SITKA BOAT HARBOR HERRING SPAWN DEPOSITION STUDY

1996 SURVEY RESULTS

By

Robert Larson

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The Alaska Department of Fish and Game (ADF&G) entered into a cooperative agreement with the U.S. Fish and Wildlife Service (USF&WS), agreement COOP-93-065 number 1448-0007-93-7770, in the spring of 1993 to document the extent of herring spawning activities within the boundaries of the proposed small boat harbor at Sitka, Alaska. The monitoring study is part of the U.S. Army Corps of Engineers project plans for the harbor and will be used to determine if construction and operation of the harbor will have adverse effects on traditional spawning within this area. Construction of the harbor was started during the fall of 1994 and terminated during the herring spawning time period in March of 1995. The pre-impact surveys covered by this agreement occurred in April 1993 and 1994. The 1995 survey occurred with the breakwater almost completed but no additional structures in place. The 1996 survey occurred with the breakwater complete and most of the finger floats and pilings installed.

OBJECTIVES

The study is designed to document the habitat and herring spawning patterns prior to the construction of the harbor and to provide post-construction monitoring. Aerial surveys will document herring spawn timing and spawn geographic distribution of the greater Sitka Sound herring population. Habitat within the proposed breakwater boundaries and herring egg densities will be described through examination of permanent experimental sites. Data collection will be possible for two years prior to construction, with at least two years of data collection after the harbor is completed.

METHODS

Aerial and Skiff Surveys

Aerial and skiff surveys are the standard method for documenting timing and location of herring spawning activities in Southeast Alaska. Surveys are conducted on a daily basis during the time herring are expected to be spawning in the area. Surveys are generally conducted with the aid of a small, fixed-wing aircraft, or skiff, by Department of Fish and Game employees. A daily log of herring distributions and spawning activities is maintained with shoreline lengths of herring spawning activities recorded on 1:40,000 scale NOAA navigation chart notes 17326 and 17324. The annual total miles of spawn is a sum of the amount of shore receiving spawn for the season without regard to the number of days spawning occurred.

Spawn Deposition Sampling

The spawn deposition survey technique for estimating numbers of herring eggs by spawning area has been used in Southeast Alaska since 1976. It has become the most common method of estimating herring escapements in recent years and is one of the major components of the age-structured analysis (ASA) method of projecting a subsequent year's forecasted return of spawning biomass.

The basic field sampling procedure entails two-person SCUBA teams swimming along line transects and recording visual estimates of the number of eggs within a sampling frame placed on the bottom at five-meter distances along the transects. Because the frames (i.e., samples) are spaced equidistantly along transects, the record of the number of frames along a transect is also used to compute transect length. Along each transect, Diver one swims the specified inter-frame distance and places the frame on the bottom in a haphazard fashion (i.e., to minimize or avoid bias). Diver two then visually estimates the number of eggs within the frame boundary and records the number of eggs within the frame on a preprinted data form carried by Diver two. Diver two records the sequential number of the sample along with data on depth, substrate, and temperature. If time and conditions allow, Diver one also estimates the number of eggs for comparison with Diver two's estimates and as a training exercise for Diver one.

Starting points for transects in the control area are located randomly along the shore in areas where aerial or skiff surveys indicated probable spawn deposition. Transects are oriented perpendicular to the shoreline. Transects extend from the intertidal to either 15 meters of depth or until no further egg deposition is observed. The transect is extended above the waterline as far as egg deposition occurs. Dives are generally limited to 15 meters because deeper dives severely limit total bottom time for SCUBA divers and pose safety risks when conducted repetitively over several days. In addition, little if any herring egg deposition normally occurs deeper than 15 meters. The number of transects for Sitka Sound was estimated from previous surveys to achieve a statistical objective of producing an estimate of mean egg density with a standard error within +/- 20% of the mean.

Visual Estimate Correction

Since visual estimates, rather than actual counts, of eggs within the sampling frame are recorded, measurement error occurs. To minimize the influence of measurement error on final estimates of total egg deposition, diver-specific correction coefficients (h_i) are used to adjust estimates of egg density. Correction coefficients are estimated by visually estimating the number of eggs within a sampling frame and then collecting all of the eggs within the frame for later enumeration. To collect the eggs, divers either remove them from the substrate (e.g., rock) or collect the substrate (e.g., kelp) for later removal of the eggs.

Estimates of Total Egg Deposition

Total egg deposition for a particular spawning ground (t_i) is estimated as:

$$t_i = a_i \bar{d}_i \tag{1}$$

where a_i is the estimated total area (m^2) on which eggs have been deposited and $\bar{d}_i$ is the estimated mean density of eggs (eggs/m^2) at spawning area i. The total area on which eggs have been deposited (a_i) is estimated as:

$$a_i = l_i \bar{w}_i \tag{2}$$

where l_i is the total meters of shoreline receiving spawn (determined from aerial and skiff surveys) and $\bar{w}_i$ is the mean length of transects conducted at spawning area i.

The mean density of eggs/m^2 at area i ($\bar{d}_i$) is estimated as:

$$\bar{d}_i = \left[\frac{\sum v_{hij} c_{hk}}{\sum m_{ji}} \right]^{-0.1} \tag{3}$$

where v_{hij} is the visual estimate of egg numbers by diver h, at area i, quadrate j. The c_h term refers to a diver-specific correction coefficient to adjust visual estimates made by diver h for substrate k, and m_{ij} is the number of quadrates visually estimated at area i. Divers visually estimate egg density within 0.1 m quadrates. The -0.1 exponent expands the mean density from a 0.1 m^2 to a 1.0 m^2 unit basis. Diver-specific correction factors (c_h) are estimated as:

$$c_h = \frac{\bar{k}_h}{\bar{v}_h} \tag{4}$$

where $\bar{v}_h$ is the mean visual estimate of egg numbers for diver h and $\bar{k}_h$ is the mean laboratory count of egg samples collected from quadrates visually estimated by diver h.

Spawning Biomass Estimation

The total number of eggs per spawning area is a key estimate used in forecasting herring spawning biomass. In Sitka, the estimate of total eggs is used as part of an ASA model with age composition, maturity, mortality, and growth data to estimate future returns. The final 1996 Sitka Sound herring spawning return biomass estimate and the subsequent forecast return for 1997 will be determined by ASA. For comparison purposes, a 1996 spawning biomass for the study area and control can be directly estimated from the number of eggs as:

$$b = \frac{ti}{L * 100{,}928{,}570} \qquad (5)$$

where: b = estimated total spawning biomass.
(100,928,570 is the 1996 eggs to spawning biomass conversion).

L = egg loss correction factor (=0.9) that accounts for an estimated 10% egg mortality between the time eggs are deposited and spawn deposition surveys are conducted.

Fecundity

To better estimate the relationship between population size and number of eggs deposited on the spawning grounds, a fecundity study was conducted in Sitka Sound in 1996. Although not part of the cooperative agreement between the State and the USF&WS, the relationship between the number of eggs observed on the spawning ground and the biomass of herring required to deposit that number of eggs is critical in our understanding of herring population dynamics for the Sitka Sound spawning stock. The spawning biomass for 1996 was calculated from this data.

RESULTS AND DISCUSSION

Aerial and Skiff Surveys

Aerial surveys began on March 15 in the Sitka area. A mile and a half of active spawn was recorded outside Crow Island on March 22. A major spawn began the next day with thirteen nautical miles reported, but peaked on May 25 with over 35 nautical miles that day. Spawn dissipated from that point and remained spotty until May 16. The total spawn tallied 45.6 nautical miles, including one nautical mile in the boat harbor. This is more than the 37.3 nautical miles received in 1995. The entire 1.0 nautical mile of shore within the boat harbor study area received spawn again in 1996, but on two separate time periods. The first occurred on March 24 through 26 and again on April 10 through 14.

Visual Estimate Correction

Eleven pairs of visual estimates and laboratory egg counts were obtained from two of the Department of Fish and Game divers that participated in the survey (Table 1). Vegetative substrates included eelgrass, fucus, and large brown kelp. Individual diver corrections, laboratory counts compared to visual estimates, ranged from 0.2 to 2.1. The final visual estimate calibration data used to determine the number of eggs for the 1996 surveys was based on the sum of all samples taken since 1982; it is diver and substrate-specific (Table 2).

Estimates of Total Egg Deposition

Two separate spawn deposition surveys occurred for the small boat harbor area as a result of the two separate spawning events (Table 5). The first spawn deposition survey began with the five permanent transects within the small boat harbor on April 2 and 4 and the second on April 23 and 24 (Figure 1). Surveys outside the boat harbor area were performed from March 31 through April 3. A total of 26 randomly selected transects were completed (1.7 nautical miles of beach with spawn per transect) for the 44.6 nautical miles of spawn outside the boat harbor that had been deposited prior to April 7 (Figure 2). The first survey for the boat harbor had an average transect length of 130 meters, with an average density of 215,448 eggs per square meter. The second had an average transect length of 131 meters with an average density of 269,459 eggs per square meter. Because no hatching was evident from the first spawn due to a high egg mortality, the second spawn deposition survey was used to compute an estimate of total eggs in the boat harbor. The total number of eggs and the resultant biomass estimate did not account for any egg loss for the time of the first spawn to the second spawn survey, a time when most of the eggs from the first spawning would normally be hatched and disappear. The resultant boat harbor escapement estimate is 1,288 tons (including a 10% egg loss factor). For the area outside the boat harbor (26 transects, 44.6

nautical miles of spawn) the average transect length was 105 meters with an average density of 371,989 eggs per square meter. The resultant escapement estimate for Sitka Sound outside the breakwater was 35,658 tons (Table 2).

