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Abundance, Age, Sex, and Size Composition for Pacific Herring in Lower Cook Inlet, 1988

by
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State of Alaska Steve Cowper, Governor

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ABSTRACT

Harvests of Pacific Herring (*Clupea harengus pallasi*) from the Kamishak and Outer District sac roe fishery within the Lower Cook Inlet management area of Alaska were sampled for sex, age, weight, and length during April and May of 1988. In the Kamishak District, late spawners were also sampled for sex, age, length, and weight.

In the Kamishak District, estimates of harvest and spawning biomass were 5043.7 tonnes (5548.1 tons) and 21,818 tonnes (24,000 tons), respectively. Males were 51.8% of the catch samples. The dominant age groups in the weighted catch sample were the 4, 5, 7, 8, and 9 age class from the 1984, 1983, 1981, 1980 and 1979 year classes, respectively. They made up 21.6%, 20.6%, 20.1%, 10.5%, and 10.7% of the sample, respectively. Mean weight and length of the weighted catch sample were 199 g and 236 mm. The age and sex composition of the herring that spawned during the period of the harvest was assumed to be the same the catch. The age composition of the late spawner sample, from the period after the fishery was closed, was 23.0% 3-year-old and 66.3% 4-year-old. The sex of over two-thirds of the late spawner samples was not determined. Of the remainder, 19.1% were females. Means weight and length of the late spawner samples were 101 g and 196 mm.

In the Outer District, only the catch estimate of 51.4 tonnes (56.6 tons) was available. The sex composition of the combined samples was 66.2% males, 33.8% females, and 23.5% sex unknown. The 4-year-old fish from the 1984 year class accounted for 81.1% of the catch. Mean weight and length of the combined samples were 111 g and 199 mm.

KEY WORDS: Abundance, age, *Clupea harengus pallasi*, herring, length, Lower Cook Inlet, sex, weight.

INTRODUCTION

The Lower Cook Inlet management area is comprised of all waters west of the longitude of Cape Fairfield, north of the latitude of Cape Douglas, and south of the latitude of Anchor Point (Figure 1). Since 1961, catches of Pacific herring (*Clupea harengus pallasi*) have been documented in all districts except the Barren Islands. Throughout this period, the Alaska Department of Fish and Game (ADF&G) maintains a resource monitoring program to collect data from the fishery and the contributing spawning populations. Purse seines have been the only gear allowed in the sac roe fishery. Entry into the sac roe fishery was limited in 1978, at which time 75 permits were issued. Sampling of the herring catch for age, sex, weight and length data began in 1972 and has been reported annually in the Lower Cook Inlet Annual Management Report Series. Assessment of the spawning biomass began in 1978 with a program of aerial surveys and test fishing for age composition. A total closure of the commercial herring fishery occurred for the period 1980-84 because of low stock abundance. Only the Kamishak, Eastern, and Outer Districts were since reopened.

The timing of the spring sac roe fishery has been from mid-April to early May. Older herring tend to appeared on the spawning grounds before the younger herring. Herring movement within the Kamishak District has generally been from south to north. The current management strategy limits the harvest rate to 20% of the estimated biomass by weight for age-5 and older herring and 10% of the biomass by weight of herring age-4 and younger. Age, weight, and length (AWL) data from the purse seine sac roe fishery are used to determine run timing of the younger fish, update the harvest strategy, monitor year class strengths, measure recruitment, and prepare a long-range forecast of abundance.

The objectives of the 1988 Lower Cook Inlet herring sampling program for the Kamishak District were to (1) estimate the prespawning and spawning biomass using aerial survey techniques, (2) estimate the age composition of the harvest and spawning biomass, (3) calculate the biomass of each age group, (4) provide estimates across time and geographical areas, and (5) provide estimates as soon as possible to support in-season decision making. The objectives for the Outer District were to estimate the age composition of the harvest as soon as possible to support in-season management decisions.

METHODS

Lower Cook Inlet sac roe herring catches are normally reported separately for the following management districts: Kamishak, Outer and Eastern (Figure 1). In 1988, however, the Kamishak District was subdivided into seven areas (Figure 2). Each of the management districts and areas was considered a geographical sampling strata.

The sac roe and test fishery was not expected to be more than 3 weeks in duration; in 1987 the commercial harvest was obtained within a very short 3-d period (Schroeder et al., 1987). Furthermore, the younger fish were not expected to appear until the latter half of the fishery. For those reasons, each day of actual commercial or test fishing was considered a temporal sampling strata.

Sample sizes were set for each sampling strata such that all of the estimated age class (i) proportions, p_i, from a multinomial population of k age groups were simultaneously within a specified distance, d, of their true population age proportions, Π_i, 95% of the time $(1 - \alpha)$. That is

$$\Pr \{ \bigcap_{i=1}^{k} | p_i - \pi_i | \leq d \} \geq 1 - \alpha,$$

where d and α, the confidence level, was chosen to be 0.05. Thompson (1987) calculated a maximum sample size of 510 for a worse case scenario when three age classes were present in equal numbers and $d = \alpha = 0.05$. Any deviation in the number of age classes or unequal contributions by age class would require a smaller sample size. Therefore, the numbers of fish initially collected and sent back to Homer for processing was the worse case scenario (510), plus an generous allowance (30%) for unreadable scales. Sample sizes were estimated when about two-thirds (300 fish) of the sample were processed. At that time, the age proportions, p_i, were determined. These were then used as *a priori* estimates to calculate a sample size n such that

$$\Sigma \alpha_i < \alpha \quad (\alpha = 0.05), \tag{1}$$

where

$$\alpha_i = 2(1 - \Phi(z_i)), \tag{2}$$

$\Phi(z_i)$ = area under the standard normal distribution, and

$$z_i = d \sqrt{n_i} / \sqrt{(p_i(1-p_i))}. \tag{3}$$

The smallest n that satisfied equations (1)-(3), rounded up to the nearest 20 fish (herring scales were mounted on glass slides in groups of 20), increased by the observed unreadable rate, and rounded up again the nearest 20 fish, was then used as estimated to total numbers of fish to process. If, after n fish, it was determined that the *a priori* estimate of sample size was insufficient, additional fish was processed.

Samples were obtained during each fishery opening from randomly selected fishing vessels throughout a management subarea. Ideally, for each fishing period, samples from the catch of a minimum of two boats were collected. These fishing vessels would be waiting for a tender to pump their fish out of their pursed seines when samples were dip-netted from the seine net. Samples were similarly obtained from test fish catches where a purse seiner was contracted to fish at a time and area designated by the department. The samples were packaged in 15-kg (33 lb) boxes and flown to Homer for processing. If there were more fish than required for a sampling strata, each 15-kg box was subsampled.

Each fish was measured to the nearest millimeter from the tip of the snout to the end of the hyperal plate and weighed to the nearest gram. Sex was determined from an inspection of either the gonads or sex products. The scales of up to 20 fish were mounted on a glass slide. One scale was removed, preferably, from the left side of the herring above the pectoral fin, 3 or 4 scales posterior of the operculum. If scales above the pectoral fin were not present on the left side, then they collected from the same area on the right side of the fish. If the herring was from a sample where most of the scales were missing, then any scale available was used. The scales were cleaned, dipped in a 10% mucilage solution and positioned unsculptured side down on a labeled glass slide. Images of scales were magnified 29 X by a microfiche reader and the number of annuli per scale was counted to determine age.

Estimates of standard error by age class were derived according the procedures for stratified random sampling described by Snedecor and Cochran (1967).

$$SE = \sqrt{(\Sigma\ C_h^2 * s_h^2 / n_h)},$$

where C_h^2 = the herring catch in the *h*th stratum.
s_h^2 = the sample variance in the *h*th stratum.

It was of interest to describe the age composition as it differed through time and by location. Yet, if differences did not exist it was desirable to pool samples adjacent in time and area to minimize sampling. The decision to pool samples was based on a chi-square test of a contingency table for age categories by location. The null hypothesis being tested was that both samples were from the same multinomial population. Samples were pooled only if the null hypothesis was accepted, i.e., no significant difference through time and area, $\alpha > 0.05$.

The total tonnage of the herring harvest during each period was obtained from harvest receipts (fish tickets) which document each sale by a licensed fishermen. The spawning biomass was obtained from aerial surveys.

A total of 28 serial surveys were conducted in the Kamishak District between 18 April and 3 June. Many of these were only partial surveys due to weather and water conditions. Surveys are flown as close to an altitude of 610 m (2,000 ft) as possible in a single engine air craft (DeHaviland Beaver or Cessna 185). The surveys were flown at various tide stages. However, the period between low slack water to approximately 3-4 h into the flood appeared to provide the best water clarity and the most visible schools of herring. The total number of schools were counted and individual schools were estimated as to volume of herring in tons by experienced observers. Aerial survey estimates are calibrated in the following manner. The aerial surveyor will estimate the tonnage of a school while in the air and then direct a fishing vessel to set its seine around the same school. The tonnage of herring in the seine is then compared with the aerial surveyor's estimate. Estimated tonnages made by aerial surveyors were found to be very close to the tonnages delivered by the fishing vessel to a tender. In 1987, the aerial survey estimates were only 1.3% higher than the tonnage delivered in two separate test sets. No calibrations were made in 1988.

