FRI-UW-7814
September 1978

FISHERIES RESEARCH INSTITUTE
College of Fisheries
University of Washington
Seattle, Washington 98195

ACOUSTIC ASSESSMENT OF HERRING STOCKS IN ALASKA DURING 1977-1978

by

Richard E. Thorne

FINAL REPORT
State of Alaska Department of Fish and Game
For the period October 10, 1977 - June 30, 1978

Approved

Submitted September 12, 1978

Director

ACOUSTIC ASSESSMENT OF HERRING STOCKS IN ALASKA DURING 1977-1978

INTRODUCTION

Acoustic techniques of fishery resource assessment are becoming increasingly used in fishery management throughout the world because of their accuracy, efficiency, and timeliness. The University of Washington has been an important center for the development of these techniques, especially through its Sea Grant Marine Acoustics Program. These developments include techniques for herring stock assessment which are being routinely used in herring management by both Washington and Alaska state fisheries agencies. Because of the large capital cost of acoustic data processing systems, acoustic analysis services have been provided by the University through contracts with the Fisheries Research Institute (F.R.I.). Results of analysis of acoustic data from surveys conducted by Alaska Department of Fish and Game (ADF&G) during the past year have been previously reported to ADF&G by telephone, since timeliness is a crucial factor. These results and the procedures used in the analysis are consolidated in this final contract report for the 1977-1978 field season.

PROCEDURES

The surveys were conducted primarily by ADF&G personnel in southeastern Alaska aboard ADF&G research vessels Auklet, Kittiwake, and Sundance. Additional data were collected in cooperation with the National Marine Fisheries Service (NMFS) at Auke Bay aboard the John N. Cobb and Searcher. As in previous years the acoustic system aboard all the vessels was the Ross 200 A echo sounder modified for collection of data on analog magnetic tape (Thorne et al. 1972). This system operates at 105 kHz with a 7^{o} circular transducer (nominal full beam angle) and a pulse length of 0.6 msec. The acoustic data are heterodyned to 5 dKz for recording on tape. The survey procedure is to define an area encompassing a herring concentration by preliminary search or previous experience, then run a series of oblique transects spaced evenly over the area.

After the survey, the tapes are sent to FRI either by mail or Alaska Airlines Gold Streak Express, depending upon time limitations. The data are rapidly analyzed and the results telephoned to ADF&G. Data analysis is by echo integration. The present data analysis system uses a PDP 11/45 computer with special software and hardware modifications (Thorne 1977). Density estimates are based on an assumed acoustic target strength of -33 dB/kg.

RESULTS AND DISCUSSION

A total of 99 surveys was conducted (Table 1). The amount of acoustic survey data collected and processed was 83 hr, the largest total since the program began in 1971. Quality of the data continued to improve.

Substantial concentrations of fish were observed in Lisianski, Fritz Cove, Deer Island, Katlian, Sitka, Favorite Bay, and Seymour Canal. In some cases fish abundance was considerably greater than expected. Two possible explanations for these high densities are: (1) uncertainty associated with the acoustic system parameters, and (2) presence of unusually high numbers of immature fish. Because of the large number of acoustic data collection systems, in use in southeastern Alaska, calibration of all systems is difficult and some have not been completely checked. Updating of the calibration data is especially important since improvements in data collection procedures to avoid saturation may have resulted in slightly different system responses. Complete recalibration of the systems, including measurement of source level, receiving response, receiving linearity, calibration oscillator input, and TVG performance, is recommended before the next field season. In addition, data logging procedures shoud be modified to include a check of the TVG performance. This could readily be done by measuring the calibration oscillator voltage at approximately the depth of maximum fish abundance simultaneous with measurement at the reference depth, which is 100 msec (75 m).

Unusually large concentrations of immature herring were observed throughout southeastern Alaska in 1977-1978. Acoustic target strength

Table 1. Results of acoustic surveys on herring in southeastern Alaska during 1977-1978.

