



PACIFIC HERRING (Clupea pallasii) SPAWNING GROUND
RESEARCH IN SOUTHEASTERN ALASKA, 1977

By:
Dennis Blankenbeckler

1978

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PACIFIC HERRING (Clupea pallasii) SPAWNING GROUND

RESEARCH IN SOUTHEASTERN ALASKA, 1977

By

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INTRODUCTION

This is the second in a series of annual reports designed to discuss herring (*Clupea pallasii*) spawn production in Southeastern Alaska. General aerial surveys on major spawning stocks, including three detailed comprehensive surveys, are summarized and discussed. The Alaska Department of Fish and Game, recognizing the commercial interest in herring, has initiated comprehensive spawning ground studies. This study is a follow-up of a pilot study conducted by Blankenbeckler in 1976 in which background information and present field and laboratory methods are discussed (Blankenbeckler 1976).

The present study is expanded from the 1976 pilot work and is designed to collect herring life history information and to determine the feasibility of estimating the number of spawning herring from their egg deposition. This quantifiable data will be used as ground truth to hydro-acoustical biomass estimates made prior to spawning, as a data base for estimating egg mortality and as a base for determining harvest quotas. Life history information includes the following:

1. Vegetation type and herring preference.
2. Determination of egg densities for varied substrates.
3. Timing and temperature of spawning.
4. Egg development.
5. Estimates of egg mortality for various densities and substrates.

This baseline information will be used to determine the feasibility for developing a survey method for annually assessing herring escapement and spawning ground conditions in Southeastern Alaska.

RESULTS

General Spawning Surveys

Results of available information from all survey methods in terms of an index of the linear miles of beach receiving spawn in 1977, including dates, is shown in Table 1. It should be emphasized before drawing conclusions from this data that effort and intensity of aerial surveys has varied considerably over the years.

Table 1. Summary of linear miles of beach receiving herring spawn in Southeast Alaska.

YEAR AND LINEAR MILES OF BEACH SPAWN OBSERVED

LOCATION	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979			
CRAIG	12.2	11.7	13.6	11.6	11.5	12.6	3.5				11.5	11.2	12.3	14.2	12.4	9.2		11.7	4.5	7.5	7.1						2.5			
KAH SHAKES-Boca deQuadra SHORE NAKAT			7.9	9.2	3.4	2.5	5.7	7.0											9.5			6.0	11.0	9.5	11.3					
CLEVELAND PENN. BEHM CANAL			5.9	6.4	3.5	5.9	7.8	5.5											2.0	3.0		1.0	2.0	1.0			3.2			
ERNEST SOUND ROCKY BAY				7.5	2.6														3.0				3.0	3.0						
AUKE BAY LYNN CANAL	8.2	9.4	12.2	10.0	28.1	24.1	10.8	12.9											11.5	-	8.3	10.6	13.2	10.9	14.6	9.5				
SITKA				Includes all of Sitka area															Sitka Strait only											
			100.0	79.8	92.8	45.9	44.5				19.2	20.8	23.0	15.0	16.5	15.0	11.3	13.1	10.8	7.5	8.5	8.0	10.0	6.0						
SEYMOUR CANAL																			3.0				4.5	3.2	2.5					
HYDABURG McFARLAND ISLAND											8.0	9.0	7.8	5.0	4.5				4.0	1.8	0.7						0.7			
KWAIN BAY HAM ISLAND																			3.0			3.0	3.0				3.2			
KASSAN BAY																			4.0	1.0	1.0	1.0	1.0				2.5			
HOOD & CHAIK BAY																			1.5	10.0	2.0	1.7	3.4	2.3	1.7					
GAMBIER BAY																			0.5											
SKAGWAY HARBOR																			1.0											
DAVIDSON IN./MARBLE ISLAND																					1.0	1.0	1.0	1.0						
PORT CAMDEN																											0.3			

1
2
1

Kah Shakes - Boca de Quadra Comprehensive Study

Major spawning was documented first on March 29 and continued until April 4, 1977. A total of 12.0 linear miles of beach receiving spawn was observed from aerial and boat surveys (Table 1). A total of 20 transects was established at 0.5 mile intervals along the beach in the area receiving spawn. Sampling was conducted on April 13, 14, 15, 18 and 19, representing 30 man-days of work. Figure 1 illustrates the study area.