RESULTS

The 1988 Lower Cook Inlet sac roe herring fishery took place in only two districts: Kamishak and Outer Districts. The preseason forecast of abundance for the Kamishak District was 43,479 tonnes (47,827 tons) with a harvest of about 6,329 tonnes (6962 tons) expected. A total of 75 seiners participated, harvesting 5,043.7 tonnes (5548.1 tons). There was no preseason forecast prepared for the Outer District. Only one seiner fished the Outer District for a total harvest of 51.4 tonnes (56.6 tons). No estimates of spawning biomass in the Outer District was made in 1988.

Kamishak District Commercial Catch

Within the Kamishak District, there were 17 fishery openings (Appendix A). Many of the openings occurred on the same day and some were merely a postponement of a closure. As a result, there were only 6 d between 22 and 30 April and 1 d in May when herring were caught and sold to a processor. Although there were catch reports and samples from six different geographical areas, some of the catch reports and samples were combined. As a result, there were eight commercial fishing sampling periods (Table 1). The sample sizes of readable scales from these eight periods ranged from 377 to 774 (Table 2).

The first sampling period refers to the harvest of 876.9 tonnes (964.6 tons) from Area #5 on 22 April and from Area #6 between 22 and 23 April (Table 1). Although the establishment of the areas was designed to facilitate catch reporting by geographical area, much of the catch occurred near Chenik and Amakdedori, on the boundary of Areas #5 and 6 where separating the catch by area was meaningless. Fortunately, there was no statistical difference between the age compositions from these two areas (χ = 16.72, P = .17, df = 12; Table 3). Therefore, 368 samples from Area #5 and 406 samples from Area #6 were combined to create the first sampling stratum (Table 4). In the combined sample, the age groups greater than 10% were the 4-, 5-, and 7-year-old fish. Mean lengths and weights were 237 mm and 197 g.

Fishing in Area #9 on 25 and 26 April lead to a landing of 155.3 tonnes (170.8 tons; Table 1). Two samples from Iniskin Bay, Area #9, were also collected on those two dates. The smaller sample of 212 herring from 25 April was pooled with the larger sample of 390 from 26 April. The pooled sample had a mean length and weight of 232 mm and 187 g. The age groups greater than 10% were the 4-, 5-, 7-, and 9-year-old fish (Table 5).

The third sampling strata was taken from a harvest of 2,565.8 tonnes (2822.4 tons) on 27 April from Areas #5 and 6. There was only one sample of 394 herring near the boundary of the two areas (Chenik in Area #6). There were five age groups that were greater than 10%: 4-, 5-, 7-, 8-, and 9-year-olds. Mean lengths and weights were 237 mm and 202 g (Table 6).

The fourth sampling strata represents the harvest 249 tonnes (273.7 tons) from Area #7 between 22 and 28 April (Table 1). Of that catch, 190.1 tonnes or 209.1 tons, was taken on 28 April. A catch sample of 518 readable scales between Areas #6 and 7 was obtained between Bruin Bay and Fortification Bluff. These samples had a mean length and weight of 238 mm and 202 g. Again, five age groups comprised 10% or more of the total samples: 4-, 5-, 7-, 8-, and 9-year-olds (Table 7).

The fifth sampling strata was taken from a harvest of 480.8 tonnes (528.9 tons) from Area #9 on 27 and 28 April. On 28 April, 395 readable scales were obtained from Iniskin Bay or Area #9. Mean lengths and weights were 237 mm and 194 g. As in Area #7, the same five age groups dominated (Table 8).

The sixth and seventh sampling stratum were taken from a harvest of 314.5 tonnes (346.0 tons; 29 April; Area #8) and 355.5 tonnes (346.0 tons; 30 April; Area #9). On 29 April, there was a sample of 470 scales from Iniskin Bay, Area #9,

and another 113 readable scales from Ursus Cove, Area #8 (Table 9). The latter sample was too small to be meet the desired levels of precision and accuracy.

On 30 April there was another catch sample of 377 readable scales from Ursus Cove (Table 10). The age frequency of the Iniskin Bay (29 April) and the Ursus Cove (30 April) samples were found to be statistically different (χ = 34.02, P < .001, df = 12; Table 3). The smaller Ursus Cove (29 April) sample, however, was not different from the Iniskin Bay (29 April) sample (χ = 11.23, P = .5, df = 12) or the 30 April Ursus Cove sample (χ = 16.81, P = .08, df = 10), meaning that it could be combined with either. It was combined with the Iniskin Bay (29 April) sample because the P-value from that pair was greater.

The combined Iniskin Bay and Ursus Cove sample from 29 April had five age groups that made up 10% or more of the samples: 4-, 5-, 7-, 8-, and 9-year-olds, in that order (Table 9). The 30 April Ursus Cove sample had only three dominant age groups: 4-, 5-, and 7-year-olds (Table 10). The major difference between the two Ursus Cove samples (29 and 30 April) was in the 4- and 11-year-old age classes (as indicated by their large cellular contribution to the total chi-square value). For the 4-year-old fish, the difference was 18.9% on 29 April and 31.3% a day later. Although the 11-year-old fish did not exceed 10%, the differences between the two sample days were also great, dropping from 6.9% to 2.9%. Mean lengths and weights for the two days were 236 mm and 192 g and 231 mm and 180 g, respectively.

The last catch sample was taken from a series of aerial survey calibration sets made on 7 May. From a catch of 46.6 tonnes (51.3 tons) in Area #7, Fortification Bluff, 426 readable scales were taken. Mean length and weight were 236 mm and 200 g (Table 11).

Throughout the entire fishing season, five age groups were predominant in the age composition (weighted by sample period): 4-, 5-, 7-, 8-, and 9-year-olds. Estimated mean length and weight of the entire sac roe harvest were 236 mm and 198 g (Table 12).

Kamishak District Spawning Biomass

Prior to the start of spawning and the sac roe fishery, 19 and 20 April, aerial surveyors detected little or no herring biomass. Three small test fish samples collected during this period (Table 13). There were so few fish present at this time that these samples represented the entire test fish catch. These samples were not used to determine any catch or spawner age composition.

The herring that spawned during the commercial fishery, 22 April to 7 May, was considered to be the early spawners. Their age composition was assumed to be similar to the commercial catch (Table 14).

After the sac roe fishery, a shift in age composition toward the younger herring was expected. The spawning biomass with clear shift in age composition would be considered the late spawners. Because there was no commercial fishery, test fishing resumed, providing three samples. The first sample was collected on 7 May in Ursus Cove (Table 15). The age groups with compositions in excess of 10%, were the 4-, 5-, 7- and 8-year-olds. There was no major shift in age composition.

The 4-year-old herring were still only 25% of the total sample. This sample was not used to determine the late spawner age composition.

The second sample was collected on 24 and 25 May in Oil and Dry Bay (Table 16). The sample from Oil and Dry Bay were pooled because similar age frequencies (χ = 11.85, P = .5, df = 12; Table 3). This sample was also the northernmost sample of the season. The age composition of this sample began to indicate a slight shift toward the younger herring. The 4-year-old herring were up to 36% of the sample. This sample was also not used to determine spawner age composition.

The third sample was collected on 25 May in Iniskin Bay (Table 17). This sample clearly showed a shift in age composition (Figure 3). The 3- and 4-year-old herring were now 23.0 and 66.3% of the total sample, respectively. This was the sample used to (1) calculate the age composition of the late spawning biomass, and consequently (2) the number of 3-year-old herring recruits. On a percentage basis, the numbers of 3-year-old herring is low, which could be interpreted as a poor recruitment of 3-year-olds. If the recruitment of 3-year-olds is an indication of year class strength, then the 1985 year class may be weak.

The estimated age composition of the combined early and late spawning biomass is presented in Table 18. Aerial survey estimates of spawning biomass by area are presented in Table 19. Because of poor visibility, the spawning estimates in Table 19 may be on the conservative side. As such, the aerial survey estimates of abundance was less than the preseason forecast.

Outer District Commercial Catch

During 1988 the Outer District was open for continuous fishing beginning on 20 April and ending on 14 May. During this 25-d opening, 51.4 tonnes (56.6 tons) of herring were harvested in the sac roe fishery. There were two samples taken: 486 readable scales on 5 May and 79 readable scales on 10 May (Table 20). The latter sample was too small to provide meaningful age composition by itself, and therefore, the two samples were combined. More than 81% of the combined samples were age-4 herring with another 9.6% being age 3. Mean lengths and weights were 199 mm and 111 g.

LITERATURE CITED

Snedecor, G.W., and W.G. Cochran. 1967. Statistical Methods, 6th edition. John Wiley and Sons, New York, New York.

Thompson, S.K. 1987. Sample sizes for estimating multinomial proportions. The American Statistician 41:42-46.

Schroeder, T.R. 1987. Lower Cook Inlet area annual finfish management report, 1987. Alaska Department of Fish and Game, Division of Commercial Fisheries, (Unpublished Region 2 report), Homer.

TABLES AND FIGURES

Table 1. Sac roe herring catch (tonnes) by area and date, Kamishak District, 1988.

Date	Management Areas (south to north)				
	#5 McNeil & Chenik	#6 Amakdedori & Bruin	#7 Fortification Bluff	#8 Ursus Cove	#9 Iniskin Bay
22 April	773.0	89.1	38.2		
23		14.8			
24					
25					85.5
26			4.4		69.7
27	2462.8	103.0	15.9		67.7
28			190.1	13.5	413.1
29				121.5	278.1
30				179.5	77.4
1 May					
2					
3					
4					
5					
6					
7			46.6		
Total	3235.8	206.9	295.2	314.5	991.5

Table 2. Sample sizes of readable herring scales.