For comparison, the 1995 escapement estimate of 1,078 tons from inside the proposed boat harbor was computed using 170 meters width of spawn and a density of 273,464 eggs/m^2. The spawn deposition estimate for the area outside the boat harbor was 38,591 tons, using a 93-meter width of spawn and a density of 517,296 eggs/m^2 from the spawn survey plus an additional 1.8 nautical miles of lost spawn that occurred after the spawn deposition survey. The egg to spawning biomass conversion for 1995 was 88,739,928 eggs to ton of spawning fish.

Individual transect data with the number of eggs per quadrant, vegetation type, and depth is included for the boat harbor study (Table 4). The daily aerial and vessel herring spawning activity survey log is also included (Table 5).

Fecundity

Fecundity estimates were calculated for the Sitka herring stock in 1995 and 1996. In 1996, 105 herring were sampled and that fecundity to weight relationship (y=-2503.9 + 222.5 * weight) was used to calculate the 1996 spawning biomass to egg conversion (Figure 3).

Table 1. Individual spawn deposition diver calibration estimates, 1996.

INDIVIDUAL VISUAL AND LAB ESTIMATES BY DIVER AND SUBSTRATE							
Area	Date	Observer	Substrate	Eggs/ ml	Visual est.	Lab count	Lab/ visual
Sitka	4-Apr-96	BD	hir	422	320,000	360,947	1.13
Sitka	4-Apr-96	DG	hir	422	280,000	360,947	1.29
Sitka	4-Apr-96	BD	hir	355	160,000	222,230	1.39
Sitka	4-Apr-96	DG	hir	355	130,000	222,230	1.71
Sitka	4-Apr-96	BD	elg	376	60,000	99,640	1.66
Sitka	4-Apr-96	DG	elg	376	160,000	99,640	0.62
Sitka	4-Apr-96	BD	red	246	65,000	80,770	1.24
Sitka	4-Apr-96	DG	red	246	40,000	80,770	2.02
Sitka	4-Apr-96	BD	elg	315	260,000	272,973	1.05
Sitka	4-Apr-96	DG	elg	315	240,000	272,973	1.14
Sitka	4-Apr-96	BD	mac	324	100,000	135,270	1.35

Table 2. Southeast herring spawn deposition diver calibration factors, 1996.

	SUBSTRATE				
DIVER	Eel Grass	Fucus	Hair Kelp	Large Brown Kelp	Other*
Davidson	0.89	1.19	1.23	0.90	1.24
Larson	1.09	1.08	1.33	1.09	1.1

Note: Estimates based on 1982-88, and 1993-96 diver calibration data.

Table 3. Sitka herring spawn deposition survey, 1996.

SITKA HARBOR HERRING FIRST SPAWN DEPOSITION SURVEY 1996				
Number of estimates	136		BD	RL
Total number of eggs/.1 meter quadrant (1,000s)	2,930		396	2,534
Average length of transects in meters	131	(total samples*5 meters/total [5] transects)		
Lineal meters of shoreline receiving spawn	1,852	(1.0 nautical miles of shore* 1852 meters/nmile)		
Area of survey in square meters	241,797	(length of shoreline * average width of transects)		
Average density of quadrant samples (1,000s)	21.54	(total eggs[1,000s] / total number of observations)		
Average density of eggs per square meter	215,448	(average .1 meter quadrant sample*1,000 eggs*10 meters)		
Total number of eggs in survey area	52,094,656,128	(total survey area in meters * total eggs per meter)		
Unadjusted escapement estimate in tons	516	(total number of eggs / 100,928,570 eggs per ton of spawners)		
Corrected escapement using 10% egg loss	574	(adjustment to account for 10% egg loss prior to survey)		
Eggs to spawning biomass conversion 100,928,570 eggs/ton based on 1996 Sitka Sound fecundity sampling.				

SITKA HARBOR HERRING SECOND SPAWN DEPOSITION SURVEY 1996				
Number of estimates	130		BD	RL
Total number of eggs/.1 meter quadrant (1,000s)	3,503	Corrected sum	2,319	1,184
Average length of transects in meters	130	(total samples*5 meters/total [5] transects)		
Lineal meters of shoreline receiving spawn	1,852	(1.0 nautical miles of shore* 1852 meters/nmile)		
Area of survey in square meters	240,760	(length of shoreline * average width of transects)		
Average density of quadrant samples (1,000s)	26.95	(total eggs[1,000s] / total number of observations)		
Average density of eggs per square meter	269,459	(average .1 meter quadrant sample*1,000 eggs*10 meters)		
Total number of eggs in survey area	64,875,004,400	(total survey area in meters * total eggs per meter)		
Unadjusted escapement estimate in tons	643	(total number of eggs / 100,928,570 eggs per ton of spawners)		
Corrected escapement using 10% egg loss	714	(adjustment to account for 10% egg loss prior to survey)		

SITKA AREA (EXCLUDING HARBOR) HERRING SPAWN DEPOSITION SURVEY 1996					
Number of estimates	571		WB	BD	RL
Total number of eggs/.1 meter quadrant (1,000s)	21,241	Corrected sum	6,868	9,509	4,863
Average length of transects in meters	105	(total samples*5 meters/total [26] transects)			
Lineal meters of shoreline receiving spawn	82,599	(44.6 nautical miles of shore* 1852 meters/nmile)			
Area of survey in square meters	8,707,226	(length of shoreline * average width of transects)			
Average density of quadrant samples (1,000s)	37.20	(total eggs[1,000s] / total number of observations)			
Average density of eggs per square meter	371,989	(average .1 meter quadrant sample*1,000 eggs*10 meters)			
Total number of eggs in survey area	3,238,992,165,312	(total survey area in meters * total eggs per meter)			
Unadjusted escapement estimate in tons	32,092	(total number of eggs / 100,928,570 eggs per ton of spawners)			
Corrected escapement using 10% egg loss	35,658	(adjustment to account for 10% egg loss prior to survey)			
43.4 nm outside the boat harbor from the first spawn and 1.2 nm from the second spawn=44.6 nm of spawn outside the boat harbor					

Outside the boat harbor with 44.6 nmiles of spawn	35,658
Sitka boat harbor with 1.0 nmiles of spawn	714
Total biomass in Sitka Sound for 45.6 nmiles of spawn	36,372

Table 4. Sitka harbor herring spawn deposition study, 1996. Dates: April 2 & 4, 1996. Divers: Bob Larson (RL), Bill Davidson (BD), Dave Gordon (DG), Ed Grossman (EG), and Duane Peterson (DP).

TRANSECT #	INCREMENT (Meters)	DEPTH (Feet)	BOTTOM TYPE	VEGETATION TYPE	BD CORRECTION	RL CORRECTION
p1	5	1	cbl		0	0
		3	cbl	fuc	14.3	0
		7	cbl	fir	3.72	0
		9	cbl	red	0	0
		11	cbl	cor	0	0
		12	cbl	lbk	7.2	0
		14	cbl	lbk	36	0
		17	cbl	lbk	3.6	0
		20	cbl	lbk	0.9	0
		23	cbl	lbk	0.9	0
		25	snd		0	0
		28	snd	lbk	0	0
		30	cbl		0	0
S2	5	1	cbl	fuc	0	0
		3	cbl		0	0
		4	cbl	fuc	8.33	0
		5	mud	fuc	2.38	0
		5	mud	fuc	2.38	0
		7	cbl	fir	4.96	0
		7	gvl	ulv	3.72	0
		7	gvl	fir	3.72	0
		7	cbl		12.4	0
		8	cbl		2.48	0
		8	cbl	lbk	27	0
		9	cbl	lbk	36	0
		10	cbl		0	0
		10	cbl	red	149	0
		11	cbl		0	0
		12	cbl	lbk	9	0
		13	cbl	lbk	54	0
		14	snd	lbk	6.3	0
		16	snd	lbk	0.9	0
		17	snd		0	0
		18	snd	lbk	7.2	0
		20	snd	lbk	0	0
		21	snd	lbk	0	0
		23	snd	lbk	0	0
		24	snd	lbk	0	0
		25	snd		0	0
		26	snd	lbk	0	0
		27	snd		0	0
		28	snd		0	0
p3	5	-1	bld	fuc	0	43.2
		2	cbl	fir	0	88
		3	snd		0	0
		3	snd		0	0
		3	cbl	fir	0	77
		4	cbl	fir	0	220
		4	cbl	fir	0	121
		4	cbl	fir	0	165
		4	cbl	lbk	0	38.2
		5	cbl	lbk	0	54.5
		5	cbl	lbk	0	32.7
		5	cbl	lbk	0	27.3
		6	cbl	lbk	0	10.9
		7	cbl	lbk	0	5.45
		7	gvl	lbk	0	0
		7	bld	lbk	0	0
		10	bld	lbk	0	0
		11	snd	lbk	0	0
		11	gvl	lbk	0	0

