PACIFIC HERRING RESEARCH, SOUTHEAST ALASKA

Final Report for the Period 1 July 1988 to June 30, 1989

By

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ABSTRACT

The Alaska Department of Fish and Game conducted surveys to assess herring (*Clupea harengus pallasi*) for abundance, distribution, and age composition. Priority survey areas were established by action of the Alaska Board of Fisheries. Areas surveyed included Anita Bay, Farragut Bay, Meares Passage, Craig, Tenakee Inlet, Sitka Sound, Boca de Quadra, Hoonah and Lisianski Inlet. Samples for age-weight-length analysis were taken from either the spawning grounds, the commercial fisheries, or from mid-water trawling during acoustic surveys. Baseline information was collected from diver surveys to assess herring escapements and document spawning ground conditions. Total biomass of spawning herring was computed from estimates of egg densities related to the area receiving spawn.

INTRODUCTION

The abundance of herring (*Clupea harengus pallasi*) in Southeast Alaska exhibits wide fluctuations from year to year. In order to monitor these changes a data base reflecting abundance, age structure, and spawning success is required to manage the resource.

The goal of this project is to provide biological data necessary for the scientific management of herring stocks by the Alaska Department of Fish and Game (ADF&G) throughout Southeast Alaska. Objectives required to accomplish this goal are as follows:

1. Refine and develop hydroacoustic equipment to make reliable herring biomass estimates.

2. Conduct biological sampling in Southeast Alaska for age and growth analysis to determine stock conditions.

3. Develop, conduct, and evaluate spawning ground success to provide life history information and spawner biomass data to use as a comparison to hydroacoustic estimates and as a basis for establishing commercial harvest quotas.

4. Conduct inseason management responsibilities as required.

HYDROACOUSTIC ASSESSMENT OF SOUTHEAST ALASKA HERRING STOCKS

Objective

Refine and develop hydroacoustic equipment to make reliable herring biomass estimates.

Procedures

Major stocks of herring were assessed from the R/V *Steller* during winter prespawning concentrations. The acoustic system consists of a modified Ross 200A echo sounder, a Sony digitizer, and beta tape recorder for signal storage. This system operates at 150 KH_z with a 7° circular transducer. This system is fully calibrated. Sonar is also used to search for herring concentrations.

Hydroacoustic surveys are conducted in known herring concentration areas from October through May. November and march are target time periods. Two biologists working full time, plus support from Area Management Biologists, are required to conduct the surveys.

Surveys require defining an area encompassing a herring concentration. This is accomplished by previous experience, or searching with sonar. A series of assessment surveys are then conducted on the area of herring concentration. A series of transects spaced evenly over the area is conducted to determine the density. During surveys, mid-water trawl samples are also conducted to determine size, age, and species composition of targets observed. ADF&G presently has one mid-water trawl with a 20 ft. x 20 ft. opening, equipped with a Furuno Model FNR-200 Mark II net recorder. After the surveys are completed, the magnetic tapes are analyzed by Echo integration within the Department or under contract with the University of Washington. In certain instances where accurate computer analyzed surveys are not possible due to herring distribution, visual estimates are made by experienced observers.

Results

Herring stocks throughout Southeast Alaska were acoustically surveyed from the R/V *Steller* during November and March. Specific locations of herring stocks surveyed are shown in Figure 1. Results of computer analyzed surveys are summarized in Table 1. Biomass of sexually mature herring greater than 185 mm standard length ranged from 15 million kilograms (Sitka) to 72 million kilograms (Anita Bay).

AGE, GROWTH, AND LENGTH FREQUENCY STUDIES

Objective

Conduct biological sampling on herring in Southeast Alaska for age and growth analysis to determine stock conditions.

Procedures

Herring samples were collected from ADF&G purse seines, cast nets, and mid-water trawls. Scales were mounted and read in Ketchikan for age, length, and weight analysis.

