

**REVIEW OF THE 1992 LOWER COOK INLET
COMMERCIAL HERRING FISHERY
REPORT TO THE ALASKA BOARD OF FISHERIES**



by
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Regional Information Report¹ No. 2A92-15

Alaska Department of Fish and Game
Division of Commercial Fisheries, Central Region
333 Raspberry Road
Anchorage, Alaska 99518

October 1992

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INTRODUCTION

Commercial herring fishing occurs in four of the five districts in Lower Cook Inlet (Figures 1 and 2). Herring fishing began in the Southern District in 1914 as a gillnet fishery within Kachemak Bay (Figure 2). Eight saltries, six near Halibut Cove, were operating during the peak of the fishery. Fishing with purse seines began in 1923, and after three subsequent years of average annual harvests approaching 8,000 short tons (st), herring populations, and the fishery, collapsed.

The next Lower Cook Inlet herring fishery began in 1939 and was centered in the Resurrection Bay and Day Harbor area of the Eastern District (Figure 2). This was a purse seine fishery with the product used exclusively for oil and meal reduction. Peak harvests occurred from 1944-46 averaging 16,000 st each year, and stocks sharply declined thereafter, apparently due to over-exploitation.

Japanese markets for a salted herring roe product resulted in development of a sac roe fishery in the 1960's. Market demand and the relatively high prices paid to fishermen caused rapid expansion of the fishing fleet and harvest. Although Department management and research efforts lagged behind the rapid growth of the fishery, conservative management strategies and guideline harvest levels were established in response to historical over-exploitation of these fisheries.

This report: (1) provides results from the 1992 Lower Cook Inlet herring stock assessment program; (2) reviews and evaluates the 1992 sac roe harvest in Kamishak Bay District; and (3) presents preliminary biomass projections and management strategy for the 1993 herring fishing season.

A total of 2,282 short tons (st) of Pacific herring was landed in the Kamishak Bay District during 1992 (Figure 1, Tables 1-3). The

herring sac roe harvest was about 19% higher than the 1991 harvest of 1,922 st but only about one-third the record high catch of 6,132 tons set in 1987 (Table 3). Estimated exvessel value of the 1992 harvest was \$1.4 million (Table 3).

Of the 78 permits issued for Lower Cook Inlet, only 56 permit holders made deliveries in 1992. A total of 11 processors/buyers purchased herring this season and roe recoveries averaged 9.7% for the sac roe harvest (Table 1).

The total herring spawning biomass in the Kamishak Bay District, estimated from aerial surveys and post-season age composition analysis, was 24,077 st, over 46% higher than the preseason forecast of 16,431 st. Age composition differed significantly from the preseason projection, with recruitment of young fish (ages 4 and 5) over three times greater than forecasted.

No sac roe herring fishery occurred in the Southern District (Figure 2) in 1992 as fish were never present in sufficient numbers to allow a harvest. The Outer and Eastern Districts (Figure 2) were opened to purse seining for a six-hour period each day for approximately three weeks but few herring were observed by the one participating boat and spotter combination and no harvest occurred. The lack of interest by processors and fishermen in these areas was due to past years' predominance of young (age 3 and 4) fish, roe recoveries historically below 10%, and the exploratory nature of the fishery.

MANAGEMENT SUMMARY - 1992 SEASON

Assessment Methods

Aerial surveys were conducted throughout the herring spawning season to determine relative abundance and distribution of herring in the Kamishak Bay and Southern Districts. Data collection

methods were consistent with those used the previous two seasons. Numbers and distribution of herring schools, location and extent of milt, and visibility factors affecting survey results were recorded on index maps for each survey. Standard conversion factors of 1.52 st (water depths of 16 ft or less), 2.56 st (water depths between 16 and 26 ft) and 2.83 st (water depths greater than 26 ft) per 538 sq. ft were used to convert estimated herring school surface areas to biomass.

Survey conditions in the Kamishak Bay District were generally excellent throughout the early part of the season, with relatively few days hampered by low cloud ceilings, fog, or high winds. However, poor weather after the fishery in May limited surveys of the district for 18 consecutive days. Only 18 surveys were completed in the Kamishak Bay District, and 14 in the Southern District. No comprehensive surveys of the Outer and Eastern Districts were conducted this season.

In the Kamishak District, commercial landings were sampled to determine age, size, and sexual maturity of herring. In addition, test fishing by volunteer purse seine vessels was conducted to collect samples for roe recovery analysis prior to the fishery. Test fishing data was also used in post-season analysis to interpret aerial survey biomass data.

