

REGIONAL INFORMATION REPORT NO. 5J93-06



**Preliminary Forecasts Of Catch and Stock Abundance
for 1993 Alaska Herring Fisheries**

Edited

by

Fritz Funk

May 1993

The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports. These reports frequently serve diverse ad hoc informational purposes or archive basic uninterpreted data. To accommodate timely reporting of recently collected information, reports in this series undergo only limited internal review and may contain preliminary data; this information may be subsequently finalized and published in the formal literature. Consequently, these reports should not be cited without prior approval of the author or the Division of Commercial Fisheries.

PRELIMINARY FORECASTS OF CATCH AND STOCK ABUNDANCE FOR 1993

ALASKA HERRING FISHERIES

Edited

By

Fritz Funk

REGIONAL INFORMATION REPORT NO. 5J93-06

Alaska Department of Fish and Game
Division of Commercial Fisheries
P.O. Box 25526
Juneau, Alaska 99802-5526

May 1993

EDITOR

Fritz Funk is statewide herring biometrician for the Alaska Department of Fish and Game, Division of Commercial Fisheries, P.O. Box 25526, Juneau, AK 99802-5526.

ACKNOWLEDGMENTS

This report is based on information contributed by Division of Commercial Fisheries biologists and biometricians located in offices throughout the state. Many of area research and management biologists, other than the authors of individual sections, supplied summaries of the 1992 fishing season, informal harvest outlooks, and other information incorporated in this report.

TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	vi
LIST OF FIGURES	viii
ABSTRACT	x
INTRODUCTION	1
SOUTHEAST REGION	5
Introduction	7
Southeast Alaska Winter Food/Bait Fishery	8
Southeast Alaska Sac Roe Herring Fisheries	9
Southeast Alaska Spawn-on-Pound-Kelp Fisheries	10
CENTRAL REGION	13
Prince William Sound Sac Roe, Spawn-on-Kelp, and Food/Bait Fisheries	15
Lower Cook Inlet Herring Fishery	16
Togiak District, Bristol Bay, Sac Roe, and Spawn-on-Kelp Fisheries	18
ARCTIC-YUKON-KUSKOKWIM REGION	23
Introduction	25
Security Cove Sac Roe Fishery	27
Goodnews Bay Sac Roe Fishery	29
Cape Avinof Sac Roe Fishery	30
Nelson Island Sac Roe Fishery	31
Nunivak Island Sac Roe Fishery	32
Cape Romanzof Sac Roe Fishery	33
Norton Sound Sac Roe Fishery	35
Port Clarence Sac Roe Fishery	37
WESTWARD REGION	39
Kodiak Food/Bait Fishery	41
Kodiak Sac Roe Fishery	41
Port Moller (North Peninsula) Sac Roe Fishery	42
South Peninsula Sac Roe Fishery	43
Dutch Harbor Food/Bait Herring Fishery	43
LITERATURE CITED	44

LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Summary of 1992 Alaska statewide harvests and values for sac roe, spawn-on-kelp, and food/bait herring fisheries	46
2. Preliminary forecasts of harvest and abundance for 1993 Alaska sac roe herring fisheries	47
3. Preliminary forecasts of harvest and abundance for 1993 Alaska spawn-on-kelp and food/bait herring fisheries	48
4. Summary of harvest, value and participation in 1992 Alaska sac roe herring fisheries by fishery area	49
5. Summary of harvest, value and participation in 1992 Alaska food/bait herring fisheries by fishery area	50
6. Summary of harvest, value and participation in 1992 Alaska spawn-on-kelp herring fisheries by fishery area	51
7. Glossary of some terminology used in describing herring stock assessment	52
8. Summary of harvest policy and fishery regulations for Alaska sac roe herring fisheries	53
9. Summary of Alaska harvest policy and fishery regulations for Alaska spawn-on-kelp and food/bait herring fisheries	54
10. Alaska herring fisheries, area management offices and fishery managers to contact for additional information	55
11. Herring spawning threshold levels for major herring stocks in Southeast Alaska and Yakutat	56
12. Southeast Alaska sac roe herring harvest by area in tons, 1971–1992	57
13. Summary of Southeast Alaska spawn deposition information for 1992	58
14. Projection of the spawning biomass for Prince William Sound in 1993	59
15. Allocation of allowable harvest for Prince William Sound in 1993	60
16. Forecast of 1993 Kamishak District herring abundance and projected harvest by age class	61
17. Allocation of the projected 1993 Kamishak Bay herring harvest	62
18. Togiak District year class composition of the 1992 Pacific herring harvest, escapement, and total run biomass and the 1993 projected biomass	63
19. Security Cove District year/age class composition of the 1992 Pacific herring harvest, escapement, and total run biomass and the 1993 projected biomass by weight and number of fish	64
20. Goodnews Bay District year/age class composition of the 1992 Pacific herring harvest, escapement, and total run biomass and the 1993 projected biomass by weight and number of fish	65
21. Cape Avinof District year/age class composition of the 1992 Pacific herring harvest, escapement, and total run biomass and the 1993 projected biomass by weight and number of fish	66

LIST OF TABLES (Continued)

<u>Table</u>	<u>Page</u>
22. Nelson Island District year/age class composition of the 1992 Pacific herring harvest, escapement and total run biomass and the 1993 projected biomass by weight and number of fish	67
23. Nunivak Island District year/age class composition of the 1992 Pacific herring escapement, and total run biomass and the 1993 projected biomass by weight and number of fish	68
24. Cape Romanzof District year/age class composition of the 1992 Pacific herring harvest, escapement, and total run biomass and the 1993 projected biomass by weight and number of fish	69
25. Norton Sound District year/age class composition of the 1992 Pacific herring harvest, escapement, and total run biomass and the 1993 projected biomass by weight and number of fish	70

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. Locations of Alaska herring fisheries	71
2. Alaska Department of Fish and Game management regions and herring regulatory statistical areas	72
3. Herring harvests from all Alaska herring fisheries, 1930–1992, with the projected 1993 harvest	73
4. Alaska sac roe herring harvests from all areas, 1978–1992, with the projected 1993 sac roe harvest	74
5. Harvest policy for Southeast Alaska herring fisheries, showing the relationship between allowable exploitation rate and the mature biomass, expressed as a multiple of the established threshold level	75
6. Map of Prince William Sound, Alaska and the major herring spawning areas	76
7. Abundance estimates and thresholds for Prince William Sound herring, 1973–1993	77
8. Forecast age distribution and average weight in the purse seine and gillnet harvests in Prince William Sound for 1993	78
9. Recruitment time series (year class size at age 3) for Prince William Sound	79
10. Spawner-recruit information for Prince William Sound herring	80
11. Kamishak Bay, Southern, Outer, and Eastern Districts of the Lower Cook Inlet management area	81
12. Kamishak District herring biomass by year, 1979, 1986–1993	82
13. Estimates of abundance for Togiak District herring from aerial surveys and from the age-structured assessment (ASA) model, showing the threshold level below which fishing is not allowed	83
14. Age distribution of the Togiak District herring population by number, in 1992 (top) and projected for 1993 (bottom)	84
15. Age distribution of the Togiak District herring biomass by weight, observed in 1992 (top) and projected for 1993 (bottom)	85
16. Security Cove District herring biomass, 1981–1992, with 1993 projected biomass (*) (top), and age composition by weight of the 1993 projected biomass (bottom), showing the projected average weight at age	86
17. Goodnews Bay District herring biomass, 1981–1992, with 1993 projected biomass (*) (top), and age composition by weight of the 1993 projected biomass (bottom), showing the projected average weight at age	87
18. Cape Avinof District herring biomass, 1985–1992, with 1993 projected biomass (*) (top), and age composition by weight of the 1993 projected biomass (bottom), showing the projected average weight at age	88
19. Nelson Island District herring biomass, 1985–1992, with 1993 projected biomass (*) (top), and age composition by weight of the 1993 projected biomass (bottom), showing the projected average weight at age	89
20. Nunivak Island District herring biomass, 1985–1992, with 1993 projected biomass (*) (top), and age composition by weight of the 1993 projected biomass (bottom), showing the projected average weight at age	90

LIST OF FIGURES (Continued)

<u>Figure</u>		<u>Page</u>
21.	Cape Romanzof District herring biomass, 1980–1992, with 1993 projected biomass (*) (top), and age composition by weight of the 1993 projected biomass (bottom), showing the projected average weight at age	91
22.	Norton Sound District herring biomass, 1980–1992, with 1993 projected biomass (*) (top), and age composition by weight of the 1993 projected biomass (bottom), showing the projected average weight at age	92

ABSTRACT

The Pacific herring *Clupea pallasii* sac roe harvest in Alaska for 1993 is projected to be 76,063 tons (ton=2,000 pounds). Herring food/bait harvests for 1993 are projected to be 9,938 tons. Herring spawn-on-pound-kelp fisheries are expected to produce 335 tons of product and spawn-on-wild-kelp harvests are expected to produce an additional 443 tons. The projected sac roe, food/bait, and spawn-on-kelp harvests are expected to increase from the 1992 levels. The 1992 herring harvest had an estimated value to fishermen of \$31,504,867. Of the total 1992 value, sac roe fisheries contributed \$25,160,330, spawn-on-pound-kelp fisheries \$3,722,000, food/bait fisheries \$2,135,156, and spawn-on-wild-kelp fisheries \$487,381. Excellent recruitment from the 1988 year class in most areas has caused stock levels to increase. In many areas the 1988 year class appears to be the largest on record. This strong year class will be age 5 for the 1993 harvest.

KEY WORDS: Herring, *Clupea pallasii*, herring harvest projection, herring stock assessment, herring sac roe fishery, herring food/bait fishery, herring spawn-on-kelp fishery

INTRODUCTION

Commercial sac roe and food/bait fisheries for Pacific herring *Clupea pallasii* are conducted in more than 20 locations in Alaska (Figure 1). This publication summarizes the 1992 commercial fisheries in each of the areas and describes harvest projections for the 1993 commercial herring fishing season. Harvest and forecast summaries for individual herring fishing areas in this report are grouped by four management regions which are defined for administrative and regulatory purposes (Figure 2).

Herring Management and Harvest Policies

The Alaska Constitution mandates that fisheries resources are to be managed on a sustained yield basis. To ensure sustained yield and prevent localized depletion, most herring fisheries in Alaska are regulated in units or *regulatory stocks* (i.e., geographically distinct spawning aggregations defined by regulation). Those aggregations may occupy areas as small as several miles of beach or as large as all of Prince William Sound.

Herring sac roe and spawn-on-kelp fisheries are always prosecuted on individual regulatory stocks. Management of food/bait herring fisheries is more complicated because they are conducted in the fall and winter when herring from several regulatory stocks may be mixed together. If more than one herring fishery harvests a particular regulatory stock, Alaska Board of Fisheries regulations usually allocate percentages of the allowable harvest to each fishery.

In general, Alaska herring fishery quotas are based on a variable exploitation rate harvest policy. The Alaska Board of Fisheries has established a maximum exploitation rate (fraction of the spawning population removed by the fishery) of 20%. Fisheries are closed if stock size falls below the *threshold level*—the minimum stock size thought necessary to guarantee sustained yield from the stock. Lower exploitation rates are used when herring stocks decline to near-threshold levels. In some areas, the amount that the exploitation rate is reduced when stocks decline has been explicitly specified by the Board of Fisheries. The exploitation rate is multiplied by the forecast biomass to determine the annual quota. Occasionally a harvest quota is modified if new biomass information becomes available before the fishery begins.

The Alaska Board of Fisheries also sets regulations that control the types and amounts of fishing gear that may be used, allocates the allowable harvest among user groups, and sets the range of dates allowed for fisheries. Within the Board's harvest policy framework, the Alaska Department of Fish and Game (ADF&G) sets the allowable harvest each season based on stock size. ADF&G also determines the exact opening and closing times each season. For sac roe fisheries, openings are timed to occur when herring have produced the maximum amount of roe. The duration of openings is also set to achieve harvest quotas as closely as possible. Entry into most herring fisheries in Alaska has been limited under the authority of the Commercial Fisheries Entry Commission (CFEC).

Stock Assessment and Forecast Methods

For major herring stocks, ADF&G conducts detailed stock assessment programs and makes formal projections of the expected biomass and harvests for the upcoming year. These programs and projections are described in detail for areas in which they occur.

Two primary methods are used to estimate herring abundance in Alaska. The spawn deposition survey method back-calculates herring abundance from the number of eggs deposited. When herring have completed spawning, ADF&G divers estimate the density of eggs deposited, the area of the spawning beds, and the total number of eggs deposited. Estimates of fecundity are then used to convert the number of eggs into the number of spawning female herring; estimates of the sex ratio and weights of herring are used to convert the number of females into total spawning biomass.

In the aerial survey method of estimating abundance, ADF&G biologists observing from small aircraft estimate the surface area of herring schools. These areas are converted into biomass using data from individual schools that were captured by purse seines and weighed after aerial surveyors estimated the surface area of the school. Typically, herring accumulate on the spawning grounds over a number of days prior to spawning, and so only the peak biomass observed during the buildup is used. At the end of the season the peak biomasses from each "spawning event" are added together to estimate the total spawning biomass for the season. The peak biomass accounting method becomes complicated when herring from more than one spawning event are present in one area. When this occurs, information about age and size composition is used to attempt to distinguish the herring associated with each spawning event.

For smaller stocks, detailed stock assessment programs are not conducted, and ADF&G prepares informal harvest outlooks based on recent average harvest levels and other available information. While harvest projections represent what is thought to be the best use of the available information, caution is advised in the interpretation of the results. Many of the projections are based on preliminary information, and harvests have on occasion been substantially different from initial projections.

Herring forecasts for 1993 are based on projecting the spring 1992 biomass estimates forward to 1993, accounting for growth, mortality, harvest removals, and recruitment over the year. While there is some uncertainty in each of these factors, recruitment—i.e., the number of newly-matured fish returning to spawn for the first time—may vary tremendously from year to year. Only a fraction of herring are sexually mature and recruited to the fishery by the time they are three years old. In Gulf of Alaska areas most herring are recruited by age 4, but in the Bering Sea herring are not fully recruited until at least age 5. Projections are most reliable for herring year classes which are fully recruited, i.e. older age groups. Forecasts for some Alaska herring stocks attempt to predict the number of herring which will recruit for the first time, but the reliability of these predictions is not high. In other areas recruitment is conservatively assumed to be zero.

In a few instances additional growth and age composition information is obtained from overwintering herring stocks which is used to further refine recruitment estimates.

Statewide Harvest Trends

The largest harvests of Alaska herring occurred during the reduction fisheries in the 1930s, and during the foreign herring fishery in the Bering Sea in the late 1960s (Figure 3). Reduction plants, which processed herring for fish meal and oil, ceased production by the mid-1960s. When domestic inshore sac roe fisheries began to fully utilize Bering Sea herring around 1980, foreign harvests were eliminated under provisions of the Magnuson Fishery Management and Conservation Act. Since that time, statewide commercial harvests in all herring fisheries have averaged about 50,000 tons (tons=2,000 lbs). In recent years sac roe fisheries have accounted for about 85% of the total herring harvest, averaging about 42,000 tons annually (Figure 4).

The 1992 herring harvest had an estimated value to fishermen of \$31,504,867 (Table 1) which was slightly higher than the 1991 value of \$27,622,539. Of the total 1992 value, sac roe fisheries contributed \$25,160,330, spawn-on-pound-kelp fisheries \$3,722,000, food/bait fisheries \$2,135,156, and spawn-on-wild-kelp fisheries \$487,381.

The total harvest for 1993 is projected to be 76,063 tons of herring from sac roe fisheries (Table 2) and an additional 9,938 tons from food/bait herring fisheries (Table 3). Herring spawn-on-kelp fisheries are projected to harvest 778 tons of herring spawn on kelp. The projected 1993 herring sac roe catch is larger than the 1992 harvest of 63,992 tons of herring (Table 4). The projected 1993 herring bait harvest is also larger than the 8,835 tons harvested in 1992 (Table 5). The 1993 projected spawn-on-kelp harvest is slightly larger than the 1992 harvest (Table 6).

Excellent recruitment from the 1988 year class in most areas has caused stock levels to increase. In many areas the 1988 year class appears to be the largest on record. This strong year class will be age 5 in the 1993 harvest.

Additional Forecast and Regulatory Information

A number of specialized terms used in this report are defined in Table 7. All harvests and biomasses in this report are reported in tons (2,000 lbs), units used extensively in the herring industry. The 1992 harvest totals refer to the January 1, 1992 to December 31, 1992 calendar year. However, the seasons for some food/bait herring fisheries occasionally span into the early part of the following calendar year. In recent years this has only occurred for the Kodiak food/bait herring fishery. For the 1992-93 Kodiak food/bait herring fishery all of the harvest occurred during 1992 although the fishery technically remained open during early 1993.

A booklet describing regulations for all of Alaska's herring fisheries is available from ADF&G offices. Summaries of harvest policies and regulations for Alaska sac roe herring fisheries are given in Table 8 and for Alaska spawn-on-kelp and food/bait herring fisheries in Table 9. The management of many herring fisheries is further described in fishery management plans. In some cases, these management plans are regulations adopted by the Alaska Board of Fisheries and appear in the herring regulation booklet. In other cases, separate fishery management plan publications are available from the area management offices near where the fishery occurs.

For many herring fisheries, fishermen and processors are required to register with the local fishery area manager prior to the start of the fishing season. For each principal herring fishery, Table 10 lists the appropriate fishery manager to contact for more information about the fishery. During the herring season prerecorded telephone messages describing the progress of the herring fisheries are available from most ADF&G area offices. These telephone numbers are also listed in Table 10.

SOUTHEAST REGION

AUTHORS

Robert C. Larson
Fishery Biologist
Petersburg

David W. Carlile
Biometrician
Douglas

SOUTHEAST REGION

Introduction

Herring have been commercially harvested in Southeast Alaska since the 1880s. From the 1890s to the mid-1960s the catch was used primarily for reduction to meal and oil. The reduction fishery occurred on mixed stocks of feeding herring during the summer months. The reduction fishery production peaked during the 1920s and 1930s when annual harvests commonly exceeded 100,000 tons. The reduction industry was phased out in the mid-1960s because of a decline in the abundance of herring combined with the development of the Peruvian anchovy reduction industry.