Date	Management Areas (south to north)					
	#5 McNeil & Chenik	#6 Amakdedori & Bruin	#7 Fortification Bluff	#8 Ursus Cove	#9 Iniskin Bay	#10 Oil & Dry
20 April					438	
22		774				
26					602	
27	394					
28		518			395	
29					600	
30				377		
7 May			426	407		
25					409	1146

Table 3. Probability of age composition being similar from chi-square test of independence by date and area.

		Iniskin 19-20 Apr	Chenik 22 Apr	Amakdedori 22 Apr	Iniskin 25-26 Apr	Chenik 27 Apr	Bruin 28 Apr	Iniskin 28 Apr	Iniskin 29 Apr	Ursus 29 Apr	Ursus 30 Apr	Ursus 7 May	Fort. Bl. 7 May	Oil 24-25 May	Dry 25 May
Chenik	22 Apr	0.06	x	x	x	x	x	x	x	x	x	x	x	x	x
Amakdedori	22 Apr	0.00	0.17	x	x	x	x	x	x	x	x	x	x	x	x
Iniskin	25-26 Apr	0.08	0.32	0.00	x	x	x	x	x	x	x	x	x	x	x
Chenik	27 Apr	0.13	0.34	0.00	0.44	x	x	x	x	x	x	x	x	x	x
Bruin	28 Apr	0.10	0.00	0.00	0.00	0.90	x	x	x	x	x	x	x	x	x
Iniskin	28 Apr	0.18	0.10	0.00	0.00	0.25	0.25	x	x	x	x	x	x	x	x
Iniskin	29 Apr	0.33	0.25	0.00	0.25	0.90	0.50	0.15	x	x	x	x	x	x	x
Ursus	29 Apr	0.25	0.10	0.02	0.50	0.83	0.66	0.40	0.50	x	x	x	x	x	x
Ursus	30 Apr	0.02	0.01	0.01	0.12	0.01	0.00	0.00	0.00	0.08	x	x	x	x	x
Ursus	7 May	0.22	0.01	0.00	0.00	0.03	0.00	0.01	0.00	0.50	0.40	x	x	x	x
Fort. Bl.	7 May	0.03	0.00	0.00	0.00	0.38	0.90	0.15	0.12	0.25	0.42	0.00	x	x	x
Oil	24-25 May	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	x	x
Dry	25 May	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	x
Iniskin	25 May	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4. Age, sex, and size composition of Pacific herring sac roe harvest by purse seine in Areas # 5 and # 6, (Chenik and Amakdedori) Kamishak District, 22 April 1988.

		Sex				Percent	Weight			Length			Biomass	
	Age	No. Male	No. Female	No. Unknown	Total No.	of Total	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	# Fish X 1000	Tons Tonnes
	1													
	2													
	3	2	0	0	2	.5	91	8.5	2	188	4.2	2		
	4	47	47	0	94	25.5	126	16.1	94	212	9.1	94		
	5	33	26	0	59	16.0	166	19.3	59	232	7.6	59		
	6	6	4	0	10	2.7	212	16.4	10	246	5.2	10		
	7	40	28	0	68	18.5	220	23.2	68	249	7.5	68		
Chenik	8	18	21	0	39	10.6	245	25.8	39	254	7.2	39		
	9	24	15	0	39	10.6	262	25.1	39	259	6.6	39		
	10	11	7	0	18	4.9	258	30.0	18	261	6.3	18		
	11	15	10	0	25	6.8	276	39.3	25	264	10.6	25		
	12	9	3	0	12	3.3	270	10.0	12	259	11.7	12		
	13	1	1	0	2	.5	307	12.7	2	271	4.9	2		
	14													
	15													
Sample Total		206	162	0	368	100.0	201	60.5	368	240	21.0	368		
	1													
	2													
	3													
	4	77	60	0	137	33.7	133	31.6	137	213	12.5	137		
	5	30	27	0	57	14.0	165	30.7	57	228	12.1	57		
	6	3	9	0	12	3.0	202	40.7	12	237	15.8	12		
	7	36	35	0	71	17.5	226	28.6	71	247	8.4	71		
Amakdedori	8	18	19	0	37	9.1	227	42.8	37	247	14.8	37		
	9	11	19	0	30	7.4	248	41.4	30	254	12.7	30		
	10	16	10	0	26	6.4	264	41.9	26	257	12.9	26		
	11	10	12	0	22	5.4	261	52.5	22	255	15.9	22		
	12	6	5	0	11	2.7	271	31.6	11	260	7.8	11		
	13	0	1	0	1	.2	296	.0	1	268	.0	1		
	14	1	0	0	1	.2	257	.0	1	248	.0	1		
	15	1	0	0	1	.2	281	.0	1	268	.0	1		
Sample Total		209	197	0	406	100.0	193	62.2	406	234	21.4	406		

-Continued-

Table 4. (page 2 of 2)

	Age	Sex: No. Male	Sex: No. Female	Sex: No. Unknown	Percent: Total No.	Percent: of Total	Weight: Mean (g)	Weight: SD	Weight: Number Weighed	Length: Mean (mm)	Length: SD	Length: Number Measured	Biomass: # Fish X 1000	Biomass: Tons	Biomass: Tonnes
	1														
	2														
	3	2	0	0	2	.3	91	8.5	2	188	4.2	2	12	1	1
	4	124	107	0	231	29.8	130	26.6	231	212	11.2	231	1329	190	173
	5	63	53	0	116	15.0	166	25.5	116	230	10.2	116	667	122	111
	6	9	13	0	22	2.8	207	31.7	22	241	12.8	22	127	29	26
	7	76	63	0	139	18.0	223	26.2	139	248	8.0	139	800	196	178
Areas Combined	8	36	40	0	76	9.8	236	36.1	76	251	12.1	76	437	114	103
	9	35	34	0	69	8.9	256	33.6	69	257	9.9	69	397	112	102
	10	27	17	0	44	5.7	262	37.2	44	258	10.7	44	253	73	66
	11	25	22	0	47	6.1	269	46.0	47	259	13.9	47	270	80	73
	12	15	8	0	23	3.0	270	22.4	23	259	9.8	23	132	39	36
	13	1	2	0	3	.4	303	11.0	3	270	3.8	3	17	6	5
	14	1	0	0	1	.1	257	.0	1	248	.0	1	6	2	1
	15	1	0	0	1	.1	281	.0	1	268	.0	1	6	2	2
All Samples Combined		415	359	0	774	100.0	197	21.4	774	237	21.4	774	4453	965	877
Sex Composition		53.6	46.4												
Unaged		28	29	0	57	7.4	219	20.0	57	245	20.0	57			
Sex Composition		49.1	50.9												

Table 5. Age, sex, and size composition of Pacific herring sac roe harvest by purse seine in Area # 9, (Iniskin Bay) Kamishak District, 25-26 April 1988.

		Sex				Percent	Weight			Length			Biomass	
	Age	No. Male	No. Female	No. Unknown	Total No.	of Total	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	# Fish X 1000	Tons Tonnes
25 April	1													
	2													
	3	1	1	0	2	.9	91	4.9	2	190	4.9	2		
	4	29	17	0	46	21.7	122	16.5	46	207	16.1	46		
	5	14	17	0	31	14.6	158	18.0	31	224	6.6	31		
	6	3	3	0	6	2.8	194	19.9	6	237	6.5	6		
	7	20	19	0	39	18.4	203	24.9	39	240	6.4	39		
	8	19	6	0	25	11.8	219	26.2	25	244	7.2	25		
	9	10	12	0	22	10.4	243	31.6	22	248	8.8	22		
	10	6	10	0	16	7.5	249	33.2	16	250	10.0	16		
	11	6	10	0	16	7.5	253	49.2	16	254	11.7	16		
	12	2	2	0	4	1.9	272	58.5	4	261	13.6	4		
	13	2	2	0	4	1.9	302	36.1	4	263	10.2	4		
	14	1	0	0	1	.5	310	.0	1	258	.0	1		
	15													
Sample Total		113	99	0	212	100.0	194	58.1	212	234	20.5	212		
26 April	1													
	2													
	3	1	0	0	1	.3	69	.0	1	174	.0	1		
	4	52	47	0	99	25.4	121	24.1	99	206	15.0	99		
	5	59	41	0	100	25.6	159	23.6	100	225	9.3	100		
	6	8	3	0	11	2.8	174	36.7	11	235	7.5	11		
	7	27	27	0	54	13.8	211	28.4	54	243	8.0	54		
	8	17	13	0	30	7.7	223	29.6	30	248	8.0	30		
	9	17	27	0	44	11.3	240	36.1	44	251	9.5	44		
	10	8	10	0	18	4.6	243	33.6	18	253	10.0	18		
	11	11	8	0	19	4.9	260	33.9	19	256	10.1	19		
	12	4	5	0	9	2.3	248	50.6	9	256	17.5	9		
	13	1	2	0	3	.8	258	36.1	3	265	6.5	3		
	14	0	2	0	2	.5	280	13.4	2	266	.7	2		
	15													
Sample Total		205	185	0	390	100.0	183	56.5	390	231	21.6	390		

-Continued-

Table 5. (page 2 of 2)

