MEMORANDUM State of Alaska

TO: Distribution

DATE: Nov. 21, 1983

FILE NO:

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SUBJECT: 1984 Bering Sea Pacific Herring "Forecast"

The attached tables contain projections for spawning population biomass for all eastern Bering Sea fishing districts in 1984. I've included all my work so that I can get at least partial credit for any incorrect projections. I used a very simple approach to generate projections - I just used average growth and mortality rates for each age class to calculate biomass for 1984 from estimated 1983 spawning escapements(total run minus catch). I didn't take the removals due to the Dutch Harbor food/bait fishery into account when projecting population sizes for Togiak, Security Cove and Goodnews Bay. This would have slightly decreased 1984 projections for these three districts. Assuming our 1983 aerial assessment estimates were accurate, these projections should represent a minimal estimate of available biomass for 1984 since recruitment of younger age classes is so difficult to predict. I feel that projections for ages 6 through 9+ are probably more reliable than for ages 3 through 5.

Table 1 shows the 1984 "forecast" as well as 1983 population sizes. Table 2 shows the information I used to make the projections and the actual equations used for calculations. Table 3 shows mean spawning biomass (by age class) for all districts. You can use this table to get a better idea of what "average" run sizes are for each district. Table 4 shows the data I used to generate Table 3.

Admittedly the data are not extensive and, therefore, projections should be viewed with extreme caution. However, if we find ourselves unable to obtain aerial survey information for any district in 1984, at least we will have some basis for setting harvest levels. It will be interesting to see how close these "forecasts" come to actual assessments. I predict that these predictions are probably going to be less than actual assessment estimates.

Distribution: Anchorage: Arvey, Florey, Kingsbury, Meacham, Regnart, Geiger
Juneau: Pennoyer, Clark, Gaffney
Field Offices: Dillingham - Skrade, Minard, Nelson
Bethel - Schultz, Huttunen
Nome - Schwarz, Lean

cc: Whitmore, Bergstrom

Table 1. Pacific herring spawning population assessments for eastern Bering Sea commercial fishing districts in 1983 and projections for 1984.

Age	1983 Total Run (m.t.)	1983 Catch (m.t.)	1983 Escapement (m.t.)	1984 Total Run (m.t.)	1984 Catch-20%E (m.t.)
			TOGIAK		
3	45	4	41	?	
4	5,056	219	4,837	86	
5	42,094	6,247	35,847	5,901	
6	60,097	12,915	47,182	36,958	
7	2,453	670	1,783	42,699	
8	3,348	671	2,677	1,475	
9+	14,976	3,760	11,216	9,628	
Total	128,069	24,486	103,583	96,747	19,349
			SECURITY COVE		
3	12	0	12	?	
4	516	5	511	25	
5	1,520	162	1,358	623	
6	2,708	517	2,191	1,400	
7	400	113	287	1,983	
8	209	28	181	237	
9+	435	148	287	332	
Total	5,800	973	4,827	4,600	920
			GOODNEWS BAY		
3	trace	0	trace	?	
4	409	45	364	?	
5	769	110	659	444	
6	1,363	207	1,156	679	
7	136	19	117	1,046	
8	17	9	8	97	
9+	206	5	201	142	
Total	2,900	395	2,505	2,408	482
			CAPE ROMANZOF		
3	15	0	15	?	
4	720	79	641	34	
5	1,140	203	937	805	
6	2,155	362	1,793	976	
7	345	65	280	1,612	
8	105	5	100	233	
9+	520	26	494	406	
Total	5,000	740	4,260	4,066	813

Table 1. Continued.

Age	1983 Total Run (m.t.)	1983 Catch (m.t.)	1983 Escapement (m.t.)	1984 Total Run (m.t.)	1984 Catch-20%E (m.t.)
			NORTON SOUND		
3	0	0	0	?	
4	3,494	108	3,386	?	
5	6,452	795	5,657	4,253	
6	11,601	2,254	9,347	5,895	
7	2,652	596	2,056	8,403	
8	230	81	149	1,709	
9+	1,071	322	749	613	
Total	25,500	4,156	21,344	20,873	4,175

Table 2. Information used in projecting 1983 Pacific herring biomass to expected spawning biomass in 1984.

General equation: $B_{t+1} = B_t \, (e^{[G-M]}) \, (R_{t+1} / R_t)$ where

B_{t+1} = expected 1984 biomass of age t+1 herring,

B_t = 1983 biomass of age t herring,

G = instantaneous growth rate for the age interval t to t+1,

M = instantaneous mortality rate for the age interval t to t+1,

R_{t+1} = proportion of age t+1 herring recruited to spawning population in 1984, and

R_t = proportion of age t herring recruited to spawning population in 1983.

SOUTHERN STOCKS (TOGIAK, SECURITY COVE AND GOODNEWS BAY):

1/ Growth equations: $L = 315.44 \left\{1-e^{(-0.22[t+2.23])}\right\}$; $W = 0.000001 \, L^{3.479}$ where

L = standard length (cm) of an age t herring, and

W = weight (gm) of a herring with standard length L.

