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ACOUSTIC ASSESSMENT OF HERRING STOCKS IN ALASKA DURING 1978-1979

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FINAL REPORT
State of Alaska Department of Fish and Game
For the period October 1, 1978-August 31, 1979

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Submitted August 3, 1979

Director

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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 (FRI). 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 1978-1979 field season.

PROCEDURES

The surveys were conducted primarily by ADF&G personnel in southeastern Alaska aboard ADF&G research vessels Auklet, Kittiwake, Steller and Sundance. In addition, one survey was collected in co-operation with the National Marine Fisheries Service (NMFS) at Auke Bay aboard the Murre II. As in previous years the acoustic systems aboard all the vessels were Ross 200 A echo sounders modified for collection of data on analog magnetic tape (Thorne et al. 1972). These systems operate at 105 kHz with 7° circular transducers (nominal full beam angle). The acoustic data are heterodyned to 5 kHz for recording on magnetic tape.

The hydroacoustic systems are fully calibrated. The system parameters which are monitored are source level, transducer receiving response, receiver gain, receiver linearity, TVG, and pulse length. Parameters except receiver gain and TVG are reasonably stable and are measured at least once each year, usually at the beginning of the survey season. These parameters are measured with a special calibration system including a calibrated standard hydrophone on a frame which is attached by a diver to a special mounting plate behind the transducer on the hull. The receiver gain characteristics are measured for every run by the use of an internal calibration signal in the hydroacoustic system. The acoustic parameters of the various systems are given in Table 1.

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 141 surveys was conducted. The amount of acoustic survey data collected and processed was 91 hr, the largest total since the program began in 1971. Quality of the data was generally high. The description of the various surveys and the biomass estimates are given in Table 2.

Substantial concentrations of fish were observed in several areas including Lisianski, Sitka, Anita Bay and Seymour Canal. Populations were generally higher than the previous year, apparently due to successful recruitment.

Several aspects of the data are particularly interesting. Agreement between replicate runs with the same vessel was usually good. In addition, a 14-run two-vessel comparison was conducted in the Sitka area during 17-19 March. The mean density over 14 runs was 9.8 lbs/m^2 from the Kittiwake and 7.0 lbs/m^2 from the Steller. Unfortunately, the Steller followed behind the Kittiwake for all 14 runs and some reduction

in echostrength was noted in the Steller data due to interference from the wake of the Kittiwake. This factor probably accounts for the 29 percent lower mean estimate from the Steller. The lead vessel should be alternated in future multiship comparisons.

In general, the results were in good agreement with other sources of information on the stock sizes, especially subsequent fishery catch and spawning biomass data. One exception was the Seymour Canal data which appeared to be unreasonably high. A similar situation was noted the previous year. Several factors may help explain this discrepancy. One possibility is a significant portion of immature herring which do not appear in the subsequent fishery or spawning biomass data and also have a higher target strength per unit biomass factor. Secondly, these fish in Seymour Canal have distinctly different behavior and distributional patterns compared to the earlier runs in different areas. This altered behavior could conceivably affect the target strength or linearity assumptions in the hydroacoustic data processing. A third possibility is that the discrepancy is not acoustical in nature, but the result of a transient population which does not spawn in the area, thus is not accounted for in the fishery or spawning biomass data. An advantage of the steadily growing data base of good, quantitative acoustic data on the various runs of herring throughout southeastern Alaska is that occasional irregularities or exceptions can be detected, accounted for, and eventually, hopefully, understood.

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.

Table 1. Summary of calibration data for hydroacoustic systems aboard various Alaska Department of Fish and Game vessels during 1978-79.