Collection of Herring

Herring samples for age and growth analysis were collected by either mid-water trawl, purse seine, or cast net catches on the spawning grounds. The trawl samples were obtained with the R/V *Steller*. A small purse seine or cast net was utilized when fish were in the shallows during spawning. Samples for age and growth analysis were taken from several sets, and separated spatially and chronologically whenever possible. All fish were either processed fresh or frozen for later examination in the laboratory. A target of 600 herring for each stock was set as a goal. Herring fecundity samples were taken from Seymour Canal and Sitka stocks in 1988 and 1989. A total of 210 samples was taken from Sitka and 32 samples from Seymour Canal to expand the fecundity data base for these stocks.

Laboratory Methods

In the laboratory, herring were thawed immediately prior to examination. The standard length of each fish, from the tip of the snout to the caudal peduncle, was recorded to the nearest whole millimeter on a caliper measuring board. Weights were taken on an electronic balance to the nearest whole gram.

Scales were cleaned and dipped in a solution of 10% mucilage glue and water and placed unsculptured side down for permanent mounting on glass slides. Aging was conducted using a dissecting microscope, varying the light source for optimum image of annuli, or by using a Microfiche reader. Scale reading results were spot-checked by a second reader for verification. The fish were assigned an anniversary data for each completed growing season. All samples collected were taken before growth had resumed in the spring. For example, if a herring was hatched in the spring of 1986 and collected in the fall of 1987, two growing seasons had occurred (Age II). If the herring had been collected in the spring of 1988 before growth had resumed, it was still recorded as Age II. All scales and original data are filed and available for review upon request.

In order to supply rapid age frequency analysis, a field method utilizing plastic mylar was used. Approximately 100 herring were placed on a mylar sheet and standard lengths marked with a soft lead pencil. By calculating length versus age data from previous laboratory analyses an overlay was prepared. This served as a rapid means for evaluating recruitment.

Results

Samples were taken from Juneau, Tenakee Inlet, Lisianski Inlet, Meares Passage, Boca de Finas, Craig, Seymour Canal, Boca de Quadra, and Sitka Sound during the reporting period. Specific locations of sampling are shown in Figure 1. Approximately 5,800 herring were analyzed for age and growth in the laboratory (Table 2).

For all herring stocks in Southeast Alaska, with the exception of Seymour Canal, a dominant 1984 year class (Age IV) is evident in the age composition. Preliminary analysis of fecundity and length/weight data revealed that Sitka Sound herring of the dominant 1984 year class are below normal size and fecundity for their age. This correlates with the poor quality of commercial roe in Sitka last year.

SPAWNING GROUND SURVEYS

Objective

Develop, conduct, and evaluate spawning ground success to provide:

1. Life history information;

2. Spawner biomass data to use as a comparison to hydroacoustic estimates;

3. A population biomass estimate to use as a basis for establishing commercial harvest quotas.

Procedures

Aerial surveys were conducted to provide an index of spawning success in terms of beach area receiving spawn. Intensive spawning ground surveys utilizing SCUBA transects determined substrate type, egg densities, and predator relationships of Southeast Alaska herring stocks.

The following methods were used in the estimation of egg deposition.

Index of Beach Spawn

An index, reported as linear nautical miles of beach receiving spawn, was determined by aerial and boat surveys.

Aerial surveys were conducted on a periodic schedule to document presence of eggs on intertidal kelp, milt present in the water, herring schools, and bird and sea mammal activity. In certain areas skiffs were used to monitor the coastline or to collect the same information.

Favorable weather conditions, experienced observers, and low tides were prerequisites to successful data collection.

Comprehensive Spawning Ground Surveys

SCUBA divers were used to collect samples and to document biological and physical parameters on established transects.