TRANSECT #	INCREMENT (Meters)	DEPTH (Feet)	BOTTOM TYPE	VEGETATION TYPE	BD CORRECTION	RL CORRECTION
p3	5	11	bld	lbk	0	0
		11	gvl	lbk	0	0
		11	gvl	lbk	0	0
		11	gvl	lbk	0	0
		11	bld	lbk	0	0
		10	bld	lbk	0	0
		10	bld	lbk	0	0
		10	snd	lbk	0	0
p4	5	1	rck	fuc	0	27
		7	rck	fuc	0	37.8
		9	rck	fil	0	138
		9	snd	elg	0	43.6
		10	snd	elg	0	164
		10	mud	lbk	0	5.45
		10	mud	lbk	0	10.9
		10	mud	lbk	0	38.2
		11	cbl	lbk	0	87.2
		12	cbl	lbk	0	98.1
		12	gvl	lbk	0	76.3
		12	cbl	lbk	0	65.4
		12	cbl	fir	0	44
		13	cbl	lbk	0	76.3
		13	gvl	lbk	0	32.7
		13	cbl	lbk	0	87.2
		13	cbl	lbk	0	21.8
		13	cbl	lbk	0	54.5
		14	cbl	lbk	0	4.36
		13	cbl	lbk	0	54.5
		14	cbl	lbk	0	43.6
		14	rck	lbk	0	60
		15	cbl	lbk	0	27.3
		16	rck	lbk	0	21.8
		17	cbl	lbk	0	32.7
		16	cbl	lbk	0	32.7
		17	gvl	lbk	0	43.6
		17	gvl	lbk	0	16.4
		18	gvl	lbk	0	5.45
		19	rck	fir	0	11
		20	rck	lbk	0	5.45
		20	rck	lbk	0	1.09
		22	rck	lbk	0	0
		23	rck	lbk	0	0
		25	gvl	lbk	0	0
		27	gvl	lbk	0	0
		28	gvl	lbk	0	0
p5	5	1	rck	bar	0	0
		5	mud	elg	0	54.5
		6	gvl	elg	0	1.09
		5	snd	elg	0	0
		5	snd	elg	0	0
		5	mud	elg	0	0
		5	mud	elg	0	0
		5	mud	elg	0	0
		8	gvl		0	0
		8	gvl		0	0
		8	snd		0	0
		9	snd	elg	0	0
		7	snd	fir	0	5.5
		8	snd	fir	0	11
		8	snd	fir	0	11
		8	snd	fir	0	11

TRANSECT #	INCREMENT (Meters)	DEPTH (Feet)	BOTTOM TYPE	VEGETATION TYPE	BD CORRECTION	RL CORRECTION
p5	5	8	snd	elg	0	5.45
		9	snd	elg	0	0
		8	snd	elg	0	2.18
		10	snd	elg	0	1.09
		11	snd	elg	0	65.4
		11	snd	elg	0	0
		11	snd	elg	0	0
		13	snd	elg	0	0
		15	mud	lbk	0	2.18
		17	mud	lbk	0	2.18
		17	mud		0	0
		18	mud		0	0

Table 5. Sitka harbor herring second spawn deposition survey, 1996. Dates: April 23 & 24, 1996. Divers: Bob Larson (RL), Bill Davidson (BD), and Dave Gordon (DG).

TRANSECT #	INCREMENT (Meters)	DEPTH (Feet)	BOTTOM TYPE	VEGETATION TYPE	BD CORRECTION	RL CORRECTION
p1	5	(+4)	rck	fuc	0	54
		0	rck	fir	0	133
		7	rck	lbk	0	65.4
		8	rck	lbk	0	54.5
		9	cbl	lbk	0	43.6
		10	snd	lbk	0	1.09
		11	bvd	lbk	0	0
		12	snd	lbk	0	0
		15	cbl	lbk	0	0
		17	snd	lbk	0	0
		20	snd	lbk	0	0
		22	snd		0	0
		23	mvd	lbk	0	0
p2	5	5	bld	fuc	179	0
		2	snd	fuc	59.5	0
		1	snd		0	0
		2	snd	fuc	119	0
		3	snd	fuc	214	0
		3	gvl	fuc	23.8	0
		5	gvl	lbk	90	0
		5	gvl	lbk	90	0
		6	gvl	lbk	99	0
		6	gvl	lbk	18	0
		6	gvl	lbk	40.5	0
		9	gvl	lbk	13.5	0
		11	gvl	lbk	2.7	0
		13	gvl	lbk	18	0
		15	gvl	lbk	27	0
		17	gvl	lbk	18	0
		20	gvl	lbk	36	0
		22	gvl	lbk	67.5	0
		23	gvl	lbk	3.6	0
		24	mud	lbk	45	0
		27	mud	lbk	27	0
		28	mud	lbk	4.5	0
		28	snd	lbk	45	0
		28	snd		0	0
		29	snd		0	0
p3	5	1	rck	fir	36.9	0
		2	cbl	fir	36.9	0
		4	cbl	fir	14.8	0
		4	cbl	fir	30.8	0
		6	cbl	lbk	3.6	0
		6	cbl	lbk	0.9	0
		8	cbl	lbk	9	0
		9	cbl	lbk	7.2	0
		9	cbl	lbk	27	0
		10	cbl	lbk	27	0
		11	cbl	lbk	18	0
		13	cbl	gor	12.4	0
		13	cbl	lbk	18	0
		14	cbl	lbk	16.2	0
		14	cbl	lbk	31.5	0
		15	cbl	lbk	40.5	0
		16	cbl	lbk	31.5	0
		16	cbl	lbk	13.5	0
		17	cbl	lbk	9	0
		18	cbl	lbk	1.8	0

TRANSECT #	INCREMENT (Meters)	DEPTH (Feet)	BOTTOM TYPE	VEGETATION TYPE	BD CORRECTION	RL CORRECTION
p3	5	18	cbl	lbk	0.9	0
		18	cbl	lbk	0	0
		19	cbl	lbk	0	0
		18	cbl	bld	8.68	0
		18	cbl	cbl	9.92	0
		17	cbl	lbk	0.9	0
		19	cbl	lbk	1.8	0
		19	bld	lbk	0	0
		19	bld	lbk	0	0
p4	5	0	rck	fuc	59.5	0
		3	snd	elg	44.5	0
		4	gbl	fir	43.1	0
		6	snd	los	2.48	0
		6	snd	blk	31	0
		6	snd	lbk	54	0
		6	snd	lbk	27	0
		6	snd	elg	17.8	0
		6	snd	lbk	36	0
		7	snd	lbk	54	0
		8	snd	lbk	4.5	0
		8	snd	lbk	63	0
		9	snd	lbk	13.5	0
		9	snd	lbk	31.5	0
		9	snd	lbk	18	0
		9	snd	lbk	36	0
		10	snd	lbk	18	0
		10	snd	lbk	10.8	0
		11	snd	lbk	45	0
		11	snd	lbk	4.5	0
		11	snd	lbk	4.5	0
		12	snd	lbk	13.5	0
		12	snd	lbk	9	0
		13	snd	lbk	4.5	0
		14	snd	lbk	10.8	0
		15	snd	lbk	13.5	0
		16	snd	lbk	0	0
		19	snd	lbk	0	0
p5	5	0	rck	fuc	0	0
		2	snd		0	0
		3	snd	elg	0	2.18
		3	snd	elg	0	21.8
		4	snd	elg	0	43.6
		4	snd	elg	0	65.4
		4	snd		0	0
		5	snd		0	0
		5	snd		0	0
		5	snd		0	0
		5	snd	fir	0	33.3
		5	snd	elg	0	60
		5	snd	elg	0	49.1
		5	snd	elg	0	76.3
		5	snd	elg	0	164
		5	snd	fir	0	20
		5	snd	fir	0	26.6
		5	snd		0	0
		5	snd	los	0	1.1
		5	snd	fir	0	6.65
		6	snd	fir	0	13.3

TRANSECT #	INCREMENT (Meters)	DEPTH (Feet)	BOTTOM TYPE	VEGETATION TYPE	BD CORRECTION	RL CORRECTION
p5	5	6	snd	elg	0	109
		7	snd	elg	0	98.1
		8	snd		0	0
		9	snd	elg/lbk	0	33
		10	snd		0	0
		13	snd	lbk	0	5.45
		13	snd	lbk	0	1.09
		15	snd	lbk	0	1.09
		15	snd	lbk	0	2.18
		16	snd		0	0
		16	snd		0	0
		17	snd		0	0
		18	snd		0	0
		18	snd		0	0
		19	snd		0	0

Table 6. Sitka area herring spawn survey, 1996. Dates: March 31 & April 1-4, 1996. Divers: Bob Larson (RL), William Bergmann (WB), Bill Davidson (BD), Dave Gordon (DG), Ed Grossman (EG), and Duane Peterson (DP).