Vessel	Effective dates	Source level (dB)	Receiving response (dB)	Internal calibrator level (M volts)	Pulse length (msec)	Computer normalizing constant	Linearity correction
Kittiwake	1978-79	124.3	-80.2	0.50	0.6	0.26	None
Auklet	1978-79	122.5	-79.5	0.50	0.55	0.37	Gain 3 - 0.30 Gain 5 - 0.46
Steller	Before 10/23	124.7	-79.3	0.50	0.7	0.17	None
	After 10/23	122.5	-79.3	2.50	0.6	8.1	None
Sundance	Before 12/1	122.5	-81.8	0.50	0.55	0.68	0.57
	After 12/1	122.2	-81.8	2.50	0.55	17.0	None

Table 2. Results of acoustic surveys on herring in Southeastern Alaska during 1978-79.

Area	Date	Vessel	Run #	Area m^2	Lbs/m^2	Biomass	Comment
Lisianski Straits	11/12/78	Kittiwake	1	6,905,400	1.37	9,460,398	
Lisianski Straits	11/12/78	"	2	889,631	7.16	6,369,758	
Lisianski Straits	11/12/78	"	3	8,285,362	1.59	13,173,726	
Lisianski (Stag Bay)	11/12/78	"	4	1,361,243	2.18	2,967,510	
Sitka (Olga Straits)	11/19/78	"	1	5,680,779	0.34	1,931,464	
Sitka (Katlian) Area 1	11/20/78	"	1	728.854	1.44	1,049,549	
Sitka (Katlian) Area 1	11/20/78	"	2	535,923	2.19	1,173,671	
Sitka (Katlian) Area 2	11/20/78	"	3	3,044,060	14.23	43,316,973	
Sitka (Katlian) Area 2	11/20/78	"	4	2,626,020	2.8	7,352,856	
Thorne Arm	11/19/78	Sundance	1	4,491,030	1.96	8,802,418	
Thorne Arm	11/19/78	"	2	2,893,982	1.39	4,022,634	
Tongass Narrows	11/20/78	"	1	707,418	1.11	785,234	
Tongass Narrows	11/20/78	"	2	493,049	0.36	177,497	
Bull Island (George Inlet)	11/07/78	"	1	289,398	7.71	2,231,258	
Favorite Bay	11/04/78	Auklet	1	415,340	7.16	2,973,834	
Favorite Bay	11/04/78	"	2	542,621	4.07	2,208,467	
Tuxekan Passage	11/30/78	Sundance	1	1,918,603	0.56	1,074,418	
Tuxekan Passage	11/30/78	"	2	1,918,603	2.33	4,470,344	
El Capitan	11/27/78	"	1	7,663,692	0.24	1,839,286	
Ward Cove	11/21/78	"	1	313,382	7.51	2,353,498	

Table 2. Results of acoustic surveys on herring in Southeastern Alaska during 1978-79. - Continued

Area	Date	Vessel	Run #	Area m^2	Lbs/m^2	Biomass	Comment
Deer Island	11/29/78	Sundance	1	2,658,176	0.86	2,286,031	
Deer Island	11/29/78	Steller	2	2,786,797	0.38	1,058,982	
Deer Island	11/29/78	"	3	3,687,147	0.22	811,172	
Deer Island	11/19/78	"	3	1,279,000	0.83	1,061,570	
Deer Island	11/19/78	"	4	2,477,000	0.44	1,089,880	
Tenakee Inlet	12/2/78	Kittiwake	1	2,902,226	1.36	3,947,027	
Tenakee Inlet	12/02/78	"	2	2,110,710	2.20	4,643,562	
Anita Bay (outside)	10/04/78	Sundance	1	7,717,284	0.52	4,012,988	
Anita Bay (outside)	10/04/78	"	2	10,332,586	0.77	7,956,091	
Behm Narrows	10/20/78	Steller	2	3,044,039	2.35	7,153,491	Gain too high
Anchor Pass	10/20/78	"	1	557,359	4.12	2,296,319	
Anchor Pass	10/20/78	"	2	557,359	4.52	2,519,262	
Boca de Finas	10/28/78	Sundance	1	4,501,749	0.19	855,332	
El Capitan	10/27/78	"	1	3,719,302	2.26	8,405,623	
Favorite Bay	10/12/78	Kittiwake	1	328,252	2.92	1,124,936	
Hood Bay	10/12/78	"	1	4,086,408	0.18	735,553	
Deer Island	10/25/78	Steller	1	1,280,000	1.28	1,638,400	
Deer Island	10/25/78	"	3	1,530,000	0.83	1,269,900	
Deer Island	10/26/78	"	1	2,065,000	1.46	3,014,900	
Deer Island	10/26/78	"	2	1,858,000	1.12	2,080,960	
Anita Bay	10/26/78	"	1	18,870,000	1.05	19,813,500	