	Age	Sex: No. Male	Sex: No. Female	Sex: No. Unknown	Total No.	Percent of Total	Weight: Mean (g)	Weight: SD	Weight: Number Weighed	Length: Mean (mm)	Length: SD	Length: Number Measured	Biomass: # Fish X 1000	Biomass: Tons	Biomass: Tonnes
	1														
	2														
	3	2	1	0	3	.5	83	12.9	3	184	9.6	3	4	0	0
	4	81	64	0	145	24.1	122	21.9	145	206	15.3	145	200	27	24
	5	73	58	0	131	21.8	159	22.4	131	225	8.7	131	181	32	29
	6	11	6	0	17	2.8	181	32.6	17	236	7.0	17	23	5	4
	7	47	46	0	93	15.4	208	27.2	93	242	7.5	93	128	29	27
25 - 26 April	8	36	19	0	55	9.1	221	27.9	55	246	7.8	55	76	18	17
	9	27	39	0	66	11.0	241	34.5	66	250	9.3	66	91	24	22
	10	14	20	0	34	5.6	246	33.0	34	251	9.9	34	47	13	12
	11	17	18	0	35	5.8	257	41.1	35	255	10.8	35	48	14	12
	12	6	7	0	13	2.2	255	52.0	13	257	16.0	13	18	5	5
	13	3	4	0	7	1.2	283	40.6	7	263	8.2	7	10	3	3
	14	1	2	0	3	.5	290	20.0	3	263	4.4	3	4	1	1
	15														
All Samples Combined		318	284	0	602	100.0	187	21.2	602	232	21.2	602	830	171	155
Sex Composition		52.8	47.2												
Unaged		19	21	0	40	6.6	194	18.4	40	235	18.4	40			
Sex Composition		47.5	52.5												

Table 6. Age, sex, and size composition of Pacific herring sac roe harvest by purse seine in Area # 5, (Chenik) Kamishak District, 27 April 1988.

		Sex				Percent	Weight			Length			Biomass		
	Age	No. Male	No. Female	No. Unknown	Total No.	of Total	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	# Fish X 1000	Tons	Tonnes
	1														
	2														
	3	1	1	0	2	.5	89	12.0	2	181	8.5	2	65	6	6
	4	41	34	0	75	19.0	135	103.0	75	207	10.8	75	2422	360	327
	5	46	37	0	83	21.1	164	19.6	83	228	9.1	83	2680	482	438
	6	2	5	0	7	1.8	196	25.0	7	238	7.6	7	226	49	44
	7	44	42	0	86	21.8	218	24.7	86	244	9.1	86	2777	665	605
27 April	8	21	22	0	43	10.9	238	29.8	43	251	8.4	43	1388	364	331
	9	21	23	0	44	11.2	247	26.7	44	253	7.5	44	1421	385	350
	10	11	9	0	20	5.1	263	26.7	20	257	7.7	20	646	187	170
	11	9	14	0	23	5.8	259	34.5	23	257	9.0	23	743	211	192
	12	4	3	0	7	1.8	293	28.8	7	264	10.4	7	226	73	66
	13	2	1	0	3	.8	294	39.9	3	266	8.1	3	97	31	28
	14	1	0	0	1	.3	251	.0	1	263	.0	1	32	9	8
	15														
Sample Total		203	191	0	394	100.0	202	69.0	394	237	20.3	394	12721	2822	2566
Sex Composition		51.5	48.5												
Unaged		9	17	0	26	6.6	223	12.5	26	243	12.5	26			
Sex Composition		34.6	65.4												

Table 7. Age, sex, and size composition of Pacific herring sac roe harvest by purse seine in Area # 6, (Bruin Bay) Kamishak District, 28 April 1988.

		Sex			Percent		Weight			Length			Biomass		
	Age	No. Male	No. Female	No. Unknown	Total No.	of Total	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	# Fish X 1000	Tons	Tonnes
	1														
	2														
	3														
	4	52	32	0	84	16.2	124	18.0	84	207	9.4	84	199	27	25
	5	68	55	0	123	23.7	166	22.4	123	228	9.2	123	292	53	48
	6	8	6	0	14	2.7	183	27.6	14	235	13.2	14	33	7	6
	7	63	51	0	114	22.0	223	22.5	114	246	7.9	114	270	66	60
28 April	8	27	34	0	61	11.8	240	30.1	61	251	8.2	61	145	38	35
	9	29	24	0	53	10.2	248	28.0	53	252	8.4	53	126	34	31
	10	9	10	0	19	3.7	257	37.6	19	255	7.7	19	45	13	12
	11	20	14	0	34	6.6	263	35.2	34	258	11.2	34	81	23	21
	12	7	3	0	10	1.9	266	33.4	10	258	9.1	10	24	7	6
	13	1	2	0	3	.6	278	42.4	3	255	13.7	3	7	2	2
	14	2	0	0	2	.4	281	87.7	2	259	14.8	2	5	1	1
	15	1	0	0	1	.2	273	.0	1	262	.0	1	2	1	1
Sample Total		287	231	0	518	100.0	202	54.3	518	238	18.9	518	1228	273	249
Sex Composition		55.4	44.6												
Unaged		9	10	0	19	3.7	210	19.7	19	241	19.7	19			
Sex Composition		47.4	52.6												

Table 8. Age, sex, and size composition of Pacific herring sac roe harvest by purse seine in Area # 9, (Iniskin Bay) Kamishak District, 28 April 1988.

		Sex				Percent	Weight			Length			Biomass		
	Age	No. Male	No. Female	No. Unknown	Total No.	of Total	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	# Fish X 1000	Tons	Tonnes
	1														
	2														
	3	3	4	0	7	1.8	90	30.5	7	192	16.2	7	44	4	4
	4	42	29	0	71	18.0	120	21.2	71	208	10.5	71	446	59	54
	5	41	44	0	85	21.5	164	31.2	85	227	10.7	85	534	96	88
	6	15	5	0	20	5.1	197	30.2	20	241	11.1	20	126	27	25
	7	36	45	0	81	20.5	213	24.0	81	246	6.8	81	509	119	109
28 April	8	22	20	0	42	10.6	227	29.4	42	249	7.1	42	264	66	60
	9	19	28	0	47	11.9	250	26.3	47	255	7.6	47	295	81	74
	10	6	6	0	12	3.0	245	27.5	12	252	6.8	12	75	20	18
	11	9	15	0	24	6.1	264	42.0	24	260	13.6	24	151	44	40
	12	1	2	0	3	.8	276	25.0	3	257	3.6	3	19	6	5
	13	1	1	0	2	.5	257	4.2	2	266	.0	2	13	4	3
	14	0	1	0	1	.3	289	.0	1	270	.0	1	6	2	2
	15														
Sample Total		195	200	0	395	100.0	194	56.3	395	237	20.5	395	2482	529	481
Sex Composition		49.4	50.6												
Unaged		14	11	0	25	6.3	202	19.8	25	243	19.8	25			
Sex Composition		56.0	44.0												

Table 9. Age, sex, and size composition of Pacific herring sac roe harvest by purse seine in Areas # 8 and # 9, (Ursus Cove and Iniskin Bay) Kamishak District, 29 April 1988.

		Sex				Percent	Weight			Length			Biomass	
	Age	No. Male	No. Female	No. Unknown	Total No.	of Total	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	# Fish X 1000	Tons Tonnes
	1	0	17	1	18	3.7	804	197.0	18	241	33.0	18		
	2	0	0	1	1	.2	22	.0	1	125	.0	1		
	3	3	1	0	4	.8	79	10.3	4	184	10.8	4		
	4	48	41	1	90	18.5	115	19.8	90	204	15.1	90		
	5	54	46	0	100	20.5	158	21.6	100	226	9.2	100		
	6	4	3	0	7	1.4	178	19.2	7	234	7.2	7		
	7	44	39	0	83	17.0	214	23.5	83	245	8.9	83		
Iniskin Bay	8	26	26	0	52	10.7	221	26.0	52	247	8.7	52		
	9	22	37	0	59	12.1	241	31.6	59	252	10.3	59		
	10	9	13	0	22	4.5	253	33.0	22	255	9.8	22		
	11	19	18	0	37	7.6	258	24.8	37	257	8.4	37		
	12	5	4	0	9	1.8	273	17.6	9	260	6.0	9		
	13	0	1	0	1	.2	278	.0	1	262	.0	1		
	14	1	1	0	2	.4	256	29.0	2	254	4.9	2		
	15	0	2	0	2	.4	287	26.9	2	265	12.7	2		
Sample Total		235	249	3	487	100.0	215	133.8	487	235	22.9	487		
	1													
	2													
	3													
	4	11	9	0	20	17.7	123	13.5	20	208	22.4	20		
	5	17	12	0	29	25.7	168	34.2	29	230	7.4	29		
	6													
	7	14	11	0	25	22.1	206	28.4	25	244	10.9	25		
Ursus Cove	8	7	7	0	14	12.4	236	26.0	14	256	7.0	14		
	9	2	8	0	10	8.8	248	33.5	10	261	10.1	10		
	10	7	2	0	9	8.0	239	49.3	9	253	16.2	9		
	11	2	1	0	3	2.7	241	36.4	3	251	10.0	3		
	12	0	1	0	1	.9	273	.0	1	254	.0	1		
	13	0	1	0	1	.9	307	.0	1	273	.0	1		
	14	0	1	0	1	.9	274	.0	1	265	.0	1		
	15													
Sample Total		60	53	0	113	100.0	195	54.0	113	238	21.9	113		

