HERRING SPAWN SURVEY

COOS BAY, OREGON

WINTER 1977-78

Compiled by

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INTRODUCTION

A study was undertaken in winter 1977-78 to obtain data on the spawning stock of Pacific herring, Clupea harengus pallasi, utilizing the Coos Bay estuary. This study centered on two objectives; (1) to record the distribution and time of herring spawn and (2) estimate the fish biomass spawning in Coos Bay.

Data was obtained from eight different spawns, occurring from mid-January to the end of April. Distribution of spawn areas extended from within one km of the mouth of the bay to the tributary sloughs in the upper part of the estuary, 22 km from the mouth.

The type of substrate utilized for spawning was quite variable. The most extensive spawns, with respect to area, were on the eelgrass beds (Zostera marina) growing on mud flats in the lower part of the bay, whereas the most intensive (most dense) spawn was on the supportive pilings of cargo loading docks in the mid and upper bay. One area utilized for spawning and representing approximately one quarter of the estimated spawning biomass is a submerged rock reef, exposed at low tide, near the mouth of the bay. This area is subject to higher wave energy than is found in other parts of the bay and is comprised of a variety of substrates.

The actual number of spawns was greater than that for which data was recorded, due to intermittent, overlapping spawns in a particular area. No attempt was made to segregate overlapping spawns, thereby a continuous spawn was treated as one.

Procedure for estimating herring biomass was taken from a similar study in Humboldt Bay, Calif. (Rabin, 1976).

METHODS AND MATERIALS

Surveys were made on a daily basis, weather permitting, of the areas known to have been used for spawing in previous years. At low tide, surveys of each area were made by direct observation. At high tide, survey of an area involved using a three meter aluminum boat and two rakes, wired back to back and towed through eelgrass beds. In some instances higher-than-normal bird congregations or activity indicated the presence of a spawn.

Measurements and mapping of a spawn area was conducted using a 300 ft. polypropylene rope, two 20 ft. ropes, bouys and reference to landmarks and navigation aids. In areas where spawn extended subtidally, visual estimates were made of distance involved (for distances less than 15 m.). When spawn occurred on dock pilings, direct measurement was made of vertical extent, mean circumfrence and total number of pilings with spawn, including an estimate of percent cover.

In those spawns where total length was extensive, width measurements were taken every 75 paces (approx. 50 m.). Estimates were made along each width transect of percentage of substrate containing spawn. Where a variety of substates were involved, estimates were made of the percentage of each type along a transect.

Between 10 and 18 samples were taken from each spawn area. The type of substrate dictated the sampling method used. Where the spawn was fairly level, sampling was done with a 0.15 m^2 ring, tossed randomly and all vege--tation removed within the ring. On rocks and pilings sampling was done by three different methods. On rocks, all eggs were counted within a randomly placed 6.15 cm^2 ring. On logs and pilings, all eggs were counted or removed for counting within a randomly placed 27.3 cm^2 ring, Sampling of vegetation on rocks was done with a randomly placed 0.02 m^2 ring.

Dating of each spawn was accomplished by comparison of developmental stage of embryo to those described by Outram (1955).

All samples were washed to remove sand and debris and allowed to drain. They were then weighed to nearest 0.1 gm and either worked up immediately or preserved in 10% formalin.

The number of eggs in each sample was hand counted. When volume of

sample was large or egg density high, a 5 – 50% subsample was counted to determine total number of eggs.

Calculation of herring biomass for each spawn, except those on dock pilings, was made with the following equation:

$$\frac{\left(\begin{array}{c}\text{mean weight of} \\ \text{substrate in kg/m}^2\end{array}\right)\left(\begin{array}{c}\text{area of spawn} \\ \text{in m}^2\end{array}\right)\left(\text{mean \# eggs/ kg substrate}\right)}{\text{110 eggs / gm spawning herring (regardless of sex)}}$$

The mean weight of substrate per m^2 was calculated from weights of substrate with eggs still attached. The number of eggs per gm. of herring was taken from a fecundity study in Humboldt Bay Calif. (Rabin, Barnhardt 1976).

Calculation of biomass of spawners on dock pilings was made by a simpler equation:

$$\frac{\left(\text{mean \# eggs / m}^2\right)\left(\text{area of spawn in m}^2\right)}{\text{110 eggs / gm spawning herring}}$$

RESULTS

Table 1. summarizes spawn data and herring biomass in Coos Bay for winter 1977-78. Where more than one sampling method was used on a spawn, the type of substrate for which data was calculated is indicated in parenthesis. Several spawns are included that were not sampled. The March 27 spawn in Isthmus Slough was on logs tied in rafts to be loaded as ship's cargo. The impracticality of measuring and sampling prevented any collection of data. Evidence of spawn was found on the pilings of several cargo loading docks in the upper (eastern) part of the bay. The eggs had already hatched, thus no samples were taken. The letters beside each spawn location are for reference to Figure 1., depicting the area of study.