Spawning area utilized was similar to 1976 with the exception that the area was more extensive, especially in the Black Island area. Vegetation utilized was similar as reported by Blankenbeckler (1976). Eel grass (Zostera marina) and rock kelp (Fucus furcatus) made up the majority of the spawning substrate.

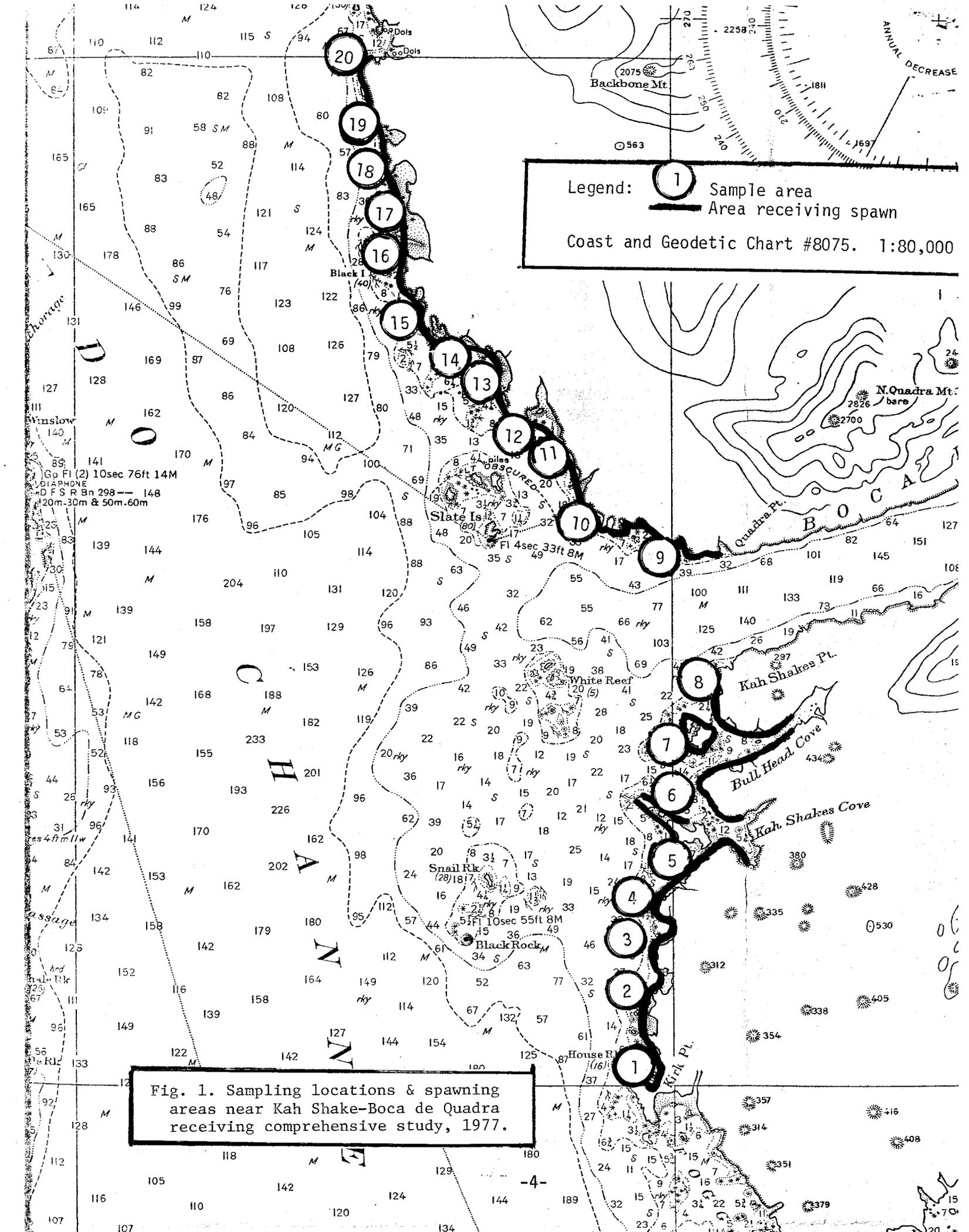
Water temperature during incubation ranged from 44° to 46° F. Depth of spawning was observed from the +12' tide line to a -26' depth^{1/}.