Date	Location	Run	Vessel	Survey area ($10^6 m^2$)	Estimated density (lb/m^2)	Biomass ($10^6 lb$)	Comments
10/06/77	Deer Island	1	Auklet	1.46	0.68	0.99	
10/12/77	Deer Island	1		1.94	3.07	6.0	
		2		1.94	2.37	4.66	
10/13/77	Deer Island	1		1.33	0.28	0.38	Early morning
10/14/77	Deer Island	1		0.77	2.42	1.85	
		2		0.77	4.21	3.24	
10/13/77	Anita Bay	1		8.23	0.17	1.40	
		2		8.23	0.12	0.99	
10/19/77	Tongass Narrows	1		0.96	0.15	0.14	
		2		0.96	0.08	0.07	
10/24/77	Boca de Finas	1	Sundance	11.88	0.32	3.8	
		2		11.88	0.58	6.9	
11/03/77	Port Camden	1	Auklet	10.43	0.44	4.6	
11/04/77	Whale Bay	1	Cobb	2.13	1.35	2.88	Mixed size
11/04/77	Necker Bay	1		3.05	2.00	6.1	Mixed size
		2		2.26	0.4	0.9	
11/05/77	Crawfish Inlet	1		3.89	0.55	2.14	Juveniles
11/13/77	Lisianski	1		2.67	8.3	22.2	Borrowed echo sounder -
		2		2.48	8.9	22.1	100 μv cal input
		3		2.98	11.1	33.1	" " "
11/19/77	Anita Bay	1	Auklet	9.17	0.65	5.98	
		2		4.76	0.56	2.69	
11/19/77	Olga Strait	1	Cobb	4.24	0.59	2.50	
		2		4.88	0.28	1.37	
11/21/77	Deer Island	1	Auklet	1.16	1.2	1.39	
		2		0.50	6.3	3.15	
		3		1.73	1.6	2.72	
11/23/77	Scow Bay	1		3.1	0.55	1.72	
		2		2.4	0.98	2.35	

Table 1. Results of acoustic surveys on herring in southeastern Alaska during 1977-1978 - continued.

Date	Location	Run	Vessel	Survey area ($10^6 m^2$)	Estimated density (lb/m^2)	Biomass ($10^6 lb$)	Comments
11/29/77	Anita Bay	1	Auklet	6.61	0.31	2.05	
		2	(cont'd)	2.73	0.62	1.69	
11/30/77	Fools Inlet	1		2.00	0.02	0.04	
12/01/77	Boca de Finas	1	Sundance	5.57	0.10	0.56	
	Deer Island	1	Auklet	1.32	1.96	2.59	
		2		1.32	1.91	2.52	
12/01/77	Clupea Bight	1	Auklet	0.62	0.03	0.02	
12/02/77	Deer Island	1		0.95	1.16	1.10	
		2		0.95	5.25	4.99	
12/14/77	Fritz Cove	1	Searcher	3.42	1.8	6.15	
12/15/77	Port Camden	1	Auklet	2.39	0.68	1.63	Some saturation
		2		4.13	0.80	3.30	
		3		1.93	0.56	1.08	
12/16/77	Keku Strait	1		1.25	0.73	0.91	
12/17/77	Katlian	1	Sundance	3.13	3.1	9.7	
		2		4.52	2.1	9.5	
12/18/77	Katlian	1		5.33	2.6	13.8	
		2		4.19	2.2	9.2	
12/27/77	Scow Bay	1	Auklet	1.47	1.16	1.71	
		2		0.4	1.52	0.61	
01/04/78	Fritz Cove	1	Sundance	3.76	2.9	10.6	
		2		1.96	3.9	7.6	
01/05/78	Fritz Cove	1		4.03	2.7	10.8	
		2		2.11	2.4	5.1	Fish moved
01/11/78	Deer Island	1	Auklet	1.28	2.7	3.46	
		2		1.03	3.3	3.41	
		3		1.11	3.8	4.24	
		4		1.32	3.7	4.89	

Table 1. Results of acoustic surveys on herring in southeastern Alaska during 1977-1978 - continued.

