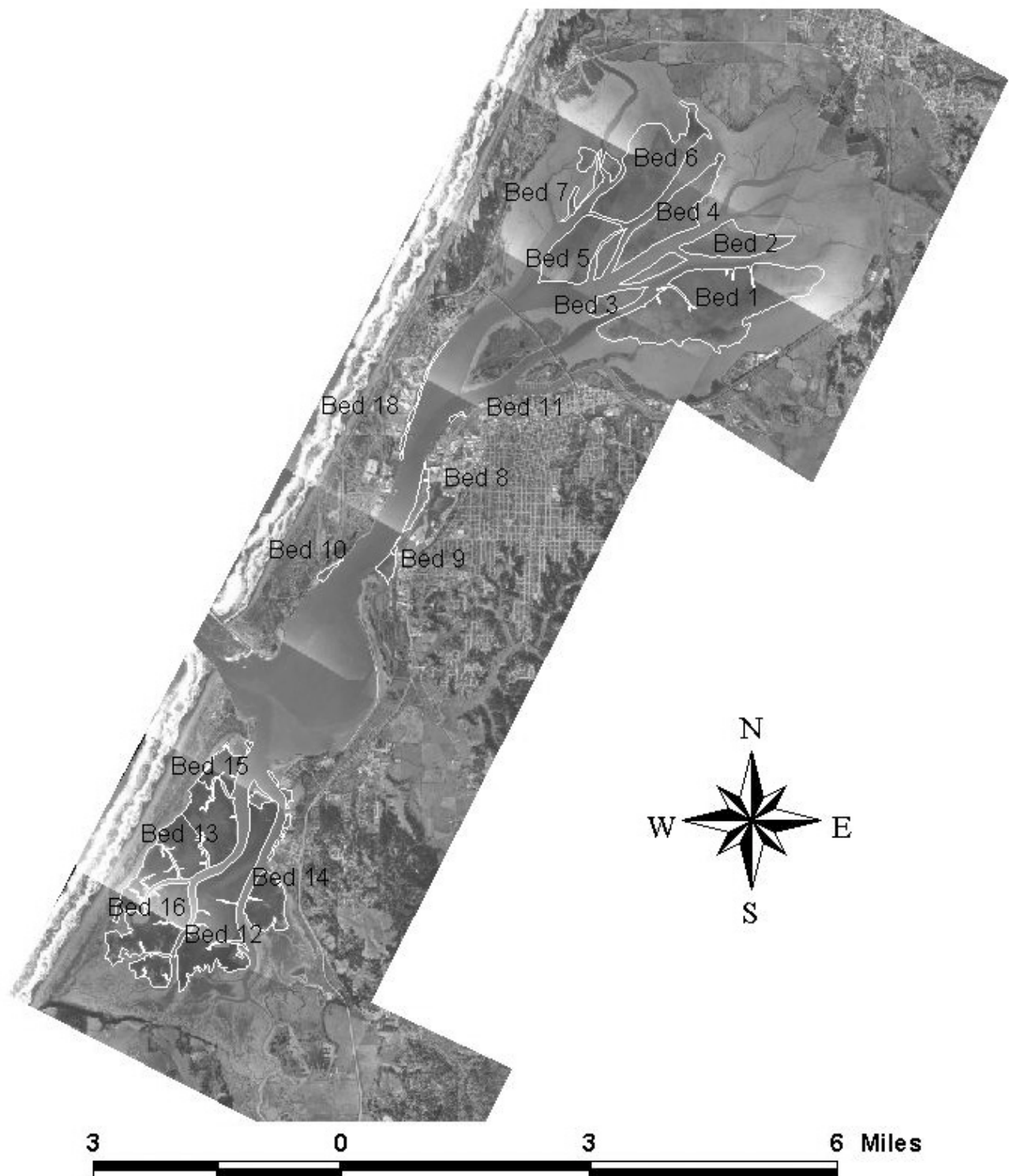
Due to the current state budget crisis, the Department will be evaluating, in consultation with the Director's Herring Advisory Committee, whether an annual monitoring and assessment of the herring population in Humboldt Bay and Crescent City is needed. While a monitoring and assessment program is essential for the proper management of the larger fisheries in the state (e.g. San Francisco and Tomales Bays), the fishery resources in Humboldt Bay and Crescent City would, most likely, not be put at risk without yearly monitoring and assessment. The possibility of reducing the frequency of monitoring and assessment will need to be investigated. However, if there was a reduction in the frequency of assessments, the Department biologist would still need to maintain their role in overseeing the orderly closure of the fishery when permittees have reached their quota.