Predation, especially by herring gulls, glaucous wing gulls and surf scoters was considered heavy. During the survey period 13,000 gulls and 16,000 surf scoters were estimated in the area. Seventeen surf scoters sampled contained 430 to 1,040 herring eggs in their gizzards, averaging 616 eggs.

Egg deposition ranged from 0 to 3,443,500 eggs per square meter, averaging 224,280. The number of egg layers covering the substrate in the sample areas ranged from 0 to 3, averaging 1.1. Egg layers were visually estimated by divers during the surveys. Deposition sampling indicated that 257 billion eggs were present prior to hatching (Table 2). This represents 9.75 million pounds of herring spawners. This number was determined by using the average fecundity (20,000 eggs/female), assuming an equal percentage of males and females in the population, knowing the average egg density, and knowing the average weight of herring (0.38) prior to spawning.

The total population biomass before harvest and spawning was estimated at 15.3 million pounds. This figure was computed by adding the total pounds of herring spawners computed from the egg density, the commercial gillnet harvest (1.66 million pounds) and by applying a predation loss correction factor of 25%. Egg mortality has been estimated at 25-40% in Southeastern Alaska by Montgomery, 1958. Using this data, a commercial exploitation rate of 10.8% occurred in 1977 by the set net gillnet fishery.

^{1/} As measured from the 0' tide reference.



Legend: **1** Sample area
 — Area receiving spawn
 Coast and Geodetic Chart #8075. 1:80,000

Fig. 1. Sampling locations & spawning areas near Kah Shake-Boca de Quadra receiving comprehensive study, 1977.

Table 2. Summary of transects and deposition calculations for Boca de Quadra study area, 1977.

Width (meters) of spawn deposition	Transect Number (spaced at 0.5 nautical mile intervals)										Transect Number (spaced at 0.5 nautical mile intervals)									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
30			-1'		-10'		-6'													
60		-4'																		
90																				
120																				
150																				
180																				
210																				
240																				
270																				
300																				
Average Density/m ²	67	650	172,175	0	24,862	0	31,510	10,534	40,313	27,221	13,635	38,843	0	21,565	0	794	18,687	48,625	840	232
Sample Interval(m)	10	10	10	10	10	10	10	10+ expansion	10	10	10	10	10	10	10	10	10	10	10	10
No. of Samples	1	4	2	0	4	0	2	11	9	6	7	7	0	1	0	3	10	10	10	3
Width in meters	10	40	20	0	40	0	20	300	90	60	70	70	0	10	0	30	100	100	100	30

Average width = 54.5 m
 Length = 11.3 nautical miles, 1852 m = 1 naut. mi. = 20,927.6 m
 Area = 1,140,554.2
 Total deposition = 256,944,050,176, representing 12,847,202 females
 at 20,000 eggs/female. Assume 50:50 sex ratio = 25,694,404 herring.
 Average weight 0.38 lbs.