Table 2. Results of acoustic surveys on herring in Southeastern Alaska during 1978-79. - Continued.

Area	Date	Vessel	Run #	Area m^2	Lbs/m^2	Biomass	Comment
Anita Bay	10/26/78	Steller	2	16,230,000	0.88	14,282,400	
Deer Island	10/25/78	"	2	950,000	0.30	285,000	
Anita Bay	10/27/78	"	1	14,780,000	0.73	10,789,400	
Port Houghton	11/01/78	"	1	3,130,000	0.27	845,100	
Port Houghton	11/01/78	"	2	2,590,000	0.19	492,100	
Port Houghton	11/01/78	"	3	2,540,000	0.15	381,000	
Lisianski Straits	11/11/78	Kittiwake	1	1,608,934	0.79	1,271,057	
Lisianski Straits	11/11/78	"	2	2,818,952	1.97	5,553,335	
Lisianski Straits	11/11/78	"	3	2,818,952	2.00	5,637,904	
Idaho Inlet	12/06/78	"	1	4,201,632	1.62	6,806,643	
Idaho Inlet	12/06/78	"	2	3,129,787	2.22	6,948,127	
Bold Island	12/15/78	Sundance	1	1,532,658	0.16	245,225	
Short Bay	12/01/78	Steller	1	385,864	0.55	212,225	
Port Camden	12/09/78	"	1	4,120,000	0.23	948,000	
Port Camden	12/10/78	"	1	3,440,000	0.14	326,000	
Anita Bay	11/20/78	"	1	17,716,000	0.27	4,783,320	
El Capitan	01/09/79	Sundance	1	3,912,234	0.80	3,129,787	
Meares Passage	01/11/79	"	1	2,465,244	0.20	493,049	
Fritz Cove	01/18/79	Kittiwake	1	1,629,204	2.90	4,724,692	
Sitka (Olga Straits)	01/10/79	"	1	1,597,049	29.20	46,633,830	
Sitka (Olga Straits)	01/10/79	"	2	1,597,049	39.30	62,764,025	

Table 2. Results of acoustic surveys on herring in Southeastern Alaska during 1978-79. - Continued.

Area	Date	Vessel	Run #	Area m^2	Lbs/m^2	Biomass	Comment
Sitka (Olga Straits)	01/14/79	Kittiwake	1	1,189,747	52.60	62,580,692	
Sitka (Olga Straits)	01/14/79	"	2	2,682,796	21.10	35,506,995	
Crawfish Inlet	01/13/79	"	1	1,007,534	1.20	1,209,040	
Crawfish Inlet	01/13/79	"	2	1,071,845	2.90	3,108,350	
Crawfish Inlet	01/11/79	"	1	418,020	3.20	1,337,600	
Lisianski Inlet	01/15/79	"	1	2,679,612	9.40	25,188,352	
Lisianski Inlet	01/15/79	"	2	1,843,573	11.00	20,279,303	
Clover Pass (Grant Isl)	01/18/79	Sundance	1	1,028,971	1.00	1,028,971	
Clover Pass (Grant Isl)	01/18/79	"	2	1,157,593	0.50	578,797	
Behm Narrows	01/20/79	"	1	608,808	0.10	60,880	
Deer Island	01/16/79	Steller	1	3,010,000	0.64	1,926,400	
Deer Island	01/16/79	"	3	780,000	3.0	2,340,000	
Sitka (Katlian)	02/17/79	Sundance	1	3,869,360	6.62	25,600,000	
Sitka (Katlian)	02/20/79	"	1	3,011,884	5.76	17,300,000	
Sitka (Katlian)	02/18/79	"	1	2,872,545	7.94	22,800,000	
Sitka (Katlian)	02/19/79	"	1	3,794,331	10.38	39,400,000	
Sitka (Olga Straits)	02/20/79	"	3	975,379	0.54	530,000	
Sitka (Olga Straits)	02/20/79	"	1	857,476	0.46	390,000	
Sitka (Olga Straits)	02/20/79	"	2	857,476	1.34	1,150,000	
Sitka (Olga Straits)	02/19/79	"	2	353,709	1.52	540,000	
Sitka (Olga Straits)	02/19/79	"	1	1,552,202	0.40	62,000	