-Continued-

Table 9. (page 2 of 2)

	Age	Sex: No. Male	Sex: No. Female	Sex: No. Unknown	Total No.	Percent of Total	Weight: Mean (g)	Weight: SD	Weight: Number Weighed	Length: Mean (mm)	Length: SD	Length: Number Measured	Biomass: # Fish X 1000	Biomass: Tons	Biomass: Tonnes
	1	0	17	1	18	3.0	804	197.0	18	241	33.0	18	51	45	41
	2	0	0	1	1	.2	22	.0	1	125	.0	1	3	0	0
	3	3	1	0	4	.7	79	10.3	4	184	10.8	4	11	1	1
	4	59	50	1	110	18.3	117	18.9	110	205	16.6	110	309	40	36
	5	71	58	0	129	21.5	160	25.2	129	227	9.0	129	362	64	58
	6	4	3	0	7	1.2	178	19.2	7	234	7.2	7	20	4	3
	7	58	50	0	108	18.0	212	24.8	108	245	9.3	108	303	71	64
Areas Combined	8	33	33	0	66	11.0	224	26.6	66	249	9.1	66	185	46	42
	9	24	45	0	69	11.5	242	31.7	69	253	10.6	69	194	52	47
	10	16	15	0	31	5.2	249	38.1	31	254	11.7	31	87	24	22
	11	21	19	0	40	6.7	257	25.6	40	256	8.5	40	112	32	29
	12	5	5	0	10	1.7	273	16.6	10	260	6.0	10	28	8	8
	13	0	2	0	2	.3	293	20.5	2	268	7.8	2	6	2	2
	14	1	2	0	3	.5	262	23.1	3	257	7.5	3	8	2	2
	15	0	2	0	2	.3	287	26.9	2	265	12.7	2	6	2	2
All Samples Combined		295	302	3	600	100.0	211	22.7	600	236	22.7	600	1685	391	355
Sex Composition		49.4	50.6												
Unaged		17	17	0	34	5.7	199	19.8	34	240	19.8	34			
Sex Composition		50.0	50.0												

Table 10. Age, sex, and size composition of Pacific herring sac roe harvest by purse seine in Area # 8, (Ursus Cove) Kamishak District, 30 April 1988.

		Sex			Percent		Weight			Length			Biomass		
	Age	No. Male	No. Female	No. Unknown	Total No.	of Total	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	# Fish X 1000	Tons	Tonnes
	1														
	2														
	3														
	4	68	49	1	118	31.3	124	23.0	118	208	11.3	118	546	74	68
	5	49	47	0	96	25.5	163	22.6	96	227	9.6	96	444	79	72
	6	5	3	0	8	2.1	191	29.6	8	237	6.9	8	37	8	7
	7	33	24	0	57	15.1	208	28.0	57	243	9.5	57	264	60	55
30 April	8	13	19	0	32	8.5	230	17.9	32	249	6.2	32	148	37	34
	9	14	21	0	35	9.3	246	30.8	35	252	9.4	35	162	44	40
	10	7	6	0	13	3.4	270	26.3	13	258	8.5	13	60	18	16
	11	4	7	0	11	2.9	280	26.2	11	261	5.9	11	51	16	14
	12	1	3	0	4	1.1	262	32.5	4	262	10.3	4	19	5	5
	13	3	0	0	3	.8	261	10.7	3	269	9.5	3	14	4	4
	14														
	15														
Sample Total		197	179	1	377	100.0	180	55.6	377	231	20.8	377	1744	346	315
Sex Composition		52.4	47.6												
Unaged		13	19	0	32	8.5	228	13.4	32	249	13.4	32			
Sex Composition		40.6	59.4												

Table 11. Age, sex, and size composition of Pacific herring sac roe harvest by purse seine in Area # 7, (Fortification Bluff) Kamishak District, 7 May 1988.

		Sex			Percent		Weight			Length			Biomass		
	Age	No. Male	No. Female	No. Unknown	Total No.	of Total	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	# Fish X 1000	Tons	Tonnes
	1														
	2														
	3	0	1	0	1	.2	94	.0	1	182	.0	1	1	0	0
	4	30	35	0	65	15.3	129	19.4	65	208	10.1	65	36	5	5
	5	70	47	0	117	27.5	164	20.2	117	226	8.4	117	64	12	10
	6	6	6	0	12	2.8	195	26.0	12	235	8.7	12	7	1	1
	7	32	56	0	88	20.7	220	23.5	88	244	8.7	88	48	12	11
7 May	8	19	22	0	41	9.6	233	31.5	41	248	10.2	41	22	6	5
	9	19	26	0	45	10.6	252	27.2	45	254	8.0	45	25	7	6
	10	9	2	0	11	2.6	251	22.3	11	255	7.5	11	6	2	2
	11	15	16	0	31	7.3	268	31.8	31	258	9.5	31	17	5	5
	12	5	4	0	9	2.1	273	26.6	9	260	10.7	9	5	1	1
	13	2	2	0	4	.9	254	39.9	4	262	5.0	4	2	1	1
	14	0	2	0	2	.5	276	13.4	2	268	2.1	2	1	0	0
	15														
Sample Total		207	219	0	426	100.0	200	52.6	426	236	19.0	426	233	51	47
Sex Composition		48.6	51.4												
Unaged		19	15	0	34	8.0	198	12.5	34	236	12.5	34			
Sex Composition		55.9	44.1												

Table 12. Age, sex, and size composition of Pacific herring sac roe harvest by purse seine, areas and dates combined, Kamishak District, 1988.

Age	Sex			Total	Percent of	Weight			Length			Biomass		
	No. Male	No. Female	No. Unknown	No.	Total	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	# Fish X 1000	Tons	Tonnes
1	0	17	1	18	.2	804	46.4	18	241	7.8	18	51	45	41
2	0	0	1	1	.0	22	.0	1	125	.0	1	3	0	0
3	11	8	0	19	.5	89	5.5	19	185	3.5	19	137	13	12
4	497	400	2	899	21.6	130	5.3	899	208	.6	899	5487	782	711
5	481	399	0	880	20.6	164	1.2	880	228	.6	880	5224	938	853
6	60	47	0	107	2.4	196	4.2	107	239	1.4	107	599	128	116
7	389	377	0	766	20.1	217	1.5	766	245	.6	766	5099	1219	1108
8	207	209	0	416	10.5	235	2.5	416	250	.7	416	2665	689	627
9	188	240	0	428	10.7	248	2.3	428	254	.6	428	2711	738	671
10	99	85	0	184	4.8	260	3.5	184	256	1.0	184	1219	350	318
11	120	125	0	245	5.8	262	4.0	245	258	1.1	245	1473	425	386
12	44	35	0	79	1.9	280	5.5	79	261	2.0	79	471	145	132
13	13	14	0	27	.7	287	13.6	27	266	2.8	27	166	53	48
14	6	7	0	13	.2	262	5.3	13	261	1.0	13	62	17	15
15	2	2	0	4	.1	282	8.2	4	266	3.8	4	14	6	5
All periods combined	2117	1965	4	4086	100.0	199	1.8	4086	236	.6	4086	25376	5548	5043

Table 13. Age, sex, and size composition of Pacific herring test fish harvest by purse seine in Area # 9, (Iniskin Bay) Kamishak District, 19-20 April 1988.

		Sex				Percent	Weight			Length		
	Age	No. Male	No. Female	No. Unknown	Total No.	of Total	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
	1											
	2											
	3											
	4	9	5	0	17	14.3	128	12.8	5	216	12.4	17
	5	13	12	0	29	24.4	176	22.3	13	230	8.7	29
	6	2	2	0	5	4.2	185	25.0	4	236	3.4	5
	7	3	11	0	17	14.3	225	19.9	8	245	6.5	17
19 April	8	10	11	0	26	21.8	229	30.7	18	248	9.7	26
	9	6	8	0	15	12.6	225	34.2	10	246	8.9	15
	10	2	2	0	4	3.4	230	18.4	4	250	7.9	4
	11	1	4	0	5	4.2	323	12.7	2	262	10.1	5
	12											
	13	0	1	0	1	.8	0	.0	0	266	.0	1
	14											
	15											
Sample Total		46	56	0	119	100.0	210	45.0	64	239	15.4	119
	1											
	2	0	0	13	13	4.1	17	3.9	12	117	9.9	13
	3	4	1	0	5	1.6	83	13.5	5	186	11.9	5
	4	44	27	0	71	22.3	118	19.1	71	210	9.7	71
	5	40	44	0	84	26.3	157	25.8	84	229	10.8	84
	6	0	5	0	5	1.6	200	24.4	5	239	8.6	5
	7	25	22	0	47	14.7	203	22.8	47	243	7.7	47
20 April	8	8	23	0	31	9.7	227	24.5	31	251	7.7	31
	9	17	14	0	31	9.7	235	22.6	31	253	9.1	31
	10	3	9	0	12	3.8	250	23.7	12	256	6.8	12
	11	9	9	0	18	5.6	259	29.9	18	259	7.7	18
	12											
	13											
	14	2	0	0	2	.6	292	67.9	2	266	18.4	2
	15											
Sample Total		152	154	13	319	100.0	174	62.2	318	229	30.5	319
	1											
	2	0	0	13	13	3.0	17	3.9	12	117	9.9	13
	3	4	1	0	5	1.1	83	13.5	5	186	11.9	5
	4	53	32	0	88	20.1	119	18.9	76	211	10.5	88
	5	53	56	0	113	25.8	159	26.1	97	230	10.3	113
	6	2	7	0	10	2.3	193	24.4	9	238	6.4	10
	7	28	33	0	64	14.6	206	23.6	55	244	7.4	64
19 - 20 April	8	18	34	0	57	13.0	228	26.7	49	250	8.8	57
	9	23	22	0	46	10.5	232	25.8	41	251	9.5	46
	10	5	11	0	16	3.7	245	23.7	16	254	7.4	16
	11	10	13	0	23	5.3	265	34.6	20	260	8.1	23
	12											
	13	0	1	0	1	.2	0	.0	0	266	.0	1
	14	2	0	0	2	.5	292	67.9	2	266	18.4	2
	15											
All Samples Combined		198	210	13	438	100.0	180	27.5	382	232	27.5	438
Sex Composition		48.5	51.5									
Unaged		14	18	0	35	8.0	218	19.5	28	243	19.5	35
Sex Composition		43.8	56.3									

Table 14. Age composition of Pacific herring spawn estimated from catch data, Kamishak District, 22 April - 7 May, 1988.