Average egg layers = 1.14
 Range egg layers = 0-3
 Density range m² = 0-3,443,500/m²
 Average density = 22,528
 Temp. range = 44 - 46 F.
 Predation = heavy - 13,000 gulls,
 16,000 surf scoters

No herring larvae were observed during the survey, indicating hatching prior to the survey, which would bias the biomass estimates based on egg density. Samples in Bullhead Cove (Fig. 1) revealed "mounds" of fertile, loose eggs located in sand depressions, similar to 1976. Since beginning these studies this was the only area where this phenomenon has been observed.

No degradation of the spawning beds by the gillnet fishery was noted by the survey divers in the area (Quandra Point to Point Sykes).

No hydroacoustical estimate comparison could be made for this spawning stock. Herring were not distributed in concentrations off the spawning beaches in 1976 or 1977 where reliable acoustical estimates could be made.

Sitka Comprehensive Study

Major spawning was documented first on April 13 and continued until April 19, 1977. A total of 6.0 linear miles of beach were observed by aerial surveys to have received spawn (Table 1). A total of 13 transects was established at 0.5 mile intervals along the beach in the spawning area (Table 3). Sampling was conducted on April 26, 27 and 28, representing 12 man-days of work. Figure 2 illustrates the sampling area.

The spawning area utilized was similar to 1976, with the exception that no spawning was observed in East Sitka Sound and spawning was observed in the Kasinana Island complex. Vegetation utilized for spawning was similar as reported by Blankenbeckler in 1976. Eel Grass (Zostera marina) and rock kelp (Fucus furcatus) comprised the majority of the spawning substrate.

Water temperature during incubation ranged from 44° to 48° F. Depth of spawning was observed from +12' tide line to -20' depth.

Predation, especially by gulls and surf scoters, was considered moderate. No estimate of birds was made for the area, but the heaviest concentrations were observed near Halibut Point.

Egg deposition ranged from 0 to 3,143,000 per square meter, averaging 556,670. The range of egg layers covering the substrate at sampling points ranged from 0-4 egg layers, averaging 1.8. Egg layers were estimated visually by divers. Deposition sampling indicated 264 billion eggs were present prior to hatching (Table 3). This represents 9.78 million pounds of herring spawners. This number was computed in a manner similar to that for the Ketchikan area, but using 0.37 pounds as an average weight as determined from samples taken during purse seine test fishing in 1977.

Table 3. Summary of transects and deposition calculations for Sitka Sound study area, 1977.

-----11,112 meters-----

		Transect Number (spaced at 0.5 nautical mile intervals)												
		1	2	3	4	5	6	7	8	9	10	11	12	13
Width (meters) of spawn deposition	30													
	60													
	90													
	120													
	150													
		(Zostera, sand, Fucus)	(mixed Fucus, Zostera, Laminaria, Ulva)	(Fucus, Laminaria)	(Zostera, sand, rock)	(Laminaria, sand, rock)	(Laminaria, Zostera)	(Laminaria, Zostera)	(sand, no vegetation)	(Laminaria, Zostera, Fucus)	(Laminaria)	(Fucus, Ulva)	(Fucus, pebbles, sand)	(Zostera, Laminaria, Fucus)
Average Density/ m ²		18,608	41,713	370	51,594	71,758	186,162	103,300	0	34,860	28,368	62,100	28,100	96,750
Sample Interval (m)		10	10	5	10	10	10	10	0	10	10	10	10	10
No. of Samples		12	9	1	5	3	4	3	0	13	7	3	1	7
Width in meters		120	90	5	50	40	40	40	0	130	70	30	10	70

Average width = 42.7m
 Length = 6.0 nautical miles. 1852m = 1 naut. mile - 11,112 m
 Area = 474,482m² (sampled .0001%)
 Total deposition = 264,129,894,990 eggs.
 Represents 13,206,494 @ 20,000 eggs/female
 Assume 50:50 sex ratio = 26,412,988 herring
 1977 calculation Ave. Wt. = .33 lbs. = 8,716,286 lbs.
 1977 Ave. Wt. from sample = .37 lbs. = 9,772,805 lbs.