Age	L	Age Interval	2/ G	1/ M	1/ (R_{t+1} / R_t)	3/ $(R_{t+1} / R_t) \, (e^{[G-M]})$
3	216	3 - 4	0.293	0.25	2.005	2.093
4	235	4 - 5	0.229	0.15	1.127	1.220
5	251	5 - 6	0.176	0.18	1.035	1.031
6	264	6 - 7	0.129	0.23	1.001	0.905
7	274	7 - 8	0.100	0.29	1.000	0.827
8	282	8 - 9	0.085	0.36	1.000	0.760
9	289	9 -10	0.060	0.45	1.000	0.677
10	294					

1/ From Fried and Wespestad (1983) - paper delivered at Nanaimo International Herring Symposium

2/ $G = 3.479 \, (\ln[L_{t+1}] - \ln [L_t])$

3/ Multiply biomass of age t herring in 1983 by this factor to obtain projected biomass of age t+1 herrring in 1984.

Table 2. Continued.

NORTHERN STOCKS (CAPE ROMANZOF AND NORTON SOUND):

Growth equations: $L = 289.07 \left\{1-e^{(-0.29[t+0.97])}\right\}$; $W = 0.000001\ L^{3.479}$

Age	L	Age Interval	G	M	(R_{t+1} / R_t)	$(R_{t+1} / R_t)\ (e^{[g-m]})$
3	198	3 - 4	0.378	0.25	2.005	2.279
4	221	4 - 5	0.258	0.15	1.127	1.256
5	238	5 - 6	0.187	0.18	1.035	1.042
6	251	6 - 7	0.122	0.23	1.001	0.899
7	260	7 - 8	0.105	0.29	1.000	0.831
8	268	8 - 9	0.066	0.36	1.000	0.745
9	273	9 -10	0.049	0.45	1.000	0.670
10	277					

Table 3. Mean spawning biomass of Pacific herring in eastern Bering Sea commercial fishing districts, 1978-1983.

Age	1/ Togiak Biomass (m.t.) Mean	1/ Togiak Biomass (m.t.) St. dev.	2/ Security Cove Biomass (m.t.) Mean	2/ Security Cove Biomass (m.t.) St. dev.	2/ Goodnews Bay Biomass (m.t.) Mean	2/ Goodnews Bay Biomass (m.t.) St. dev.
3	1,650	1,347	133	153	133	153
4	24,483	29,679	2,233	2,581	1,100	1,127
5	47,783	42,235	1,500	1,000	733	306
6	26,533	24,143	1,100	1,389	533	751
7	18,050	18,161	367	351	133	153
8	8,383	7,512	300	100	133	153
9+	7,583	4,552	333	208	300	100

	2/ Cape Romanzof		2/ Norton Sound	
3	100	100	467	416
4	1,100	781	6,500	5,717
5	1,100	500	6,267	2,850
6	900	1,153	4,633	6,231
7	400	300	2,167	1,762
8	333	208	567	252
9+	667	287	767	351

1/ 1978-1983

2/ 1981-1983

Table 4. Spawning biomass of Pacific herring in eastern Bering Sea commercial fishing districts, 1978-1983.

Age	1/ Biomass (m.t.) 1978	1979	1980	1981	1982	1983
			Togiak			
1&2	5,700	0	0	0	0	0
3	2,900	2,000	2,000	3,000	0	0
4	54,000	2,200	1,600	69,600	14,400	5,100
5	73,000	114,000	800	7,100	49,700	42,100
6	20,400	50,100	24,300	1,600	2,700	60,100
7	4,000	42,000	23,900	35,300	600	2,500
8	5,000	400	8,400	21,400	11,800	3,300
9+	7,600	6,100	1,300	5,900	9,600	15,000
Total	172,600	216,800	62,300	143,900	88,800	128,100
			Security Cove			
3				300	100	0
4				5,200	1,100	500
5				500	2,500	1,500
6				400	200	2,700
7				700	0	400
8				300	400	200
9+				100	400	500
Total				7,500	4,600	5,800
			Goodnews Bay			
3				300	100	0
4				2,400	500	400
5				400	1,000	800
6				100	100	1,400
7				300	0	100
8				100	300	0
9+				300	400	200
Total				3,900	2,400	2,900
			Cape Romanzof			
3				200	100	0
4				2,000	600	700
5				600	1,600	1,100
6				0	500	2,200
7				700	100	400
8				400	500	100
9+				500	1,000	500
Total				4,400	4,400	5,000

1/ Biomass figures rounded to nearest 100 m.t.

Table 4. Continued

Age	1/ Biomass (m.t.) 1978	1979	1980	1981	1982	1983
				Norton Sound		
3				800	600	0
4				13,100	3,100	3,300
5				3,400	9,100	6,300
6				500	1,600	11,800
7				3,600	200	2,700
8				600	800	300
9+				800	400	1,100
Total				22,800	15,800	25,500

1/ Biomass figures rounded to nearest 100 m.t.