TRANSECT #	INCREMENT (Meters)	DEPTH (Feet)	BOTTOM TYPE	VEGETATION TYPE	WB CORRECTION	BD CORRECTION	RL CORRECTION
1	5	-1	bld	fuc	0	0	86.4
		1	bld	fir	0	0	137.5
		3	bld	lbk	0	0	136.25
		6	bld	lbk	0	0	109
		10	rck	fir	0	0	165
		18	rck	lbk	0	0	0
		21	snd		0	0	0
		23	snd		0	0	0
2	5	-5	rck	fuc	136.4	0	0
		3	cbl	fir	198	0	0
		4	rck	fir	143	0	0
		8	cbl	lbk	8.9	0	0
		11	gvl	lbk	0.89	0	0
		12	shl	lbk	17.8	0	0
		14	shl	lbk	0	0	0
		16	shl		0	0	0
		18	shl	lbk	0	0	0
		20	snd	lbk	0	0	0
		22	rck	lbk	0	0	0
3	5	-1	rck	fuc	99.2	0	0
		8	rck		0	0	0
		10	rck		0	0	0
		11	bld		0	0	0
		12	cbl		0	0	0
		13	cbl		0	0	0
		14	shl	red	0	0	0
		15	cbl		0	0	0
		16	cbl		0	0	0
		16	cbl	lbk	0	0	0
		16	cbl	lbk	0	0	0
		17	cbl	lbk	0	0	0
		17	cbl	lbk	0	0	0
4	5	0	rck		0	0	0
		12	rck	fir	0	0	137.5
		14	cbl	hir	0	0	2.66
		19	bld	hir	0	0	6.65
		24	snd	hir	0	0	1.33
		30	cbl	lbk	0	0	0
		34	cbl	lbk	0	0	0
5	5	2	cbl		0	0	0
		3	cbl		0	0	0
		9	cbl		0	0	0
		8	cbl	fir	0	0	121
		10	cbl	fir	0	0	1.1
		11	snd		0	0	0
		12	snd	elg	0	0	109
		17	mud	los	0	0	1.1
		20	mud	lbk	0	0	0
		22	mud	lbk	0	0	0
6	5	1	cbl	fuc	0	0	0
		8	bld	hir	0	0	99.75
		9	mud	elg	0	0	130.8
		11	mud	elg	0	0	109
		11	mud	elg	0	0	87.2
		13	mud	elg	0	0	87.2
		15	mud	lbk	0	0	1.09
		17	mud	lbk	0	0	0
		20	mud		0	0	0
		22	mud		0	0	0
11	5	14	bdl	lbk	0	9	0
		14	cbl	lbk	0	7.2	0
		15	cbl	lbk	0	9	0
		15	cbl	lbk	0	72	0
		13	bdl	lbk	0	45	0
		12	bdl	lbk	0	0	0
		8	rck	ulv	0	1.24	0
		5	rck	fuc	0	13.09	0
		9	rck	ulv	0	0	0
7	5	-1	rck	fuc	0	35.7	0
		3	rck	lbk	0	67.5	0
		8	gvl	lbk	0	1.8	0
		10	gvl	los	0	1.24	0
		12	gvl	los	0	4.96	0
		13	gvl	hir	0	12.3	0
		15	gvl		0	0	0
		17	cbl	lbk	0	0	0
		17	rck	lbk	0	0	0
		18	snd	lbk	0	0	0
		19	rck	lbk	0	0	0
		19	gvl	lbk	0	0	0
		19	gvl	lbk	0	0	0
		20	gvl	lbk	0	0	0
		20	gvl	lbk	0	0	0
		21	gvl	lbk	0	0	0
		21	gvl	lbk	0	0	0
		22	gvl	lbk	0	0	0
8	5	-2	bld		0	6.2	0
		1	rck	fuc	0	107.1	0
		3	rck		0	99.2	0
		3	rck	fir	0	186	0
		3	rck		0	43.4	0
		4	rck	fir	0	124	0
		6	rck		0	99.2	0
		6	rck	los	0	49.6	0
		6	rck	los	0	99.2	0
		6	rck	los	0	49.6	0
		6	rck	lbk	0	54	0
		6	rck	lbk	0	90	0
		7	rck	lbk	0	99	0
		7	rck	lbk	0	13.5	0
		8	rck	lbk	0	18	0
		9	rck	lbk	0	54	0
		9	rck	lbk	0	81	0
		10	rck	lbk	0	90	0
		10	rck	lbk	0	72	0
		11	rck	lbk	0	1.8	0
		11	rck	lbk	0	6.3	0
		13	rck	lbk	0	31.5	0
		14	rck	lbk	0	22.5	0
		14	rck	lbk	0	10.8	0
		16	rck	lbk	0	13.5	0
		16	rck	lbk	0	22.5	0
		15	rck	lbk	0	3.6	0
		17	rck	lbk	0	27	0
		18	rck	lbk	0	4.5	0
		20	rck	lbk	0	0	0
		20	rck	lbk	0	0	0
		22	rck	lbk	0	0	0
		24	rck	lbk	0	0.9	0
		26	rck	lbk	0	0	0
		27	rck	lbk	0	0	0
		28	rck	lbk	0	0	0
9	5	2	rck		0	0	2.2
		11	rck		0	0	27.5
		14	rck	lbk	0	0	43.6
		15	rck	lbk	0	0	54.5
		17	rck	lbk	0	0	59.95
15	5	46	gvl	lbk	0	0	21.8
		50	gvl	lbk	0	0	65.4
		55	gvl	lbk	0	0	10.9
		59	gvl	lbk	0	0	0
16	5	1	rck	fuc	49.6	0	0
		8	rck	lbk	26.7	0	0
		10	rck	lbk	40.05	0	0
		11	rck	lbk	13.35	0	0
		12	rck	hir	24	0	0
9	5	18	cbl	lbk	0	0	32.7
		20	cbl	lbk	0	0	1.09
		22	gvl	lbk	0	0	3.27
		23	rck	lbk	0	0	5.45
		24	gvl	lbk	0	0	2.18
		25	cbl	lbk	0	0	38.15
		27	gvl	lbk	0	0	54.5
		29	gvl	lbk	0	0	16.35
		30	gvl	lbk	0	0	5.45
		32	gvl	lbk	0	0	2.18
		34	gvl	lbk	0	0	2.18
		36	gvl	lbk	0	0	3.27
		37	gvl	lbk	0	0	2.18
		39	gvl	lbk	0	0	5.45
		42	gvl		0	0	0
		44	snd		0	0	0
10	5	4	rck	fuc	0	0	0
		9	rck	fir	0	0	0
		10	rck	fir	0	0	33
		12	rck	lbk	0	0	5.45
		13	snd	lbk	0	0	38.15
		13	mud	lbk	0	0	10.9
		13	mud	lbk	0	0	16.35
		14	mud	elg	0	0	13.08
		14	mud	elg	0	0	10.9
		11	rck	ulv	0	0	1.1
		7	rck	fuc	0	0	21.6
		8	rck	fir	0	0	27.5
		13	cbl		0	0	38.5
		13	mud	lbk	0	0	2.18
		13	mud	lbk	0	0	49.05
		13	cbl	lbk	0	0	10.9
		12	cbl	lbk	0	0	76.3
		12	cbl	lbk	0	0	21.8
		13	cbl	lbk	0	0	59.95
		13	cbl	lbk	0	0	98.1
		12	cbl	lbk	0	0	38.15
		14	rck	lbk	0	0	16.35
		14	rck	lbk	0	0	16.35
		14	rck	lbk	0	0	32.7
		14	snd	lbk	0	0	49.05
		14	cbl	lbk	0	0	16.35
		14	snd	los	0	0	5.5
		10	rck		0	0	165
		6	rck	fuc	0	0	1.08
		12	rck	lbk	0	0	0
		23	snd		0	0	0
		27	snd		0	0	0
		30	snd		0	0	0
		32	snd		0	0	0
		33	snd		0	0	0
11	5	2	rck	fuc	0	11.9	0
		6	bld	fuc	0	47.6	0
		8	gvl	fir	0	2.48	0
		10	bld	hir	0	43.05	0
		10	snd	elg	0	26.7	0
		12	bld	hir	0	61.5	0
		13	snd	hir	0	6.15	0
		14	gvl	lbk	0	9	0
17	5	38	gvl	lbk	0	4.5	0
18	5	39	gvl	lbk	0	18	0
		0	rck		0	0	0
		3	rck		55	0	0
		5	rck	fuc	434	0	0
		8	rck	fil	247.5	0	0
		9	rck	fil	165	0	0
		10	rck	fil	77	0	0
		11	cbl		22	0	0

-Continued-

Table 6. (page 2 of 3)