The commercial utilization of Southeast Alaska herring resources is very controversial. Although the subsistence and personal use harvest levels are a minor portion of the total annual catch, they are important to local residents. Commercial harvesting is viewed as reducing the local availability of herring. Additionally, herring are a major forage fish, and their abundance is necessary to ensure healthy populations of predatory fish, such as salmon and halibut.

Currently most of the annual herring harvest is taken in the spring sac roe fishery which developed in the early 1970s. The sac roe fishery takes herring immediately prior to spawning when egg maturity is highest. A spawn-on-wild-kelp fishery occurred during the 1960s; however, this fishery was phased out in the early 1970s. New herring spawn-on-pound-kelp fisheries were approved by the Alaska Board of Fisheries to begin in Hoonah Sound in the spring of 1990 and in the Craig area in the spring of 1992.

Southeast Alaska herring supply a substantial proportion of the statewide needs for bait in longline and crab fisheries. Bait harvests occur during the fall and winter months when herring are in a condition best suited for bait. Most of the bait harvest is taken by purse seine gear. Relatively small quantities of herring are harvested in a fresh bait pound fishery, where herring are captured with purse seines and held alive in net enclosures until the bait is needed. Existing regulations also provide for a herring fishery to produce frozen tray packs of herring bait for use in sport and commercial troll salmon fisheries. However, no harvest has occurred for this purpose in recent years.

The management approach for Southeast Alaska herring fisheries is based on assessing populations to ensure that minimum spawning threshold levels are met prior to allowing a harvest. Current threshold levels range from 1,000 tons for the herring harvested in the Hoonah Sound spawn-on-pound-kelp fishery to 7,500 tons for the Sitka Sound sac roe fishery (Table 11).

Herring stocks with a spawning biomass of less than 2,000 tons, of which there are many, are not opened for harvesting in either the Southeast Alaska winter bait or sac roe fisheries. Under

the current harvest policy, a herring stock of 2,000 tons of adult fish would allow for an annual harvest of 200 tons of herring. Harvests cannot be reliably constrained to amounts smaller than 200 tons because of the large number of highly efficient fishing vessels involved. However, a winter bait harvest of 100 tons has been allowed in the Yakutat area where low fishing effort has allowed smaller harvests to be adequately controlled.

Annual harvest quotas are determined from a variable exploitation rate harvest policy. A 10% exploitation rate is allowed if a stock is just above the threshold level. At larger stock sizes the exploitation rate increases, up to a maximum of 20% when the biomass is 6 times the threshold level. The increases in exploitation rate amount to adding 2% to the exploitation rate every time the spawning biomass increases by an amount equal to the threshold (Figure 5).

To determine 1993 harvest levels in Southeast Alaska, the exploitation rate was applied to the spring 1992 spawning biomass. The 1992 herring populations were not projected forward to 1993, but the biomass in 1993 will be similar to that of 1992 when the processes of recruitment and growth balance natural mortality. In general, natural mortality and growth are relatively constant from year, whereas recruitment can vary by several orders of magnitude.

Spawn deposition surveys are the primary stock assessment method used in Southeast Alaska. Herring spawn deposition surveys were conducted in eight areas during the spring of 1992.

The 1988 year class remains a strong component of all the northern Gulf of Alaska herring stocks, from northern British Columbia to Kodiak, including Southeast Alaska stocks. As a result of this strong year class, many stocks are at or near historical high levels. The last strong year class resulted from eggs spawned in 1984, and there is some evidence that the 4-year abundance cycle may be continuing, particularly for Sitka Sound herring. During the summer 1992 salmon purse seine season there were a number of anecdotal accounts of large numbers of young-of-the-year herring (1992 year class) present in Sitka Sound and other areas of northern Southeast Alaska.

Southeast Alaska Winter Food/Bait Fishery

Winter herring fishing is allowed by regulation in Districts and Sections 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11-B, 11-C, 12, 13-A, 13-B (only south of the latitude of Aspid Cape), 13-C, 14, 15-A, and 16 in the Southeast Alaska Area and in the entire Yakutat Area. The general fishing season is specified to be from October 1 through February 28 in both areas. In the Southeast Alaska Area regulations specify the actual open fishing periods to be established by emergency order. In recent years, all of the harvest has occurred during the month of January. Although the existing regulations specify purse seines, set gillnets, and trawls as legal allowable gear, only purse gear has been actively fished in recent years.

Three locations were identified as having harvestable quantities of bait herring for January 1992 openings. The Craig/Klawock herring stock had an estimated spawning biomass of 17,800 tons in 1991, which produced a quota of 2,281 tons for the traditional harvesting areas of Bocas de Finas/Meares Pass. Surveys conducted in the Lisianski Inlet and Port Houghton/Hobart Bay areas determined that stocks were just above threshold levels, allowing for a harvest of 250 tons at Lisianski Inlet and 200 tons at Port Houghton/Hobart Bay. By the end of the season, 2,718 tons of winter bait had been harvested. The fishery in the Craig/Klawock area occurred from January 14 to 24, 1992, while the fishery in Lisianski Inlet took place on January 13, 1992. There was no harvest in the Port Houghton/Hobart Bay area due to a lack of herring in the restricted area opened to fishing. Surveys conducted in the Tenakee Inlet area determined that herring abundance was below the minimum threshold level.

Based on 1992 spawning levels, five areas were determined to have harvestable quantities of herring for the winter 1992/93 bait openings. These areas include Craig, Ernest Sound, Hobart Bay, Necker Bay, and Lisianski Inlet. An estimated spawning biomass of 12,350 tons at Craig provides for a quota of 1,362 tons. For Hobart Bay, a quota of 495 tons is available, based on a spawning biomass of 4,100 tons. At Lisianski Inlet, a spawning biomass of 5,750 tons will allow a quota of 722 tons. Ernest Sound and Necker Bay had sufficient spawning biomasses to provide quotas of 200 and 722 tons, respectively.

Southeast Alaska Sac Roe Herring Fisheries

Four sac roe herring fishing areas have been established by regulation in Southeast Alaska. They include two exclusive purse seine areas (Sitka Sound and Lynn Canal) and two exclusive set gillnet areas (Kah Shakes/Cat Island and Seymour Canal). Both gear types are under a limited entry system. For the 1992 season, 92 permanent and 30 interim-use gillnet permits and 44 permanent and 7 interim-use purse seine permits were issued.

A harvest of 6,614 tons of herring occurred during the 1992 season. This harvest resulted from a Sitka Sound catch of 5,368 tons and a catch at the Kah Shakes/Cat Island area of 1,246 tons (Table 12). In Sitka Sound, a 14.3% harvest rate was applied to the 1991 spawning biomass estimate of 23,450 tons to establish a quota of 3,356 tons for the Sitka herring purse seine fishery. The fishery was placed on 2-hour notice effective at 8:00 a.m. Monday, March 30. Test sampling for roe maturity began on March 28 and continued on a daily basis through April 5. The fishery opened at noon on April 6 and was closed after 1 hour and 23 minutes of fishing. This was the shortest opening since the inception of the sac roe fishery in the early 1970s. The total catch was 5,368 tons, which exceeded the quota by 2,000 tons.

For the 1992 Kah Shakes/Cat Island area fishery, an exploitation rate of 11.5% was applied to the 1991 biomass estimate of 10,450 tons, resulting in a quota for 1992 of 1,200 tons.

Aerial surveys of the Kah Shakes area began on March 4. There were no apparent schools of herring in the area. The R/V Sundance arrived at the Kah Shakes area on March 18 to conduct hydroacoustical surveys of the area. Several small schools of herring were located, but very little bird or sea lion activity was noted. Aerial surveys on March 28 and 29 showed an increase in herring activity in the Cat Island area. On March 30 the first spawn of the year was observed at Cat Island, but no activity had been noted in the Kah Shakes area.

The Kah Shakes/Cat Island area was placed on 12-hour notice effective 5:00 p.m., April 1, and the fishery was opened at 9:30 a.m., April 3. The fishery was closed at 6:45 p.m. on April 3, with a one-hour grace period. Eight companies were represented on the grounds with landings made by 115 boats. Roe recovery ranged from 10 to 17%. The final 1992 harvest for the Kah Shakes/Cat Island area was 1,246 tons. Approximately 2.6 linear miles of spawn was observed in the Kah Shakes area and 18.7 miles in the Cat Island area.

In the spring of 1992, approximately 21.3 miles of beach were recorded as having received herring spawn in the Kah Shakes/Cat Island areas. Herring which normally spawn on Annette Island also appeared to have spawned at Cat Island. Subsequent spawn deposition surveys provided an estimated spawning population of approximately 8,000 tons (Table 13).

Based on this biomass, the Southeast Alaska harvest policy provides for a harvest rate of 10.7% of the spawning stock or a harvest of 867 tons. Because it is likely that fishermen from the Annette Island Reserve will also be harvesting herring destined to spawn at Cat Island, ADF&G intends to make allowance for this harvest to ensure conservation of the resource. The allowance is based on the average sac roe harvest on the Annette Island Reserve of 150 tons. After allowing for the Annette Island harvest, the balance of the quota, 717 tons, would be harvested by Southeast herring gillnet and sac roe permit holders.

Based on the 1992 spawn deposition survey, an estimated 48,450 tons of spawning biomass in Sitka provides a 1993 quota of 9,691 tons. Spawn surveys conducted in Seymour Canal during the spring of 1992 indicated that populations are below the required threshold level; therefore, no fishery will occur in 1992. The Lynn Canal area also remains below its required threshold level.

Southeast Alaska Spawn-on-Pound-Kelp Fisheries

There are three types of herring pound fisheries in Southeast Alaska: tray pack bait, fresh bait, and spawn-on-pound-kelp. The tray pack pound fishery was created in 1979 when the Board of Fisheries allocated a harvest of up to 100 tons. Only limited catches occurred in the early 1980s. In recent years there has been no participation.

The fresh bait pounds are allowed by regulation under a permit system in six areas, including Tee Harbor, Indian Cove, Farragut Bay, Scow Bay, Sitka Sound, and Lisianski Inlet. Current regulations specify annual harvest quotas of 100 tons each for Farragut Bay, Scow Bay, and Sitka Sound, 60 tons each for Tee Harbor and Indian Cove, and 25 tons for Lisianski Inlet. The average annual catch for the past 10 years (since 1983) was 43.8 tons for all areas combined. In 1992, pounds were operated in Sitka Sound and Farragut Bay with a total harvest of 32 tons and an exvessel value of \$22,628.

There are two spawn-on-pound-kelp fisheries in Southeast Alaska, Craig, and Hoonah Sound (Figure 1). The spawn-on-kelp fishery for the Craig area was initiated in the spring of 1992. The harvest limit was established at 15% (403 tons) of the total guideline harvest level (2,684 tons) for the Craig/Klawock stock. For the 1992 season, 531 fisherman applied for permits and were eligible to participate in the fishery. On March 10, 248 herring pounds were on the grounds; they each received allocations of 310 blades of kelp and 1.6 tons of herring. Harvest of herring began at noon on March 18 and closed at 8:00 p.m. on March 23, 1992. A total of 25.7 tons (51,400 lbs) of spawn on kelp, worth approximately \$164,269, was harvested by 229 participants. Final product quality was greatly reduced due to the harvest of immature herring, poor quality of kelp, and inexperienced handling of both kelp and herring.

In the Hoonah Sound area, the amount of herring allowed for the spawn-on-kelp pound fishery is fixed at 150 tons, or 12 tons of product. In 1992, its third year of operation, the fishery opened by emergency order on April 6, 1992, and the harvest of herring began on April 17, and continued through April 26, when fishing was closed by emergency order. A total of 46,132 lbs (23 tons) of spawn-on-kelp product, valued at \$321,540, was harvested by 108 participants. The average price per pound of \$7.00 was down from the \$7.50 paid in 1991.

For 1993, the Craig pound fishery allocation is 240 tons of herring, equivalent to 19.2 tons of spawn-on-kelp product.

CENTRAL REGION

AUTHORS

Prince William Sound

Fritz Funk
Statewide Herring Biometrician
Juneau

Evelyn D. Biggs
Fishery Biologist
Cordova

Lower Cook Inlet

Henry J. Yuen
Fishery Biologist
Anchorage

Wesley A. Bucher
Fishery Biologist
Homer

Togiak District/Bristol Bay

Katherine Rowell
Fishery Biologist
Anchorage

Linda Brannian
Regional Biometrician
Anchorage

Fritz Funk
Statewide Herring Biometrician
Juneau

CENTRAL REGION

Prince William Sound Sac Roe, Spawn-on-Kelp, and Food/Bait Fisheries

Pacific herring spawn throughout Prince William Sound each year from mid-April through early May. All herring that spawn within the coastal waters of Prince William Sound between Point Whittshed and Cape Fairfield are managed as a single stock (Figure 6).

A harvest policy framework has been established by the Alaska Board of Fisheries' Prince William Sound herring management plan (5 AAC 27.365) which allows for an exploitation rate ranging from 0% to 20% of the projected spawning biomass. Commercial fishing is not allowed if the spawning biomass is expected to be less than 8,400 tons. If the expected spawning biomass is between 8,400 and 42,500 tons, the exploitation rate is set between 0% and 20% based upon the ADF&G assessment of stock status. If the projected spawning biomass exceeds 42,500 tons, the exploitation rate is set at 20%. The allowable harvest of herring is allocated as follows: 16.3% to the fall food/bait fishery, 8% to the spawn-on-wild-kelp fishery, 14.2% to the spawn-on-pound-kelp fishery, 58.1% to the purse seine sac roe fishery, and 3.4% to the gillnet sac roe fishery.

Beginning in late March ADF&G staff survey the coastline of Prince William Sound twice weekly from small aircraft until a significant biomass of herring is observed. After herring are first sighted, aerial surveys are conducted daily to measure the accumulation of herring biomass, document herring distribution, and map the observed miles of spawn. When the herring have completed spawning, ADF&G divers conduct spawn deposition surveys. Additional sampling is conducted to estimate the age, weight, length, and sex composition of the harvest and spawning population.

Aerial survey estimates of herring biomass date back to 1974 and have ranged from 1,323 tons in 1975 (an estimate thought to be low because of poor visibility) to 77,810 tons in 1981. Estimates of the number of miles of spawn date back to 1978 and have ranged from 47.4 miles in 1978 to 166.3 miles in 1988. Spawn deposition surveys were conducted in 1983, 1984, 1988, 1989, 1990, 1991, and 1992. Spawn deposition survey biomass estimates ranged from 1.45 to 2.18 times larger than aerial survey biomass estimates from 1984 to 1990.

In 1992 the total harvest of herring in Prince William Sound was 26,267 tons. Of this total, 22,367 tons was harvested during spring roe fisheries and 3,900 tons during the fall 1992 food/bait fishery. Of the spring fisheries, the purse seine sac roe fishery harvested 16,784 tons, and the gillnet sac roe fishery 940 tons. The spawn-on-pound-kelp and spawn-on-wild-kelp fisheries harvested an equivalent of 2,625 and 2,018 tons of herring.

An age-structured assessment (ASA) model was used to estimate the 1992 abundance and forecast for 1993. The model determined abundance estimates which best fit spawn deposition

estimates in 1984, and 1988–92, age composition of the gillnet and purse seine harvests from 1973–1992, and a relative abundance index derived from miles of milt observed during aerial surveys.

Using the ASA model, the total spawning population of herring in Prince William Sound in 1992 was estimated to be 1.067 billion fish having an aggregate weight of 110,831 tons (Table 14). This is estimated to be the highest biomass observed in Prince William Sound since at least 1973 (Figure 7).

The 1993 spawning biomass of herring in Prince William Sound is projected to be 134,133 tons (Table 14). An annual survival rate of 68% was assumed in making the forecast. The mean size of an individual herring in 1993 is expected to be 120 grams in the purse seine fishery and 132 grams in the gillnet fishery (Figure 8).

The size of herring year classes at age-3 has ranged from the 2.147 billion herring of the 1988 year class to 20.6 million of the 1989 year class (Figure 9). The relationship between spawning biomass and resulting recruits is not well defined (Figure 10).

Because the 1993 spawning biomass is projected to exceed 42,500 tons, the 1993 allowable harvest is determined using the maximum exploitation rate of 20%. The allowable harvest for the 1993 management year is 26,827 tons of herring. Following the allocation percentages specified in the management plan, the fall 1993 food/bait herring fishery is allocated 4,373 tons of herring, the 1993 spawn-on-wild-kelp fishery is allocated 2,146 tons of herring (equivalent to 268 tons of spawn-on-kelp product), the 1993 spawn-on-pound-kelp fishery is allocated 3,809 tons of herring (equivalent to 305 tons of spawn-on-kelp product), the 1993 purse seine sac roe fishery is allocated 15,586 tons, and the 1993 gillnet sac roe fishery is allocated 912 tons (Table 15).

Lower Cook Inlet Herring Fishery

The Lower Cook Inlet Management Area is subdivided into the Kamishak Bay, Southern, Outer, and Eastern Districts (Figure 11). Only the Kamishak Bay District has consistently supported sac roe fisheries. Formal abundance forecasts are prepared only for the Kamishak Bay District.

The present-day sac roe fishing started as early as 1969 in the Eastern and Southern Districts and in 1973 in the Kamishak Bay District. During 1978, herring biomass fell to low levels and all fishing districts were closed to commercial fishing. The Kamishak Bay, Eastern, and Outer Districts were reopened in 1985. The Southern District was reopened to fishing only during 1989. The Eastern and Outer Districts were closed again in 1990. Currently, all of the Lower Cook Inlet sac roe harvest is from the Kamishak Bay District where roe recovery rates are higher because the fish are older. The Kamishak Bay harvest and total run biomass peaked in 1987 at 6,132 and 35,332 tons, respectively (Figure 12).

A substantial proportion of the herring that spawn in Kamishak Bay overwinter in Shelikof Strait, an area traditionally fished by the Kodiak food/bait herring fishery. Because of this, Board of Fisheries regulations (5 AAC 27.535) restrict Kodiak food/bait fishery harvests of Kamishak stocks to 2% of the most recent Kamishak Bay District forecast. While the Board of fisheries has not defined an explicit harvest policy for the Kamishak Bay District, ADF&G has established a threshold biomass of 8,000 tons, below which harvests are not allowed. Board of Fisheries regulations allow only purse seine gear in the lower Cook Inlet sac roe fisheries.