Average egg layers = 1.25
 Range egg layers = 0-4
 Density range m² = 556,670/m²
 Average density = 55,667/sample
 Temp. range = 44° - 48°F. Temp. stratified with depth.
 No heavy bloom noted as in 1976.
 Predation = birds heaviest around Halibut Pt. similar to 1976.

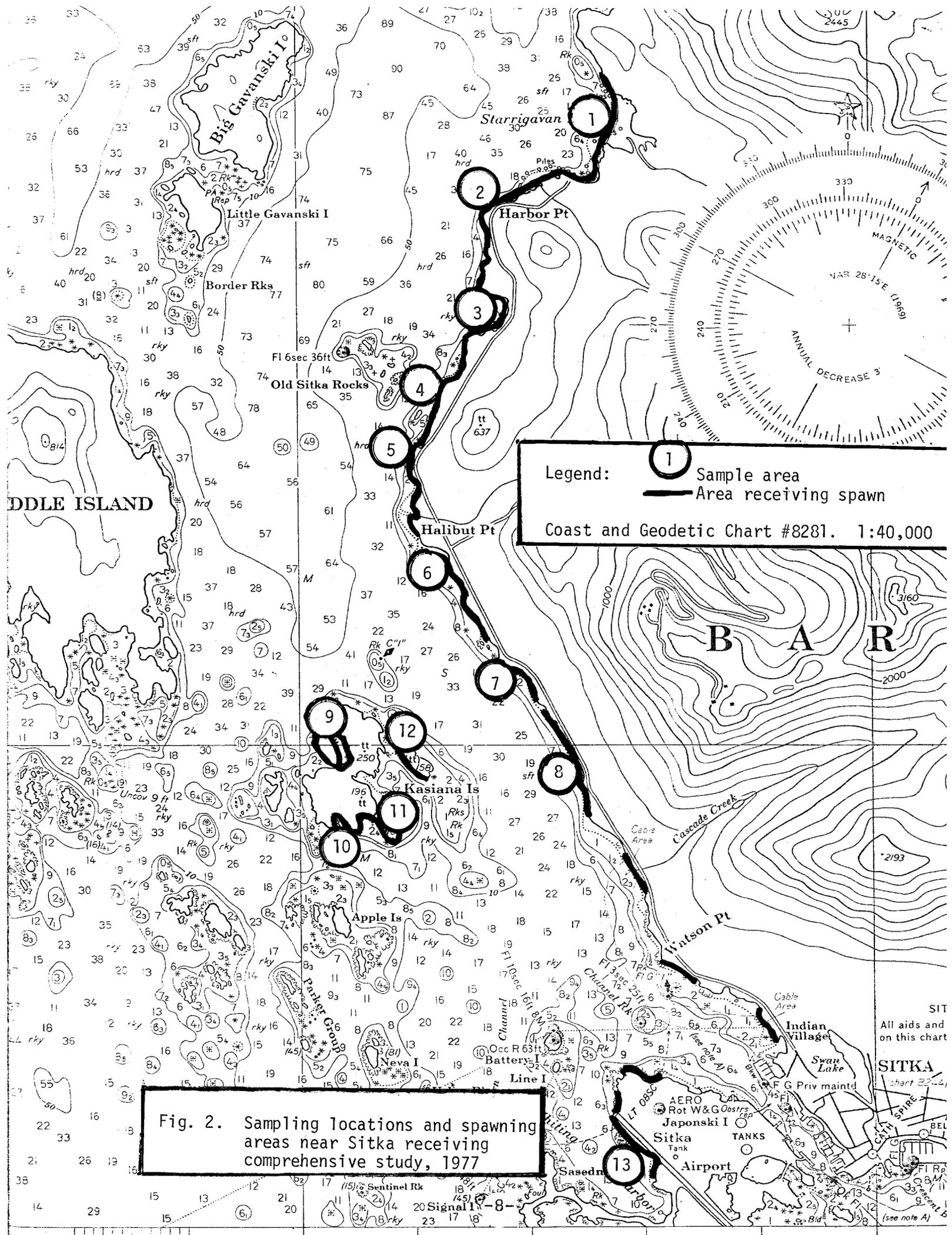


Fig. 2. Sampling locations and spawning areas near Sitka receiving comprehensive study, 1977

The total population biomass before harvest and spawning was estimated as 13.0 million pounds. This figure was computed by applying a predation correction factor of 25%. It should be noted that the actual predation figure is not known for this area, but is based on other work conducted in Alaska (Montgomery 1958).