An estimate of the spawning stock of Coos Bay herring for 1977-78 is 131,388 kg (145 tons).

Table 1. Spawn data and herring biomass in Coos Bay, Oregon for winter 1977-78.

Spawn date	Location	Type of substrate	Area (m^2)	Mean # eggs / kg substrate	kg substrate / m^2	# eggs / m^2	# eggs spawned ($\times 10^6$)	Spawning Biomass kg	Biomass (tons)
22-25 Jan.	North Spit (A)	eelgrass	42710	4233	0.5171	N. A.*	93.5	850	(0.9)
25 Jan.	Fossil Pt. (B)	eelgrass, algae, rock	42855	8975	0.9348	N. A.	359.5	3269	(3.6)
16 Feb.	Fossil Pt. (B)	"	35436	29292	2.4830	N. A.	2863.7	26033	(28.6)
27 Feb.	North Spit (A)	eelgrass	67349	21761	1.4884	N. A.	2181.4	19831	(21.8)
19 March	Isthmus Slough (F)	log rafts	---------- NOT SAMPLED ----------					-	
21 March	Ford Dock (C)	dock pilings	4871	N. A.	N. A.	1658583	8079.0	73445	(80.8)
27 March	Haines Inlet (D)	rock, Fucus	88	1593 (on	1.4150 Vegetation)	140588 (on rock)	8.3	76	(0.1)
27 Mar. – 2 Apr.	Coos Bay Docks (F)	dock pilings	1289	N. A.	N. A.	142662	183.9	1672	(1.8)
early April	upper-bay docks (E)	dock pilings	---------- NOT SAMPLED ----------					-	

* —— not applicable

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Table 1. (cont.)

Spawn date	Location	Type of substrate	Area (m^2)	Mean # eggs / kg substrate	kg substrate / m^2	# eggs / m^2	# eggs spawned ($x10^6$)	Spawning Biomass kg	Biomass (tons)
13-14 April	Ford Dock (C) *	rock, algae	2919	3652 (on vegetation)	0.9275	276067 (on rock)	681.9	6212	(6.8)
25 April	Coos Bay Dock (F)	dock pilings	-------- NOT SAMPLED --------						
TOTAL								131388	(144.5)

* --- spawn on pilings not sampled (very light density)