SPAWNING POPULATION

Kamishak Bay District

During the 1992 season aerial surveys to estimate biomass in the Kamishak Bay District were conducted from April 17 through June 10; herring were first observed April 22. Daily biomass estimates did not exhibit the normal trends in abundance i.e., build-up, peak, and decline. The highest daily biomass observations were made on April 30 (7,179 st), and May 1 (3,746 st). Unlike previous years,

there was no distinct separation in age composition of the population, where early fish showed a high proportion of older age fish and later fish showed a high proportion of younger fish. In fact, early test fish samples as well as commercial catch samples documented an unusually high percentage of age 4 fish this season.

Post-season data analysis from aerial surveys, test fishing, and commercial harvests resulted in a total spawning biomass estimate of 24,077 st (Table 3). This was considered a minimal estimate since an additional (undocumented) quantity of herring was known to be present during the first two weeks of May when aerial surveys were hampered by poor weather.

Only 6.5% of the total biomass (by weight) was composed of ages 9-14 herring. Ages 7-8 accounted for 14%, ages 5-6 herring 17.4%, while newly recruited ages 3 and 4 herring represented 62% of the total spawning population (Figure 4).

Limited spawning was observed from April 29 - May 21 throughout the district. Most observations of spawning were recorded between April 29 - May 1, but nearly all sightings were relatively few and small in size. The heaviest spawning was observed inside Bruin Bay on May 1 when an estimated 3.2 linear miles were recorded.

Southern District

A total of 14 aerial surveys of the Southern District were flown between April 27 and June 5, resulting in a final biomass estimate of 3,330 st. The majority of the herring were observed in Mud Bay, Bear Cove, and Mallard Bay, with the peak individual biomass survey (1,378 st) occurring on June 5. Peak surveys in areas where herring have historically been observed were as follows: Bear Cove, 333 st on June 5; Mallard Bay, 628 st on May 18; and 740 st east of the Homer Spit on June 5. No age composition or roe recovery samples were collected from the Southern District in 1992.

Outer and Eastern Districts

Only one partial aerial survey of the Outer and Eastern Districts was flown during the 1992 season. The size of the area and the characteristically poor weather in the Gulf of Alaska, which precludes surveys on a regular basis, makes aerial biomass estimation in these two districts impractical. However, incidental observations of herring in June during the early part of the salmon season confirmed the presence of herring in these two districts again this season.

COMMERCIAL FISHERY

Kamishak Bay District

Kamishak Bay was re-opened to commercial herring fishing in 1985 after a five-year closure beginning in 1980 due to a severe decline in abundance. The herring stocks appeared to rebound quickly in response to the closure, and since 1985, the Kamishak Bay District has been regulated to achieve a 10-20% exploitation rate mandated by the Board of Fisheries. By 1989, fishing efficiency had evolved to a level where intensive regulatory management was required to ensure maximum value of the harvest and maintain the guideline harvest level while protecting younger age fish. Management strategy during the last three years has stabilized the harvest at approximately one-third the record high catch of 6,132 tons set in 1987 (Table 3). Although management prior to 1990 allowed this fishery to be open on a specific calendar date, since that time, industry technicians have been asked to evaluate test fish samples for roe recovery prior to commercial harvests to help maximize product quality and value.

Pre-season management strategy in 1992 called for a guideline harvest level of 1,479 tons based on a 10% exploitation of the previous year's final biomass estimate. The conservative harvest

rate was selected because of concern regarding the low abundance of recruit age herring during 1990 and 1991.

This season only one open fishing period was allowed in the Kamishak Bay District on April 24, with a total fishing time of just 30 minutes in Management Areas 5 and 6 (Figure 1). The overall quality of the sac roe harvest suffered because of the large influx of young recruit-age herring into the population. This situation was unusual for the Kamishak Bay fishery where older (generally ripe) fish have historically dominated the early segment of the run.

Age composition and roe maturity were opposing factors in the staff's attempt to determine the optimum time for the opening. Test fishing sample results between April 21 and April 24 clearly indicated a decreasing trend in mean weight and an increasing abundance of younger age fish, as shown in the following table:

Date	Mean Wt.	% Age 4	Mature Roe %	Immature Roe %	% Ripe Females
4/21	192	37.1	6.8		40.9
4/22	182	39.0	9.6	3.9	48.0
4/23	180	43.8	10.6	1.5	41.3
4/24	152	61.4	10.3	0.5	40.6

Unfortunately, when the mean weight of the fish was highest and the older age classes dominated the population, the mature roe percentage was the lowest.

Another factor which compounded the problem and compromised the timing of the fishery was the shortage of tenders and processing vessels. Because most buyers were still finishing operations in the Prince William Sound herring fishery, the arrival of most

tenders in Kamishak Bay was delayed until the evening of April 23. Although most of the actual fishing fleet was present on the grounds, many tenders were still arriving throughout the day of the fishery and many companies still had not yet registered with the Department.