Hydroacoustical estimates made in Sitka in 1977 during April resulted in a high survey of 11.3 million pounds. The acoustical estimates agree closely with the egg density estimates, being only 13% lower.

Kasaan Bay Comprehensive Study

Major spawning was documented first on April 22 and was estimated to have occurred for only 1 or 2 days. A total of 2.5 linear miles of beach received spawn as observed from on-the-ground skiff surveys. A total of six transects was established on the beach at 0.5 mile intervals in the spawning area. Sampling was conducted on May 4 and 5, representing 8 man-days of work. Figure 3 illustrates the sampling area. Vegetation utilized for spawning was predominately eel grass (Zostera marina) and rock kelp (Fucus furcatus). Limited Ulva, Laminaria and Endocladis were observed as being utilized as spawning substrate.

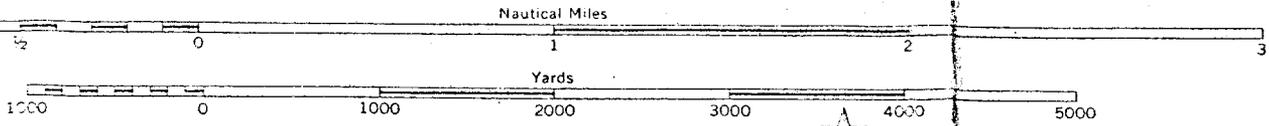
Water temperature during incubation ranged from 47° to 49° F. Depth of spawning was observed from +10' to -5' depth.

Predation, especially by gulls and surf scoters, was considered heavy. A total of 3,000 gulls and 5,000 surf scoters was estimated in the area during the survey period.

Deposition ranged from 0 to 1,125,000 eggs per square meter, averaging 152,760. The number of egg layers covering the substrate in the sample areas was estimated to have ranged from 0 to 2, averaging 0.8. Deposition sampling indicated 35 billion eggs were present prior to hatching (Table 4). This represents 1.17 million pounds of herring spawners. This number was determined in a manner similar to that used in the Ketchikan study area, except that an average over all areas of 0.33 pounds per herring was used since no sampling occurred on the grounds during 1977.

The total population biomass before spawning was estimated at 1.55 million pounds. This figure was computed in a similar manner as the Ketchikan study area using a 25% egg mortality correction factor.

Hydroacoustical estimates made in Kasaan Bay in 1977 during March resulted in a high survey of 0.9 million pounds. The acoustical estimates compared to the egg density estimates were 42% lower.



Legend: **1** Sample area
 Area receiving spawn
 Coast and Geodetic Chart #8142. 1:40,000