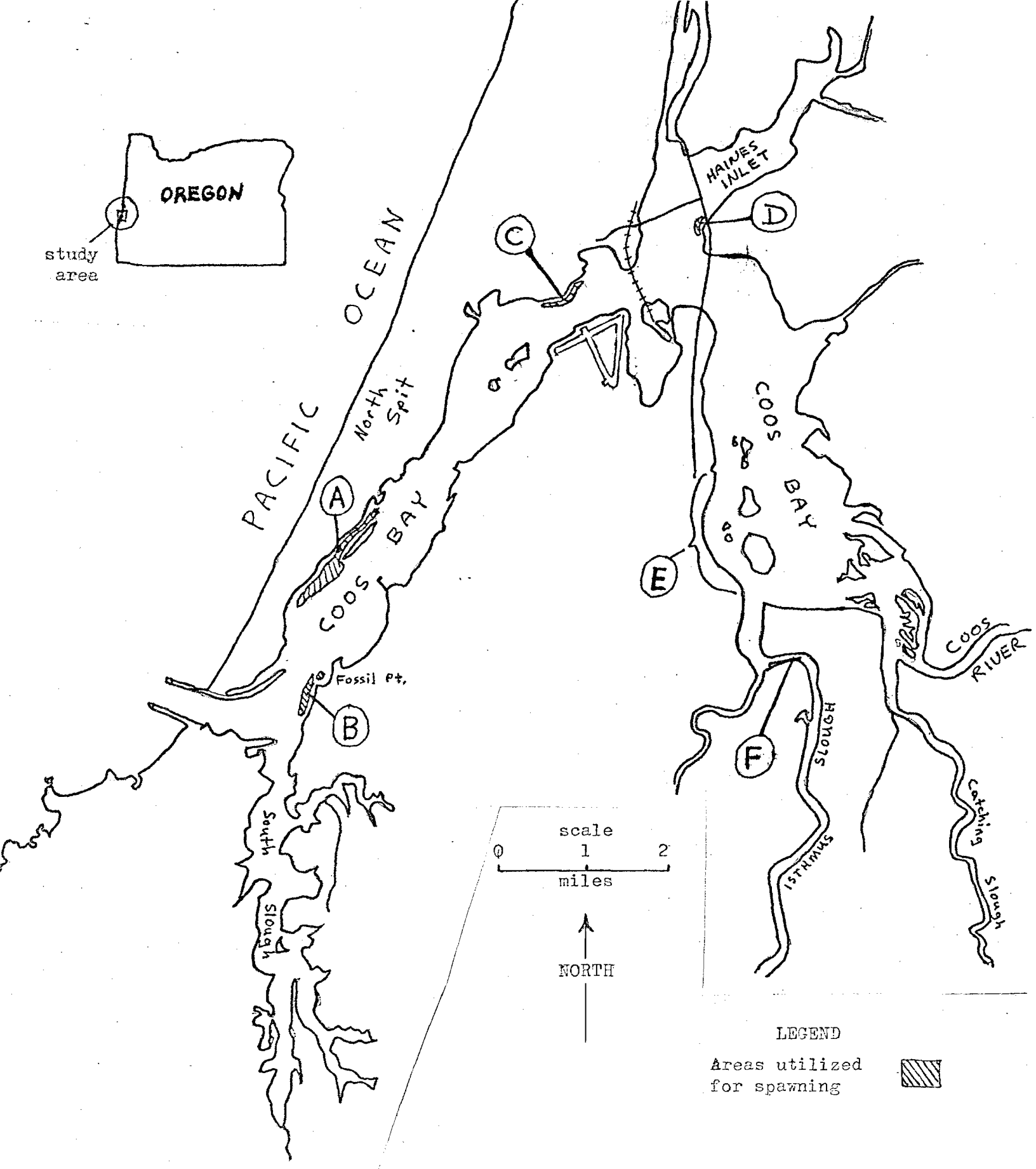

Figure 1. Locations of herring spawn in Coos Bay, winter 1977-78.

DISCUSSION

Spawning Biomass Estimate

We feel that our estimate of the spawning stock of Coos Bay herring should be considered minimal. A degree of error results from both natural causes and data-gathering technique.

There is a substantial degree of bird predation when spawn on vegetation is exposed at low tide. Outram (1958) estimated total predation at 56% to 99% and found 66% of predation occurred within 3 days of spawning. Hardwick (1973) found predation could amount to as much as 90% one week after spawning. These are maximum amounts, the degree of predation being quite variable. An effort was made to to complete all sampling before a significant amount of predation had occurred, but this was not always possible. Some degree of predation usually took place before sampling was initiated of completed.

It is suggested that many eggs do not become attached to a substrate or become detached during incubation. On several occasions we observed large numbers of loose eggs washed up on shore or lodged in crevices or tide pools. When spawn occurred on dock pilings, slime or epiphytes on the surface probably prevented many eggs from attaching, evidenced by the continual detachment of eggs from the piling surface by wave action.

Error in field measurement and technique also contributed to producing a minimal biomass estimate. Several of the spawn areas were of high relief and taking a linear measurement across such a surface give an erroneous number. In some instances a portion of a spawn would remain sub-tidal, thus inaccessible to quantify. This occurred at the North Spit spawn (22-25 Jan.) and on the pilings at Ford Dock (21 March).

With the exception of the Coos Bay Dock spawn (27 March-2 April), no data was taken from the spawn occurring on dock pilings in the upper, eastern part of the bay. They were estimated to be of light density and extent, but were dispersed over a large expanse of pilings. We do not feel these spawns would contribute significantlyto the total biomass estimate.

The spawn that occurred on log rafts in Isthmus Slough (19 March) was not discovered until the logs were loaded as ship's cargo. Though we have

no estimate of the extent of this spawn, intensity appeared to be moderate to heavy.

Of course, we are not certain that we were able to locate or acquire knowledge of all herring spawn that occurred in Coos Bay in 1977-78.

Spawning Behavior

It was noted that the earliest spawns occurred near the mouth of the bay, reaching a point 22 km from the mouth. Outram (1951) found that water of a low salinity stimulated herring to spawn while in captivity. Rabin (1976) noted that most spawning in Humboldt Bay occurred in the eelgrass beds closest to the creeks from which the bay receives most of its freshwater. He believes that freshwater influenced the location of spawning activity in the bay. Heavy rains and runoff during winter place the salt wedge in Coos Bay closer to the mouth. Less precipitation in spring permits higher saline conditions further up the bay. Spawning behavior was observed to coincide with this freshwater influence and a similar pattern of spawning might occur in subsequent years with normal weather patterns.

We found that incubation lasted for 8-10 days, at a mean water temp. of 11.5°C (high tide). This is an anomalously high winter water temperature, the mean Jan.-March temperature for the previous seven years being 9.4°C.

Our estimate of herring biomass compares favorably with estimates of 338,248 kg (372 tons) and 219,208 kg (241 tons) in 1974-75 and 1975-76, respectively, in Humboldt Bay, but is considerably less than the estimated 6559 and 4734 tons that spawned in 1973-74 and 1974-75, respectively, in Tomales Bay (Spratt, 1976).

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