The calm sunny weather, uncharacteristic for Kamishak Bay, prevailed through Friday, April 24 but the marine weather forecast projected a significant deterioration in local weather conditions late that evening and continuing for several days. Because the forecasted poor weather (40k gale force winds) could have precluded the opportunity to conduct a fishery for some time, the staff concluded that further delay of the fishery would likely result in reduced roe recoveries due to the influx of younger (immature) fish and/or an increase in the number of spawn-outs. Since the management strategy attempts to minimize the harvest of younger age fish, and given the favorable weather conditions at the time, the decision was made to open the fishery that day. In retrospect, fishing probably should have occurred on April 23 to achieve maximum roe quality, when the mean weight of the fish was significantly higher. However, the industry was not adequately prepared to handle the catch until April 24.

Approximately 30 commercial spotter aircraft were present during the opening. Weather and water conditions allowed easy observation of herring from the air, and much of the seining was done with the aid of spotter airplanes. The bulk of the harvest occurred between Chenik Reef and Fortification Bluff with the total catch amounting to 2,282 st (Table 1). This was 800 st more than the preseason guideline but approximately 1,100 st less than the 1985-91 average catch (3,404 st) for Kamishak Bay District (Table 2).

Preliminary value of the Kamishak Bay District herring harvest to fishermen was estimated at \$1.4 million (Table 3). Sac roe prices were estimated at \$600 per short ton for 10% roe, plus or minus

\$100 for each 1.0% change. The estimated average roe recovery of 9.7% for the sac roe harvest yielded an exvessel price of \$570 per short ton without accounting for any post-season adjustments. Most companies paid an "on-grounds" base price with additional post-season settlements to be paid after price finalization with the foreign market.

By Board of Fisheries directive, the Kamishak Bay District herring fishery is managed with the intent of harvesting 10-20% of the available biomass. The overall exploitation was 9.5% of the estimated spawning biomass, based on a total harvest of 2,282 st and a total biomass estimate of 24,077 st.

Note: Staff proposal #2 would establish a formal management plan for the Kamishak Bay commercial sac roe herring fishery.

Southern District

Management strategy for the Southern District sac roe fishery was changed in 1989 to allow for a limited harvest of 150-200 st for the purposes of obtaining age, weight, length and roe recovery information. Sac roe herring had not been fished in the Southern District since 1979 when poor stock conditions forced an area-wide closure. Only one other fishery has occurred since that time, when 171 st of 8.9 percent herring were harvested by 10 vessels in one 2.5-hour opening in Mallard Bay during 1989.

A commercial harvest of sac roe herring was not allowed in the Southern District in 1992 because aerial surveys failed to document sufficient quantities of herring to warrant an opening.

Note: Proposal #358 seeks to establish a herring roe on kelp pound fishery in Kachemak Bay.

Outer and Eastern Districts

During the early years of sac roe herring fishing in Lower Cook Inlet, seining within the Outer and Eastern Districts primarily occurred in Resurrection Bay. Following a period of suspected overexploitation, herring stocks throughout Lower Cook Inlet generally declined after 1973. Concern over this decline prompted the Board of Fish and Game in 1974 to establish a 4,000-ton quota for all of Lower Cook Inlet with the Outer and Eastern Districts each allocated 1,000 st. The quotas were never utilized since stock abundance continued to decline, and the Outer and Eastern Districts were closed to fishing from 1975-1984.

In 1985, the sac roe fishery was allowed to resume in the Outer and Eastern Districts on a very conservative basis, even though no noticeable change in spawning biomass had been observed. Because of reduced stock abundance and extreme vulnerability to fishing, guideline harvest levels were set at 150-200 st for each of the four fishing areas created within these two districts (Figure 2). Fishing effort in 1985 was minimal and the majority of the harvest (216 st) once again occurred in Resurrection Bay (Table 2).

Only limited and sporadic harvests have occurred in these two districts since 1985, and the majority of both the herring harvest and the observed biomass during the past six years has been comprised of ages 3 and 4 fish. Unlike the Southern and Kamishak Bay Districts, samples from the Outer and Eastern Districts have contained up to 14% age 2 (sexually immature) herring. Although sampling has been limited, no discernable shift to older age herring has ever been observed, suggesting the possibility that the Outer and Eastern Districts may be feeding and rearing grounds for juvenile fish of Prince William Sound origin.

In 1991 the two districts were opened to purse seining for a six-hour period each day for three weeks; effort amounted to four boats

and one spotter aircraft. In 1992 the areas were again opened to fishing on a similar schedule, but only one boat and spotter expressed interest and put forth a very limited effort. Despite significant opportunity for exploratory fishing on a daily basis in the Outer and Eastern Districts for the past two seasons, the predominance of juvenile herring in the population, and the history of marginally acceptable roe recoveries from fish caught in these areas, has contributed to a lack of interest by fishermen and processors.