Date	Location	Run	Vessel	Survey area ($10^6 m^2$)	Estimated density (lb/m^2)	Biomass ($10^6 lb$)	Comments
01/13/78	Deer Island (cont'd)	1	Auklet	1.61	3.4	5.47	
01/10/78	Anita Bay	1	(cont'd)	4.29	0.3	1.29	
01/13/78	George Inlet	1	Sundance	1.18	0.6	0.71	Some fish outside
		2		1.18	0.6	0.71	
01/17/78	Fritz Cove	1	Cobb	4.71	0.9	4.23	
		2		3.20	1.65	5.28	
01/23/78	Lisianski	1		6.06	0.65	4.2	
01/24/78	Lisianski	1		5.10	1.7	8.7	
01/25/78	Lisianski	1		3.57	0.34	1.1	
01/27/78	Olga Strait	1		3.14	3.4	12.0	
01/30/78	Anchor Pass	1	Sundance	0.35	1.0	0.35	
	West Crawfish	1	Cobb	1.46	0.42	0.61	
02/02/78	Alvin Bay	1	Auklet	1.87	1.0	1.87	Some saturation
		2		0.83	1.4	1.16	
		3		1.76	2.0	3.52	
02/05/78	Fritz Cove	1	Cobb	5.61	0.16	0.90	
02/09/78	Tee Harbor	1	Kittiwake	1.33	0.8	1.1	
02/10/78	Breadline	1		0.86	0.7	0.6	
02/26/78	Favorite Bay	1		0.52	7.2	3.7	Saturated
		2		0.52	14.7	7.6	Some saturation
		3		0.52	31.2	16.2	Immatures ?
03/20/78	Brothers Island	1	Auklet	14.3	0.1	1.43	Pollack
03/21/78	Seymour Canal -	1	"	1.24	0.65	0.8	Near bottom
03/22/78	- Dorn Island	1		1.55	0.40	0.6	
		2		0.47	0.46	0.2	
03/23/78	Sitka-Dog Point	1	Kittiwake	1.98	15.3	29.0	Partially corrected
		2		1.41	20.4	28.6	for tape recorder malfunction

Table 1. Results of acoustic surveys on herring in southeastern Alaska during 1977-1978 - continued.

Date	Location	Run	Vessel	Survey area ($10^6 m^2$)	Estimated density (lb/m^2)	Biomass ($10^6 lb$)	Comments
03/31/78	Sitka-Middle Island	1	Kittiwake	2.73	8.9	24.3	
		2	(cont'd)	4.80	1.1	5.3	
04/05/78	Windfall Harbor	1	Auklet	4.30	3.3	14.2	
		2		1.42	5.5	7.8	
04/12/78	Kaasan	1	Sundance	0.75	0.3	0.23	
		2		0.83	2.2	1.8	
04/22/78	Seymour Canal	1	Auklet	3.32	9.8	32.5	Near surface - some
04/23/78	Seymour Canal	1		5.39	4.4	23.7	immatures
		2		4.38	1.9	8.4	
		3		3.11	8.4	26.1	
		4		4.69	5.8	27.2	
04/24/78	Seymour Canal	1	Kittiwake	4.06	4.6	18.7	
04/25/78	Seymour Canal	1		4.66	5.9	27.5	
05/04/78	Seymour Canal	2		6.30	4.4	27.7	
05/05/78	Seymour Canal	1		6.00	0.86	5.2	

information on fish is meager, but does suggest greater reflection per unit weight for smaller fish. Thus the -33 dB/kg target strength assumption which has been used for herring in both Alaska and Washington may be inaccurate under these conditions. Pending additional information on target strength, results from areas with substantial concentrations of immature herring should be viewed with caution.

LITERATURE CITED

Thorne, R. 1977. A new digital hydroacoustic data processor and some observations on herring in Alaska. J. Fish. Res. Board Can. 34(12):2288-2294.

Thorne, R., E. Nunnallee, and J. Green. 1972. A portable hydroacoustic data acquisition system for fish stock assessment. Washington Sea Grant Publ. 72-4:15 pp.