Age	# Fish X 1000	Biomass Tons	Biomass Tonnes
1	11	0	0
2	11	0	0
3	499	43	39
4	19821	2823	2566
5	18903	3400	3091
6	2156	466	424
7	18429	4401	4001
8	9645	2493	2266
9	9810	2672	2429
10	4412	1266	1151
11	5337	1539	1399
12	1704	524	476
13	595	190	173
14	226	65	59
15	50	18	16
Total	91607	19900	18091

Table 15. Age, sex, and size composition of Pacific herring spawn by test purse seine in Area # 8, (Ursus Cove) Kamishak District, 7 May 1988.

		Sex			Percent		Weight			Length		
	Age	No. Male	No. Female	No. Unknown	Total No.	of Total	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured
	1											
	2											
	3	1	2	0	3	.7	89	7.9	3	191	7.6	3
	4	61	41	0	102	25.1	126	22.4	102	209	10.3	102
	5	61	49	0	110	27.0	162	20.1	110	226	8.0	110
	6	4	5	0	9	2.2	194	20.0	9	237	5.5	9
	7	32	41	0	73	17.9	215	24.7	73	245	6.8	73
7 May	8	22	29	0	51	12.5	230	26.7	51	248	8.3	51
	9	17	17	0	34	8.4	239	26.8	34	253	8.3	34
	10	6	7	0	13	3.2	256	28.6	13	255	8.5	13
	11	7	0	0	7	1.7	247	28.4	7	251	9.1	7
	12	2	1	0	3	.7	270	32.3	3	256	5.0	3
	13											
	14	0	1	0	1	.2	357	.0	1	286	.0	1
	15	0	1	0	1	.2	275	.0	1	260	.0	1
Sample Total		213	194	0	407	100.0	183	51.7	407	232	19.3	407
Sex Composition		52.3	47.7									
Unaged		18	15	0	33	8.1	200	15.4	33	239	15.4	33
Sex Composition		54.5	45.5									

Table 16. Age, sex, and size composition of Pacific herring spawn by test purse seine in Area # 10, (Oil and Dry Bay) Kamishak District, 24-25 May 1988.

	Age	Sex: No. Male	Sex: No. Female	Sex: No. Unknown	Percent: Total No.	Percent: of Total	Weight: Mean (g)	Weight: SD	Weight: Number Weighed	Length: Mean (mm)	Length: SD	Length: Number Measured
	1											
	2											
	3	21	26	0	47	5.5	81	20.3	47	181	10.4	47
	4	168	149	0	317	37.4	121	19.4	317	204	9.9	317
	5	172	174	0	346	40.9	155	19.8	346	220	12.4	346
	6	9	4	0	13	1.5	173	25.2	13	230	10.6	13
Oil Bay	7	25	27	0	52	6.1	202	27.2	52	240	9.7	52
24 - 25 May	8	11	18	0	29	3.4	220	24.9	29	245	6.7	29
	9	11	7	0	18	2.1	217	33.1	18	245	9.6	18
	10	5	6	0	11	1.3	241	56.8	11	253	7.8	11
	11	2	5	0	7	.8	261	30.3	7	254	5.1	7
	12	2	1	0	3	.4	262	63.4	3	263	11.8	3
	13	0	2	0	2	.2	271	4.9	2	258	6.4	2
	14	1	0	0	1	.1	302	.0	1	267	.0	1
	15	0	1	0	1	.1	129	.0	1	200	.0	1
Sample Total		427	420	0	847	100.0	147	42.6	847	215	19.4	847
	1											
	2											
	3	10	3	0	13	4.3	81	12.4	13	182	7.8	13
	4	60	37	0	97	32.4	119	18.1	97	203	9.3	97
	5	67	58	0	125	41.8	156	20.0	125	221	7.9	125
	6	3	5	0	8	2.7	177	19.7	8	234	8.8	8
Dry Bay	7	10	14	0	24	8.0	201	23.0	24	240	7.7	24
25 May	8	10	3	0	13	4.3	205	26.1	13	242	12.2	13
	9	7	5	0	12	4.0	217	35.3	12	248	6.5	12
	10											
	11	3	2	0	5	1.7	239	28.7	5	253	9.3	5
	12	1	1	0	2	.7	284	26.2	2	264	8.5	2
	13											
	14											
	15											
Sample Total		171	128	0	299	100.0	152	41.7	299	218	18.6	299
	1											
	2											
	3	31	29	0	60	5.2	81	18.8	60	182	9.9	60
	4	228	186	0	414	36.1	120	19.1	414	204	9.7	414
	5	239	232	0	471	41.1	155	19.9	471	220	11.4	471
	6	12	9	0	21	1.8	174	22.8	21	232	9.8	21
	7	35	41	0	76	6.6	201	25.8	76	240	9.1	76
samples combined	8	21	21	0	42	3.7	215	25.9	42	244	8.8	42
	9	18	12	0	30	2.6	217	33.4	30	246	8.5	30
	10	5	6	0	11	1.0	241	56.8	11	253	7.8	11
	11	5	7	0	12	1.0	252	30.3	12	254	6.8	12
	12	3	2	0	5	.4	270	48.2	5	264	9.4	5
	13	0	2	0	2	.2	271	4.9	2	258	6.4	2
	14	1	0	0	1	.1	302	.0	1	267	.0	1
	15	0	1	0	1	.1	129	.0	1	200	.0	1
All Samples Combined		598	548	0	1146	100.0	149	19.2	1146	216	19.2	1146
Sex Composition		52.2	47.8									
Unaged		50	39	0	93	8.1	152	16.6	89	219	16.6	89
Sex Composition		56.2	43.8									

Table 17. Age, sex, and size composition of Pacific herring spawn by test purse seine in Area # 9, (Iniskin Bay) Kamishak District, 25 May 1988.

		Sex			Percent		Weight			Length			Biomass		
	Age	No. Male	No. Female	No. Unknown	Total No.	of Total	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	# Fish X 1000	Tons	Tonnes
	1	0	0	1	1	.2	3	.0	1	70	.0	1	90	0	0
	2	0	0	2	2	.5	14	2.8	2	107	7.1	2	180	3	3
	3	12	17	65	94	23.0	77	8.0	94	180	6.5	94	8445	713	648
	4	37	54	180	271	66.3	105	16.3	271	200	8.8	271	24346	2821	2564
	5	5	3	26	34	8.3	131	17.0	34	216	8.2	34	3054	439	399
	6	1	0	0	1	.2	154	.0	1	234	.0	1	90	15	14
	7	0	3	2	5	1.2	176	34.3	5	230	11.2	5	449	87	79
25 May	8	0	1	0	1	.2	229	.0	1	249	.0	1	90	23	21
	9														
	10														
	11														
	12														
	13														
	14														
	15														
Sample Total		55	78	276	409	100.0	101	24.9	409	196	16.6	409	36744	4100	3727
Sex Composition		41.4	58.6												
Unaged		7	3	21	31	7.6	100	12.6	31	196	12.6	31			
Sex Composition		70.0	30.0												

Table 18. Age, sex, and size composition of Pacific herring spawn by purse seine, areas and dates combined, Kamishak District, 1988.

	Sex				Percent	Weight			Length			Biomass		
Age	No. Male	No. Female	No. Unknown	Total No.	of Total	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	# Fish X 1000	Tons	Tonnes
1	0	17	2	19	.2	540	7.3	19	185	1.2	19	273	162	147
2	0	0	3	3	.1	14	1.9	3	108	4.7	3	191	3	3
3	23	25	65	113	7.0	78	.8	113	180	.6	113	8936	759	690
4	534	454	182	1170	34.5	116	.6	1170	204	.3	1170	44027	5625	5114
5	486	402	26	914	17.1	159	.4	914	226	.2	914	21792	3804	3458
6	61	47	0	108	1.8	194	.4	108	239	.1	108	2239	474	431
7	389	380	2	771	14.7	216	.4	771	245	.1	771	18738	4459	4054
8	207	210	0	417	7.6	235	.1	417	250	.0	417	9649	2495	2268
9	188	240	0	428	7.6	248	.1	428	254	.0	428	9724	2647	2406
10	99	85	0	184	3.4	260	.3	184	256	.1	184	4372	1255	1141
11	120	125	0	245	4.1	262	.3	245	258	.1	245	5283	1525	1386
12	44	35	0	79	1.3	280	.6	79	261	.2	79	1689	520	473
13	13	14	0	27	.5	287	2.6	27	266	.5	27	595	190	173
14	6	7	0	13	.2	262	1.5	13	261	.3	13	222	61	55
15	2	2	0	4	.0	282	4.1	4	266	1.9	4	50	22	20
All periods combined	2172	2043	280	4495	100.0	171	.4	4495	224	.2	4495	127781	24000	21818

Table 19. Herring biomass estimates by area, Kamishak District, 1988.