In 1992, stock assessment activities were hampered by bad weather. Aerial surveyors were grounded for 18 consecutive days in May. A preliminary estimate of the 1992 run biomass was obtained by dividing daily aerial survey estimates of run biomass by preliminary estimates of expected daily proportion. The 1992 escapement biomass was the preliminary 1992 run biomass estimate minus the 1992 final harvest estimate. Final run biomass estimate and age composition data were not available for the 1993 forecast.

No age composition samples were obtained after the fishery was completed in April 1992. Late season samples were removed from the historical database and age-specific natural mortality and recruitment rates were recalculated. The 1993 abundances by age were predicted from the updated natural mortality and recruitment rates as well as the 1992 escapement abundance estimates. Forecast abundance was converted to biomass with a predicted mean weight-at-age. Age-specific biomass was summed to obtain run biomass. Finally, the 1993 harvest was projected using the current management strategy and forecast biomass. A detailed description of the 1993 forecast for the Kamishak District is given in Yuen and Bucher (1993).

A biomass of 28,805 tons of herring is expected to return to the Kamishak Bay District in 1993 (Table 16). Herring mean weight is predicted to be 172 grams. The age composition is forecast to be 74% age 5 and 11% age 6 from the 1988 and 1987 year classes, respectively. Total allowable harvest is projected to be 2,881 tons. The harvest allocation is 2,592 tons for the Kamishak spring sac roe fishery and 288 tons for the Shelikof Strait winter bait fishery (Table 17).

The abundance and biomass of Kamishak herring peaked in 1987. The downturn that followed may have reversed itself during 1990 (Figure 12). The recent upturn is expected to continue in 1993 because of the strong recruitment of age-4 herring in 1992.

The Kamishak herring harvest policy calls for harvest rates of 10–20%. Past management strategies in Lower Cook Inlet has allowed for a 10% harvest rate on herring age 5 and younger and 20% on age 6 and older. Because age-5 herring is projected to be 74% of the abundance or 66% of the 1993 biomass, a 10% harvest rate for all age groups is anticipated as a conservative management strategy.

During 1991 and 1992, our aerial surveys of herring biomass were interrupted by bad weather and our budgets did not allow us to obtain age composition samples during the month of May when age-3 and -4 herring proportions were expected to increase. In response, we developed two new methods where total run biomass could be estimated by dividing daily biomass estimates by expected daily proportions and where the late age composition of age-3 and -4 herring could be estimated from their early age composition. We used the results from early versions of the two methods in order to produce a forecast in time for the Alaska Board of Fisheries meeting in November, 1992. Testing and final versions of the two methods are not expected to be completed until mid-1993. Therefore, the forecast in this report will differ from and supersede that in the Alaska Board of Fisheries report (Bucher and Hammarstrom 1992). The forecast in this report may be subject to further revision if the final versions of the two methods differ from the early versions.

Togiak District, Bristol Bay, Sac Roe, and Spawn-on-Kelp Fisheries

The Togiak District of Bristol Bay extends from Cape Constantine to Cape Newenham and supports the largest spawning population of Pacific herring in the eastern Bering Sea. Herring move into the Togiak District during spring months to spawn. These herring then feed during their post-spawning migration southward along the Alaska Peninsula, concentrate in the vicinity of Unalaska Island in the late summer, and return to their overwintering grounds near the Pribilof Islands in the fall. The primary harvest of this herring population occurs in the Togiak District by a sac roe fishery during the spring spawning migration. Lesser amounts are harvested during the summer months in the Dutch Harbor food/bait fishery and are taken as bycatch in the domestic pollock trawl fishery in the Dutch Harbor and Unimak Island areas.

The Bering Sea Herring Fishery Management Plan (5 AAC 27.060) establishes a threshold biomass of 35,000 tons for the Togiak stock. The commercial harvest of herring in the Togiak District sac roe fishery and the Dutch Harbor food/bait fishery is not allowed should the inseason biomass estimate of herring be less than the established threshold level. The Bristol Bay Herring Management Plan (5 AAC 27.865) allows for a maximum 20% exploitation rate on the Togiak herring stock. From the allowable harvest determined by applying the exploitation rate to the biomass estimate, 1,500 tons is set aside to allow for the biological impacts of the Togiak District herring spawn-on-kelp harvest. From the remaining allowable harvest, 7% is allocated to the Dutch Harbor food/bait fishery, and the balance is allocated to sac roe fisheries. The sac roe harvest is allocated 75% to the purse seine fishery and 25% to the gillnet fishery. In years where circumstances prevent adequate biomass assessment, the harvest level will be based on the preseason projected return. If a manageable separation of year classes occurs, a harvest of the younger age classes is allowed if a threshold biomass of 20,000 tons of these younger fish are present on the grounds.

Beginning in late April the nearshore area of the Togiak District is surveyed daily from small aircraft to determine the relative abundance, distribution of Pacific herring in the fishing district. Biomass estimates have been derived from the number and size of herring schools observed during these surveys. Use of aerial surveys to estimate the Togiak herring spawning biomass began in 1978. Aerial survey abundance estimates have ranged from 242,298 tons in 1979 to 76,960 tons in 1980 (Figure 13). The 1980 biomass was believed to have been underestimated because of poor visibility and overall poor survey conditions experienced that season.

The 1992 age distribution was estimated from herring collected daily from areas of significant biomass sightings throughout Togiak District. Volunteered commercial or ADF&G vessels made multiple purse seine or gillnet sets to capture herring throughout the spawning migration. Age structure of the population was determined from herring captured by variable mesh gillnet or purse seine gear. Samples were pooled across 3-day periods where possible to represent major fluctuations in estimated biomass for each fishing section. Herring from the commercial harvest were also sampled for age, size, and gonad condition. Samples were collected from tenders and fishing boats for each gear type and fishing section at the close of the commercial fishing period. Approximately 6,700 herring were sampled for biological data over the period of May 12 through May 27, 1992.

Cooler-than-normal spring weather conditions in the eastern Bering Sea resulted in a delayed return of herring to the Togiak District. Several small schools of herring were observed within the Togiak District May 16. Spotter pilots first observed a large biomass of herring moving inshore from the Walrus Island and Hagemeister Strait areas May 18. Fish abundance built rapidly reaching 129,256 tons observed by May 19. The first commercial fishing period for the gillnet and purse fleets gear was May 20. A large biomass was still evident 3 days after the commercial fishery, 122,887 tons being observed on May 23.

Between May 18 and May 23 herring age 9 and older composed 50% of the sampled population. The percentage of newly recruited age-4 and -5 herring increased from 17% on May 18 to 69% by May 26. The delayed entry of the run and the small biomass present in the fishing district on May 28 indicated that the duration of the run was compacted. The temporal separation of year classes observed in the past was not as evident compared to years with earlier run timing. Assessment of the younger year classes in 1992 may therefore have been better than in past years due to excellent survey conditions and the compacted entry of the run into the fishing district.

The final revised biomass estimate for the 1992 season totaled 156,955 tons and was the sum of (1) the entire peak aerial survey biomass estimate observed on May 23 (122,887 tons); (2) the commercial harvest through May 23 (24,328 tons), and (3) the aerial survey biomass estimate of May 26 which corresponded to a distinct change in the age composition from the peak abundance survey of May 23 (9,740 tons).

The commercial sac roe harvest for the Togiak District totaled 25,808 tons during the 1992 season. Herring sold for sac roe product composed 98% of the harvest. The remaining 2% of the catch was purchased for food and bait. Roe recovery averaged 9.2% for the purse seine catch and 8.8% for the gillnet catch. The purse seine fleet of 301 vessels caught 81% of the total Togiak District harvest. The seine catch of 20,779 tons was harvested in a 20-minute fishing period on May 20. The gillnet harvest of 5,030 tons was taken by 274 permit holders during seven fishing periods held from May 20 through May 27.

The 1992 Togiak District spawning migration consisted of 483 million herring and with a biomass of 156,955 tons (Table 18). Herring ranged in age from 3 to 18 years, and 53% of the biomass and 35% of the population was composed of herring age 9 and older. The 1977 (age 15) and 1978 (age 14) age classes which dominated the biomass between 1984 and 1990 exhibited a decreased contribution to the biomass from 20% in 1991 to 13% in 1992. Good recruitment into the fishery was observed for both the 1987 (age 4) and 1988 (age 5) year classes. The combined contribution of these year classes represented 31% of the biomass and 51% of the total population. A spawning escapement of 129,198 tons was estimated after subtracting harvests by the Togiak District sac roe fishery and by the Dutch Harbor food/bait fishery from the estimated spawning biomass.

Forecasts in past years were calculated by applying estimates of mortality, availability, and recruitment of the specific age classes to the previous year's estimate of escapement biomass. Forecasts have consistently been low with large variations of abundance because the current biomass estimation technique is vulnerable to poor weather conditions. Additional problems with past forecasting methods were the unexpected high survival rates of the 1977 and 1978 year classes, and the inability to predict the abundance of younger year classes recruiting into the fishery. Growth and survival rates were revised in 1991, and incorporated data collected from 1980 through 1989 in an attempt to improve forecasting accuracy. Since 1984 the forecast error has averaged 35%.

This year, age structured analysis (ASA) was implemented to generate the Togiak herring forecast for 1993. This methodology estimates mortality rates and population abundance using age composition data in conjunction with selected biomass estimates from the best aerial survey years in the history of stock assessment of the biomass. This methodology can be used to produce a forecast in years when aerial assessment estimates have been compromised by poor weather conditions. Abundance of age-4 herring in 1993 has been forecasted using the median value of historical year class strength calculated by the model. The forecasted Togiak District herring biomass in 1993 using the age structured analysis is 148,786 tons. The forecasted biomass using past methodology would have been 129,000 tons, 13% less than the projection using ASA.

Herring age 9 or older will account for 32% of the forecast biomass. The strong 1977 and 1978 year classes returning as age-16 and age-15 herring are expected to contribute only 6% of the population in biomass and 4% of the population in numbers of fish (Figures 14, 15). The 1987

and 1988 year classes returning as age-5 and age-6 herring will dominate the biomass representing 62% of the biomass and 73% in numbers of fish. The 1984 (age 9) and 1983 (age 10) year classes will be the dominant older age classes. Average weight of an individual herring is expected to be 267 grams in 1993. The 1988 year class is estimated to be the strongest since the 1978 year class. Strong recruitment was last detected in the Togiak District in 1982 and 1983, when the 1977 and 1978 year classes began to enter the spawning biomass.

In 1993 the projected total allowable harvest is 29,757 tons which represents 20% of the forecasted biomass. In accordance with the regulatory management plan, 1,500 tons is allocated to the Togiak District spawn-on-kelp fishery, 26,279 tons to the purse seine and gillnet sac roe fisheries, and 1,978 tons to the 1993 Dutch Harbor food/bait fishery. The Togiak sac roe and Dutch Harbor food/bait guideline harvest levels will be revised, if a reliable biomass can be estimated during the spring of 1993.

ARCTIC-YUKON-KUSKOKWIM REGION

AUTHORS

Security Cove, Goodnews Bay, Cape Avinof, Nelson Island, and Nunivak Island

Charles Burkey
Fishery Biologist
Bethel

Cape Romanzof, Norton Sound, and Port Clarence

Helen H. Hamner
Biometrician
Anchorage

ARCTIC-YUKON-KUSKOKWIM REGION

Introduction

The Arctic-Yukon-Kuskokwim (AYK) Region includes eight commercial herring fishing districts located in coastal areas of the northeastern Bering Sea: the Security Cove, Goodnews Bay, Cape Avinof, Nelson Island, Nunivak Island, Cape Romanzof, Norton Sound, and Port Clarence Districts (Figure 1).

In most AYK herring districts the Alaska Board of Fisheries established threshold biomass levels below which harvests are not allowed under the Bering Sea Herring Fishery Management Plan (5 AAC 27.060). Exploitation rates are limited to a maximum of 20% in all areas. In some areas the Board of Fisheries has further restricted exploitation rates to protect subsistence harvests.

The arrival of herring in the northeastern Bering Sea is greatly influenced by climate and oceanic conditions, particularly the extent and distribution of the Bering Sea ice pack. Most herring appear immediately after ice breakup which generally occurs between mid-May and mid-June. Spawning usually begins in the Security Cove District and generally progresses in a northerly direction. In some areas spawning may continue as late as July.

Aerial surveys have been used since 1978 in the Bering Sea to estimate herring spawning biomass. However, it is often difficult to obtain biomass estimates from aerial surveys in the AYK Region because of poor survey conditions caused by unfavorable weather, ice conditions, or turbid water.

Herring school surface areas are recorded in 538 ft² relative abundance index (RAI) units of 538 square feet per unit. In the AYK region, RAI units are converted to biomass using conversion factors of 1.52 tons per RAI unit for water depths of 16 feet or less, 2.58 tons per RAI unit for water depths between 16 and 26 feet, and 2.83 tons per RAI unit for water depths greater than 26 feet per RAI unit. Because purse seine gear is needed to estimate the conversion factors and purse seine gear is generally not fished in the AYK Region, these conversion factors were estimated from sampling performed in the Togiak District. Ground surveys are conducted in some districts to obtain information on the distribution and density of kelp beds and herring spawn deposition.

During 1992, 88 aerial surveys (102.9 hours of flight time) were flown in the AYK region: 12 (6.0 hours) in Security Cove, 11 (5.7 hours) in Goodnews Bay, 5 (1.2 hours) in Jacksmith Bay, 10 (6.6 hours) in Cape Avinof, 14 (7.6 hours) in Nelson Island, 10 (12.9 hours) in Nunivak Island, 7 (2.9 hours) in Cape Romanzof, 17 (60 hours) in Norton Sound, and 2 in Port Clarence.

The estimated herring biomass of 90,243 tons for the surveyed portion of the AYK herring districts sets a historical record and, if realized, will be 140% of the previous record biomass of 64,757 tons set in 1988. This dramatic increase in herring biomass is primarily due to a record biomass of herring observed in the Norton Sound District. Norton Sound herring composed 64.2% of the regional total in 1992. However, significant increases in herring biomass were also observed in the Security Cove, Goodnews Bay, Nelson Island, and Nunivak Districts, primarily due to good numbers of age-4 and -5 herring recruiting to spawning populations. The increased biomass in the Nunivak Island District is probably a result of improved aerial survey conditions. Age-8 and older herring dominated the biomass in most AYK districts. Recruits (ages 3, 4, and 5) comprised at least 15% of the biomass and 31% of the population in numbers of fish in all districts except for the Cape Romanzof District.

The 1992 herring season in the AYK Region was unusual in several ways. Because of ice conditions and low temperatures, herring arrived in coastal spawning areas from 1 to 3 weeks later than average. In many districts, for the first time in many years, the herring biomass consisted largely of recruit herring. An historical record biomass of herring was observed in Norton Sound. However, because ice prevented processors from reaching Norton Sound until late in the season, the Norton Sound fishery did not open. Since Norton Sound is the major herring fishery in AYK, the total harvest and exvessel value of herring for the region were both near record lows.

The 1992 herring harvest for the AYK Region was approximately 2,828 tons having an estimated exvessel value of \$990,000. The harvest was 38% of the 1991 harvest and the lowest harvest since 1979. There was no commercial fishery in Norton Sound, which generally composes about two-thirds of the total AYK herring harvest. This accounts for the low 1992 AYK herring harvest. Food/bait sales during the sac roe fishery totaled 251 tons, with the remaining harvest sold as sac roe product. Buyers purchase herring during sac roe fisheries as food and bait, for a lower price, when the roe content is below the buyer's acceptable minimums for sac roe. A total of 429 fishermen participated in AYK sac roe herring fisheries during the 1992 season. This was only 65% of the fishermen who participated in the 1991 fishery and was 36% of the record 1987 effort. Again this reduction was primarily due to the lack of a fishery in Norton Sound. However, fishing effort in the AYK region has been declining since an historical high of 1,195 fishermen was reached in 1987. At that time a moratorium was placed on entry into the Nelson Island, Nunivak Island, Cape Romanzof, and Norton Sound herring fisheries. The Commercial Fisheries Entry Commission is currently in the process of issuing limited entry permits for these fisheries. All AYK Region commercial herring districts, except Security Cove and Port Clarence, are designated as superexclusive use areas.

Average roe recovery for the sac roe harvest ranged from 8.0% in the Cape Romanzof District to 9.9% in the Cape Avinof District with a regional average of 9.1%. Exploitation rates (the percentage of the biomass harvested) were low in all AYK herring districts in 1992. The total exploitation rate for the AYK Region was only 3.1% due to the large biomass observed in

Norton Sound and the lack of a commercial fishery in that district. Exploitation rates ranged from 0.5% in the Nunivak Island District to 13.3% in the Goodnews Bay District. The overall exploitation rate for districts which had commercial herring fisheries in 1992 was 8.8%.

There was no herring fishery in the Port Clarence District because no buyers were present in the district. Surveyed subsistence fishermen from selected Yukon-Kuskokwim River Delta villages harvested approximately 100 tons of herring.

Gillnets were the only gear fished in AYK in 1992. An attempt was made to sample at least 420 herring from each district. Similar sampling goals were set for all test fishing samples for each 7-day sampling period. Age composition of the entire run was calculated by combining the numbers of fish by age class in the commercial catch with those in the escapement. Herring from test fish and commercial catches were sampled in all but the Nunivak Island and Port Clarence Districts to estimate age, size, and sexual maturity of herring and to note the occurrence of other schooling fishes. Approximately 8,630 herring from commercial and test catches were sampled from six of the eight AYK herring districts during the 1992 fishing season.

Projections from postfishery escapement estimates, using mean rates of natural mortality and growth for each age class, indicate that the 1993 minimal spawning biomass for the northeastern Bering Sea herring stocks (Security Cove to Norton Sound) should be approximately 67,335 tons. Increased recruitment of 3- through 5-year-old herring could increase the 1993 observed biomass over projected biomass estimates in all districts. However, in accordance with the AYK Region harvest policy, newly recruited age classes will not be targeted by the commercial fishery. Because current methods of forecasting herring biomass in the AYK region are highly inaccurate, harvest levels will be established during the season in accordance with the observed biomass, where possible.

Security Cove Sac Roe Fishery

The Security Cove District consists of all waters between Cape Newenham and the Salmon River. The estimated biomass of herring in the Security Cove District has ranged from 2,300 tons in 1987 to 8,300 tons in 1981 (Figure 16).