The Department is recommending that no regulatory changes are needed for the 2004-2005 season for Humboldt Bay and Crescent City Pacific herring roe fisheries.

Literature Sited

- Rabin, D.J. and R.A. Barnhart. 1986. Population characteristics of Pacific herring, *Clupea harengus pallasii*, in Humboldt Bay, California. Calif. Dept. Fish and Game, Mar. Res. Div. Admin. Rpt. 91-4, 41 pp.
- Spratt, J.D., T.O. Moore, and P. Collier. 1991. Biomass estimates of Pacific herring, *Clupea pallasii*, in California from the 1991-92 Spawning-ground surveys. Calif. Dept. Fish and Game, Mar. Res. Div. Admin. Rpt. 91-4, 41 pp.
- Spratt, J.D. 1981. Status of the Pacific herring, *Clupea harengus pallasii*, resource in California 1972 to 1980. Calif. Dept. Fish and Game, Fish. Bull. 171. 107 p.

Humboldt Bay Eelgrass Beds



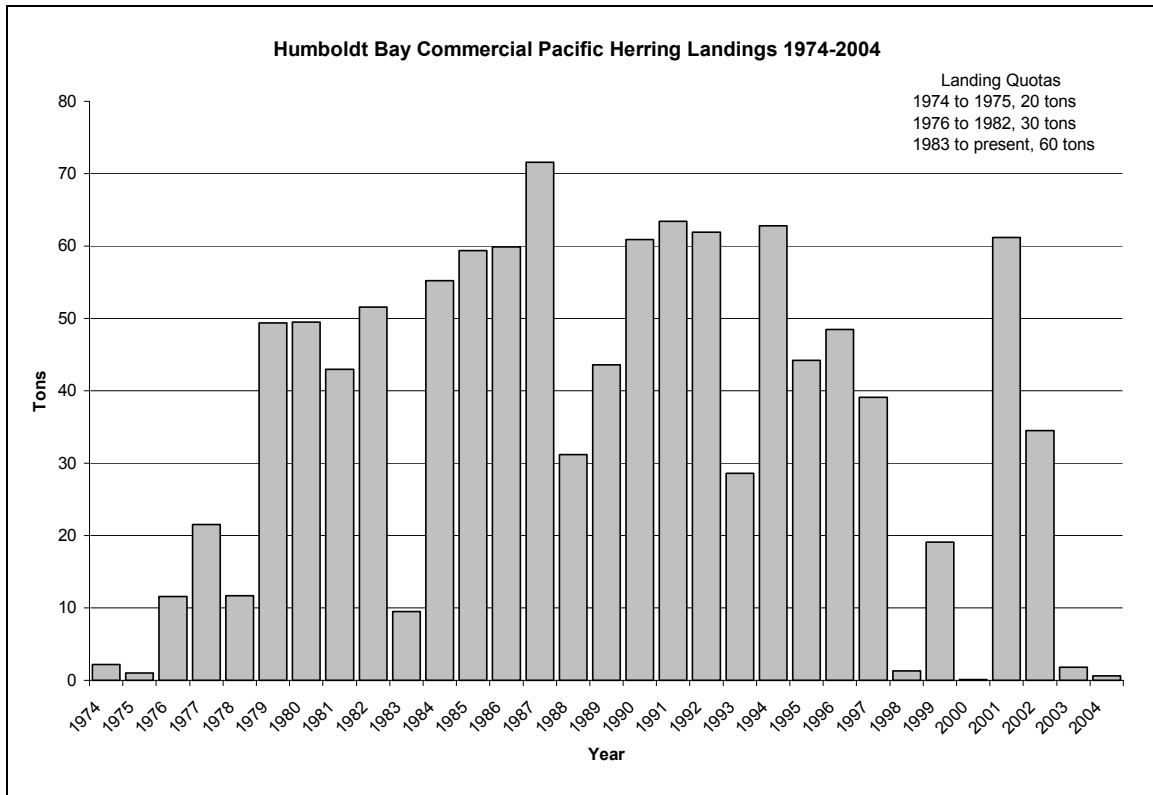
(Figure 1)

Table 1. Pacific herring biomass estimates in Humboldt Bay for seasons when surveys were conducted.