Spawning study areas were delineated by systematic aerial and boat surveys. Once the spawning area was defined, transects were established at 400 to 800 m (1/4 to 1/2 mi.) intervals along the beach. Compass courses were set perpendicular to the shore with sampling at 5 m intervals. Divers followed the compass heading until spawn or vegetation disappeared. Data collected included depth, temperature, substrate type, egg layers, and visual estimates of eggs in a 0.1 square meter frame. Underwater video tapes were also taken of the substrate and sample collection activities. Samples of substrate and eggs were collected for laboratory analysis to verify visual density estimates. Sampling equipment used was as follows:

1. Compass, used to set transect courses;

2. Sample frame, 0.1 square meters in area, made from perforated 18.30 mm (3.4 in) plastic pipe. A pocket thermometer and a depth gauge was permanently mounted on the sample frame;

3. Small sample bags (approximately 2 liter capacity) and a larger collection bag to hold individual samples.

Kelp and egg samples were transferred from the divers bag to 4 liter (1 gallon) size water tight zip lock bags and preserved in Gilson fluid for later laboratory analysis. Only a small amount, 1/4 to 1/2 liter (1/2 to 1 pint), of Gilson fluid was added to a sample for preservation. Preserved samples were then taken to the laboratory for chemical separation and counting. The following is a detailed procedure for determining egg densities from collected samples.

1. Decant the Gilson fluid from the sample bags.

2. Add one normal KOH to the sample bag and mix thoroughly through the sample. Allow the sample to soak for 1.5 hours in KOH digestive hydrolysis. Placing the sample bag in a hot water bath accelerates digestion (eel grass can stand a strong digestion, while other kelps disintegrate quickly, impeding egg sorting).

3. Drain off KOH and place sample in a 4 liter (1 gallon) plastic bucket.

4. Repeated cold water washes of the sample to loosen the attached eggs. Decant and filter each wash through a fine mesh sieve. The majority of the eggs in the sample can be removed and collected from the filtrate.

5. The remaining eggs must be cleaned from the substrate by careful manual scraping. The loose eggs must be clean of kelp debris for accurate volumetric analysis.

6. Hand count and record all eggs that are lost or cannot be cleaned from the substrate.

7. The loose egg sample must be allowed to soak in 1.0 normal buffered formal saline solution for approximately 24 hours to assure a standardized volumetric displacement.

8. The preliminary step in quantitative analysis is to determine the standard displacement of 1,000 eggs. This is done by hand counting 1,000 eggs from a number of samples and determining the average displacement.

9. Hand count totals are added to the sample displacement and this figure is expanded by a factor of 10 to determine eggs/m^2 at each sample station. One technician can work up approximately six samples per day at a chemical cost of approximately $2.00 per sample.

Results

Comprehensive spawning ground surveys utilizing SCUBA were conducted at Seymour Canal, Lisianski Inlet, Farragut Bay, Hoonah, Tenakee Inlet, Sitka Sound, Kah Shakes and Craig. A summary of data collected is presented in Table 3.

Seymour Canal

A total of 31 transects were sampled in Seymour Canal. By back-calculating estimates of total egg present to required spawners, a biomass of 2.8 x 10^6 kilograms of herring spawned in 1989.

Lisianski Inlet

A total of 13 transects were sampled in Lisianski Inlet. By back-calculating estimates of total egg present to required spawners, a biomass of 1.0 x 10^6 kilograms of herring spawned in 1989.

Farragut Bay

A total of 9 transects were sampled in the Farragut Bay area. By back-calculating estimates of total egg present to required spawners, a biomass of 0.2 x 10^6 kilograms of herring spawned in 1989.

Hoonah Sound

A total of 16 transects were sampled in the Hoonah Sound area. By back-calculating estimates of total egg present to required spawners, a biomass of 3.8 x 10^6 kilograms of herring spawned in 1989.

Tenakee Inlet

A total of 19 transects were sampled in the Tenakee Inlet area. By back-calculating estimates of total egg present to required spawners, a biomass of 4.9 x 10^6 kilograms of herring spawned in 1989.

Sitka Sound

A total of 51 transects were sampled in the Sitka Sound area. By back-calculating estimates of total egg present to required spawners, a biomass of 24.7 x 10^6 kilograms of herring spawned in 1989.

Kah Shakes

A total of 18 transects were sampled near Kah Shakes. By back-calculating estimates of total egg present to required spawners, a biomass of 3.0 x 10^6 kilograms of herring spawned in 1989.