The Alaska Board of Fisheries has established a threshold biomass level of 1,200 tons for the Security Cove fishery. Commercial fishing is not allowed until aerial survey biomass estimates reach 1,200 tons. The maximum exploitation rate is restricted to 20% of the available biomass. When weather conditions prevent biomass assessment, the fishery is only allowed if significant spawning activity is documented and the forecasted biomass is expected to exceed 1,200 tons. In this case, the harvest is 20% of the forecasted biomass. The commercial herring fishery in the Security Cove District has been regulated by emergency order since 1981 to provide for an orderly fishery and periodic reassessment of herring biomass. Emergency order authority is used

to adjust the occurrence and length of fishing periods commensurate with stock strength, fishing effort, and spawning activity.

During the 1992 season, a total of 12 aerial surveys were flown on 12 days from May 14 to June 9. Five of these were flown under acceptable survey conditions. Herring schools were first observed in the district on May 21. The peak biomass of 6,939 tons was sighted on May 31. This does not include 834 tons of herring harvested prior to the survey. The total biomass of 7,773 tons was calculated by combining the commercial catch with the May 31 aerial survey estimate. This is the largest biomass observed in the Security Cove District since 1981. A total of 17.5 linear miles of milt was documented during aerial surveys, with peak spawning occurring on May 31 when 5.5 miles of milt were seen.

The 1992 commercial herring season in the Security Cove District consisted of five openings during May 25 to May 29 for a total fishing time of 32 hours. A total of 834 tons of herring was harvested and consisted of 697 tons of sac roe, 127 tons of bait-quality herring and 10 tons of discarded herring. Overall, sac roe herring had an average roe recovery of 9.2%. On May 22, the harvest quota was raised to 789 tons from the preseason forecast of 608 tons after 3,944 tons were observed during an aerial survey of the district. The quota was increased to 860 tons on May 24 after 4,300 tons were sighted. An aerial survey on May 31 documented a biomass of 6,939 tons. However, the harvest quota was not increased because fishermen and processors were no longer present in the area. The commercial exploitation rate was 10.7% of the estimated available biomass. Six processors purchased herring in Security Cove. A total of 58 fishermen made 178 deliveries. The average price was \$450 per ton for 10% roe recovery, with an increase or decrease of \$45 per ton for each percentage point above or below 10%. Value of the harvest to fishermen was about \$285,000.

The Security Cove test fishing with variable mesh gillnets, from May 18 to May 29, provided 1,006 herring samples for biological data. Ages 4 and 5 dominated the return in both biomass and numbers of fish. Age-9 and older herring composed 33.7% of the biomass (Table 19). Recruit herring represented 70% of the return in numbers of fish. A sample of 412 herring was taken from the commercial catch. Age-9 and older herring represented 74.2% of the catch by weight. Young fish, 3, 4, and 5 years old, composed only 1% of the catch.

The projected return to the Security Cove District in 1993 is 6,282 tons (Figure 16). A 20% exploitation rate would result in a harvest of about 1,256 tons. The increased recruitment of younger age fish into the population allows a 20% exploitation rate for the Security Cove herring stock in 1993. A larger catch may occur if the 1993 biomass assessment is greater than the projection. Age-5 and -6 herring are expected to dominate the return. Age-9 and older herring are expected to compose approximately 28% of the biomass (Figure 16).

Goodnews Bay Sac Roe Fishery

The Goodnews Bay District consists of the waters of Goodnews Bay inside the north and south spits and a line between the Ukfigag River and the Tunulik River. Since 1981, the estimated biomass of herring in the Goodnews Bay District has ranged from 2,000 tons in 1987 to 5,572 tons in 1992.

The management strategy for this district is similar to that used for Security Cove. The Alaska Board of Fisheries has established a threshold biomass level of 1,200 tons for the Goodnews Bay fishery. Commercial fishing is not allowed until aerial survey biomass estimates reach 1,200 tons. The maximum exploitation rate is restricted to 20% of the available biomass. When weather conditions prevent biomass assessment, the fishery is only allowed if significant spawning activity is documented and the forecasted biomass is expected to exceed 1,200 tons. In this case, the harvest is 20% of the forecasted biomass. Emergency order authority is used to adjust the occurrence and length of fishing periods commensurate with stock strength, fishing effort, and spawning activity.

During the 1992 season, eleven aerial surveys were flown on 11 days from May 14 to June 9. Only four of these surveys were flown under satisfactory conditions. A survey on May 24 documented 3,633 tons and 1,939 tons were sighted during a survey on June 9. The total biomass estimate of 5,572 tons was calculated by combining the two surveys. A total of 5.2 linear miles of milt was observed during aerial surveys, a peak of 2.2 miles observed May 22.

The 1992 commercial herring season in the Goodnews Bay District consisted of seven openings during May 29 to June 1 for a total fishing time of 29 hours. A total of 740 tons of herring was harvested and consisted of 711 tons of sac roe and 29 tons of bait-quality herring. Overall, the sac roe quality herring had an average roe recovery of 9.5%. The harvest quota was raised from the preseason projection of 596 tons to 727 tons after a May 24 aerial survey that indicated 3,633 tons of herring in the district. The exploitation rate of herring was 13.3% of estimated available biomass. Three processors bought herring from 78 fishermen with an estimated exvessel value of \$286,000.

Department test fishing was conducted from May 18 to May 29. Department staff sampled a total of 909 herring for biological data. Age-8 herring dominated (19.3%) the biomass whereas age 4 dominated (20.9%) the return in numbers of fish (Table 20). Age-9 and older herring represented 52.3% of the biomass. Young herring, ages 3, 4, and 5, were 40.1% of the spawning population. A sample of 424 herring was taken from the commercial catch. Age-9 and older herring represented 64.3% of the harvest. Young herring, ages 3, 4, and 5, were only 3.6% of the catch.

The projected return of herring to the Goodnews Bay District in 1993 is 3,600 tons (Figure 17). A 20% exploitation rate would result in a harvest of 720 tons. A larger catch may occur if the

1993 biomass assessment is greater than the projection. Ages 8 and 5 are expected to be the dominant year classes in the return. Age-9 and older herring are expected to compose approximately 50% of the biomass (Figure 17).

Cape Avinof Sac Roe Fishery

The Cape Avinof District consists of all waters extending inshore of Kikegteg, Pingurbek and Kwigluk Islands from the Ishkowiik River to the Ursukfak River. In the fall of 1989 the Alaska Board of Fisheries extended the eastern boundary of the Cape Avinof District to the Ishkowiik River (162°44' W. long.).

The Alaska Board of Fisheries has established a threshold biomass level of 500 tons for the Cape Avinof fishery. Commercial fishing is not allowed until aerial survey biomass estimates reach 500 tons. The maximum exploitation rate is restricted to 15% of the available biomass. When weather conditions prevent biomass assessment, the fishery is only allowed if significant spawning activity is documented and the forecasted biomass is expected to exceed 500 tons. In this case, the harvest is 15% of the forecasted biomass. Openings of the Cape Avinof District commercial herring fishery are regulated by emergency order.

Aerial surveys have been conducted by the department in the Cape Avinof area since 1985. Herring biomass observations of 2,000 tons, 1,225 tons, 4,108 tons and 2,083 tons were made in 1985, 1987, 1988 and 1991 (Figure 18). Weather conditions in 1986 and 1990 and ice conditions in 1989 precluded biomass estimates by aerial survey. During 1992, 10 aerial surveys were flown in the Cape Avinof District between May 29 and June 12. Only two of these surveys were flown under satisfactory conditions. An aerial survey on June 9 documented 3,095 tons of herring. Prior to this survey, 351 tons of herring had been harvested in the Cape Avinof commercial fishery. The total biomass of 3,446 tons was calculated by combining the June 9 aerial survey estimate with the commercial catch to that date. No spawn was observed in the Cape Avinof District in 1992.

This was the fifth year that a commercial herring fishery occurred in the Cape Avinof District. The 1992 commercial herring season in the Cape Avinof District consisted of three openings during June 4 to June 11 for a total fishing time of 12 hours. A total of 451 tons of herring was harvested and consisted of 442 tons of sac roe with a roe recovery of 9.9% and 9 tons of bait-quality herring. The exploitation rate of herring for the entire district was 13.1% of the estimated available biomass. In the Cape Avinof District, 121 fishermen made 335 deliveries worth approximately \$178,000 to two processors.

The department's test fishery near Kipnuk between June 7 and June 11 captured 810 herring to sample for age-sex-size data. Age-8 herring dominated the biomass whereas age-4 herring dominated the return in numbers (Table 21). Age-9 and older herring composed 46.3% of the

biomass. Recruit herring represented 32.7% of the return in numbers of fish. A sample of 528 herring was taken from the commercial catch. Age-9 and older herring made up 62.1% of the catch by weight. Recruit herring composed only 0.3% of the harvest.

The projected biomass for the Cape Avinof area in 1993 is 2,358 tons. A 15% commercial exploitation rate would result in a harvest of 354 tons. Age-5 herring are expected to be the largest year class in the returning population (Figure 18). Age-9 and older herring are expected to compose approximately 49% of the returning population.

Nelson Island Sac Roe Fishery

The Nelson Island District consists of all waters north of Chinigyak Cape and south of the southeast tip of Kigigak Island and east of 165° 30' W. longitude. Since 1985, the biomass estimates of herring in the Nelson Island District have ranged from 2,705 tons in 1990 to 9,500 tons in 1985 (Figure 19).

The commercial harvest of herring began in the Nelson Island District in 1985. The Alaska Board of Fisheries has established a threshold biomass level of 3,000 tons for the Nelson Island fishery. Commercial fishing is not allowed until aerial survey biomass estimates reach 3,000 tons. The maximum exploitation rate is restricted to 15% of the available biomass. When weather conditions prevent biomass assessment, the fishery is only allowed if significant spawning activity is documented and the forecasted biomass is expected to exceed 3,000 tons. In this case, the harvest is 15% of the forecasted biomass. This is lower than the 20% maximum exploitation rate used in most other areas and allows for subsistence harvests. The Nelson Island commercial fishery is regulated by emergency order.

To provide added protection for the subsistence harvest of herring, the additional guidelines are used. The commercial fishing threshold is set higher than in other comparable fisheries to allow for subsistence harvests. The commercial fishery is periodically closed to allow subsistence fishing to occur. Specific areas may be closed to commercial fishing to ensure the adequacy of subsistence harvests, particularly areas north of Cape Vancouver. Input from local residents is used to ensure the adequacy of subsistence herring harvests during the commercial fishing season.

Fourteen aerial surveys were flown on 12 days from May 29 to June 12 during the 1992 season. Nine of these surveys were made under acceptable conditions. An aerial survey on June 9 documented 5,275 tons of herring in the district. A total of 10.8 linear miles of milt was observed during aerial surveys, peak spawning of 3.8 linear miles occurring on June 6.

The Nelson Island District did not open to commercial fishing in 1990 or 1991 because the herring biomass was below the 3,000 tons necessary for a commercial fishery. In 1992, an aerial survey on June 9 indicated 5,275 tons of herring in the district. Based on this survey, the harvest

quota for the commercial fishery was set at 495 tons. The 1992 commercial herring season in the Nelson Island District consisted of three openings during June 10 to June 18 for a total fishing time of 10 hours. A total of 246 tons of herring was harvested and consisted of 188 tons of sac roe with a roe recovery of 8.3%, 52 tons of bait-quality herring, and 6 tons of discarded herring. Nearly 50% of the catch from the first period on June 11 was bait-quality herring. The district was not reopened because commercial test fishermen were unable to locate marketable herring. The exploitation rate was 4.7% of the available biomass. Three processors paid approximately \$78,000 to 85 fishermen who made 222 deliveries.

Test fishing with variable-mesh gillnets occurred from May 26 to June 18. From this catch, 1,300 herring were sampled for biological data. Age-4 fish dominated (19.8%) the return in numbers of fish (Table 22), whereas ages 10 and 11 dominated the biomass (15.7% and 16.0%, respectively). Age-9 and older herring composed 62.8% of the biomass. Recruit herring, ages 3, 4, and 5, represented 31.2% of the spawning population in numbers. A total of 528 herring were sampled from the commercial catch. Age-9 and older herring were 79.1% of the catch. Only 0.2% of the harvest were recruits. Herring from Nelson Island subsistence fishermen were also collected.

The spawning biomass projected to return to the Nelson Island District in 1993 is 3,514 tons. Since the projected biomass is less than 1.5 times the threshold, the exploitation rate will be reduced from the 15% maximum allowable rate to 10%. At the 10% exploitation rate, the harvest is projected to be 351 tons of herring. The harvest level will not exceed 10% unless the available biomass exceeds 4,500 tons.

Nunivak Island Sac Roe Fishery

The Nunivak Island District consists of all waters extending 3 miles seaward of mean low water from Kikoojit Rocks to the small bay approximately 2 miles east of Ingrirak Hill. Since 1985 the estimated biomass in the Nunivak Island District has ranged from 422 tons in 1990 to 6,000 tons in 1986 (Figure 20).

Commercial fishing for herring in the Nunivak Island District began in 1985. The Alaska Board of Fisheries has established a threshold biomass level of 1,500 tons for the Nunivak Island fishery. Commercial fishing is not allowed until aerial survey biomass estimates reach 1,500 tons. The maximum exploitation rate is restricted to 15% of the available biomass. When weather conditions prevent biomass assessment, the fishery is only allowed if significant spawning activity is documented and the forecasted biomass is expected to exceed 1,500 tons. In this case, the harvest is 15% of the forecasted biomass. This is lower than the 20% maximum exploitation rate used in most other areas and allows for subsistence harvests.

Fourteen aerial surveys were flown on 12 days from May 29 to June 12 during the 1992 season. Nine of these surveys were made under acceptable conditions. An aerial survey on June 9 documented 5,275 tons of herring in the district. A total of 10.8 linear miles of milt was observed during aerial surveys, peak spawning of 3.8 linear miles being sighted on June 6.

The 1992 commercial herring season in the Nunivak Island District consisted of three openings during June 4 to June 8 for a total fishing time of 6 hours. A total of 27 tons of herring was harvested and consisted of 7 tons of sac roe with a roe recovery of 8.5% and 20 tons of bait-quality herring. The exploitation rate of herring was 0.5% of the estimated available biomass. The harvest quota was raised from the preseason forecast of 337 tons to 400 tons on May 30 based on an aerial survey biomass estimate of 2,667 tons. After a biomass of 5,730 tons was sighted during a June 1 aerial survey, the harvest quota was increased to 855 tons. For the second consecutive year ice conditions restricted fishing to the southeast corner of Nunivak Island between Cape Corwin and Cape Mendenhall. Very intensive test fishing by commercial fishermen had limited success in finding marketable herring. Most samples contained a high male count and a mixture of immature, mature, and spawned out females. Fourteen fishermen made deliveries to one processor. The value of the catch to fishermen was about \$4,000. The entire harvest was taken by fishermen from the Nunivak Island area.

Ice conditions prevented the department's test fish crew from reaching the east side of the island. Test fishing was hampered by floating ice around Mekoryuk and no herring were captured. The age composition of samples collected at Nelson Island were used to estimate the age composition of herring in the Nunivak Island District. No herring were sampled from the Nunivak Island commercial catch but, based on size, the majority of the harvest appeared to be older-aged fish. The average weight of sampled fish was over 300 grams.

The projected biomass of herring returning to the Nunivak Island District in 1993 is 3,942 tons (Table 23). A 15% exploitation rate would result in a 591 ton harvest. A larger catch may occur if the 1993 biomass assessment is greater than the projection. Age-9 and older herring are expected to comprise 65% of the return (Figure 20).

Cape Romanzof Sac Roe Fishery

The Cape Romanzof District consists of all waters between the latitude of Dall Point and 62° N. latitude. Since 1980 the estimated biomass of herring in the Cape Romanzof District has ranged from 3,000 tons in 1980 to 7,500 tons in 1986 (Figure 21). Because of excessive water turbidity in the Cape Romanzof area, it is generally not possible to estimate herring biomass from aerial surveys. Biomass has been estimated using information from test and commercial catches, spawn deposition surveys, and age composition.

The Alaska Board of Fisheries has established a threshold biomass level of 1,500 tons for the Cape Romanzof fishery. The maximum exploitation rate is restricted to 20% of the available biomass. Emergency order authority will be used to adjust the occurrence and length of fishing periods. Because aerial biomass assessments are not possible, spawn deposition observations and test fishery and commercial CPUE will be used to determine the timing and duration of commercial fishing periods and relative stock abundance.

Seven aerial surveys were flown during the 1992 season from June 5 through June 18. A total of 2.9 hours were spent surveying the district. A majority of the surveys were unacceptable due to poor weather and/or turbid water conditions. A survey flown on June 11 under poor conditions documented a herring biomass of 1,292 tons. The peak biomass of 3,898 tons was sighted on June 16. A very large school was observed during this survey in Kokechik Bay; however, the school was not very dense because water depth was estimated to be less than 2 meters. A conversion factor of only 0.1 tons per 538 ft of surface area was used to estimate the biomass of this school. Observations made from the mountains near the cape earlier in the season on June 6 revealed that large thin schools were present in Kokechik Bay; however, these schools would be difficult to see except during calm winds and under direct sunlight.

Daily spawn deposition surveys in the Kokechik Bay area of the Cape Romanzof District began on June 1. The first observations were recorded on June 5 in Kokechik Bay; this initial spawn deposition was light, averaging 0.4 to 0.9 egg layers over the area where spawning occurred. A gradual increase in spawn deposition followed, both in layers of eggs and distribution. Spawn deposition peaked approximately June 12, with egg layers generally ranging from 2 to 4.7 egg layers on *Fucus* substrate and from 1 to 4.3 egg layers on rock substrate, depending on location. The last survey was conducted on June 17.

Given the difficulty of observing herring during aerial surveys, the department conducted further studies to develop a spawn deposition index this year. The major difficulty in estimating biomass from spawn deposition data in this area is the loss of spawn due to storms and desiccation. To address this problem, artificial substrates were located in intertidal spawning areas in 1992. The artificial substrate consisted of small steel platforms with 6 x 12-inch rectangular pieces of astroturf attached to a steel plate on each platform. Spawn deposited on the astroturf was removed and weighed daily at low tide. Daily removal of spawn allowed measurements of new spawn deposition and decreased the problem of spawn loss due to wave action and desiccation observed in previous studies. A total of 50 platforms were placed just north of the department's field camp between June 5 and 9. The results indicated that the largest spawn deposition occurred on June 6, 9, and 14 within the study area. Hopefully, the spawn deposition index obtained this year can be used for comparative purposes in the future.