TRANSECT #	INCREMENT (Meters)	DEPTH (Feet)	BOTTOM TYPE	VEGETATION TYPE	WB CORRECTION	BD CORRECTION	RL CORRECTION
		11	rck	hir	0	0	0
		12	rck	hir	0	0	0
		16	rck	lbk	0	0	0
		25	rck	lbk	0	0	0
12	5	1	bld		0	0	0
		3	bld	fuc	0	8.33	0
		3	bld	fuc	0	59.5	0
		4	bld	fuc	0	59.5	0
		5	cbl		0	0	0
		7	snd	los	0	2.48	0
		8	snd	los	0	1.24	0
		8	bld	fir	0	86.8	0
		10	gvl	hir	0	18.45	0
		10	gvl	lbk	0	15.3	0
		11	bld	hir	0	147.6	0
		12	cbl	hir	0	9.84	0
		12	gvl	lbk	0	4.5	0
		13	bld	lbk	0	19.8	0
		16	gvl	lbk	0	9	0
		17	gvl		0	0	0
		19	cbl	lbk	0	0	0
		21	cbl	lbk	0	0.9	0
		23	cbl	lbk	0	0.9	0
		25	cbl	lbk	0	0	0
		27	cbl	lbk	0	0	0
		30	cbl	lbk	0	0	0
		32	cbl	lbk	0	0	0
		34	cbl	lbk	0	0	0
		36	cbl	lbk	0	0	0
13	5	3	cbl		0	0	0
		4	rck	fuc	0	0	48.6
		8	rck	fir	0	0	99
		11	cbl	red	0	0	132
		12	rck	lbk	0	0	87.2
		14	cbl	lbk	0	0	5.45
		16	cbl	lbk	0	0	16.35
		18	cbl	lbk	0	0	32.7
		22	gvl	lbk	0	0	16.35
		24	gvl	lbk	0	0	13.08
		28	gvl	lbk	0	0	4.36
		30	gvl	lbk	0	0	0
		34	shl	lbk	0	0	2.18
		36	shl	lbk	0	0	2.18
		37	shl	lbk	0	0	21.8
		40	shl	lbk	0	0	43.6
		41	shl	lbk	0	0	1.09
		43	shl	lbk	0	0	21.8
		44	shl	lbk	0	0	16.35
14	5	0	rck	fuc	0	238	0
		7	rck		0	62	0
		12	rck	lbk	0	180	0
		18	rck	lbk	0	18	0
		23	snd	lbk	0	27	0
		28	snd		0	0	0
		34	gvl	lbk	0	4.5	0
		38	gvl	lbk	0	18	0
		43	gvl		0	0	0
15	5	-1	rck		0	0	33
		10	rck		0	0	121
		23	rck		0	0	132
		26	gvl	lbk	0	0	65.4
		32	gvl	lbk	0	0	38.15
		36	gvl	lbk	0	0	21.8
		41	gvl	lbk	0	0	27.25
22	5	10	gvl		0	1.24	0
		11	gvl	lbk	0	0.9	0
		11	gvl	lbk	0	0.9	0
		11	cbl		0	0	0
		12	gvl	hir	0	0	0
		13	gvl	lbk	0	0	0
		14	cbl	blk	0	0	0
		15	gvl	lbk	0	0	0
		17	gvl		0	0	0
		18	gvl	lbk	0	0	0
		19	gvl	lbk	0	0	0

TRANSECT #	INCREMENT (Meters)	DEPTH (Feet)	BOTTOM TYPE	VEGETATION TYPE	WB CORRECTION	BD CORRECTION	RL CORRECTION
		13	rck	hir	18	0	0
		13	cbl	hir	12	0	0
		14	cbl	lbk	13.35	0	0
		15	gvl	hir	1.2	0	0
		14	gvl	lbk	2.67	0	0
		15	gvl	lbk	0	0	0
		15	cbl	lbk	1.78	0	0
		15	cbl	lbk	0.89	0	0
		13	gvl	lbk	17.8	0	0
		8	rck	lbk	35.6	0	0
		4	rck	ulv	11	0	0
17	5	1	rck	fuc	0	41.65	0
		3	rck	fuc	0	119	0
		3	rck	fuc	0	71.4	0
		9	rck		0	248	0
		7	rck		0	198.4	0
		11	rck	lbk	0	180	0
		16	shl	mac	0	99.2	0
		17	snd	elg	0	142.4	0
		18	snd	elg	0	106.8	0
		20	snd	lbk	0	18	0
		21	snd	hir	0	61.5	0
		21	snd	hir	0	7.38	0
		22	snd	los	0	6.2	0
		23	snd	hir	0	30.75	0
		25	snd	hir	0	184.5	0
		26	snd	hir	0	147.6	0
		27	snd	hir	0	98.4	0
		29	snd	lbk	0	27	0
		30	snd	lbk	0	4.5	0
		32	snd	lbk	0	2.7	0
		34	snd		0	0	0
		36	snd		0	0	0
		39	snd	lbk	0	1.8	0
		40	snd		0	0	0
18	5	3	rck	fuc	0	0	0
		6	rck	fuc	0	0	0
		8	rck	ala	0	1.24	0
		18	rck	lbk	0	72	0
		19	rck	lbk	0	81	0
		15	rck	lbk	0	108	0
		18	rck	lbk	0	162	0
		23	rck		0	198.4	0
		30	rck	mac	0	434	0
		31	shl	lbk	0	31.5	0
		32	shl	lbk	0	16.2	0
		33	gvl	los	0	12.4	0
		33	gvl	los	0	9.92	0
		34	gvl	los	0	1.24	0
		35	gvl	los	0	3.72	0
		36	gvl	los	0	2.48	0
		36	gvl	los	0	6.2	0
		36	gvl	los	0	2.48	0
		36	gvl	los	0	2.48	0
		37	gvl	lbk	0	0	0
		37	gvl	lbk	0	0	0
		37	gvl	lbk	0	0.9	0
		37	gvl	lbk	0	0.9	0
		37	gvl	lbk	0	6.3	0
		37	gvl	lbk	0	3.6	0
		38	gvl	lbk	0	27	0
		37	gvl	lbk	0	22.5	0
		38	gvl	lbk	0	45	0
		38	gvl	lbk	0	15.3	0
24	5	11	rck	lbk	1.78	0	0
		14	rck	mac	11	0	0
		16	snd	red	5.5	0	0
		17	rck	lbk	13.35	0	0
		15	rck	red	16.5	0	0
		13	rck	mac	242	0	0
		15	rck	mac	286	0	0
		17	rck	red	11	0	0
		15	rck	lbk	0	0	0
		16	rck	lbk	0	0.9	0
		14	rck	lbk	0	1.8	0

TRANSECT #	INCREMENT (Meters)	DEPTH (Feet)	BOTTOM TYPE	VEGETATION TYPE	WB CORRECTION	BD CORRECTION	RL CORRECTION
		12	cbl	hir	30	0	0
		17	gvl	hir	2.4	0	0
		20	gvl	lbk	1.78	0	0
		24	gvl	lbk	1.78	0	0
		29	gvl	lbk	0	0	0
		33	gvl	lbk	0	0	0
20	5	0	rck		0	0	0
		3	rck	fuc	24.8	0	0
		3	rck	fuc	62	0	0
		5	rck	fuc	86.8	0	0
		7	rck	hir	180	0	0
		8	rck		88	0	0
		10	rck	lbk	89	0	0
		11	rck	hir	240	0	0
		12	rck	lbk	53.4	0	0
		10	rck	lbk	97.9	0	0
		13	rck	lbk	35.6	0	0
		15	gvl	hir	96	0	0
		16	gvl	hir	240	0	0
		17	gvl	lbk	31.15	0	0
		18	cbl	hir	30	0	0
		19	gvl	hir	120	0	0
		20	gvl	lbk	13.35	0	0
		21	gvl	lbk	1.78	0	0
		23	gvl	hir	1.2	0	0
		25	gvl		0	0	0
		26	gvl		0	0	0
		27	gvl	lbk	0	0	0
21	5	1	rck	fir	0	198.4	0
		4	rck	fir	0	198.4	0
		7	rck	hir	0	615	0
		10	cbl	rck	0	173.6	0
		16	cbl	lbk	0	31.5	0
		20	snd	los	0	7.44	0
		24	snd	lbk	0	31.5	0
		28	snd	fuc	0	13.09	0
		32	gvl	fir	0	37.2	0
		34	gvl	lbk	0	7.2	0
		37	gvl	lbk	0	2.7	0
		38	gvl	lbk	0	18	0
		39	gvl	lbk	0	22.5	0
		40	cbl	lbk	0	13.5	0
		40	rck		0	3.72	0
22	5	1	cbl	los	0	3.72	0
		2	cbl	los	0	2.48	0
		3	cbl	fir	0	24.8	0
		3	cbl	fir	0	24.8	0
		3	cbl	fir	0	12.4	0
		3	snd	fir	0	55.8	0
		3	gvl	fir	0	43.4	0
		4	cbl	fir	0	31	0
		5	cbl	fir	0	21.08	0
		5	cbl	fir	0	22.32	0
		5	cbl	fir	0	39.68	0
		6	cbl	fir	0	17.36	0
		7	gvl	los	0	4.96	0
		6	gvl	lbk	0	36	0
		7	snd	elg	0	89	0
		7	gvl	lbk	0	16.2	0
		7	gvl	lbk	0	31.5	0
		8	gvl	lbk	0	13.5	0
		8	gvl	lbk	0	19.8	0
		9	gvl	lbk	0	7.2	0
		9	gvl	lbk	0	6.3	0
		11	rck	lbk	0	0	0
		11	rck	lbk	0	0	0
		11	rck	lbk	0	0	0
		11	rck	lbk	0	0	0
		11	rck	lbk	0	0	0
		12	rck	lbk	0	0	0
		12	rck	lbk	0	0	0
		12	rck	lbk	0	0	0
		12	rck	lbk	0	0	0
		12	rck	lbk	0	0	0

-Continued-

Table 6. (page 3 of 3)