Area	Early[a]	Late[b]	Total
Kamishak Reef	1,273		1,273
McNeil-Chenik	2,091	482	2,573
Amakdedori-Contact Pt.	1,900	27	1,927
Bruin Bay	455	155	609
Fortification Bluff	6,309	27	6,336
Rocky Cove	64	391	455
Ursus Cove		482	482
Cottonwood Bay		55	55
Iniskin Bay	3,455	1,109	4,564
Oil Bay		364	364
Dry Bay		636	636
Offshore[c]	2,545		2,545
	18,091	3,727	21,818

[a] 25 April - 7 May
[b] 25 - 26 May
[c] (Contact Pt.-Fortification Bluff)

Table 20. Age, sex, and size composition of Pacific herring sac roe harvest by purse seine in Nuka Bay, Outer District, 3-10 May 1988.

		Sex			Percent		Weight			Length			Biomass	
	Age	No. Male	No. Female	No. Unknown	Total No.	of Total	Mean (g)	SD	Number Weighed	Mean (mm)	SD	Number Measured	# Fish X 1000	Tons Tonnes
3 May	1													
	2													
	3													
	4	36	33	11	80	93.0	119	21.2	80	203	9.8	80		
	5	1	1	1	3	3.5	123	24.0	3	207	7.4	3		
	6	1	0	0	1	1.2	170	.0	1	228	.0	1		
	7	0	1	0	1	1.2	251	.0	1	246	.0	1		
	8	0	0	1	1	1.2	163	.0	1	246	.0	1		
	9													
	10													
	11													
	12													
	13													
	14													
	15													
Sample Total		38	35	13	86	100.0	122	26.1	86	204	11.8	86		
4 May	1													
	2	0	0	1	1	.6	43	.0	1	149	.0	1		
	3	2	1	2	5	3.0	55	21.6	5	163	19.3	5		
	4	92	51	5	148	89.7	119	19.5	148	203	10.4	148		
	5	5	5	0	10	6.1	140	30.9	10	215	17.2	10		
	6													
	7	0	1	0	1	.6	201	.0	1	248	.0	1		
	8													
	9													
	10													
	11													
	12													
	13													
	14													
	15													
Sample Total		99	58	8	165	100.0	119	25.1	165	203	14.5	165		

-Continued-

Table 20. (page 2 of 3)

	Age	Sex: No. Male	Sex: No. Female	Sex: No. Unknown	Total No.	Percent of Total	Weight: Mean (g)	Weight: SD	Weight: Number Weighed	Length: Mean (mm)	Length: SD	Length: Number Measured	Biomass: # Fish X 1000	Biomass: Tons	Biomass: Tonnes
	1														
	2														
	3	7	3	37	47	20.0	62	12.7	47	167	12.6	47			
	4	74	29	72	175	74.5	97	17.9	175	195	10.5	175			
	5	5	2	3	10	4.3	122	30.0	10	208	13.9	10			
	6	1	0	0	1	.4	178	.0	1	234	.0	1			
	7														
5 May	8	0	1	0	1	.4	170	.0	1	232	.0	1			
	9	1	0	0	1	.4	269	.0	1	255	.0	1			
	10														
	11														
	12														
	13														
	14														
	15														
Sample Total		88	35	112	235	100.0	92	27.2	235	190	17.0	235			
	1														
	2														
	3	1	1	0	2	2.5	84	12.7	2	191	6.4	2			
	4	44	11	0	55	69.6	122	31.6	55	201	11.4	55			
	5	6	3	0	9	11.4	148	43.3	9	213	16.8	9			
	6	1	0	0	1	1.3	150	.0	1	224	.0	1			
	7	4	0	0	4	5.1	199	19.6	4	235	3.0	4			
10 May	8	2	1	0	3	3.8	213	24.0	3	244	6.7	3			
	9	2	2	0	4	5.1	229	10.7	4	245	5.4	4			
	10	1	0	0	1	1.3	256	.0	1	243	.0	1			
	11														
	12														
	13														
	14														
	15														
Sample Total		61	18	0	79	100.0	139	46.8	79	208	18.6	79			

-Continued-

Table 20. (page 3 of 3)

	Age	Sex: No. Male	Sex: No. Female	Sex: No. Unknown	Percent: Total No.	Percent: of Total	Weight: Mean (g)	Weight: SD	Weight: Number Weighed	Length: Mean (mm)	Length: SD	Length: Number Measured	Biomass: # Fish X 1000	Biomass: Tons	Biomass: Tonnes
	1														
	2	0	0	1	1	.2	43	.0	1	149	.0	1	1	0	0
	3	10	5	39	54	9.6	62	14.2	54	168	13.7	54	44	3	3
	4	246	124	88	458	81.1	111	23.8	458	200	11.1	458	375	46	42
	5	17	11	4	32	5.7	135	34.4	32	212	15.1	32	26	4	4
	6	3	0	0	3	.5	166	14.4	3	229	5.0	3	2	0	0
	7	4	2	0	6	1.1	208	25.9	6	239	6.9	6	5	1	1
3-10 May	8	2	2	1	5	.9	194	30.7	5	242	7.3	5	4	1	1
	9	3	2	0	5	.9	237	20.1	5	247	6.4	5	4	1	1
	10	1	0	0	1	.2	256	.0	1	243	.0	1	1	0	0
	11														
	12														
	13														
	14														
	15														
All Samples Combined		286	146	133	565	100.0	111	17.4	565	199	17.4	565	463	57	51
Sex Composition		66.2	33.8												
Unaged		13	18	5	36	6.4	127	15.7	36	206	15.7	36			
Sex Composition		41.9	58.1												

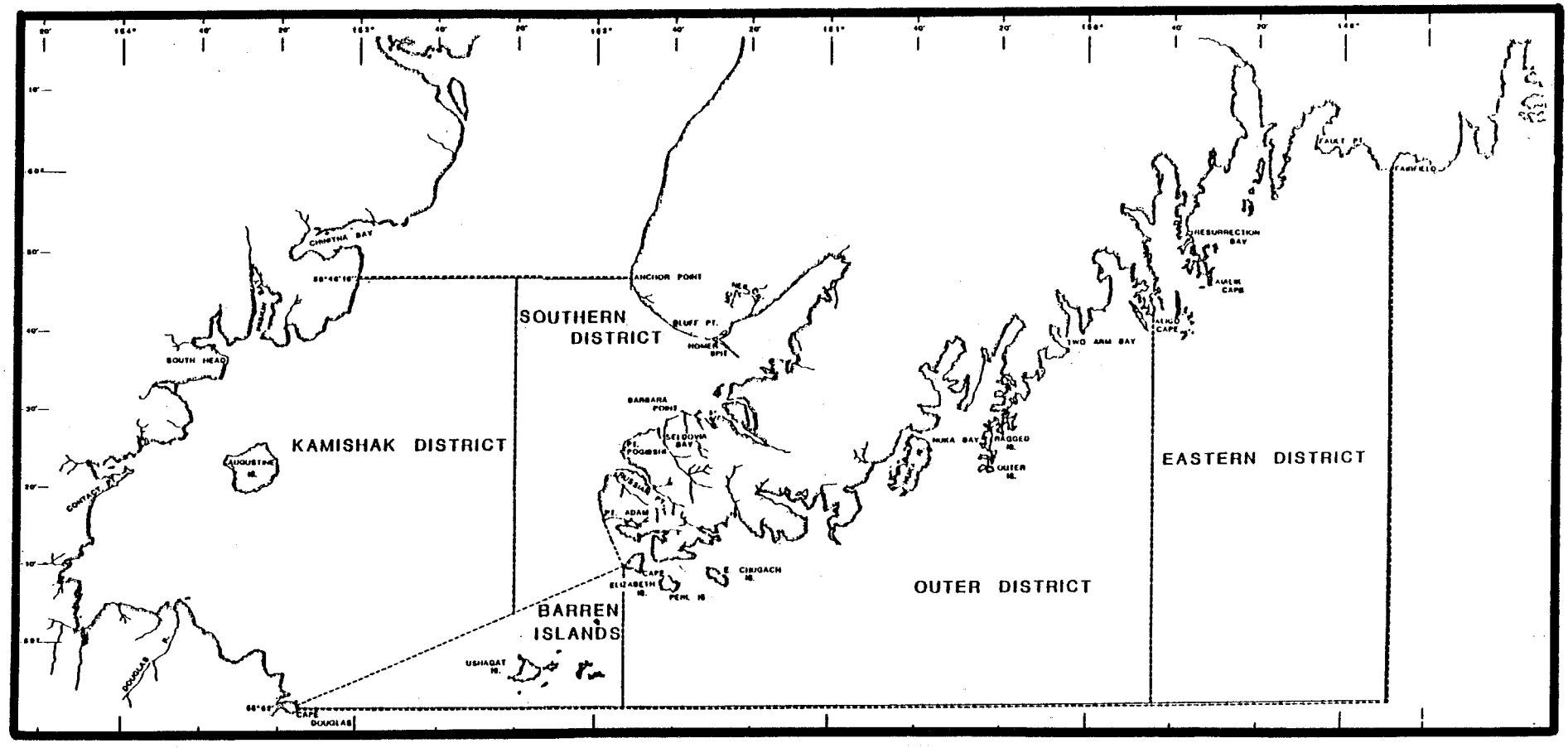

Figure 1. Sac roe herring fishing district in the Lower Cook Inlet Management Area.