The projected return to the Cape Romanzof District in 1992 was 2,700 tons, which, at a 15% exploitation rate would have resulted in a harvest of 405 tons. However, since there was no

indication inseason that the biomass had decreased from the preceding year, the commercial fishery was managed to achieve a harvest similar to the 1991 season.

Because it was not possible to estimate the biomass inseason, the projected biomass of 3,000 tons was used to manage the fishery. The herring spawning biomass based on aerial surveys was 4,428 tons. This estimate was adjusted to 4,500 tons after evaluating commercial and test fish catch rates and spawn deposition data.

The 1992 commercial herring season in the Cape Romanzof District consisted of a 2-hour period on June 11 and a 4-hour period on June 12. The commercial harvest was managed to achieve the preseason harvest projection of 405 tons, because no inseason biomass estimate was obtained. Fishing gear was restricted to one 50-fathom gillnet per vessel throughout the commercial season. A total of 530 tons of herring was harvested by 73 fishermen utilizing 73 fishing vessels. The harvest consisted of 516 tons of sac roe with an average roe recovery of 8.0% and 14 tons of bait-quality herring.

Two buyers in the Cape Romanzof District paid fishermen an average of \$383 per ton for 10% sac roe herring plus or minus \$38 a percentage point. The average price paid for bait-quality herring (less than 7% roe) was \$50 per ton. The total exvessel value of the harvest was approximately \$159,000. The two buyers were represented by one processing vessel and five tenders during the fishery. Fishing effort in 1992 was the lowest since 1985 and was 9% below the 1991 effort. Local Alaskan residents (defined as residents of Chevak, Hooper Bay, and Scammon Bay) accounted for 97% (71 permits) of the effort and 96% (509 tons) of the harvest.

Test fishing with variable-mesh gillnets was conducted by the department from June 4 to June 17. A total of 1,696 herring were caught, of which 1,062 were sampled for biological data. Age-10 herring composed 21.7% of the biomass (Table 24) followed by age-8 herring (18.8%). Age-9 and older herring composed 71.7% of the biomass. Recruits, ages 3, 4, and 5, represented 4.8% of the biomass and 9.8% of the population in numbers of fish. Because of the late arrival of herring, younger-aged fish may have arrived after termination of the department's test fishing project. Age-8 and older herring composed 98.0% of commercial catch samples.

The projected return for 1993, based upon limited data, is 2,449 tons, which would result in a 367 ton harvest at a 15% exploitation rate. If stock abundance is judged to be lower or higher than the projection, the harvest will be modified accordingly. Age-9 and -11 herring are expected to compose 21.8% and 21.4% of the biomass, respectively (Figure 21).

Norton Sound Sac Roe Fishery

The Norton Sound District consists of all waters of Alaska between the westernmost tip of Cape Douglas and Canal Point Light. Historically, the primary spawning areas within Norton Sound

have been from Stuart Island to Tolstoi Point. Additional spawning areas have been documented along Cape Denbigh and several bedrock outcroppings along the northern shore of Norton Sound between Bald Head and Topkok, especially in years when sea ice has remained in the nearshore areas into June.

The Alaska Board of Fisheries has established a threshold biomass level of 7,000 tons for the Norton Sound fishery. The maximum exploitation rate is restricted to no more than 20% of the available biomass. Emergency order authority is used to adjust the occurrence and length of fishing periods. Board of Fisheries regulations allocate 10% of the preseason projected harvest to beach seine gear, with the remaining harvest allocated to gillnet gear. Varied harvest rates may be applied to individual subdistricts based on biomass distribution, roe quality, weather, and sea ice conditions.

As in other AYK herring districts, an inseason assessment of herring biomass will supercede the projected biomass for management of the fishery, except where weather prevents obtaining an inseason estimate.

Herring biomass estimates in the Norton Sound District have fluctuated from 5,291 tons in 1978 to 57,974 tons in 1992 (Figure 22). During 1992, 17 surveys were flown on 17 different days between May 27 and June 29 for a total of 60 hours of aerial survey time. Six of these surveys were flown under acceptable survey conditions. Ice floes hampered aerial surveys until June 15 and covered much of the preferred spawning area until June 19 when ice began to retreat from west to east.

The first spawn was observed June 15 at Stuart Island and gradually increased over several days to include the south shore of Norton Sound to Tolstoi Point. Fish spawned as soon as substrate became available as ice moved away from the beach. Fifty-nine linear miles of milt were observed during surveys, peak spawning occurring June 19.

Beach surveys conducted within a few days of the peak spawn revealed 3 to 4 egg layers on *Fucus* substrate in the St Michaels area and 2 to 3 egg layers in the Black Point and Klikitarik areas.

There was no commercial herring fishery in Norton Sound during 1992. The pack ice covered over 80% of Norton Sound on June 10. Large-vessel traffic was impossible from the Yukon River north. During June 13–15, the three largest buyers considered their other commitments, the risk of moving their buying fleet through dense pack ice, and the ramifications of buying herring with less processing capacity than the probable harvest. By June 15, the five companies which initially expressed an interest in the fishery decided not to participate.

The projected Norton Sound harvest was a record 5,200 tons. The peak aerial survey flown June 20 during heavy spawning sighted 57,974 tons, which would have allowed a 11,600 ton

harvest. The exvessel value of the projected harvest (from the biomass observed in season) of the sac roe was estimated to be worth nearly 3.5 million dollars (estimated at \$300 per ton) to approximately 320 permit holders.

The Cape Denbigh test fishing project was the only test fish project funded in Norton Sound during the 1992 season. The crew operated out of Unalakleet from June 6 until June 12 because of the extensive ice cover in the Cape Denbigh area. The field crew moved to Cape Denbigh and started fishing on June 12. The test fishing project ended on June 27. A roving crew consisting of office and regional staff operated out of Unalakleet until June 25. Test fish crews sampled 1,217 herring caught with variable mesh gillnets for biological data. Age-10 herring composed 27.5% of the 1992 biomass (Table 25). The biomass consisted of 51.2% age-9 and older herring. Recruits, ages 3, 4, and 5 represented 20.8% of the biomass and 34.8% of the return in numbers of fish.

The Norton Sound projected return for 1993 is 45,270 tons. A 20% exploitation rate would result in a harvest of 9,054 tons. The beach seine harvest is, by regulation, 10% of the projected harvest, or 905 tons. The 1993 biomass is expected to be dominated by 5 (23.0%), 7 (21.0%), and 11 (20.9%) year old herring (Figure 22).

Port Clarence Sac Roe Fishery

The Port Clarence District consists of all waters between Cape Douglas and Cape Prince of Wales. Generally, it is not possible to survey this district because of ice, water stain, and poor weather. In addition, it is difficult to identify herring due to the large numbers of saffron cod, whitefish, and other pelagic species typically present in the area. Two aerial surveys were flown in 1992. Eight tons of herring were observed near Point Spencer during a survey on June 17, when most of the district was still covered with shore-fast ice. A record biomass for this district of 1,652 tons was sighted during an aerial survey on June 29.

There has been no commercial or test fishery in the Port Clarence District since 1988 because buyers have not been present in the district.

A harvest outlook is not generally projected for the Port Clarence fishery because of the lack of data on Port Clarence herring and the very limited scope of the fishery. The guideline harvest of 165 tons established by the Board of Fisheries in 1981 will determine the allowable harvest in 1992. This harvest guideline is based on 2 years of research in both the Port Clarence and Kotzebue Districts. Although this guideline has not appeared in the regulation book since 1984, it still represents the best estimate of harvestable biomass at this time.

WESTWARD REGION

AUTHORS

Kodiak Food and Bait
Kevin Brennan
Fishery Biologist
Kodiak

Dutch Harbor
Jim McCullough
Fishery Biologist
Kodiak

Kodiak Sac Roe
Dave Prokopowich
Fishery Biologist
Kodiak

South Pen./Port Moller
Jim McCullough
Fishery Biologist
Kodiak

WESTWARD REGION

Kodiak Food/Bait Fishery

Regulations allow fishing for herring for food and bait in the Kodiak area from August 1 through February 28 during periods specified by emergency order. Although seines, gillnets, and trawls are legal in the Kodiak area, only seines and trawls have been used in recent years.

The bays and inlets around Kodiak have been aggregated into 13 food/bait herring management units. The migration of the Kamishak herring stock into eastern Shelikof Strait during the winter has complicated the management of the Kodiak fishery. Board of Fisheries regulations allow harvests on Kodiak spawning stocks of 10% of the sac roe harvest in the preceding spring. In addition, a harvest of up to 2% of the preceding spring's Kamishak spawning biomass is allowed. The Kamishak stock can be present in food/bait Management Units 1, 2, 4, 5, 11, and 12. Herring harvested from these management units are considered to be from Kodiak spawning stocks if the harvests occur in inshore locations, unless age-weight-length or biomass data indicate otherwise. In some years age distributions or weight-at-age can be used to separate Kamishak and Kodiak stocks in these management units. Very large schools of herring in these management units are assumed to be Kamishak stocks. When the Kamishak food/bait quota is taken, all of these management units are closed to herring fishing to avoid further interceptions of Kamishak stocks, regardless of whether the quota of Kodiak stocks has been taken. In recent years, the total harvest in the Kodiak food/bait herring fishery has been only 200 to 400 tons.

For the 1992-93 season, the Kodiak food/bait allocation of Kamishak stocks was 270 tons and for the remaining Kodiak spawning stocks 250 tons. The 1992-93 Kodiak food/bait fishery opened on August 1, 1992. Harvests totalled 309 tons. Of that total 216 tons were estimated to have been harvested from Kamishak stocks and 93 tons from Kodiak stocks.

The preliminary harvest projection for the 1993-94 food/bait fishery targeting Kamishak stocks is 288 tons; an additional 270 tons is projected to be harvested by the fishery which targets Kodiak stocks. These projections will be updated following the collection of additional stock assessment data during the spring of 1993.

Kodiak Sac Roe Fishery

The 1992 Kodiak commercial herring sac roe season began at noon on April 15. Fishing periods were 24 hours in duration starting at noon on odd-numbered days of the week and closing at noon on even-numbered days, followed by 24-hour closures. A total of 114 permit holders participated in this fishery, consisting of 74 gillnetters and 40 purse seiners. A total of 891 landings were made, which accounted for a record high sac roe herring harvest of 4,283 tons.

The preseason guideline harvest level had been 2,720 tons. Purse seine gear accounted for 76% (3,260 tons) of the harvest, and gillnet gear accounted for 24% (1,023 tons). Roe recovery averaged 8.7% for purse seine gear and 10.2% for gillnet gear. Age-4 herring were the dominant age class harvested in the 1992 season, representing 62% of the total harvest. The remaining age classes represented the following percentages of the harvest: age 3 (3%), age 5 (27%), and ages 6-11 (8%). The average weight was 140 grams, down from the 1991 average of 152 grams. The estimated exvessel value of the fishery was 2.1 million dollars. Low herring prices greatly depressed the value of this record high harvest.

Most management districts are experiencing an increase in biomass, whereas the Uyak District has shown a decline. The preliminary guideline harvest level (GHL) for the entire Kodiak Management area sac roe fishery should be approximately 3,500 tons. Adjustments increasing or decreasing management unit GHL's are currently under evaluation. Age-5 and age-6 herring are expected to comprise the majority of the 1993 harvest. Growth rate reductions occurred in 1991 and 1992 and this trend may continue for the 1992 sac roe season.

Port Moller (North Peninsula) Sac Roe Fishery

There are three commercial herring fishing districts defined in the fishing regulations for North Peninsula waters: the Port Heiden, Port Moller, and Amak Districts. No catches were reported nor were herring observed in the Amak District. In all districts, herring may be taken with purse seines and gillnets, both gear types sharing common time and area openings.

In 1992, a total of 3,969 tons of herring were harvested from North Peninsula waters: 1,600 tons from the Port Heiden District, and 2,369 tons from the Port Moller District. In the Port Heiden District most of the harvest (1,486 tons) occurred on May 26 during a single 20-minute fishing period. About 50% (1,141 tons) of the Port Moller harvest occurred on May 29 during two 60-minute fishing periods. Of the total of 3,969 tons harvested, 3,148 tons were purchased as sac roe product and 821 tons were sold as bait or dumped after processors refused to purchase the product. The total exvessel value of the North Peninsula herring sac roe catch is estimated to be \$1,173,100.

The guideline harvest level for the 1993 North Peninsula sac roe fishery is 3,500 tons. The forecast is based on the 1992 catch of 3,969 tons and the observed biomass of 24,843 tons (16% exploitation rate). The forecast has been reduced by 275 tons to allow for North Peninsula herring that are probably harvested during the Dutch Harbor food/bait fishery. Age-class data from the 1992 harvest indicates that in 1993 age-5 and age-6 herring should dominate North Peninsula catches. The forecast includes a 1,500-ton harvest in the Port Heiden District.

South Peninsula Sac Roe Fishery

South Peninsula herring fisheries were opened to sac roe fishing by regulation on April 15 and remained open until the regulatory closure date of July 15, except for the Canoe Bay section, which closed on June 9. In 1992 commercial harvests were taken only in Canoe Bay. From June 4 to June 7, 180.4 tons were harvested by seven purse seine permit holders making 11 deliveries. The average roe recovery was 10.8%, and the exvessel value was \$78,150.

The guideline harvest level for the 1993 South Peninsula sac roe fishery is 415 tons. The forecast is based on the 1988-92 average herring sac roe catch of 267 tons and the 1992 observed biomass of 2,377 tons. Age-class data from the 1992 harvest indicates that in 1993 age-8 and age-9 herring should dominate Canoe Bay catches. No age samples were collected in 1992 from other South Peninsula areas.

Dutch Harbor Food/Bait Herring Fishery

Because the Dutch Harbor food/bait fishery harvests primarily Togiak stocks, the Dutch Harbor quota is based on the stock size at Togiak. Board of Fisheries regulations specify that the annual Dutch Harbor quota shall be determined by first subtracting 1,500 tons from the allowable Togiak harvest to account for the impact of the Togiak spawn-on-kelp fishery. Then 7% of the remaining allowable harvest is allocated to the Dutch Harbor fishery. Because other western Alaskan stocks may be present in the Dutch Harbor fishery, Board of Fisheries regulations do not allow the Dutch Harbor fishery to open if any western Alaskan herring stocks are below their thresholds. For the purpose of determining whether to open the Dutch Harbor fishery, the board established a special 2,000-ton threshold for the Nelson Island herring stock.

Regulations allow the Dutch Harbor fishery to open from July 16 through February 28 during periods specified by emergency order. In recent years the quota has been harvested within a few days after the fishery was opened.

Herring were harvested at Dutch Harbor during an earlier fishery that lasted from 1928 to 1945. A large portion of the catch was brined for either food or bait purposes; some product was frozen. The Board of Fisheries reinstated the fishery in 1981 with no harvest restrictions. In 1983 the board restricted the harvest quota to 3,527 tons and in 1986 reduced the quota to 2,453 tons. For the 1988 season, the board initiated the allocation of 7% of the allowable Togiak harvest to the Dutch Harbor fishery.

The 1992 fishery opened on July 16 at 8:00 a.m. through 10:00 a.m. and from noon through 5:00 p.m. During this first day of fishing, 1,558 tons of the 1,940 ton quota was harvested. Most of the harvest occurred in Unalaska Bay, although some herring were caught near Cape Cheerful. Because of the large harvesting capacity of the fleet and the small remaining quota, the season

was not reopened until processors and fishermen agreed to cooperatively harvest the remaining quota. Under these arrangements, six vessels holders fished on July 20 and one vessel fished on July 23, 25, and 28. Most herring were again harvested in Unalaska Bay, although two deliveries were made from Volcano Bay, about 32 miles southwest of Cape Cheerful. The total harvest amounted to 1,949 tons. At least 234 tons were processed as food and the remainder were processed as bait, with about 40 tons deadloss. The exvessel value of the fishery was estimated to be \$584,550. For 1993, the preliminary forecast of the Dutch Harbor food/bait herring harvest is 1,978 tons. The harvest quota for the Dutch Harbor fishery may be revised after the spring sac roe herring fisheries in the Bering Sea.

LITERATURE CITED

- Bucher, W.A. and L.F. Hammarstrom. 1992. Review of the 1992 Lower Cook Inlet commercial herring fishery. Report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A92-15, Anchorage.
- Yuen, H.J., and W.A. Bucher. 1993. Methods of the 1993 Kamishak herring stock projection. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A93-06, Anchorage.

TABLES AND FIGURES

Table 1. Summary of 1992 Alaska statewide harvests and values for sac roe, spawn-on-kelp, and food/bait herring fisheries.

Fishery	Harvest (short tons)	Average Price Per Ton	Exvessel Value
Sac Roe Fisheries	63,992	\$393	\$25,160,330
Spawn-on-Pound-Kelp Fisheries			
Spawn-on-Kelp Product	252	\$14,766	\$3,722,000
Equivalent Herring Harvest ^a	3,172		
Spawn-on-Wild-Kelp Fisheries			
Spawn-on-Kelp Product	434	\$1,123	\$487,381
Directed Food/Bait Fisheries	8,835	\$242	\$2,135,156
<hr/>			
Total	75,999 (total harvest of herring)		\$31,504,867
<hr/>			

^a Equivalent herring harvest using average product conversions and assuming 100% mortality.

Table 2. Preliminary forecasts of harvest and abundance for 1993 Alaska sac roe herring fisheries.