TRANSECT #	INCREMENT (Meters)	DEPTH (Feet)	BOTTOM TYPE	VEGETATION TYPE	WB CORRECTION	BD CORRECTION	RL CORRECTION
		21	gvl		0	0	0
23	5	1	bld		0	0	0
		2	bld	fuc	0	23.8	0
		6	bld	elg	0	213.6	0
		8	rck	cor	0	55.8	0
		9	snd	elg	0	71.2	0
		11	snd	elg	0	17.8	0
		13	snd	elg	0	62.3	0
		15	snd	elg	0	35.6	0
		16	mud	hir	0	43.05	0
		18	mud	lbk	0	0	0
		20	mud		0	0	0
		21	mud	lbk	0	0	0
		22	mud		0	0	0
		25	mud	lbk	0	0	0
		25	mud	lbk	0	0	0
24	5	-7	rck	fir	0	0	27.5
		-7	rck	fir	0	0	55
		-7	rck		0	0	0
		-8	rck		0	0	0
		-7	rck	fuc	0	0	10.8
		-6	rck	fuc	0	0	5.4
		-5	rck	elg	0	0	10.9
		-5	rck		0	0	0
		-4	rck		0	0	0
		-3	rck	fuc	0	0	1.08
		-3	rck	fuc	0	0	0
		-3	rck	fuc	0	0	5.4
		-2	rck	fir	0	0	44
		-1	rck	fir	0	0	49.5
		-1	rck	fir	0	0	11
		0	snd	elg	0	0	87.2
		-1	rck	fuc	0	0	16.2
		0	rck	elg	0	0	76.3
		0	rck	elg	0	0	32.7
		-1	rck	fir	0	0	22
		0	rck	fir	0	0	27.5
		4	snd	elg	0	0	272.5
		4	snd	elg	0	0	218
		0	rck	fir	0	0	22
		2	rck	mac	0	0	0
		7	rck	mac	22	0	0
		9	rck	mac	44	0	0
		4	rck	lbk	13.35	0	0
		3	rck	mac	154	0	0
		4	rck	mac	55	0	0
		3	rck	lbk	26.7	0	0
		4	rck	lbk	13.35	0	0
		8	rck	lbk	26.7	0	0
		9	rck	mac	308	0	0
		9	rck	mac	44	0	0
		7	rck	ala	0	0	0
		10	rck	mac	33	0	0
		11	rck	mac	44	0	0
		14	rck	los	1.1	0	0
		15	rck	los	462	0	0
		8	rck	lbk	0	0	0
		10	rck	mac	264	0	0
		13	rck	lbk	0	0	0
		13	rck	lbk	44.5	0	0
		12	rck	lbk	8.9	0	0
		10	rck	lbk	0	0	0

TRANSECT #	INCREMENT (Meters)	DEPTH (Feet)	BOTTOM TYPE	VEGETATION TYPE	WB CORRECTION	BD CORRECTION	RL CORRECTION
		12	rck	lbk	0	0	0
		14	rck	mac	0	496	0
		12	rck	mac	0	24.8	0
		16	shl		0	0	0
		19	rck	lbk	0	1.8	0
		21	rck		0	3.72	0
		20	rck	lbk	0	1.8	0
		19	rck	lbk	0	0.9	0
		18	rck	lbk	0	0.9	0
		22	rck	lbk	0	0	0
		22	rck	mac	0	347.2	0
		19	rck	lbk	0	0	0
		18	rck	mac	0	0	0
		18	rck	mac	0	0	0
		19	rck	mac	0	0	0
		18	rck	lbk	0	0	0
		19	rck	lbk	0	9	0
		21	rck	lbk	0	0	0
		20	rck	lbk	0	0	0
		18	rck	lbk	0	0	0
		21	rck	lbk	0	0	0
		20	rck	mac	0	0	0
		14	rck	mac	0	49.6	0
		14	rck	mac	0	1.24	0
		21	rck	lbk	0	0	0
		22	rck	lbk	0	0	0
		23	rck	lbk	0	0	0
		21	rck		0	0	0
25	5	2	shl	fir	0	0	0
		2	shl	fir	0	0	0
		2	shl	fir	0	0	0
		2	shl	fir	0	0	0
		2	rck	fir	0	0	0
		2	rck	fir	3.3	0	0
		2	rck	fir	4.4	0	0
		2	rck	fir	2.2	0	0
		3	rck	fir	6.6	0	0
		3	rck	fir	22	0	0
		4	snd	elg	30.8	0	0
		4	rck	elg	11.55	0	0
		6	rck	elg	9.24	0	0
		6	rck	elg	7.7	0	0
		6	snd	elg	92.4	0	0
		6	snd	elg	53.9	0	0
		7	mud	elg	65.45	0	0
		6	rck	elg	92.4	0	0
		7	rck	elg	77	0	0
		7	rck	elg	92.4	0	0
		9	rck	elg	84.7	0	0
		9	rck	elg	61.6	0	0
		9	rck	elg	57.75	0	0
		9	rck	elg	3.85	0	0
		10	rck	elg	11.55	0	0
		11	rck	elg	15.4	0	0
		14	rck	los	176	0	0
		11	rck	elg	61.6	0	0
		12	rck	elg	11.55	0	0
		13	rck	elg	115.5	0	0
		10	rck	elg	23.1	0	0
		11	rck	elg	123.2	0	0
		11	rck	lbk	0	0	0
		11	rck	lbk	0	0	0

TRANSECT #	INCREMENT (Meters)	DEPTH (Feet)	BOTTOM TYPE	VEGETATION TYPE	WB CORRECTION	BD CORRECTION	RL CORRECTION
		12	rck	lbk	0	0	0
		12	rck	lbk	0	0	0
		13	rck	lbk	0	0	0
		20	rck	lbk	0	0	0
		25	rck	lbk	0	0	0
		25	rck	lbk	0	0	0
		26	rck	mac	0	0	0
		29	rck		0	0	0
		33	snd		0	0	0
		34	snd		0	0	0
		34	bld	lbk	0	0	0
		33	bld	lbk	0	0	0
26	5	0	rck	fuc	0	0	0
		9	rck	lbk	0	0	0
		18	rck	lbk	0	0	0
		24	rck	lbk	0	0	0
		32	rck	lbk	0	0	0
		40	snd	lbk	0	0	0

Table 7. Sitka Sound Herring Spawning Activity Surveys, 1996.

AERIAL AND VESSEL HERRING SURVEYS, SITKA SOUND, 1996

3-15 From Sitka Sound and S to Peisar Is., 200 sea lions at 6 Mile Rk., 5 sea lions off Lisianski Peninsula.

3-17 From Sitka Sound and S to West Crawfish Inlet, 300 sea lions at Beili Rk., 30 sea lions at Jacob Rk., 80 sea lions at 6 Mile Rk., 80 sea lions in Eastern Channel.

3-18 Sitka Sound: 150 sea lions scattered throughout the Eastern Channel area including 60 at Harris Is., 20 at the Echolms and 60 in Eastern Channel.

In Eastern Channel located good schools of herring on bottom at 60 fathoms in the outer Eastern Channel area.

3-19 Sitka Sound to Povorotni Pt.: 140 sea lions in the Middle Channel area as well as gulls and eagles. 50 sea lions at Harris Is., 75 sea lions from Cascade Creek to Old Sitka, one humpback whale in Eastern Channel.

3-20 Sitka Sound-Cape Burunof to Olga St. to Hayward St.: 15 sea lions in Middle Channel, 60 sea lions at Makhnati Is., 60 sea lions at Harris Is., 70 sea lions at Middle Is./HPR/Kasiana.

3-21 Sitka Sound-Cape Burunof to Olga St. to Hayward St. 40 sea lions in the area just S of the airport and Makhnati Is., 40 sea lions at Big Gavanski, 100 sea lions in the Middle Island/Kasiana/Halibut Point area.

3-22 Sitka Sound. 1.5 miles **active spawn** on outside of Crow Is. and Middle Is.

All of Sitka Sound from West Crawfish to St. Lazaria. 2.6 miles of **active spawn** near Fred's Creek, 0.9 miles on Middle Is. and 1.8 on Crow Is.

3-23 Sitka Sound. 10.3 miles of **active spawn.**

Sitka Sound. Good schools of herring located at Promisula Bay, Port Krestof, E of Middle Is. and S of Kasiana Is. **Active spawn** increased to 13.0 miles adding Halibut Pt. and Chaichi Islands.

3-24 Sitka Sound. **Active spawn:** 1.7 miles Kruzof Is., 3.2 miles S of O'Connell Bridge, 3.4 miles along Halibut Pt., 1.3 miles Gavanski Islands, 3.4 miles Kasiana Is., 3.2 miles Gagarin Is., 4.5 miles Middle Is.

Sitka Sound. Spawn about the same in N Sitka Sound area but subsiding on Kruzof Is. and parts of Middle Is. Some schools at Port Krestof and south islands.

Table 7. (page 2 of 4)

3-25 Sitka Sound and S to Crawfish Inlet. **Active spawn** - 8.1 miles O'Connell Bridge to Entry Pt. **Active spawn** on Gavanski, Middle, Crow, Kasiana and outside islands. No herring, herring spawn, or significant concentrations of herring predators observed at Katlian Bay, Nakwasina, Promisula Bay, Siginaka Islands, Hayward Strait, or Magoon Islands. No herring, herring spawn, or significant concentrations of herring predators observed south of Eastern Channel to Crawfish Inlet. Total active spawn 32.8 miles and total cumulative 35.4 miles.

Sitka Sound and Salisbury Sound: Kruzof and HPR spawn diminishing, small schools of herring off Lisianski Pt. and Big Gavanski Is. Sea lions in Eastern Channel and Middle Channel. Spawn on islands N of Eastern Channel. No herring, herring spawn, or significant concentrations of herring predators observed in Salisbury Sound.

3-26 Sitka Sound: Spawn dissipating; 50% less than yesterday. Eleven miles of **active spawn** N of town and 4.5 miles S of town. Small schools seen at Aleutkina Bay, Silver Pt., Middle Channel, and Kasiana Is.

3-27 Sitka Sound: Scattered spots of **active spawn** from O'Connell Bridge to Entry Pt., Middle Is., and Kasiana Is. Several small schools seen in Leesofskia Bay. No herring, herring spawn, or significant concentrations of herring predators observed at Fred's Creek (Kruzof Island), Katlian Bay or Nakwasina. **Active spawn** 2.1 miles N and 1.5 miles S of the O'Connell Bridge.