OUTLOOK AND MANAGEMENT STRATEGY FOR 1993

The 1993 spawning biomass of herring in Kamishak Bay District is projected to be 28,805 st or approximately 17% higher than the 1992 biomass (Figure 3, Table 3). A schedule of increasing natural mortality with age was used to project the 1993 return. Only 21% of the biomass is expected to be 7 years or older. The 1987 and 1988 year classes are projected to represent 78% of the biomass by weight (Figure 4). Given the forecasted age composition, the average weight of the fish would equal 172 g.

Limited data indicates an increase in the 1993 herring abundance due to a significant recruitment of young (age 4) fish into the population in 1992. Although stocks appear to be building, solid confirmation of this trend is warranted before harvest rates will be increased. In keeping with the proposed management plan, a 10% exploitation rate was used to set the guideline harvest level for the 1993 season since 66% of the biomass is still expected to be age 5. Based on the 1992 biomass estimate of 24,077 st, a surplus of approximately 2,400 st would be available for harvest. Harvest allocation in accordance with the (draft) management plan would be as follows:

		<u>Tons</u>
TOTAL ALLOWABLE HARVEST	(10%)	2,400
SHELIKOF STRAITS FOOD & BAIT	(1%)	240
KAMISHAK BAY SAC ROE HARVEST	(9%)	2,160

The model used to prepare the 1993 forecast has a performance history of underestimating the actual biomass 62.5% of the time, or nearly two out of every three forecasts. Given the performance history of the forecast and the limited data base, the pre-season projections should be used with caution.

Table 1. Commercial purse seine catch of sac roe herring in short tons, and average roe recovery by statistical area, Kamishak Bay District, Lower Cook Inlet, 1992.

Statistical Area & Location	No. of Permits	No. of Landings	Tons	Roe %
249-45 Kamishak/Douglas Reefs & Mushroom Islet	4	4	248.0	9.2
249-50 McNeil Cove	a	1	52.0	8.7
249-55 Chenik Reef to Fortification Bluff	45	50	1,659.4	9.7
249-75 Contact Point	6	9	322.2	10.2

^a To comply with AS 16.05.815. **CONFIDENTIAL NATURE OF CERTAIN REPORTS AND RECORDS**, effort data has been masked where fewer than four vessels fished in a given area.

Table 2. Commercial catch of Pacific herring by district, in short tons, Lower Cook Inlet, 1962-1992.

Year	Southern	Kamishak	Eastern	Outer	Total
1962	0	0	0	0	0
1963	1	0	0	0	1
1964	0	0	0	0	0
1965	2	0	0	0	2
1966	0	0	7	0	7
1967	0	0	0	0	0
1968	20	0	0	0	20
1969	551	0	758	38	1,347
1970	2,709	0	2,100	0	4,809
1971	13	0	831	0	844
1972	1	0	30	0	31
1973	204	243	831	301	1,579
1974	110	2,114	47	384	2,655
1975	24	4,119	-	-	4,143
1976	0	4,842	-	-	4,842
1977	291	2,908	-	-	3,199
1978	17	402	-	-	419
1979	13	415	-	-	428
1980	-	-	-	-	-
1981	-	-	-	-	-
1982	-	-	-	-	-
1983	-	-	-	-	-
1984	-	-	-	-	-
1985	-	1,132	204	12	1,348
1986	-	1,959	167	28	2,154
1987	-	6,132	584	202	6,918
1988	-	5,548	0	57	5,605
1989	170	4,801	0	0	4,971
1990	-	2,264	-	-	2,264
1991	-	1,992	-	-	1,992
1992	-	2,282	-	-	2,282
Average					
1962-1991	217	1,555	309	57	1,983
1962-1976	242	755	354	56	1,352
1977-1991	123	2,755	191	60	2,930

Table 3. Estimated herring biomass and commercial purse seine catch of herring in short tons, exploitation rates, average roe recovery, number of permits fished, and exvessel value in millions of dollars, Kamishak Bay District, Lower Cook Inlet, 1978 - 1992.