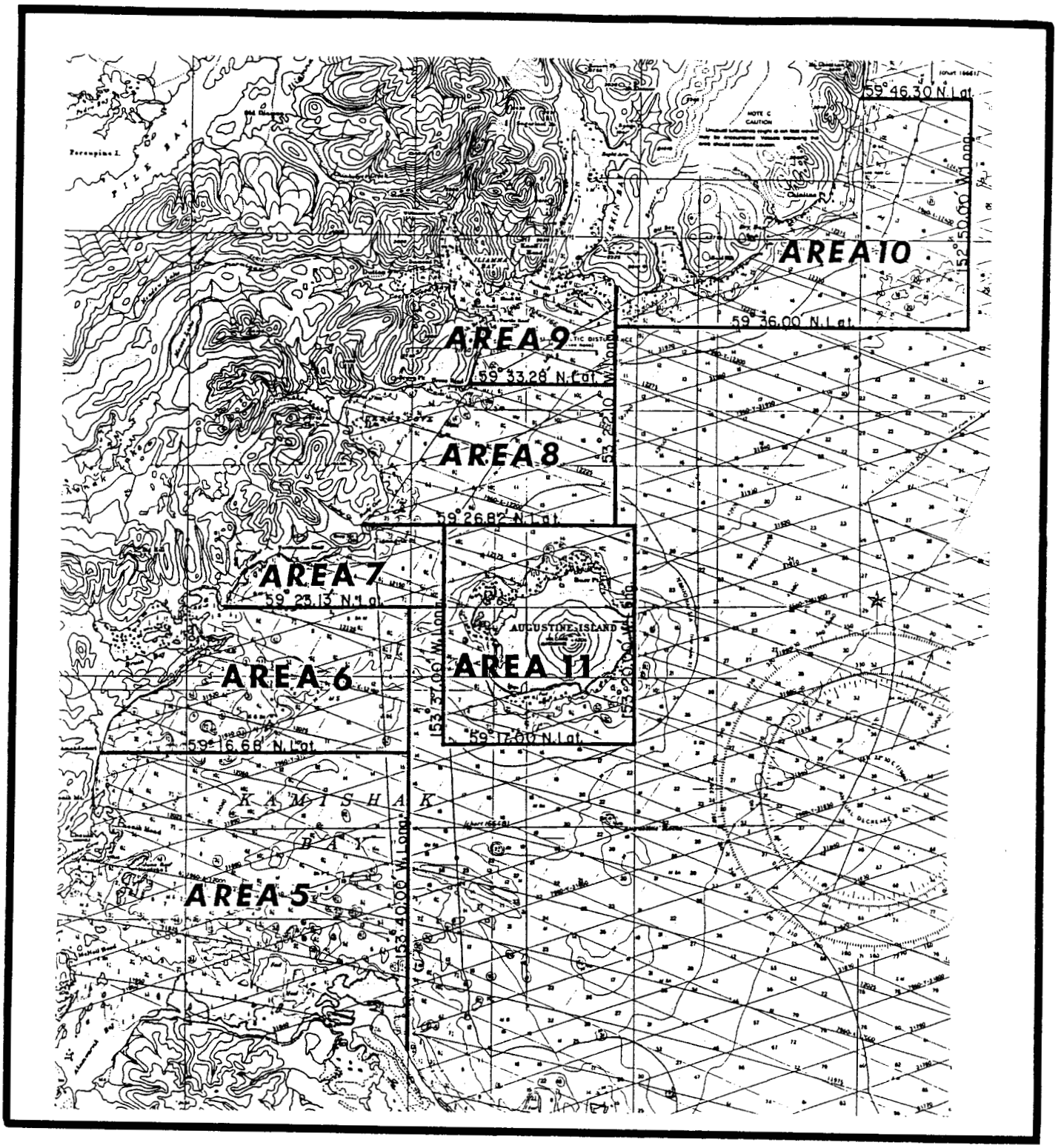

Figure 2. 1988 Kamishak District herring sac roe management areas.

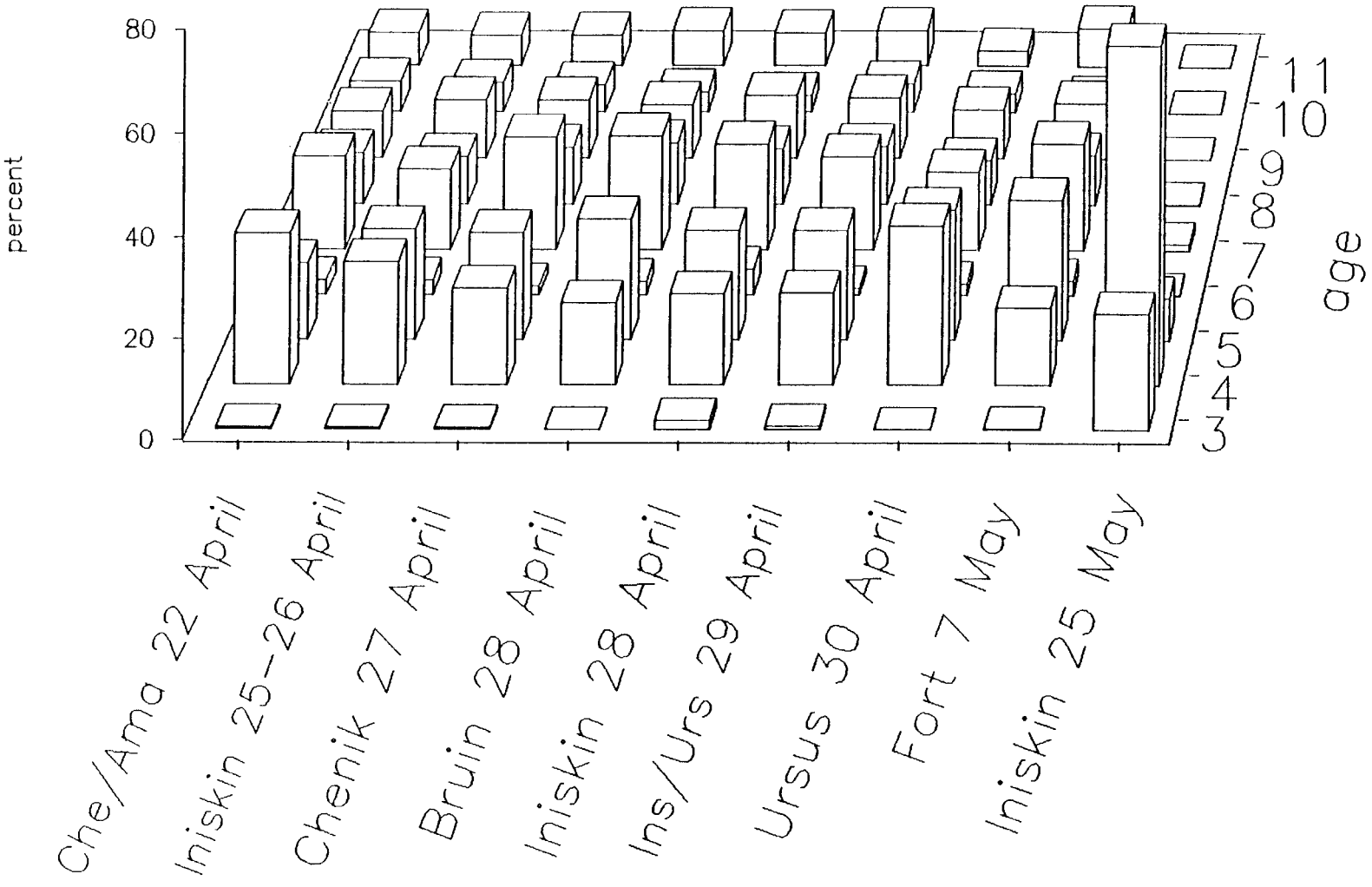

Figure 3. Herring age composition over time and area, 1988.

APPENDICES

Appendix A. Lower Cook Inlet sac roe herring fishing periods and area, 1988.

District	Opening	Date	Hours	Start (hours)	Stop (hours)
Kamishak	testfish	19-21 April			
	1	22 April	3	0700	1000
	2		5	1000	1500
	3		1	2000	2100
	4	23 April	1	1700	1800
	5	25 April	2	1200	1400
	6	26 April	2	0900	1100
	7	27 April	2	1000	1200
	8		2	1200	1400
	9		3	1400	1700
	10	28 April	2	0900	1100
	11		2	1100	1300
	12		2	1500	1700
	13	29 April	2	0900	1100
	14		2	1100	1300
	15		4	1300	1700
	16		2	1700	1900
	17	30 April	3	2100	2400
	testfish	7 May			
	testfish				
	testfish	24-25 May			
	testfish	25 may			
Outer	1	20 April-14 May	606	0600	2400

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