Craig

A total of 29 transects were sampled near Craig. By back-calculating estimates of total egg present to required spawners, a biomass of 18.0 x 10^6 kilograms of herring spawned in 1989.

MANAGEMENT OF SOUTHEAST ALASKA HERRING STOCKS

Objective

Conduct out inseason management responsibilities as required.

Results

Inseason assistance was provided to the fisheries management staff in January for managing the Craig winter bait fishery. Herring distribution, abundance, and progression of the harvest was monitored from the R/V *Steller*. Assistance was also given to the Cordova management staff in conducting their diver surveys following the Prince William Sound Oil Spill.

Table 1. Acoustic estimates of adult herring biomass by area and date conducted in Southeast Alaska.

Date	Area	Survey Number	Biomass in Kilograms > 185 mm SL
12-20-88	Anita Bay	1	72,578
12-20-88	Anita Bay	2	299,387
12-13-88	Tonowek Bay (Harmony Is.)	1	11,363,120
12-13-88	Tonowek Bay (Harmony Is.)	2	9,816,284
12-13-88	Tonowek Bay (Harmony Is.)	3	9,040,187
12-13-88	Tonowek Bay (Harmony Is.)	4	6,876,531
12-14-88	Meares Pass	1	1,909,643
12-14-88	Meares Pass	2	3,755,783
12-14-88	Meares Pass	3	2,045,723
12-14-88	Meares Pass	4	4,545,042
12-14-88	Meares Pass	5	2,748,798
11-02-88	Port Camden	1	158,759
11-02-88	Port Camden	2	2,118,298
11-08-88	Lisianski (Soap Stone)	1	14,819,014
11-08-88	Lisianski (Soap Stone)	2	21,949,560
11-09-88	Lisianski (Soap Stone)	1	8,273,609
11-04-88	Tenakee Inlet (Long Bay)	1	961,626
11-05-88	Tenakee Inlet (Long Bay)	1	1,111,313
11-05-88	Tenakee Inlet (Long Bay)	2	1,133,993
11-06-88	Tenakee Inlet (Kadashan)	1	734,827
11-06-88	Tenakee Inlet (Kadashan)	2	2,444,888
March 1989	Sitka Sound	1	15,000,000

Table 2. Summary of herring scale analysis performed during reporting period, and area sampled by date.

Area	Date	-- Percent of Age Composition by Numbers -- N	III	IV	V	VI	VII	VIII	IX	X	Mean Standard Length in mm
Tenakee Inlet (Trawl)	11/89	317	2	5	63	12	9	8	-	-	197.63
Lisianski (Spawn)	04/89	220	2	27	68	3	-	-	-	-	182.0
Craig (Spawn)	03/89	1,288	3	28	59	7	2	1	-	-	199.0
Seymour Canal (Spawn)	05/89	361	26	11	24	25	11	3	-	-	180.0
Boca de Quadra (Spawn) (prior to fishery)	03/89	525	11	34	39	12	3	1	-	-	197.0
Sitka (Spawn)	04/89	1,759	1	19	75	3	1	0	-	-	194.0
Hoonah Sound (Spawn)	04/89	70	-	13	72	11	4	-	-	-	200.2
Total		4,540									

Table 3. Summary of data collected in diver survey studies on Southeast alaska spawning grounds, 1 July 1988 through 30 June 1989.

Area	No. of Transect Diver Surveys	Sampling Time	Linear Miles of Spawn	Spawner Escape Index Kilograms x 10^6
Seymour	31	05/17-05/19/89	7.8	2.8
Lisianski Inlet	13	05/13-05/15/89	6.5	1.0
Farragut	9	05/08-05/09/89	4.5	0.2
Hoonah	16	04/18-04/19/89	17.0	3.8
Tenakee	19	05/10-05/12/89	10.9	4.9
Sitka	51	04/10-04/16/89	65.5	24.7
Kah Shakes	18	04/01-04/03/89	9.0	3.0
Craig	29	04/07-04/09/89	31.7	18.0
Total	186		152.9	58.4