Year	Spawning Biomass ^a	Commercial Catch	Total Biomass	Percent Exploitation	Average Roe %	No. of Permits	Exvessel Value ^b
1978	800	402	1,202	33.4	-	44	^c
1979	2,900	415	3,315	12.5	-	^c	^c
1980	-	0	-	-	-	-	-
1981	5,130	0	5,130	-	-	-	-
1982	4,835	0	4,835	-	-	-	-
1983	4,750	0	4,750	-	-	-	-
1984	2,885 ^d	0	6,500	-	-	-	-
1985	12,188	1,132	13,320	8.5	11.3	23	1.0
1986	24,042	1,959	26,001	7.5	10.4	54	2.2
1987	29,200	6,132	35,332	17.4	11.3	63	8.4
1988	24,000	5,548	29,548	18.8	11.1	75	9.3
1989	30,900	4,801	35,701	13.5	9.5	75	3.5 ^e
1990	17,400	2,264	19,650	11.5	10.8	75	1.8
1991	16,171 ^f	1,992	18,163 ^f	11.0	11.3	58	1.3
1992	21,795	2,282	24,077	9.5	9.7	56	1.4
1978-91 Avg. ^g	13,477	1,896	15,650	12.1	10.8	58	3.9

^a Spawning biomass estimates are minimal estimates based on aerial surveys.

^b Exvessel values exclude any postseason retroactive adjustments.

^c Data not available.

^d Spawning had already begun on first survey. Total spawning biomass estimate was higher than the peak survey estimate of 2,885 tons.

^e Includes retroactive adjustment.

^f Due to poor aerial survey conditions, 1991 biomass was calculated from the preseason estimate of abundance, adjusted to match observed age composition samples in the 1991 catch.

^g Average excludes 1980 when no data was available.

Table 4. Total biomass estimate and commercial catch of Pacific herring in short tons by age class, Kamishak Bay District, Lower Cook Inlet, 1992, and 1993 forecast.

Age	1992 Estimated Biomass	1992 Commercial Harvest	Percent by Weight	1993 Forecast Biomass	Percent by Weight
1					
2					
3	100.2	9.5	0.4	0	0
4	11,210.7	1,062.4	46.6	358	1.2
5	3,359.8	318.4	14.0	19,109	66.3
6	1,266.3	120.0	5.3	3,659	12.4
7	1,307.4	123.9	5.4	1,522	5.3
8	3,852.6	365.1	16.0	908	3.2
9	1,520.6	144.1	6.3	1,899	6.6
10	408.4	38.7	1.7	885	3.1
11	611.0	57.9	2.5	166	0.6
12	93.9	8.9	0.4	153	0.5
13	111.9	10.6	0.5	33	0.1
14	234.3	22.2	1.0	45	0.2
15	0	0	0	160	0.6
TOTAL	24,077	2,281.6	100.0	28,805	100.0