Table 2. Results of acoustic surveys on herring in Southeaster Alaska during 1978-79. - Continued.

Area	Date	Vessel	Run #	Area m^2	Lbs/m^2	Biomass	Comment
Sitka ((lga Straits)	02/18/79	Sundance	1	1,575,612	0.22	35,000	
Fritz Cove	01/25/79	Kittiwake	1	2,786,797	0.26	72,000	
Fritz Cove	01/03/79	Auklet	2	2,272,311	1.42	3,220,000	
Fritz Cove	01/03/79	"	1	2,486,680	2.13	5,300,000	
Fritz Cove	12/19/78	Murre II	1	4,501,749	0.9	4,051,574	
Deer Island	01/31/79	Steller	2	2,060,000	0.88	1,812,800	Gain too high
Anita Bay	02/03/79	"	1	5,020,000	0.67	3,363,400	Gain too high
Port Camden (Keku Str.)	03/13/79	"	2	1,248,000	0.90	1,120,000	
Seymour Canal (Winning Cove)	03/25/79	"	1	4,460,000	0.12	535.200	
Seymour Canal (Sore-finger)	03/25/79	"	2	27,550,000	0.05	1,377,500	
Scow Bay	03/27/79	"	1	1,800,000	2.80	5,040,000	
Scow Bay	03/27/79	"	2	1,830,000	1.00	1,830,000	
Scow Bay	03/28/79	"	1	2,030,000	0.17	35,000	
Scow Bay	03/28/79	"	2	2,290,000	0.97	2,220,000	
Scow Bay	03/28/79	"	3	2,300,000	0.92	2,120,000	
Seymour Canal (Staunch Pt.)	04/21/79	Sundance	1	1,800,000	1.80	3,300,000	
Seymour Canal (Staunch Pt.)	04/21/79	"	2	1,800,000	.68	1,230,000	
Seymour Canal (Wind-fall)	04/21/79	"	1	9,500,000	1.30	12,350,000	

Table 2. Results of acoustic surveys on herring in Southeastern Alaska during 1978-79. - Continued.