Fishery	Forecast Harvest	Spawning Biomass	Threshold	Exploitation Rate	Mean Weight (g)	Stock Status	
	(short tons - 2,000 lbs)					Level	Trend
Southeastern							
Kah Shakes	717					Moderate	Increasing
Sitka Sound	9,691	48,450	7,500	20.0%	111	High	Increasing
Seymour Canal	0	1,800	3,000			Low	Stable
Lynn Canal	0	1,750	5,000			Low	Increasing
Prince William Sound							
Seine	15,586	134,133	8,400	20%	120	High	Stable
Gill Net	912				132		
Lower Cook Inlet							
East/Outer Districts							
Southern District							
Kamishak District	2,592	28,805		10%	172		
Upper Cook Inlet (West)							
Kodiak	3,525	Unknown				High	Stable
Chignik							
Alaska Peninsula							
Port Moller/North	3,500	24,843				High	Stable
South Peninsula	415					Moderate	Stable
Bristol Bay (Togiak)							
Seine	19,709	148,786	35,000	20% ^c	291	High	Stable
Gill Net	6,570				279		
Kuskokwim Area							
Security Cove	1,256	6,282	1,200	20%		High	Increasing
Goodnews Bay	720	3,600	1,200	20%		High	Increasing
Cape Avinof	354	2,358	500	15%		High	Increasing
Nelson Island	351	3,514	3,000	10%		Moderate	Increasing
Nunivak Island	591	3,942	1,500	15%		High	Increasing
Cape Romanzof	355	2,369	1,500	15%			
Norton Sound							
Gill Net	8,154	45,270	7,000	20%		High	Stable
Beach Seine	900						
Port Clarence	165	Unknown				Unknown	
Total:	76,063	455,902 (Known Biomass)					

^a The Prince William Sound exploitation rate includes allowances for spawn-on-kelp and food and bait harvests.

^b Kamishak District exploitation rate includes the 1% exploitation rate of the Shelikof Strait food and bait fishery.

^c The Togiak exploitation rate includes allowances for the Togiak spawn-on-kelp fishery and the Dutch Harbor food and bait harvest.

^d Abundance and recommended harvest levels for the Kah Shakes/Cat Island area is currently being analyzed.

Table 3. Preliminary forecasts of harvest and abundance for 1993 Alaska spawn-on-kelp and food/bait herring fisheries.

Fishery	Product Harvest	Spawning Biomass	Threshold	Exploitation Rate ^a	Mean Weight (g)	Stock Status	
	(short tons - 2,000 lbs)					Level	Trend
Spawn on Pound Kelp							
Hoonah Sound ^b	11	5,750	1,000	2.6%		High	Stable
Craig ^c	19	12,350	5,000	12.9%		Moderate	Stable
Prince Wm. Sound	305	134,133	8,400	20.0%		High	Stable
Total Pound Kelp:	335						
Spawn on Wild Kelp							
Prince Wm. Sound ^d	268	134,133	8,400	20.0%		High	Stable
Togiak	175	148,786	35,000	20.0%		High	Stable
Total Wild Kelp:	443						
Directed Food and Bait							
Southeast							
Craig ^b	1,362	12,350	5,000	12.9%			
Necker Bay	200	2,000	2,000	10.0%			
Lisianski	722	5,750	2,500	12.6%			
Ernest Sound	200	2,500	2,500	10.0%			
Hobart/Houghton ^c	495	4,100	2,000	12.1%			
Prince Wm. Sound	4,373	134,133	8,400	20.0%		High	Stable
Upper Cook In.(East)	50	Unknown				Depressed	Stable
Kodiak							
Eastern Shelikof ^e	288	28,805		10.0%			
Other Kodiak ^f	270	Unknown				High	Stable
Dutch Harbor ^g	1,978						
Total Food and Bait:	9,938						

^a Pound exploitation rate computed assuming 100% mortality on impounded fish.

^b The Craig stock is exploited by both a pound fishery and a food/bait fishery. The combined exploitation rate is shown. Board of Fisheries regulations allocate 85% of the allowable Craig harvest to the food and bait fishery and 15% to the pound fishery.

^c Biomass and exploitation rate for all Prince William Sound herring fisheries. Each fishery's allocation is specified by the Board of Fisheries.

^d Biomass and exploitation rate for all Togiak fisheries. Board of Fisheries regulations allocate 175 tons of roe on kelp product to the Togiak spawn-on-kelp fishery when the Togiak stock is above threshold.

^e Biomass and exploitation rate for Kamishak stock. Shelikof fishery is allocated 10% of the allowable harvest of Kamishak stocks.

^f The Kodiak food/bait harvest is constrained to 10% of the allowable sac roe harvest by Board of Fisheries regulations.

^g The Dutch Harbor food/bait fishery harvests primarily Togiak stocks and is constrained to 7% of the allowable Togiak harvest.

Table 4. Summary of harvest, value and participation in 1992 Alaska sac roe herring fisheries by fishery area.

Fishery	Opening				Harvest (short tons)	Price Per Ton	Exvessel Value	Roe Percent	Mean Weight (g)	No. of Permits Fished
	Location	Date	Time	Duration (hours)						
Southeast										
Kah Shakes		4/03	9:30 AM	9:15	1,246	\$1,386	\$1,727,000	14.2%	150	115
Sitka Sound		4/06	12:00 PM	1:23	5,368	\$279	\$1,500,000	9.4%	88	52
Seymour Canal	Closed due to low stock abundance									
Lynn Canal	Closed due to low stock abundance									
Prince William Sound										
Seine	4 openings	4/13 - 4/21		2:00	16,592	\$400	\$6,640,000	10.0%	117	104
Gill Net	2 openings	4/23 - 4/24		11:00	940	\$800	\$752,080	10.8%	155	24
Cook Inlet										
Eastern/Outer Districts		5/10			0		\$0			
Southern District					0		\$0			
Kamishak District		4/24	5:00 PM	0:30	2,356	\$594	\$1,400,000	8.5%-13%		56
Kodiak		4/15 through 6/04; 24 hrs on, 24 off			4,283		\$2,100,000	9.1%	140	40PS;74GN
Chignik										
Alaska Peninsula										
North Peninsula	Port Heiden				1,600	\$268	\$428,700	8.5%	217	12
	Port Moller				2,790	\$267	\$744,400	9.3%	197	23
South Peninsula					180	\$433	\$78,150	10.8%	335	7
Bristol Bay (Togiak)										
Seine		5/20	10:00 PM	0:20	20,778	\$342	\$7,100,000	9.2%		244
Gill Net	7 openings,	5/20 - 5/27 for 25.5 hours			5,030	\$338	\$1,700,000	8.8%		295
Kuskokwim Area										
Security Cove	6 openings,	5/25 - 5/29		30	834	\$342	\$285,000	9.2%		58
Goodnews Bay	7 openings,	5/29 - 6/01		30	740	\$386	\$286,000	9.2%		78
Cape Avinof	3 openings,	6/04 - 6/11		14	451	\$395	\$178,000	10.1%		121
Nelson Island	3 openings	6/10 - 6/11		10	246	\$317	\$78,000	8.6%		85
Nunivak Island	3 openings	6/04 - 6/08		6	27	\$148	\$4,000	11.0%		14
Cape Romanzof	2 openings	6/09 - 6/12		6:00	530	\$300	\$159,000	8.0%		73
Norton Sound	No Fishery; Ice prevented processing vessels from reaching Norton Sound.									
Gill Net					0		\$0			
Beach Seine					0		\$0			
Port Clarence					0		\$0			
Current Statewide Total:					63,992		\$25,160,330	9.5%		

Table 5. Summary of harvest, value and participation in 1992 Alaska food/bait herring fisheries by fishery area.

Fishery	Openings		Product Harvest (short tons)	Price Per Ton	Estimated Exvessel Value	Average Weight (g)	No. of Permits Fished
	First	Last					
Southeast							
Craig	01/13	01/17	2,290				25
Lisianski	01/13	01/13	352			72	3
Tenakee Inlet							
Hobart/Houghton			0				
Prince William Sound	10/01	10/22	3,900	\$200	\$780,060		17
Upper Cook Inlet (East Side)	04/15		25				
(Chinitna Bay)	04/22		10				
Kodiak^a							
Eastern Shelikof	08/01	02/28	216	\$400	\$86,400		
Other Kodiak	08/01	02/28	93	\$400	\$37,200		7
Dutch Harbor	07/16	07/28	1,949	\$300	\$584,550	397	11
Total:			8,835	\$242	\$2,135,156		

^a By regulation the Kodiak food/bait fishery occurred from August 1, 1992 through February 28, 1993.

Table 6. Summary of harvest, value and participation in 1992 Alaska spawn-on-kelp herring fisheries by fishery area.

Spawn on Pound Kelp

Fishery	Herring Seining		Kelp Harvest Completed	Pound Removal Began	Herring Quota		Product Quota (tons)	Kelp Blades Per Permit	Harvest (tons)	Price per Pound	Exvessel Value	No. of Permits Fished
	Began	Ended			Total (tons)	Lbs Per Permit						
Hoonah Sound	Apr-06				150	2,500	11.0		23	\$6.98	\$322,000	120
Craig	Mar-18	Mar-21		Apr-22	403		32.5		19			240
Prince William Sound	Apr-07	Apr-17	Apr-25		3,446		276.0		210	\$8.10	\$3,400,000	127
Total:					3,999		320		252		\$3,722,000	487

Spawn on Wild Kelp

Fishery	Opening				Equivalent Herring Quota (tons)	Spawn on Kelp Product Quota (tons)	Actual Product Harvest (tons)	Price per Pound	Price per ton	Exvessel Value	No. of Permits Fished
	Location	Date	Time	Duration (hours)							
Prince William Sound	Tatitlek Narrows	Apr-24	1:00 PM	8	1,941	243	34				
	Tatitlek Narrows	Apr-25	9:00 AM	12			49				
	Tatitlek Narrows	Apr-26	9:00 AM	12			25				
	Tatitlek Narrows	Apr-27	8:00 AM	41			3				
	Montague	Apr-28	8:00 AM	13			39				
	Montague	Apr-29	5:00 AM	16			50				
	Montague	Apr-30	5:00 AM	12			52				
				Total:			114	252	\$0.46	\$925	\$233,381
Togiak	Area K-9	May-23	3:40 PM	3:15	1,500	175	182	\$0.70	\$1,397	\$254,000	276
Total:							434			\$487,381	

Table 7. Glossary of some terminology used in describing herring stock assessment.

Term	Definition
age class	A group of fish of the same age from the same population referenced by their current age: e.g., the 5-year-old age class of 1989 was spawned in 1984.
cohort	A group of fish of the same age from the same population referenced by the year in which they were spawned: e.g., the 1984 year class was spawned in 1984.
escapement	Herring that survive the commercial fishery and return to spawn.
natural mortality	All mortality not accounted for by commercial catches.
recruits	A young age class of fish during the first year in which they appear on the spawning grounds in substantial numbers, usually as 3- or 4-year-olds.
short ton	The 2,000 pound unit commonly used to record herring catches.
spawning biomass	The weight of the spawning herring stock.
spawning population	The number of fish in the spawning herring stock.
spawn-on-pound-kelp fishery	A fishery which harvests kelp suspended in floating enclosures upon which herring have deposited spawn; herring are captured by purse seines, transferred to the enclosures and held until spawning occurs. Herring are released from the enclosures after spawning.
spawn-on-wild-kelp fishery	A fishery which harvests naturally occurring kelp on which herring eggs have been deposited.
year class	Same definition as cohort.

Table 8. Summary of harvest policy and fishery regulations for Alaska sac roe herring fisheries.

Reg- ion	Mgt. Area	Fishery Location/Gear	CFEC Permit Code	Ltd. Entry	Super- ² Exclu- sive	Gillnet Shakers Allowed	Max. Ves. Len.	Net Specifications ³				Thres- hold (tons)	
								Mesh Size (inches)		Maximum			
								Min.	Max.	Depth (meshes)	Length (fath.)		
I	A	Kah Shakes	G34A	Yes	No	Yes		2 1/4	2 1/2	120	50		
		Seymour Canal	G34A	Yes	No	Yes		2 1/8	2 1/2	120	50		
		Sitka	G01A	Yes	No					1,700	200		
		Lynn Canal	G01A	Yes	No					1,700	200		
II	E	Prince Wm. Sound										8,400	
		Purse Seine	G01E	Yes	No					1,000	150		
	Gill Net	G34E	Yes	No	Yes		2 1/8	3	120	100			
	H	Upper Cook Inlet	G34H	No	No	Yes		2 1/8	2 1/2	Unspec.	105		
		Lower Cook Inlet	G01H	Yes	No					1,025	150		8,000
	T	Togiak											35,000
Purse Seine		G01T	No	No					16fm	100			
III	W	Security Cove	G34S	No	No	Yes		2 1/8	3 1/2	Unspec.	100/50	1,200	
		Goodnews Bay	G34W	No	Yes	Yes	30'	2 1/8	3 1/2	Unspec.	100/50	1,200	
		Cape Avinof	G34V	No	Yes	No	30'	2 1/8	3 1/2	Unspec.	100/50	500	
		Nelson Island	G34N	Yes	Yes	No	30'	2 1/8	3 1/2	Unspec.	100/50	3,000	
		Nunivak Island	G34U	Yes	Yes	No	30'	2 1/8	3 1/2	Unspec.	100/50	1,500	
	Q	Cape Romanzof	G34Y	Yes	Yes	No		2 1/8	3 1/2	Unspec.	100/50	1,500	
		Norton Sound											7,000
		Beach Seine	G02Z	Yes	Yes					850	75		
		Gill Net	G34Z	Yes	Yes	Yes		2 1/2	3 1/2	Unspec.	100/50		
		Port Clarence	G01X	No	No					850	150		
IV	K	Kodiak											
		Purse Seine	G01K	Yes	No					1,025	100		
	Gill Net	G34K	Yes	No	Yes		2 1/8	2 1/2	Unspec.	150			
	L	Chignik	G01L	No	No					1,000	100		
	M	Alaska Peninsula											
		Purse Seine	G01M	No	No					1,000	100		
		Gill Net	G34M	No	No	Yes		2 1/8	2 1/2	Unspec.	150		

¹ This table is an attempt to summarize pertinent herring regulations. Regulations listed in the appropriate section of the herring regulation book or Alaska Administrative Code should be consulted for details.

² Superexclusive use restrictions preclude permit holders, crew or vessels which have participated in any other herring fisheries from participating in fisheries that are designated as superexclusive. Superexclusive fishery participants and vessels may not fish in any other herring fisheries. The Nelson and Nunivak Island Districts are a combined superexclusive use area. Although Goodnews Bay is a superexclusive use area, participants and vessels used in the Goodnews Bay fishery may participate in the Security Cove fishery.

³ Where more than one specification is listed, Board regulations allow net specifications to be reduced by emergency order when needed to more precisely control the harvest.

Table 9. Summary of Alaska harvest policy and fishery regulations for Alaska spawn-on-kelp and food/bait herring fisheries.

SPAWN-ON-KELP FISHERIES			CFEC		Permit	Herring/ ²	Guideline	Stock
Region	Mgt. Area	Fishery	Permit Code	Limited Entry	Application Deadline	Kelp Conversion Factor	Harvest Level (GHL) Specification	Threshold (tons)
I	A	Craig						5,000
		Pound Spawn-on-Kelp	L21A	No	Jan. 31	12.5	15% of Craig GHL	
		Hoonah Sd. Pound Spawn-on-Kelp	L21A	No	Jan. 31	12.5	150 tons of herring	1,000
II	E	Prince William Sound						8,400
		Wild Spawn-on-Kelp	L12E	No		8	8% of PWS GHL	
	Pound Spawn-on-Kelp	L21E	Yes	March 1	12.5	14.2% of PWS GHL		
	T	Togiak						35,000
		Wild Spawn-on-Kelp	L12T	Yes		8.6	175 tons of kelp	
¹ This table is an attempt to summarize pertinent herring regulations. Regulations listed in the appropriate section of the herring regulation book or Alaska Administrative Code should be consulted for details.								
² Conversion from weight of herring product to equivalent weight of herring used to determine guideline harvest levels.								

Food/Bait Fisheries			CFEC		Super-		Net Specifications			Guideline	Thres-	
Region	Mgt. Area	Fishery	Permit Code	Ltd. Entry	Exclu- sive	Season Dates	Mesh Size (inches)		Maximum		Harvest Level (GHL) Specification	hold (tons)
		Location/Gear					Min.	Max.	Depth (meshes)	Length (fath.)		
I	A	Southeast										
		Craig/Meares Pass.	H01A	No	No	10/1-2/28			1,700	200	85% of Craig Gt	5,000
		Tenakee Inlet	H01A	No	No	10/1-2/28			1,700	200	Variable Rate	3,000
		Lisianski Inlet	H01A	No	No	10/1-2/28			1,700	200	Variable Rate	2,500
		Pt. Houghton/Hobart B.	H01A	No	No	10/1-2/28			1,700	200	Variable Rate	2,000
		Fresh Bait Pound	H21A	No	No	1/1-					445 tons ²	
		Tray Pack Bait Pound	H21A	No	No	7/1-3/31				100 tons		
II	E	Prince Wm. Sound									16.3% of PWS G	8,400
		Purse Seine	H01E	No	Vessel	9/1-1/31			Unspec.	Unsp.		
		Gill Net	H34E	No	Vessel	9/1-1/3	2 1/8	3	Unspec.	150		
IV	K	Kodiak									10% of sac roe harvest	
		Purse Seine	H01K	No	No	8/1-2/28			1,025	100		
		Gill Net	H34K	No	No	8/1-2/2	2 1/8	2 1/2	Unspec.	150		
	Trawl	H07K	No	No	8/1-2/28							
	L	Chignik	H01L	No	No	8/15-2/28			1,000	100		
M		Dutch Harbor				7/16-2/28					7% of Togiak harvest	
		Purse Seine	H01M	No	No				Unspec.	250		
		Gill Net	H34M	No	No		2 1/8	2 1/2	Unspec.	spec.		
¹ This table is an attempt to summarize pertinent herring regulations. Regulations listed in the appropriate section of the herring regulation book or Alaska Administrative Code should be consulted for details.												
² Fresh Bait Pound Quotas are established by area: Farragut Bay (100 tons), Scow Bay (100 tons), Tee Harbor (60 tons), Indian Cove (60 tons), Section 13-B (100 tons) and Lisianski Inlet (25 tons).												

Table 10. Alaska herring fisheries, area management offices and fishery managers to contact for additional information.