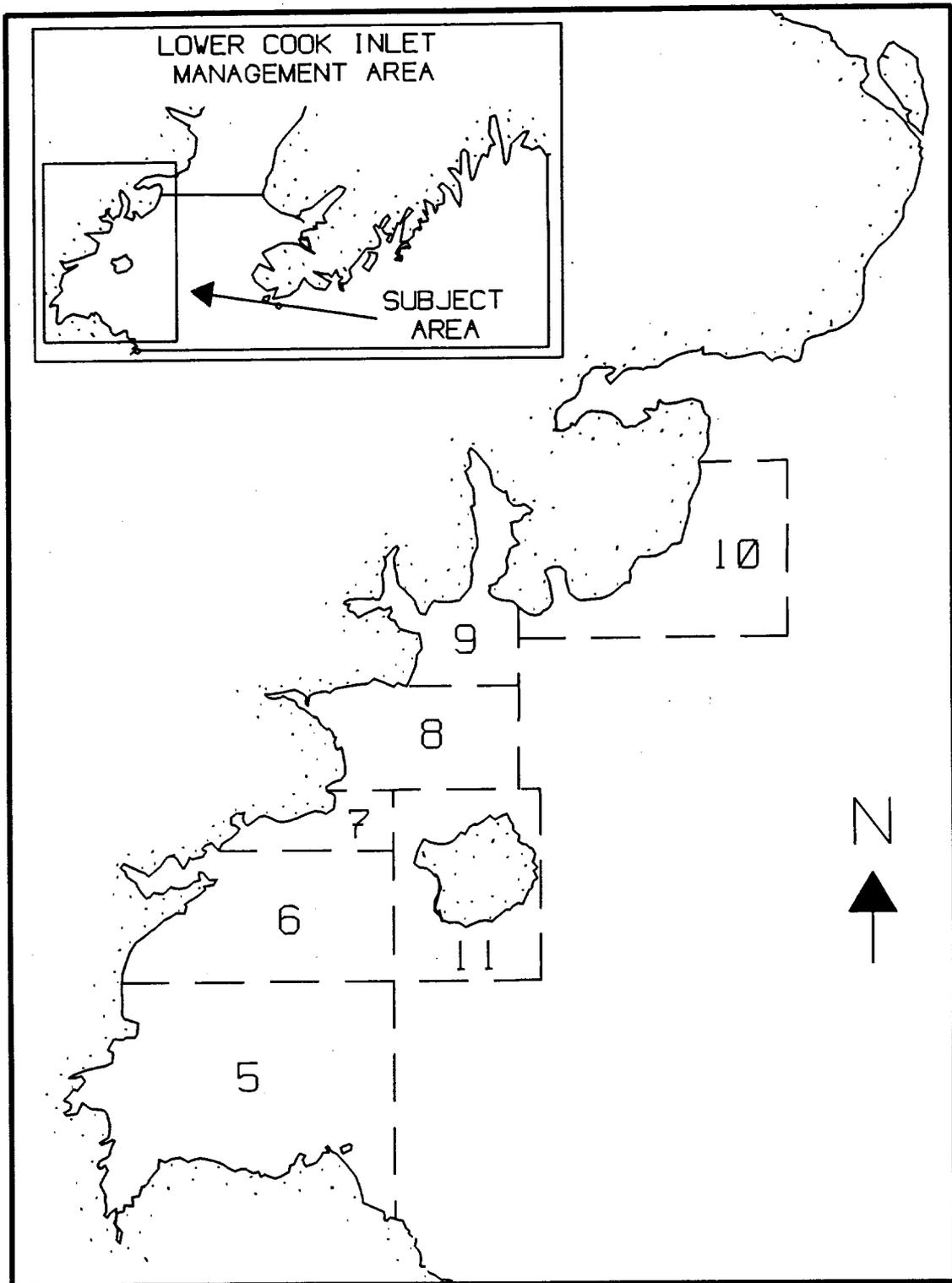


Figure 1. Commercial herring fishing areas, Kamishak Bay District, Lower Cook Inlet.