Area	Date	Vessel	Run #	Area m^2	Lbs/m^2	Biomass	Comment
Seymour Canal (Windfall)	04/28/79	Kittiwake	1	1,140,000	1.00	1,140,000	
Seymour Canal (Windfall)	04/28/79	"	2	570,000	0.98	560,000	
Seymour Canal (Staunch Pt.)	04-28-79	"	1	3,500,000	1.58	5,500,000	
Seymour Canal (Staunch Pt.)	04/28/79	"	2	2,460,000	0.97	2,400,000	
Seymour Canal (Stauch Pt.)	05/02/79	Steller	1	3,130,000	0.98	3,067,400	
Seymour Canal (Windfall)	05/02/79	"	1	1,190,000	0.82	975,800	
Anita Bay (North)	04/03/79	"	1	7,760,000	0.07	543.200	
Burnett Inlet	04/05/79	"	1	450,000	0.30	135,000	
Burnett Inlet	04/05/79	"	2	740,000	0.06	28,200	
Sitka (Olga Straits)	03/17/79	Kittiwake	1	1,093,282	0.90	983,959	Radio interference
Sitka (Olga Straits)	03/17/79	Steller	1	925,002	2.70	2,497,505	" "
Sitka (Olga Straits)	03/17/79	Kittiwake	2	653,825	5.40	3,530,655	" "
Sitka (Olga Straits)	03/17/79	Steller	2	589,515	9.70	5,718,295	" "
Sitka (Olga Straits)	03/17/79	Kittiwake	3	771,728	1.30	1,003,246	" "
Sitka (Olga Straits)	03/17/79	Steller	3	658,825	3.30	2,174,122	" "
Sitka (Katlian)	03/17/79	Kittiwake	1	2,293,748	12.00	27,524,976	" "
Sitka (Katlian)	03/17/79	Steller	1	1,961,476	4.80	9,415,084	" "
Sitka (Katlian)	03/17/79	Kittiwake	2	2,111,535	5.40	11,402,289	" "

Table 2. Results of acoustic surveys on herring in Southeastern Alaska during 1978-79. - Continued.

Area	Date	Vessel	Run #	Area m^2	Lbs/m^2	Biomass	Comment
Sitka (Katlian)	03/17/79	Steller	2	1,832,855	8.20	15,029,411	
Sitka (Katlian)	03/17/79	Kittiwake	3	1,950,758	12.00	23,409,096	
Sitka (Katlian)	03/17/79	Steller	3	1,950,758	3.20	6,242,425	
Sitka (Katlian)	03/17/79	Kittiwake	1	1,532,738	16.90	36,903,272	
Sitka (Katlian)	03/18/79	Steller	1	1,329,088	13.30	17,676,870	
Sitka (Katlian)	03/18/79	Kittiwake	2	1,618,486	12.30	19,907,377	
Sitka (Katlian)	03/18/79	Steller	2	1,329,088	9.60	12,759,244	
Sitka (Katlian)	03/18/79	Kittiwake	3	1,618,486	15.10	24,439,139	
Sitka (Katlian)	03/18/79	Steller	3	1,650,641	10.30	17,001,602	
Sitka (Olga Straits)	03/19/79	Kittiwake	1	1,446,991	7.20	10,100,000	
Sitka ((lga Straits)	03/19/79	Steller	1	1,125,437	2.50	3,300,000	Wake interference
Sitka (Katlian)	03/19/79	Kittiwake	1	1,404,117	11.50	16,100,000	
Sitka (Katlian)	03/19/79	Steller	1	1,468,428	8.10	14,600,000	" "
Sitka (Katlian)	03/19/79	Kittiwake	2	1,736,389	11.50	19,600,000	
Sitka (Katlian)	03/19/79	Steller	2	1,576,612	5.50	10,600,000	" "
Sitka (Katlian)	03/19/79	Kittiwake	3	2,122,253	8.60	18,000,000	
Sitka (Katlian)	03/19/79	Steller	3	2,497,399	3.90	9,739,856	" "
Sitka (Black Can)	03/19/79	Kittiwake	1	2,808,234	17.00	47,600,000	
Sitka (Black Can)	03/19/79	Steller	1	3,011,881	12.40	37,200,000	" "

Table 2. Results of acoustic surveys on herring in Southeastern Alaska during 1978-79. - Continued.

Area	Date	Vessel	Run #	Area m^2	Lbs/m^2	Biomass	Comment
Fritz Cove	01/18/79	Kittiwake	1	1,629,204	2.90	4,724,692	
Lynn Canal (Pearl Harbor)	04/23/79	Auklet	1	3,549,950	1.10	3,904,945	
Fritz Cove	12/19/78	Murre II	1	-	0.90	-	No area given