Southern Sitka Sound to Kanga Bay. Weak **spotty spawn** from the O'Connell Bridge to Entry Pt. Numerous small schools in Leesofskia Bay. Nothing seen in Aleutkina Bay or Redoubt/Kanga Bay area.

3-28 Sitka Sound and S to Aspid Cape. A couple small **spot spawns** N of Eastern Channel. One small school in Leesofskia Bay. 500-600 sea lions on haul out rocks S of Biorka Island. No herring, herring spawn, or significant concentrations of herring predators observed in Redoubt/Kanga Bays, Goddard, Windy Pass, or Crawfish Inlet. Only a few **spot spawns** N of town with the heaviest spawn on S Middle Is. Two groups of sea lions off Lisianski Peninsula and one humpback whale off Halibut Pt. **Spot spawn** at the Cove.

3-29 Sitka Sound N of Cape Burunof, Nakwasina, Salisbury Sound, outer Kruzof Is., and inside Kruzof to Hayward Strait. Small groups of sea lions scattered through inner Sitka Sound. One group of 100+ sea lions rafted tight in Western Channel. Several scattered groups of sea lions from Entry Pt. to Herring Cove in Silver Bay.

3-30 Sitka Sound and S to Crawfish Inlet. No herring, herring spawn or significant concentrations of herring predators observed throughout survey. Sea lions noted at Lisianski Peninsula, and just outside the new breakwater.

3-31 Sitka Sound and S to Crawfish Inlet. No herring, herring spawn or significant concentrations of herring predators observed throughout survey.

4-1 Sitka Sound and S to Crawfish Inlet. Ten sea lions off Lisianski Peninsula. No herring, herring spawn, or significant concentrations of herring predators observed.

Table 7. (page 3 of 4)

4-3 Sitka Sound and S to Crawfish Inlet. Seven pods (100 sea lions) E of Crosswise Is., no herring, herring spawn, or significant concentrations of herring predators observed.

4-5 Sitka Sound and S to Dorothy Narrows. Fifteen sea lions E of Crosswise Is., no herring, herring spawn, or significant concentrations of herring predators observed.

4-7 Sitka Sound N of Cape Burunof. Weak **spot spawn** S of Halibut Pt., no herring, herring spawn, or significant concentrations of herring predators observed.

4-8 Sitka Sound, Whale Bay, and Necker Bay. A few small schools in Silver Bay, a large school seen outside Sealing Harbor and a large school off Crescent Harbor.

4-9 Inner Sitka Sound. No spawn seen. Scattered small schools in Silver Bay and one small school in Leesofskia Bay.

4-10 Inner Sitka Sound, Salisbury Sound, and Hoonah Sound. Several good schools of herring in Crescent Bay, 0.25 miles of **spawn** in cove N of Old Thompson Harbor. Ten small schools of herring from the new breakwater to Halibut Point. Quiet in Silver and Aleutkina Bays. Nothing in Salisbury Sound.

4-11 Sitka Sound and S to Dorothy Narrows. 0.5 miles of **spawn** N of Thompson Harbor. Several schools seen in Katlian Bay. Sea lions scattered from Silver Bay to the O'Connell Bridge.

4-12 Inner Sitka Sound N of Cape Burunof. **Spawn** expanded in Thompson Harbor to 1.25 miles. **Active spawn** on Japonski Is. from Edgecumbe High School N (0.25 miles). No schools seen in Katlian and two schools off Sandy Beach. Nothing in Nakwasina.

4-13 Inner Sitka Sound. 2.0 miles of **active spawn** in Sitka Channel. No herring or spawn seen throughout rest of Sitka Sound.

4-14 Inner Sitka Sound N of Cape Burunof. 0.5 miles of **active spawn** on W Galankin Is. **Light spawn** on two adjacent small islands. A **heavy spot spawn** on the southeast corner of the runway and 2 **light spots** in Sitka Channel. Rest of the area quiet.

4-15 Inner Sitka Sound including Hayward Strait and Salisbury Sound. Spot of **active spawn** on W Galankin, **spawn heavy** and expanded on SE corner of runway (0.2 miles). No spawn or herring seen in Hayward Strait or Salisbury Sound.

4-16 Inner Sitka Sound and S to Dorothy Narrows. No spawn or herring seen. No predators in Goddard area.

4-17 Sitka Sound N of Eastern Channel and Salisbury. Nothing seen.

4-18 Sitka Sound N of Cape Burunof and Salisbury Sound. Two **spot spawns** in Sitka Channel and one **spot spawn** off Sandy Beach. One small school in Jamestown Bay.

Table 7. (page 4 of 4)

4-19 Inner Sitka Sound, Redoubt, Goddard, and Crawfish Inlets. No herring, herring spawn or significant concentrations of herring predators observed from Sitka Sound and all areas S to Whale Bay.

4-20 Inner Sitka Sound N of the O'Connell Bridge. 0.1 miles of **active spawn** in Sitka Channel. No other activity seen in Sitka Sound.

4-22 Inner Sitka Sound N of Cape Burunof. **Spot spawns** at SPC, Thompson Harbor, and Eastern Bay. No activity S of the O'Connell Bridge.

4-24 Inner Sitka Sound N of Cape Burunof. **Spot spawn** in Mosquito Cove. No activity seen elsewhere in Sitka Sound.

4-25 Inner Sitka Sound N of the O'Connell Bridge. No activity.

5-1 **Spot spawn** on small island on E side of Nakwasina Sound and **spot spawn** in Eastern Bay.

5-16 0.42 miles of **active spawn** was observed in Nevi Strait between High-water Is. and Weevil Reef.

Total spawn observed = 44.6 nautical miles

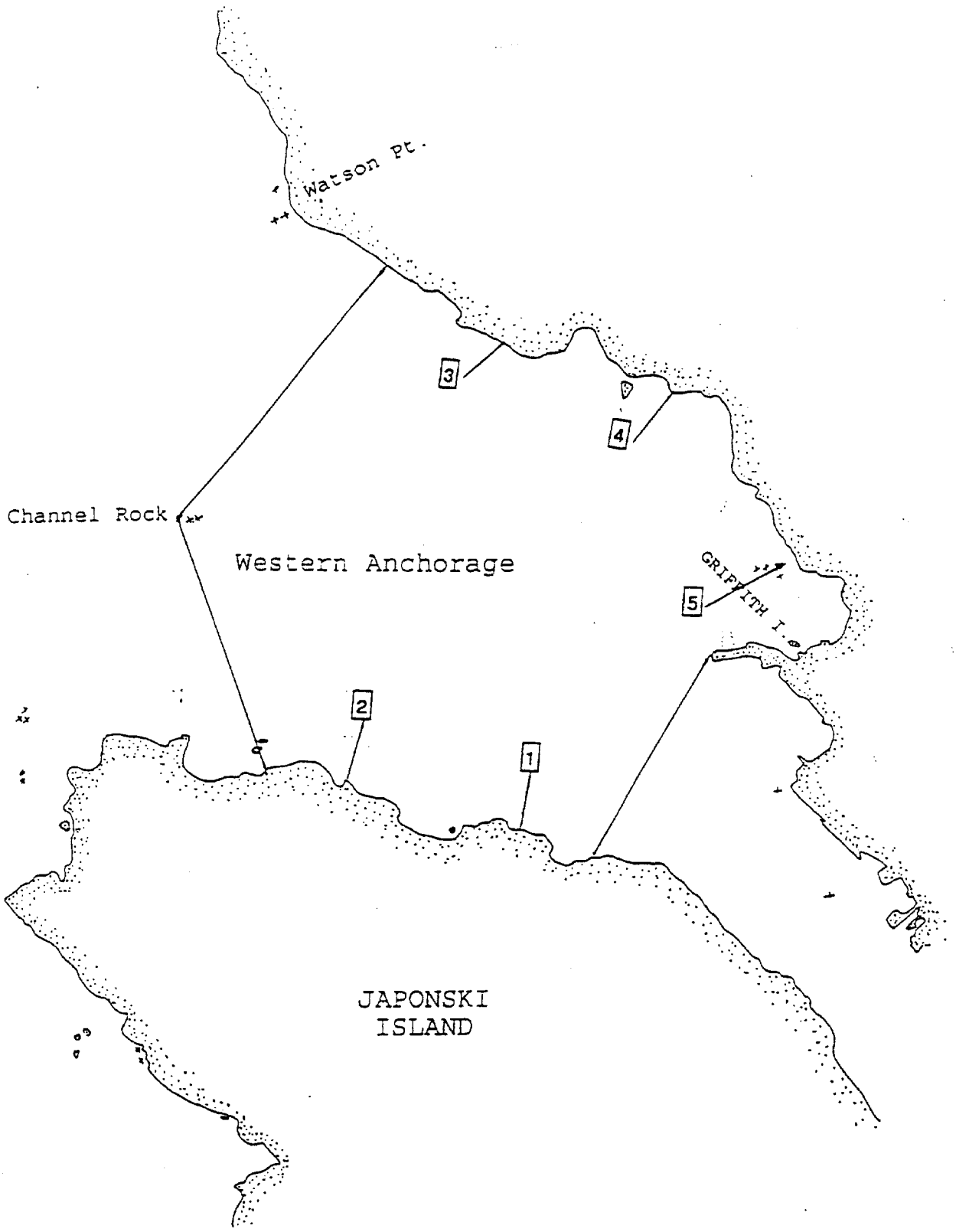

Figure 1. Herring spawn Sitka harbor, 1996.