Fishery	Office	Manager Name	Telephone (907)	
			Voice	Recorded Messages
All Southeast Region Fisheries	Juneau	Doug Mecum	465-4250	
Kah Shakes Sac Roe	Ketchikan	Philip Doherty	225-5195	225-6870
Sitka Sound Sac Roe	Sitka	Robert DeJong	747-6688	747-5022
Seymour Canal Sac Roe	Juneau	Don Ingledue	465-4250	586-3505
Craig Pound Spawn on Kelp	Ketchikan	Philip Doherty	225-5195	225-6870
Hoonah Sound Spawn on Kelp	Sitka	Robert DeJong	747-6688	747-5022
Southeast Food and Bait	Juneau	Doug Mecum	465-4250	586-3505
All Central Region Fisheries	Anchorage	Dennis Haanpaa James Brady	344-0541 344-0541	
Prince William Sound	Cordova	Wayne Donaldson	424-3213	424-7535
Lower Cook Inlet (Kamishak)	Homer	Wes Bucher	235-8191	235-7307
Upper Cook Inlet	Soldotna	Paul Ruesch	262-9368	262-9611
Togiak (Bristol Bay)	Dillingham	Tom Brookover	842-5227	842-5226
All AYK Region Fisheries	Anchorage	Richard Cannon	267-2128	
Kuskokwim Area Fisheries	Bethel	Kim Francisco	543-2433	543-2598
Cape Romanzof	Anchorage	Dan Bergstrom	267-2128	
Norton Sound	Nome	Charles Lean	443-5167	
Port Clarence	Nome	Charles Lean	443-5167	
All Westward Region Fisheries	Kodiak	Pete Probasco	486-4791	
Kodiak Area Fisheries	Kodiak	Dave Prokopowich	486-4791	486-4559
Chignik	Kodiak		486-4791	
Dutch Harbor Food and Bait	Dutch Harbor	Mike Ward	581-1239	581-2122
Port Moller (North Peninsula)	Kodiak	Jim McCullough	486-4791	
South Peninsula	Kodiak	Jim McCullough	486-4791	

Table 11. Herring spawning threshold levels for major herring stocks in Southeast Alaska and Yakutat.

Area and Type of Fishery	Threshold (tons)
Hoonah Sound (pound)	1,000
Yakutat Bay (winter bait)	1,000
Deer Island (winter bait)	2,500
Anita Bay (winter bait)	2,500
Port Camden (winter bait)	2,500
Lisianski Inlet (winter bait)	2,500
Seymour Canal (sac roe)	3,000
Tenakee Inlet (winter bait)	3,000
Tongass Narrows and George and Carroll Inlets (winter bait)	3,500
Craig/Meares Passage/Boca de Finas (winter bait and pound)	5,000
Kah Shakes/Cat Island (sac roe)	6,000
Lynn Canal (sac roe)	5,000
Sitka Sound (sac roe)	7,500
Other stocks not included above	2,000

Table 12. Southeast Alaska sac roe herring harvest by area in tons, 1971-1992.

Year	Sitka Sound	Seymour Canal	Lynn Canal	Kah Shakes	Other Areas	All Areas
1971	748	35	688	0	220 ^{a/}	1,671
1972	602	495	524	0	201 ^{b/}	1,822
1973	597	506	798	0	452 ^{c/}	2,353
1974	681	904	396	0	0	1,981
1975	1,517	0	558	0	0	2,075
1976	800	195	630	426	203 ^{d/}	2,254
1977	0	485	926	820	0	2,231
1978	175	729	954	171	0	2,029
1979	2,250	269	0	528	0	3,047
1980	4,385	0	975	1,140	0	6,500
1981	3,506	615	761	1,840	0	6,722
1982	4,363	0	551	2,279	0	7,193
1983	5,463	0	0	3,250	0	8,713
1984	5,711	518	0	2,182	0	8,411
1985	7,475	0	0	2,161	0	9,636
1986	5,443	339	0	1,537	0	7,319
1987	4,216	302	0	1,439	0	5,957
1988	9,573	586	0	1,087	0	11,246
1989	11,831	547	0	592	0	12,970
1990	3,804	359	0	0	0	4,163
1991	1,838	0	0	660	0	2,498
1992	5,368	0	0	1,246	0	6,614

a/ Washington Bay (76 tons), Lisianski Inlet (100 tons), and Yakutat Bay (44 tons).

b/ Lisianski Inlet.

c/ Yakutat Bay (158 tons), Helm Bay (194 tons), and Lisianski Inlet (100 tons).

d/ Helm Bay (26 tons), Chaik Bay (40 tons), Pybus Bay (22 tons), Gambier Bay (8 tons), and Kasaan Bay (107 tons).

Table 13. Summary of Southeast Alaska spawn deposition information for 1992.

Area	Miles of Spawn	1000s Eggs per m ²	Spawning Escapement (Tons)	Spawning Biomass Threshold (Tons)	Percent Harvest Rate	1993 Quota Tons
Kah Shakes	2.6	99	650	-		
Cat Island	18.7	116	7,450	-		
Kah Shake/ Cat Island Combined	21.3		8,100	6,000	10.7	867
Craig	22.6	214	12,350	5,000	12.9 Bait: Pound:	1362 240 ^a
Sitka	72.5	367	48,450	7,500	20.0	9691
Hoonah Sound	10.8	230	5,750	1,000	2.6	150 ^b
Seymour Canal	9.0	98	1,800	3,000	0	0
Necker Bay	4.0		2,000	2,000	10	200
Lisianski Inlet	15.3	337	5,750	2,500	12.6	722
Hobart Bay	7.6	160	4,100	2,000	12.1	495
Juneau/ Lynn Canal	4.0		1,750	5,000	0	0
Ernest Sound						
Union Bay	7.0	104	2,050			
Brownson I.	1.6					
Meyers Ch.	<u>1.3</u>					
Total	9.9			2,500	10.0	200

^a The Craig pound harvest is equivalent to 32.5 tons of spawn-on-kelp product.

^b The Hoonah Sound pound harvest is equivalent to 12 tons of spawn-on-kelp product.

Table 14. Projection of the spawning biomass for Prince William Sound in 1993.

Age	1992 ASA Escapement			Maturity	Survival Rate	1993 Projection		
	Biomass (Tons)	Weight (g)	Number (Millions)			Number (Millions)	Weight (g)	Projection (Tons)
2								
3	1,134	68	15.2	0.18	68%	25.9	69	1,978
4	87,625	88	904.6	0.67	68%	38.0	93	3,900
5	2,010	89	20.4	0.95	68%	866.1	114	109,065
6	424	116	3.3	0.99	68%	14.5	133	2,122
7	2,731	135	18.4	1.00	68%	2.3	150	373
8	14,593	144	92.0	1.00	68%	12.5	164	2,258
9+	2,312	161	13.0	1.00	68%	71.3	184	14,436
Total	110,831		1,067.0			1,030.6		134,133

Table 15. Allocation of allowable harvest for Prince William Sound in 1993.

Gear Group	^a Allocation	Quota (tons)
Purse Seine	58.1%	15,586
Gillnet	3.4%	912
Pound Kelp	14.2%	3,809
Wild Kelp	8.0%	2,146
Food and Bait	16.3%	4,373
Total:	100.0%	26,827

^a Allocation percentages are fixed by Alaska Board of Fisheries regulation 5 AAC 27.365 (c).

Table 16. Forecast of 1993 Kamishak District herring abundance and projected harvest by age class.

Age	1992 Estimated Escapement ^a	Instantaneous Mortality & Recruitment	1993 Abundance Forecast (x1,000)	Proportion by Numbers	Predicted Mean Weight (g)	1993 Forecast Biomass (tons)	Harvest Rate	1993 Total Allowable Harvest (tons)	Proportion by Weight
2	0	-4.43							
3	830	-1.02	0	0.00	63	0	0.10	0	0.00
4	79,368	-0.34	2,312	0.02	141	358	0.10	36	0.01
5	17,690	0.02	111,836	0.74	155	19,109	0.10	1,911	0.66
6	4,954	-0.19	17,292	0.11	188	3,569	0.10	357	0.12
7	4,689	0.34	5,999	0.04	231	1,522	0.10	152	0.05
8	13,520	0.68	3,344	0.02	247	908	0.10	91	0.03
9	4,694	0.48	6,846	0.05	252	1,899	0.10	190	0.07
10	1,103	0.82	2,890	0.02	278	885	0.10	89	0.03
11	1,655	1.31	488	0.00	309	166	0.10	17	0.01
12	277	1.00	448	0.00	310	153	0.10	15	0.01
13	275	0.82	102	0.00	293	33	0.10	3	0.00
14	550	0.28	121	0.00	336	45	0.10	5	0.00
15	0	1.73	416	0.00	350	160	0.10	16	0.01
Total Mean	129,605		152,094		172	28,805		2,881	

^a 1992 escapement based on preliminary estimate of 1992 run biomass (daily aerial survey estimates of run biomass divided by preliminary estimate of expected daily proportion), preliminary age composition (with no adjustment for missing late samples), and final catch biomass estimate. Final run biomass estimate and age composition data were not completed at this time.

Table 17. Allocation of the projected 1993 Kamishak Bay herring harvest.

	Exploitation Rate	Harvest (tons)
Kamishak Bay Sac Roe Fishery	9%	2,592
Shelikof Straits Bait Fishery	1%	288
Total	10%	2,881

Table 18. Togiak District year class composition of the 1992 Pacific herring harvest, escapement, and total run biomass and the 1993 projected biomass.

Year Class	Age Class	1992									1993					
		Harvest (tons)				Escape- ment (tons)	Estimated Mature Population ^a				Projected Mature Population ^b					
		Sac Seine	Roe Gill Net	Food and Bait	Total		Biomass (tons)	Thousands of Fish	Percent by Wt. by No.		Year Class	Age	Biomass (tons)	Thousands of Fish	Percent by Wt. by No.	
1989	3	17	0	0	17	221	238	1,463	0.2	0.3	1990	3	0	0	0.0	0.0
1988	4	2,009	1	0	2,010	14,411	16,421	95,635	10.5	19.8	1989	4	4,925	28,300	3.3	5.6
1987	5	4,157	124	5	4,286	28,058	32,344	149,902	20.6	31.0	1988	5	48,782	212,800	32.8	42.0
1986	6	222	29	2	253	655	908	3,790	0.6	0.8	1987	6	43,979	155,500	29.6	30.7
1985	7	206	178	6	390	1,207	1,597	4,558	1.0	0.9	1986	7	1,456	4,400	1.0	0.9
1984	8	2,146	1,307	408	3,861	18,904	22,765	59,693	14.5	12.4	1985	8	1,278	3,400	0.9	0.7
1983	9	2,447	1,352	459	4,258	16,922	21,180	49,134	13.5	10.2	1984	9	11,671	28,200	7.8	5.6
1982	10	622	165	93	880	4,879	5,759	12,732	3.7	2.6	1983	10	9,212	20,700	6.2	4.1
1981	11	1,915	548	305	2,768	10,117	12,885	25,909	8.2	5.4	1982	11	1,316	2,800	0.9	0.6
1980	12	1,431	296	191	1,918	5,412	7,330	14,657	4.7	3.0	1981	12	5,411	11,000	3.6	2.2
1979	13	1,557	332	216	2,145	11,204	13,349	25,410	8.5	5.3	1980	13	965	1,900	0.6	0.4
1978	14	2,697	469	205	3,371	10,819	14,190	25,462	9.0	5.3	1979	14	4,652	8,900	3.1	1.8
1977	15	1,049	196	56	1,301	4,372	5,673	10,328	3.6	2.1	1978	15+	15,140	28,500	10.2	5.6
1974	16	114	20	3	137	1,054	1,191	2,283	0.8	0.5						
1973	17	30	0	0	30	727	757	1,456	0.5	0.3						
1972	18	120	12	0	131	235	368	672	0.2	0.1						
Total		20,779	5,030	1,949	27,756	129,197	156,955	483,084					148,786	506,400		

^a Revised biomass estimate and age composition derived from inseason biological sampling weighted by selected observed biomass estimates.

^b Forecast age composition and biomass estimated from age structure population model.

Table 19. Security Cove District year/age class composition of the 1992 Pacific herring harvest, escapement, and total run biomass and the 1993 projected biomass by weight and number of fish.

Year Class	Age Class	Gillnet Harvest (tons)	Escapement (tons)	Total Run				1993 Projection*			
				(tons)	No. of Fish (* 1,000)	% by Number	% by Weight	(tons)	No. of Fish (* 1,000)	% by Number	% by Weight
1991	1	0	0	0	0	0.0	0.0	0	0	0.0	0.0
1990	2	0	0	0	0	0.0	0.0	0	0	0.0	0.0
1989	3	0	52	52	423	1.3	0.7	0	0	0.0	0.0
1988	4	0	1,606	1,606	10,248	32.7	20.7	108	690	2.8	1.7
1987	5	8	2,256	2,265	11,289	36.0	29.1	1,960	9,768	40.1	31.2
1986	6	10	94	103	423	1.3	1.3	2,326	9,507	39.0	37.0
1985	7	23	68	91	325	1.0	1.2	85	303	1.2	1.4
1984	8	173	862	1,035	2,928	9.3	13.3	56	159	0.7	0.9
1983	9	195	525	720	1,854	5.9	9.3	655	1,687	6.9	10.4
1982	10	127	342	469	1,041	3.3	6.0	350	777	3.2	5.6
1981	11	152	620	772	1,594	5.1	9.9	207	427	1.8	3.3
1980	12	80	152	232	455	1.5	3.0	328	643	2.6	5.2
1979	13+	65	361	426	781	2.5	5.5	206	404	1.7	3.3
Total		834	6,939	7,773	31,362	100.0	100.0	6,282	24,364	100.0	100.0

* Projections for older aged fish (>10) based upon natural mortality and growth rates derived from regression analysis of previous year's rates.

Table 20. Goodnews Bay District year/age class composition of the 1992 Pacific herring harvest, escapement, and total run biomass and the 1993 projected biomass by weight and number of fish.

Year Class	Age Class	Gillnet Harvest (tons)	Escapement (tons)	Total Run				1993 Projection*			
				(tons)	No. of Fish (* 1,000)	% by Number	% by Weight	(tons)	No. of Fish (* 1,000)	% by Number	% by Weight
1991	1	0	0	0	0	0.0	0.0	0	0	0.0	0.0
1990	2	0	0	0	0	0.0	0.0	0	0	0.0	0.0
1989	3	0	14	14	101	0.6	0.3	0	0	0.0	0.0
1988	4	0	391	391	2,310	14.2	7.0	30	175	1.7	0.8
1987	5	26	803	829	3,647	22.4	14.9	476	2,096	20.1	13.2
1986	6	14	104	117	446	2.7	2.1	827	3,143	30.1	23.0
1985	7	21	215	236	729	4.5	4.2	94	290	2.8	2.6
1984	8	204	869	1,073	2,897	17.8	19.3	178	481	4.6	4.9
1983	9	165	578	743	1,803	11.1	13.3	661	1,604	15.4	18.3
1982	10	49	539	588	1,276	7.8	10.6	385	836	8.0	10.7
1981	11	121	585	706	1,418	8.7	12.7	326	654	6.3	9.0
1980	12	88	457	546	1,033	6.4	9.8	310	587	5.6	8.6
1979	13+	52	277	329	608	3.7	5.9	313	578	5.5	8.7
Total		740	4,832	5,572	16,268	100.0	100.0	3,600	10,444	100.0	100.0

* Projections for older aged fish (> 10) based upon natural mortality and growth rates derived from regression analysis of previous year's rates.

Table 21. Cape Avinof District year/age class composition of the 1992 Pacific herring harvest, escapement, and total run biomass and the 1993 projected biomass by weight and number of fish.

Year Class	Age Class	Gillnet Harvest (tons)	Escapement (tons)	Total Run				1993 Projection ^a			
				(tons)	No. of Fish (* 1,000)	% by Number	% by Weight	(tons)	No. of Fish (* 1,000)	% by Number	% by Weight
1991	1	0	0	0	0	0.0	0.0	0	0	0.0	0.0
1990	2	0	0	0	0	0.0	0.0	0	0	0.0	0.0
1989	3	0	9	9	93	0.8	0.3	0	0	0.0	0.0
1988	4	0	356	356	2,365	19.2	10.3	20	131	1.6	0.8
1987	5	1	255	256	1,307	10.6	7.4	434	2,211	27.1	18.4
1986	6	15	373	388	1,650	13.4	11.3	263	1,119	13.7	11.2
1985	7	26	183	209	778	6.3	6.1	338	1,257	15.4	14.3
1984	8	129	504	633	1,976	16.1	18.4	152	473	5.8	6.4
1983	9	96	497	593	1,727	14.1	17.2	383	1,115	13.7	16.2
1982	10	70	390	460	1,198	9.7	13.4	332	864	10.6	14.1
1981	11	65	193	257	607	4.9	7.5	236	556	6.8	10.0
1980	12	34	152	186	389	3.2	5.4	102	214	2.6	4.3
1979	13+	16	81	97	202	1.6	2.8	100	209	2.6	4.2
Total		452	2,994	3,446	12,294	100.0	100.0	2,358	8,148	100.0	100.0

^a Projections for older aged fish (>10) based upon natural mortality and growth rates derived from regression analysis of previous year's rates.

Table 22. Nelson Island District year/age class composition of the 1992 Pacific herring harvest, escapement and total run biomass and the 1993 projected biomass by weight and number of fish.

Year Class	Age Class	Gillnet Harvest (tons)	Escapement (tons)	Total Run				1993 Projection ^a			
				(tons)	No. of Fish (* 1,000)	% by Number	% by Weight	(tons)	No. of Fish (* 1,000)	% by Number	% by Weight
1991	1	0	0	0	0	0.0	0.0	0	0	0.0	0.0
1990	2	0	0	0	0	0.0	0.0	0	0	0.0	0.0
1989	3	0	18	18	173	1.1	0.3	0	0	0.0	0.0
1988	4	0	460	460	3,235	19.8	8.7	37	261	2.5	1.1
1987	5	0	346	347	1,678	10.3	6.6	561	2,715	25.6	16.0
1986	6	3	180	183	732	4.5	3.5	357	1,424	13.4	10.2
1985	7	7	165	173	559	3.4	3.3	163	528	5.0	4.6
1984	8	40	750	790	2,343	14.3	15.0	137	406	3.8	3.9
1983	9	45	614	658	1,771	10.8	12.5	570	1,533	14.4	16.2
1982	10	54	773	827	1,997	12.2	15.7	409	988	9.3	11.6
1981	11	39	803	842	1,864	11.4	16.0	467	1,035	9.8	13.3
1980	12	26	521	548	1,158	7.1	10.4	425	899	8.5	12.1
1979	13+	31	399	430	839	5.1	8.2	388	821	7.7	11.0
Total		246	5,029	5,275	16,350	100.0	100.0	3,514	10,611	100.0	100.0

^a Projections for older aged fish (> 10) based upon natural mortality and growth rates derived from regression analysis of previous year's rates.