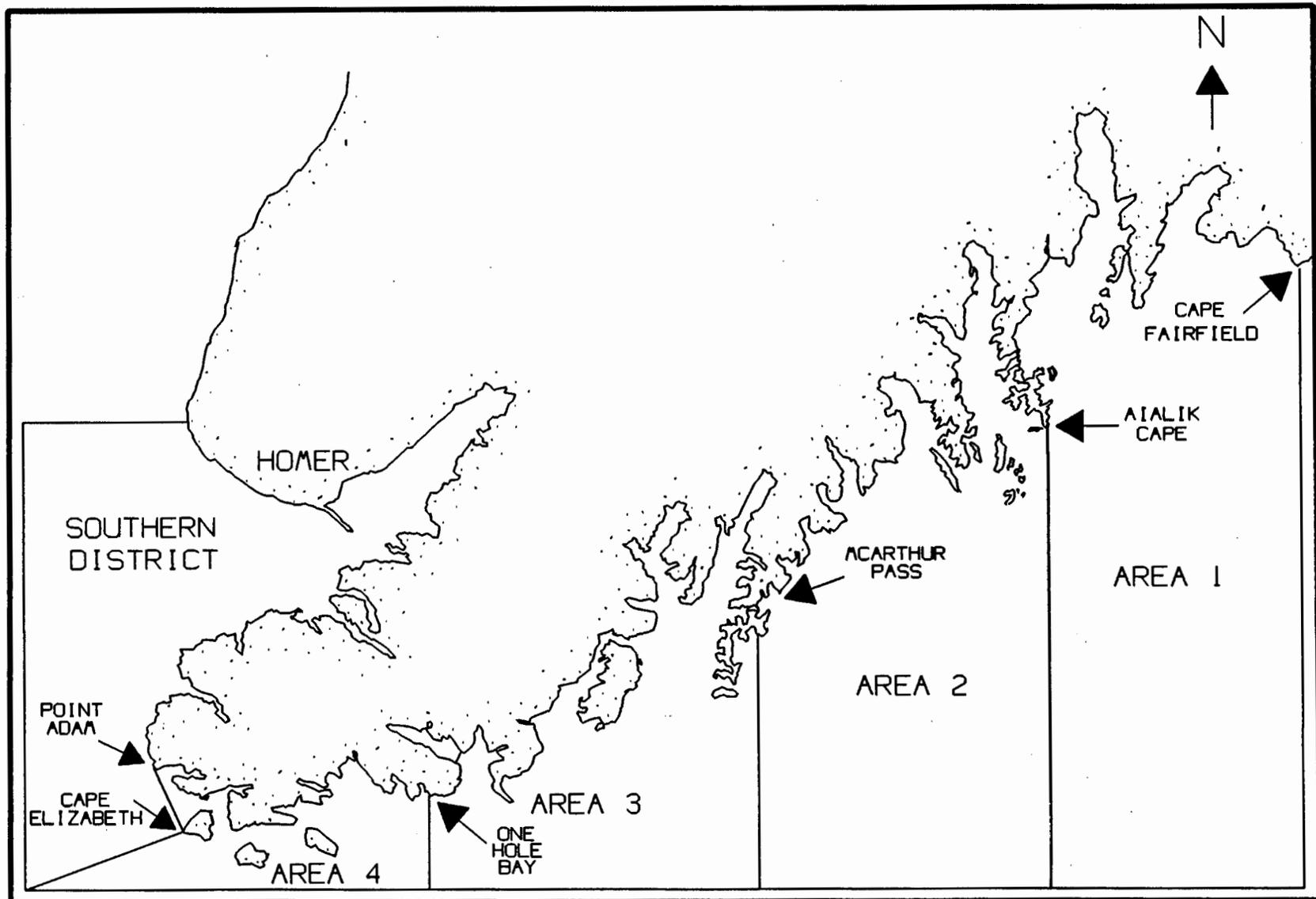


Figure 2. Commercial herring fishing areas, Outer, Eastern, and Southern Districts, Lower Cook Inlet.

KAMISHAK BAY DISTRICT HERRING BIOMASS

TOTAL INSHORE RETURNS 1978-92 and 1993 FORECAST

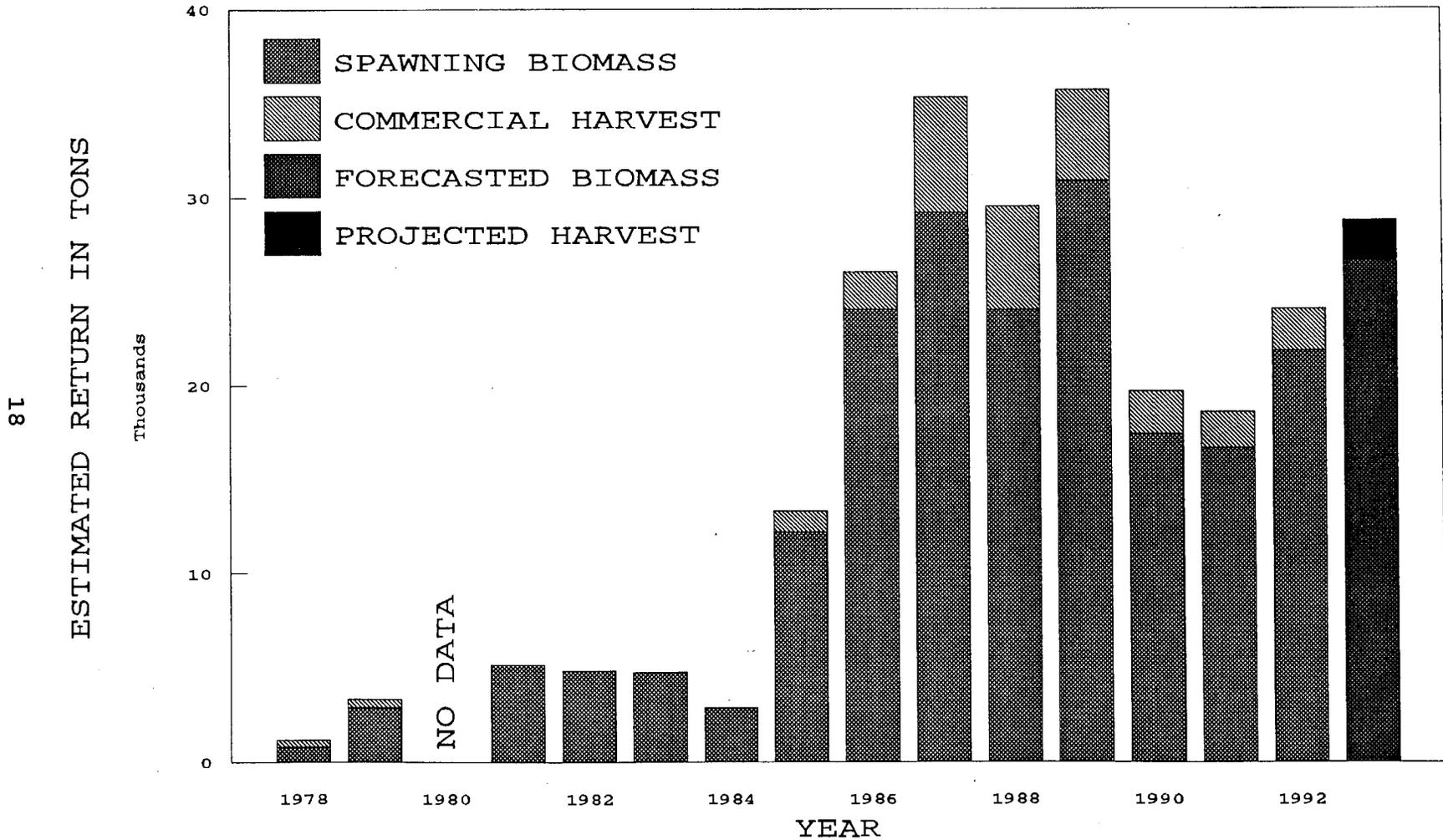


Figure 3. Biomass estimates and commercial harvests of Pacific herring in the sac roe seine fishery, Kamishak Bay District, Lower Cook Inlet, 1978-1992, and 1993 projection.