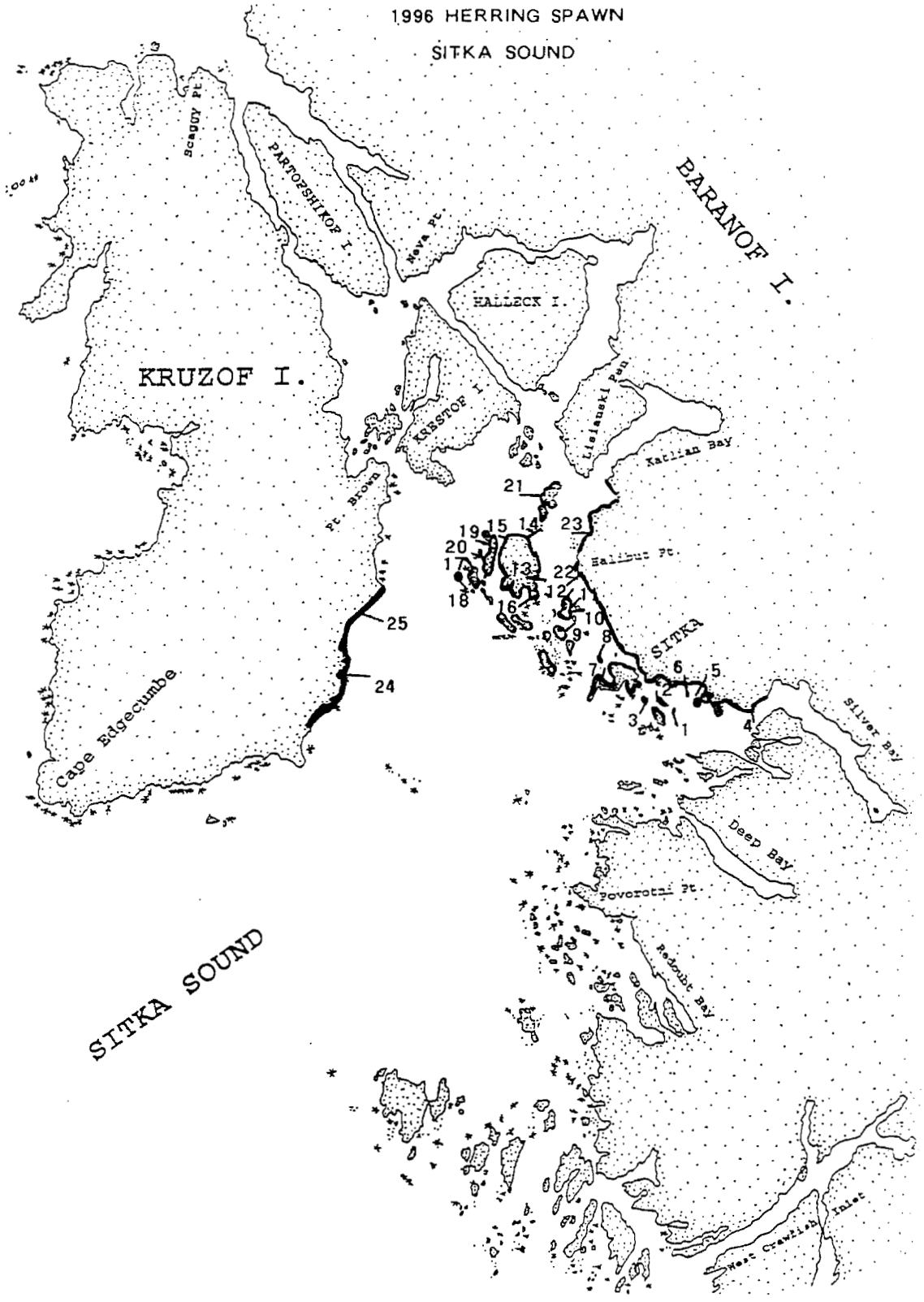

Figure 2. Herring spawn locations, Sitka Sound, 1996.

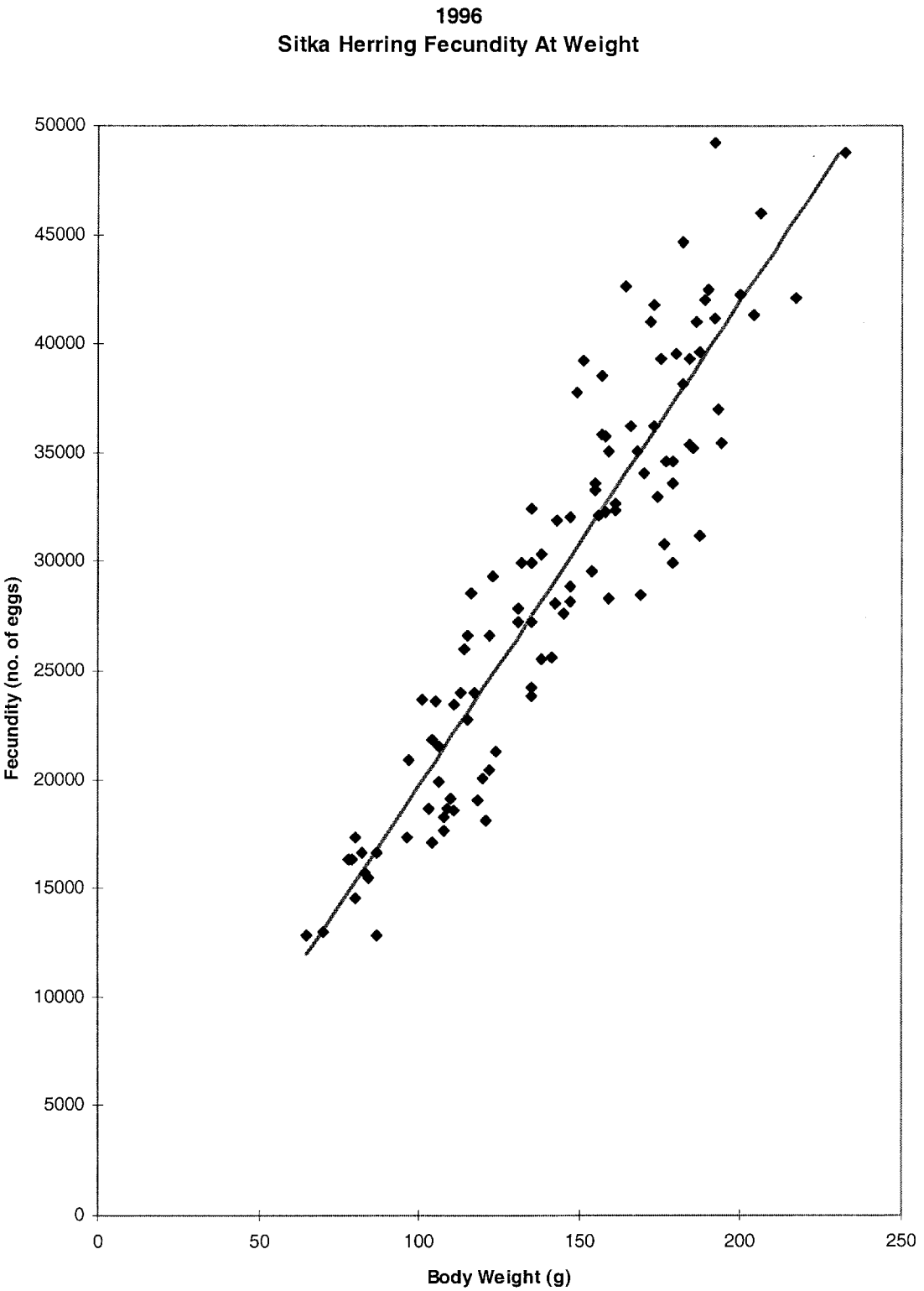

Figure 3. Fecundity to weight relationships from sampling for Sitka, 1996.

STATE OF ALASKA

TONY KNOWLES, GOVERNOR

P.O. Box 667
PETERSBURG, AK 99833
PHONE: (907) 772-3801
FAX: (907) 772-9336

DEPARTMENT OF FISH AND GAME

DIVISION OF COMMERCIAL FISHERIES
MANAGEMENT AND DEVELOPMENT

March 4, 1997

Mr. Duane Peterson
US Fish and Wildlife Service
3000 Vintage Blvd. Suite 201
Juneau, Alaska 99801-7100

Dear Duane,

Attached is the "Sitka Boat Harbor Herring Spawn Monitoring Study" data report for 1996. This data was collected in accordance with COOP-93-065 USF&WS, agreement number 1448-0007-93-7770 and fulfills the obligation by ADF&G for 1996. An itemized list of expenses follows. Please consider this expense accounting as our invoice.

Aerial surveys	1.5 hours @ $210/hr	$ 315
Underwater survey	6 man-days @ $350/day	$2,100
Volumetric egg enumeration	1 man-day @ $149/day	$ 149
	1 man-day @ $236/day	$ 236
Misc. supplies and equipment		$ 350
Data Analysis	2 man-days @ $350/day	$ 700
Report Preparation	1 man-day @ $350/day	$ 350
	Total	$4,200

Sincerely,

Robert C. Larson
Herring Research Biologist

cc: Doug Woodby

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