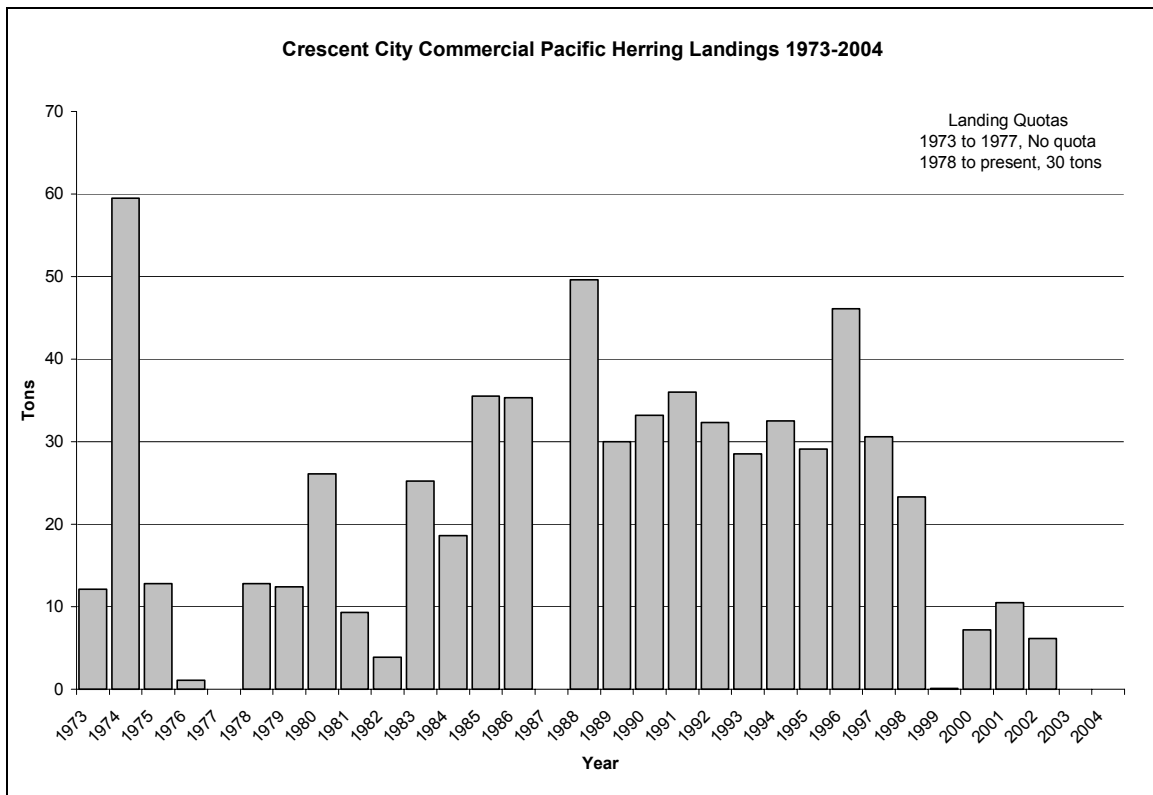
Season	Spawn Escapement (tons)	Catch (tons)	Spawning biomass (tons)
1974-75 *	372	1	373
1975-76 *	232	12	244
1990-91 **	337	63	400
1991-92 **	163	62	225
2000-01	385	61	446
2001-02	617	34	651
2002-03	167	2	169
2003-04	505	0.6	499
Mean	347		376
* Rabin and Barnhart, 1986			
** Spratt et al, 1992			

Table 2. Confidence limits for Humboldt Bay herring spawn estimates, 2002-2003 season.

Spawn Date	Eelgrass Bed	Std. Error (eggs/m ²)	D.F. n - 1	Estimated Tons	95% Conf. In
04 Jan 04	1 (North Bay)	3079.29	18	154.47	+/- 38.47
04 Jan 04	2 (North Bay)	2528.39	4	8.42	+/- 6.57
02 Feb 04	1 (North Bay)	5625.65	16	86.91	+/- 69.56
02 Feb 04	2 (North Bay)	3521.35	14	76.75	+/- 41.78
02 Feb 04	3 (North Bay)	7186.62	4	23.60	+/- 24.18
04 Feb 04	12 (South Bay)	9664.01	13	155.06	+/- 143.13
TOTAL				505.21	



(Figure 2)



(Figure 3)