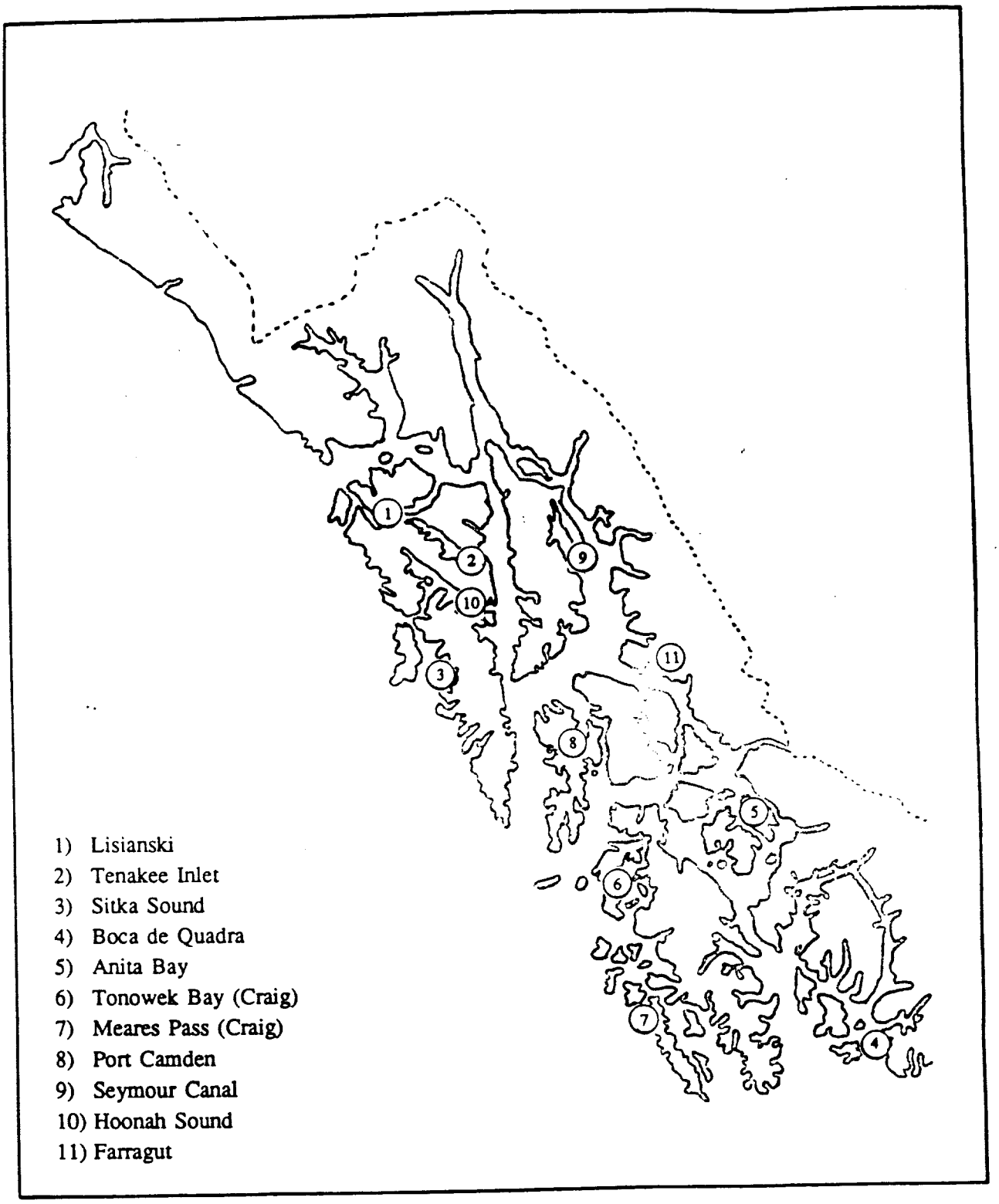

Figure 1. Southeast Alaska herring stocks, 1 July 1988 through 30 June 1989.