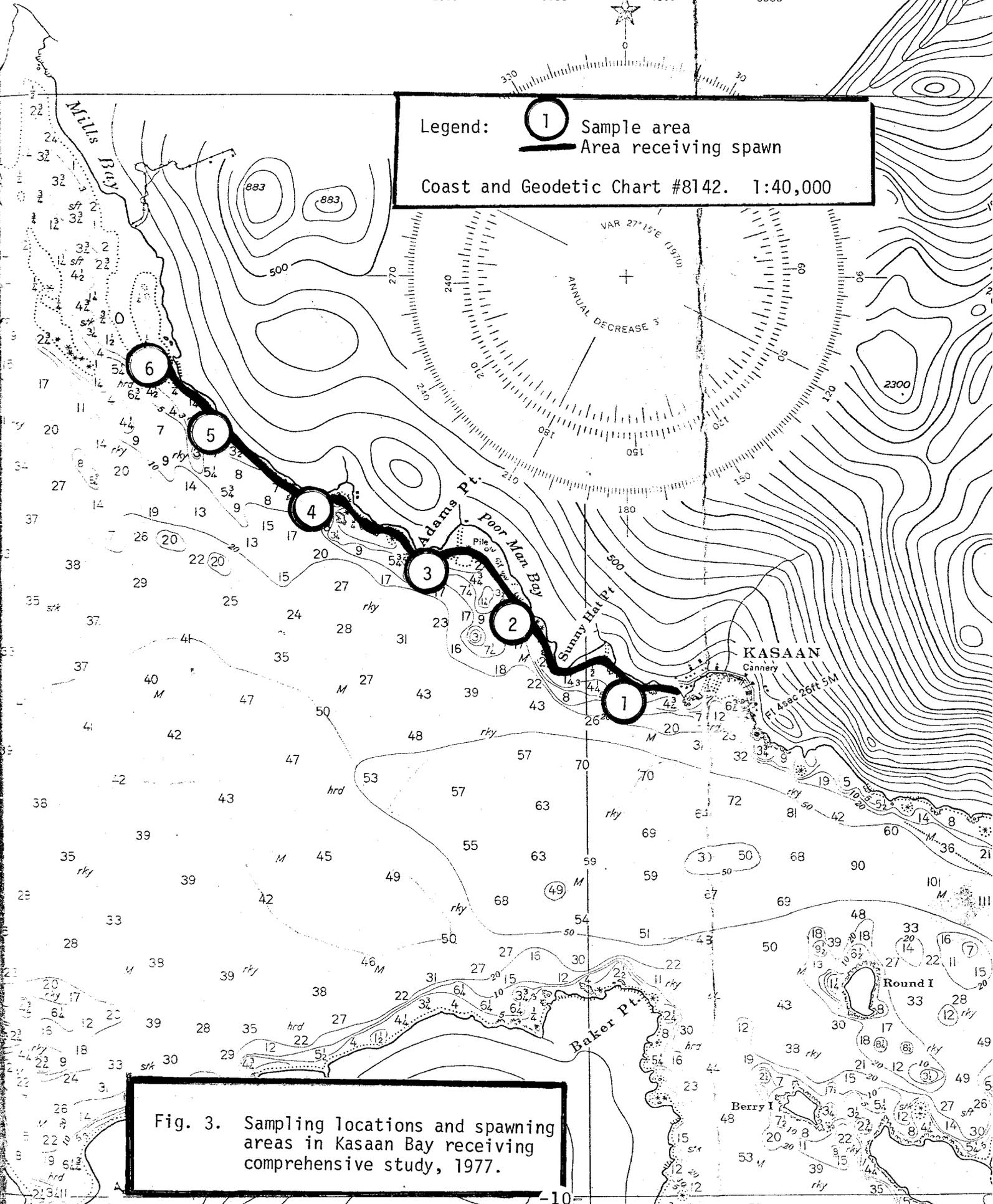
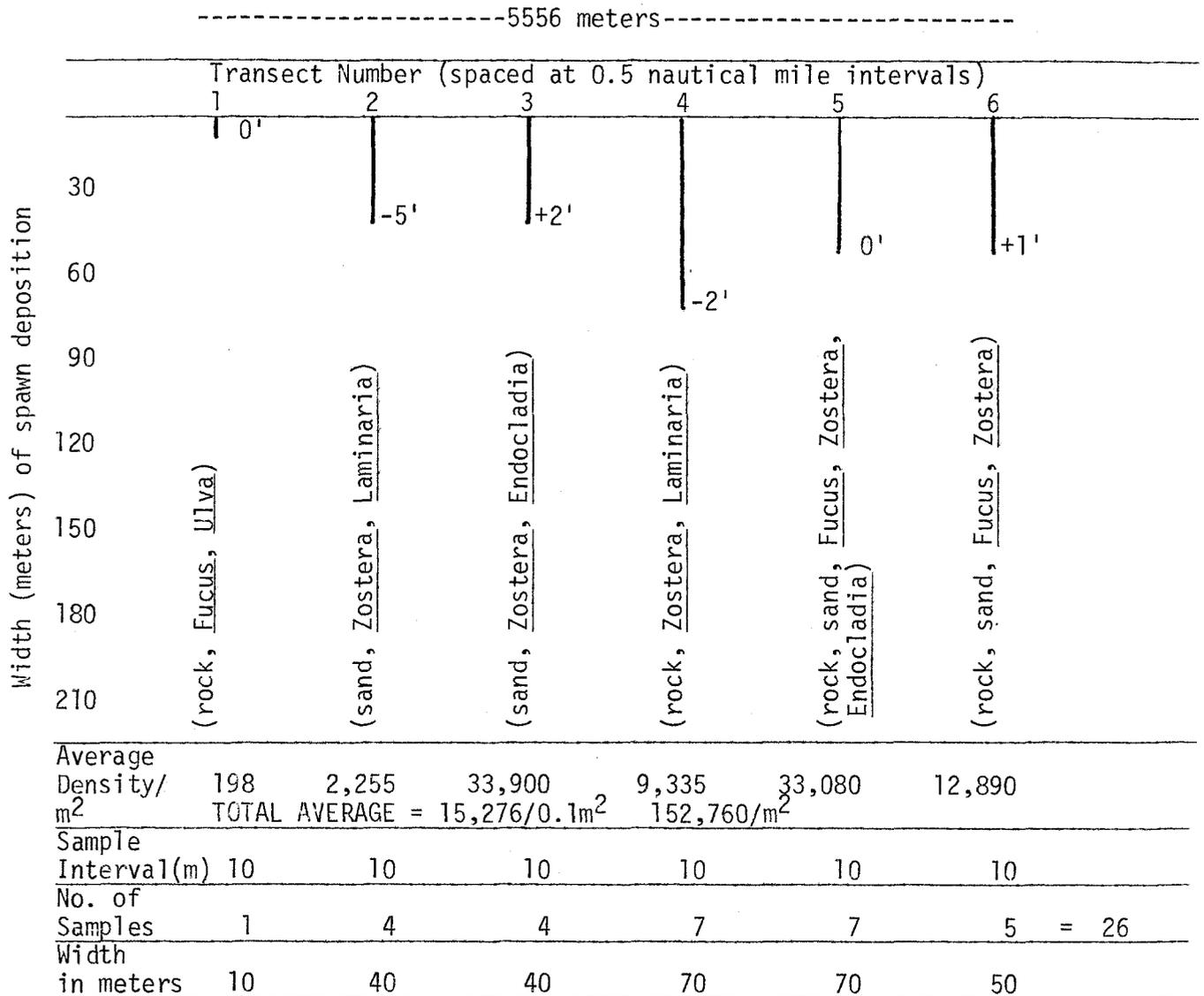


Fig. 3. Sampling locations and spawning areas in Kasaan Bay receiving comprehensive study, 1977.

Table 4. Summary of transects and deposition calculations for Kasaan Bay study area, 1977.



Average width = 41.8m
 Length = 2.5 nautical miles or 5,556m
 Area = 41.8m x 5,556m = 232,240
 Total deposition = 35,476,982,400 eggs.
 Represents 1,773,849 @ 20,000 eggs/female
 Assume 50:50 sex ratio = 3,547,698 herring
 Ave. weight 0.33/herring = 1.17 x 10⁶ lbs.

Average egg layers = 0.8
 Range egg layers = 0-2
 Density range m² = 0 -1,125,000/m²
 Temp. range = 47° - 49°F.
 Predation = heavy. 3,000 gulls,
 5,000 surf scoters

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