KAMISHAK BAY DISTRICT HERRING AGE CLASS

1992 Observed and 1993 Predicted

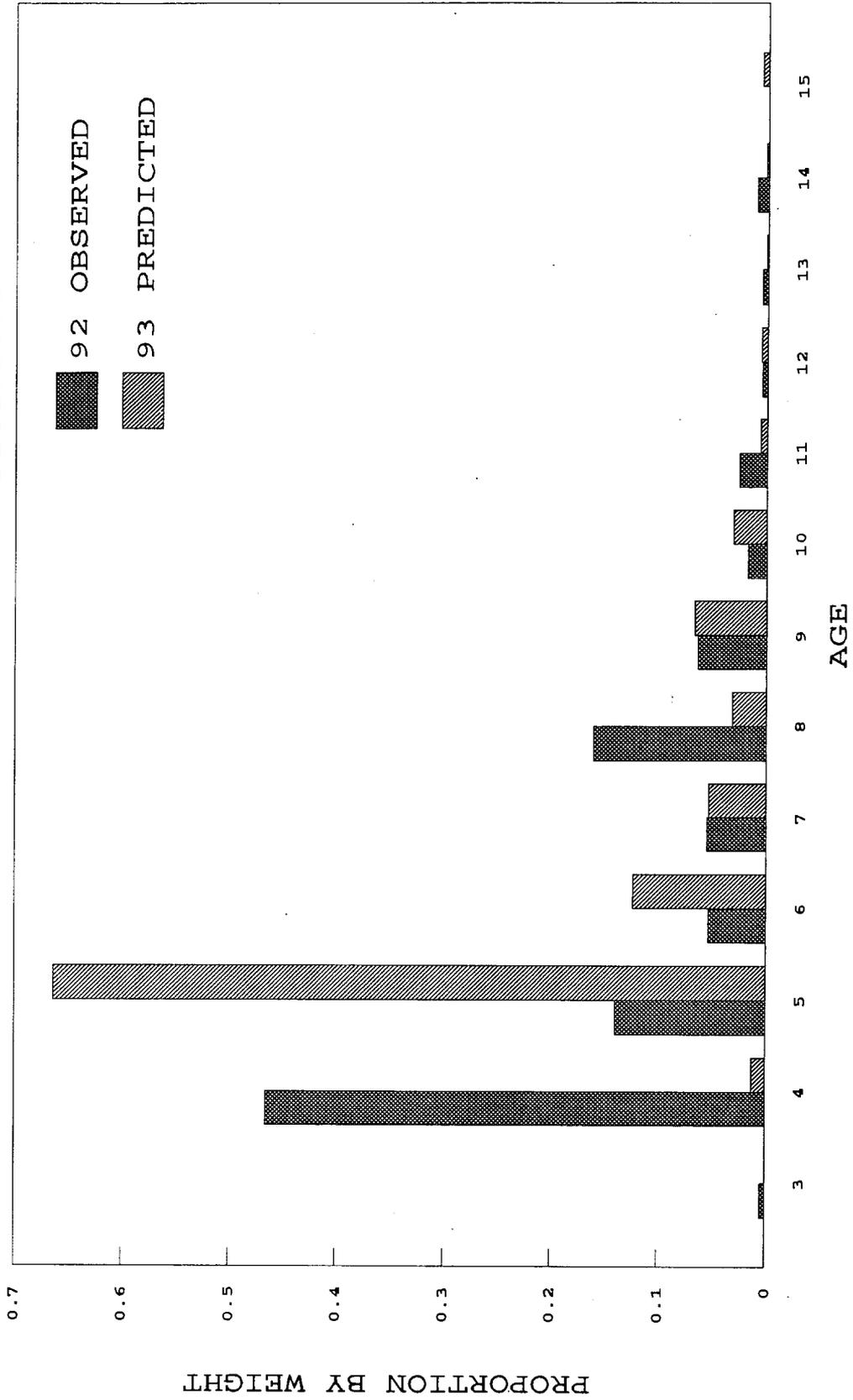


Figure 4. Observed age composition in the Pacific herring commercial sac roe harvest, Kamishak Bay District, Lower Cook Inlet, 1992, and the 1993 predicted age composition.

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