Table 23. Nunivak Island District year/age class composition of the 1992 Pacific herring escapement, and total run biomass and the 1993 projected biomass by weight and number of fish.

Year Class	Age Class	Gillnet Harvest (tons)	Escapement (tons)	Total Run				1993 Projection*			
				(tons)	No. of Fish (* 1,000)	% by Number	% by Weight	(tons)	No. of Fish (* 1,000)	% by Number	% by Weight
1991	1	0	0	0	0	0.0	0.0	0	0	0.0	0.0
1990	2	0	0	0	0	0.0	0.0	0	0	0.0	0.0
1989	3	0	19	19	187	1.1	0.3	0	0	0.0	0.0
1988	4	0	497	497	3,498	19.7	8.7	40	282	2.4	1.0
1987	5	0	375	375	1,814	10.2	6.6	606	2,936	24.9	15.4
1986	6	0	198	198	793	4.5	3.5	386	1,544	13.1	9.8
1985	7	1	186	187	607	3.4	3.3	179	583	4.9	4.5
1984	8	4	850	854	2,546	14.3	15.0	154	458	3.9	3.9
1983	9	5	707	712	1,928	10.9	12.5	646	1,750	14.8	16.4
1982	10	6	888	894	2,174	12.3	15.7	471	1,147	9.7	12.0
1981	11	4	906	910	2,025	11.4	16.0	537	1,195	10.1	13.6
1980	12	3	589	592	1,259	7.1	10.4	480	1,020	8.7	12.2
1979	13+	3	462	465	914	5.1	8.2	443	870	7.4	11.2
Total		27	5,676	5,703	17,746	100.0	100.0	3,942	11,784	100.0	100.0

* Projections for older aged fish (> 10) based upon natural mortality and growth rates derived from regression analysis of previous year's rates.

Table 24. Cape Romanzof District year/age class composition of the 1992 Pacific herring harvest, escapement, and total run biomass and the 1993 projected biomass by weight and number of fish.

Year Class	Age Class	Gillnet Harvest (tons)	Escapement (tons)	Total Run				1993 Projection ^a			
				(tons)	No. of Fish (* 1,000)	% by Number	% by Weight	(tons)	No. of Fish (* 1,000)	% by Number	% by Weight
1991	1	0	0	0	0	0.0	0.0	0	0	0.0	0.0
1990	2	0	0	0	0	0.0	0.0	0	0	0.0	0.0
1989	3	0	0	0	0	0.0	0.0	0	0	0.0	0.0
1988	4	0	106	106	687	5.7	2.4	0	0	0.0	0.0
1987	5	0	108	108	494	4.1	2.4	133	611	9.6	5.4
1986	6	4	131	135	518	4.3	3.0	112	431	6.8	4.6
1985	7	4	68	72	228	1.9	1.6	118	372	5.8	4.8
1984	8	130	718	848	2,450	20.4	18.8	57	164	2.6	2.3
1983	9	87	530	617	1,591	13.2	13.7	535	1,378	21.6	21.8
1982	10	95	884	978	2,440	20.3	21.7	355	885	13.9	14.5
1981	11	93	591	684	1,602	13.3	15.2	524	1,227	19.2	21.4
1980	12	45	377	422	929	7.7	9.4	305	671	10.5	12.4
1979	13	42	264	306	650	5.4	6.8	165	351	5.5	6.8
1978	14	24	129	154	319	2.7	3.4	95	198	3.1	3.9
1977	15	5	64	69	128	1.1	1.5	37	69	1.1	1.5
1976	16	0	0	0	0	0.0	0.0	13	25	0.4	0.5
1975	17	0	0	0	0	0.0	0.0	0	0	0.0	0.0
Total		530	3,970	4,500	12,038	100.0	100.0	2,449	6,381	100.0	100.0

^a Projections for older aged fish (> 10) based upon natural mortality and growth rates derived from regression analysis of previous year's rates.

Table 25. Norton Sound District year/age class composition of the 1992 Pacific herring harvest, escapement, and total run biomass and the 1993 projected biomass by weight and number of fish.

Year Class	Age Class	Gillnet Harvest (tons)	Beach Seine Harvest (tons)	Commercial Harvest (tons)	Total Escapement (tons)	Total Run				1993 Projection ^a			
						(tons)	(tons)	No. of Fish (* 1,000)	% by Number	% by Weight	(tons)	No. of Fish (* 1,000)	% by Number
1991	1	0	0	0	0	0	0	0.0	0.0	0	0	0.0	0.0
1990	2	0	0	0	0	0	0	0.0	0.0	0	0	0.0	0.0
1989	3	0	0	0	44	44	549	0.2	0.1	0	0	0.0	0.0
1988	4	0	0	0	8,283	8,283	56,001	25.5	14.3	101	681	0.4	0.2
1987	5	0	0	0	3,688	3,688	20,122	9.1	6.4	10,404	56,757	34.0	23.0
1986	6	0	0	0	10,550	10,550	45,618	20.7	18.2	3,843	16,618	10.0	8.5
1985	7	0	0	0	2,006	2,006	7,765	3.5	3.5	9,485	36,711	22.0	21.0
1984	8	0	0	0	3,668	3,668	11,833	5.4	6.3	1,667	5,379	3.2	3.7
1983	9	0	0	0	5,929	5,929	17,192	7.8	10.2	2,732	7,923	4.7	6.0
1982	10	0	0	0	15,948	15,948	41,622	18.9	27.5	3,973	10,368	6.2	8.8
1981	11	0	0	0	4,586	4,586	11,666	5.3	7.9	9,457	24,056	14.4	20.9
1980	12	0	0	0	1,436	1,436	3,331	1.5	2.5	2,365	5,486	3.3	5.2
1979	13	0	0	0	1,220	1,220	2,968	1.3	2.1	629	1,531	0.9	1.4
1978	14	0	0	0	601	601	1,345	0.6	1.0	441	986	0.6	1.0
1977	15	0	0	0	14	14	27	0.0	0.0	171	335	0.2	0.4
1976	16	0	0	0	0	0	0	0.0	0.0	3	6	0.0	0.0
1975	17	0	0	0	0	0	0	0.0	0.0	0	0	0.0	0.0
Total		0	0	0	57,974	57,974	220,038	100.0	100.0	45,270	168,835	100.0	100.0

^a Projections for older aged fish (>10) based upon natural mortality and growth rates derived from regression analysis of previous year's rates.

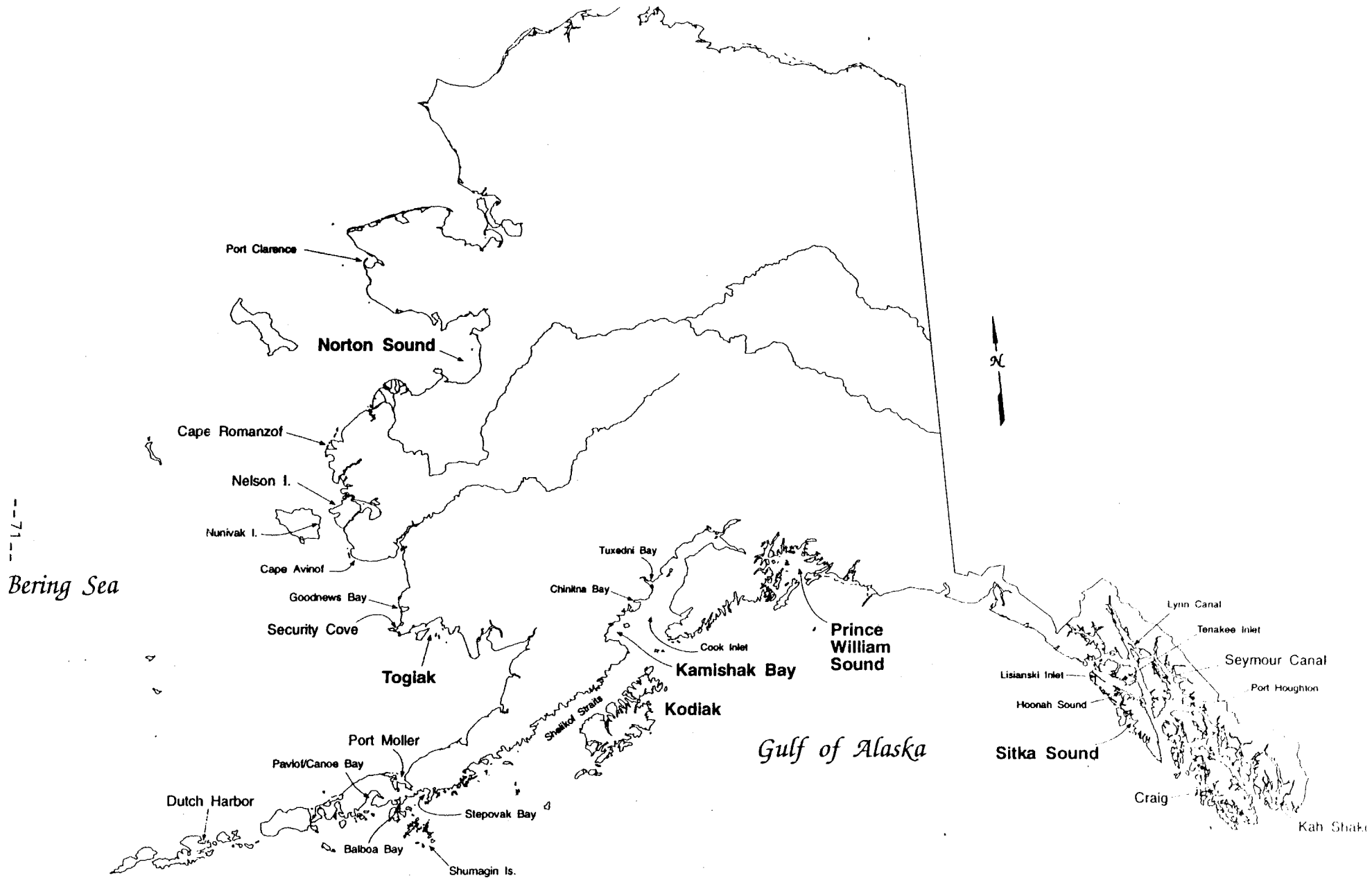


Figure 1. Locations of Alaska herring fisheries.

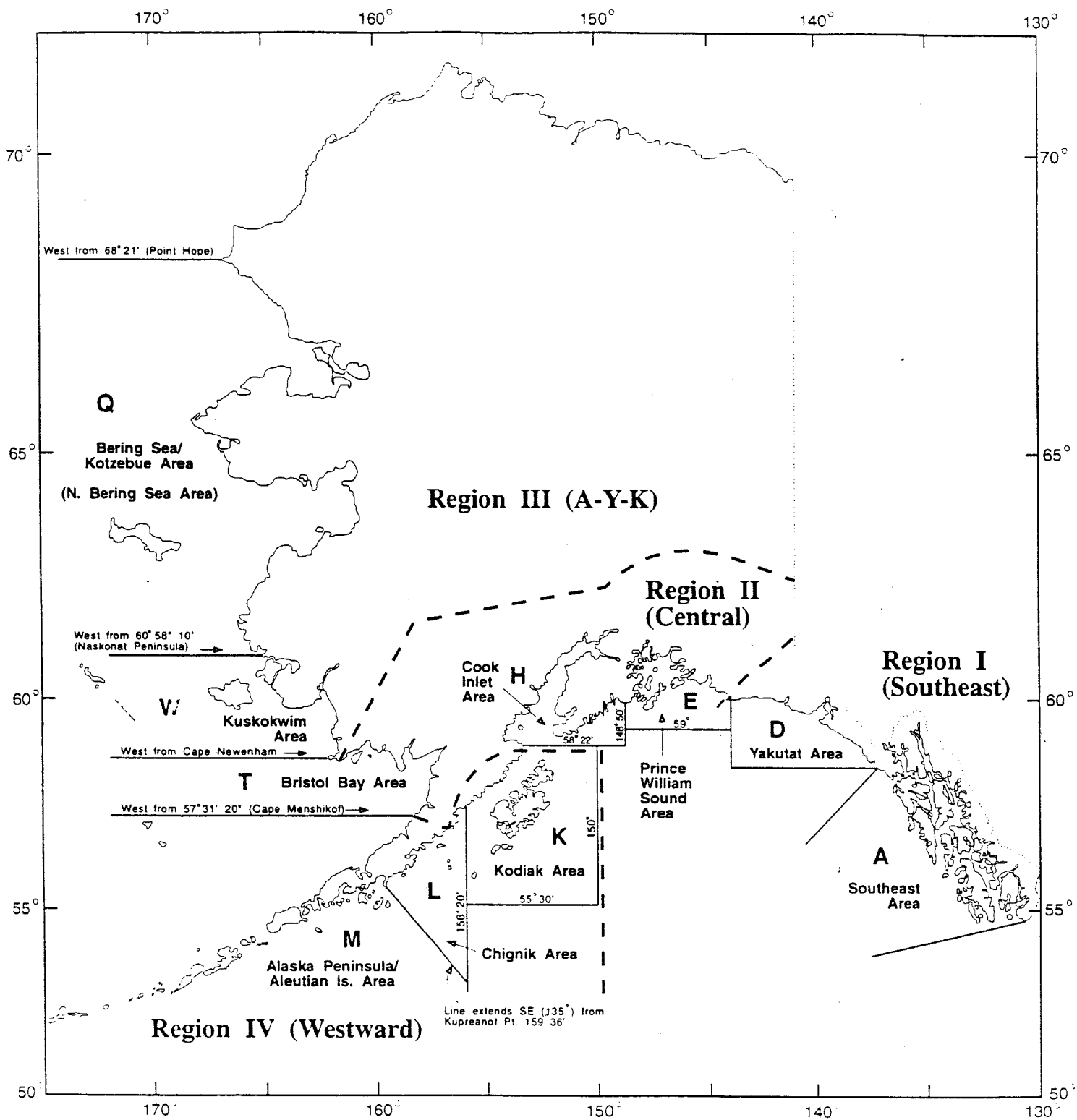


Figure 2. Alaska Department of Fish and Game management regions and herring regulatory statistical areas.

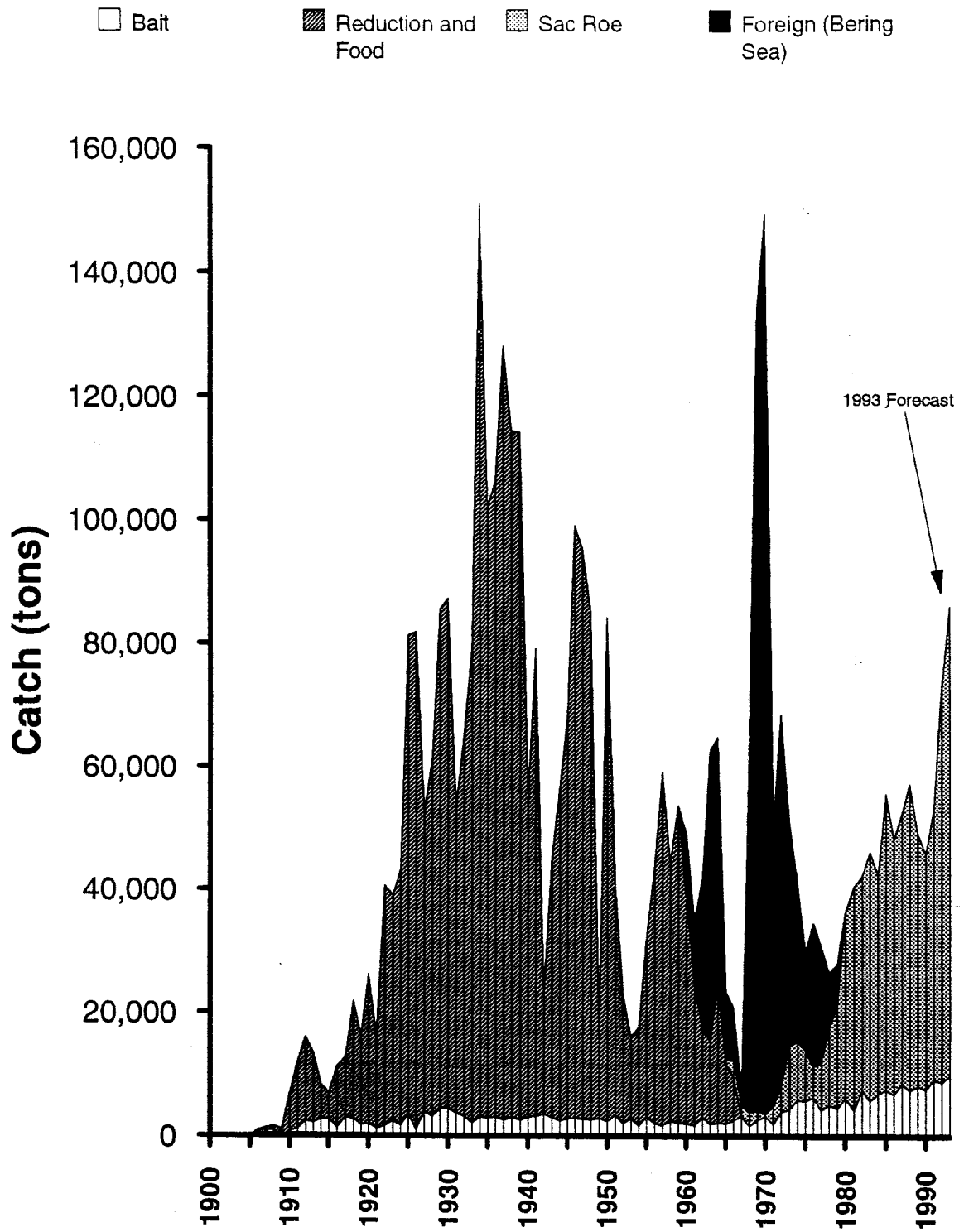


Figure 3. Herring harvests from all Alaska herring fisheries, 1930-1992, with the projected 1993 harvest.

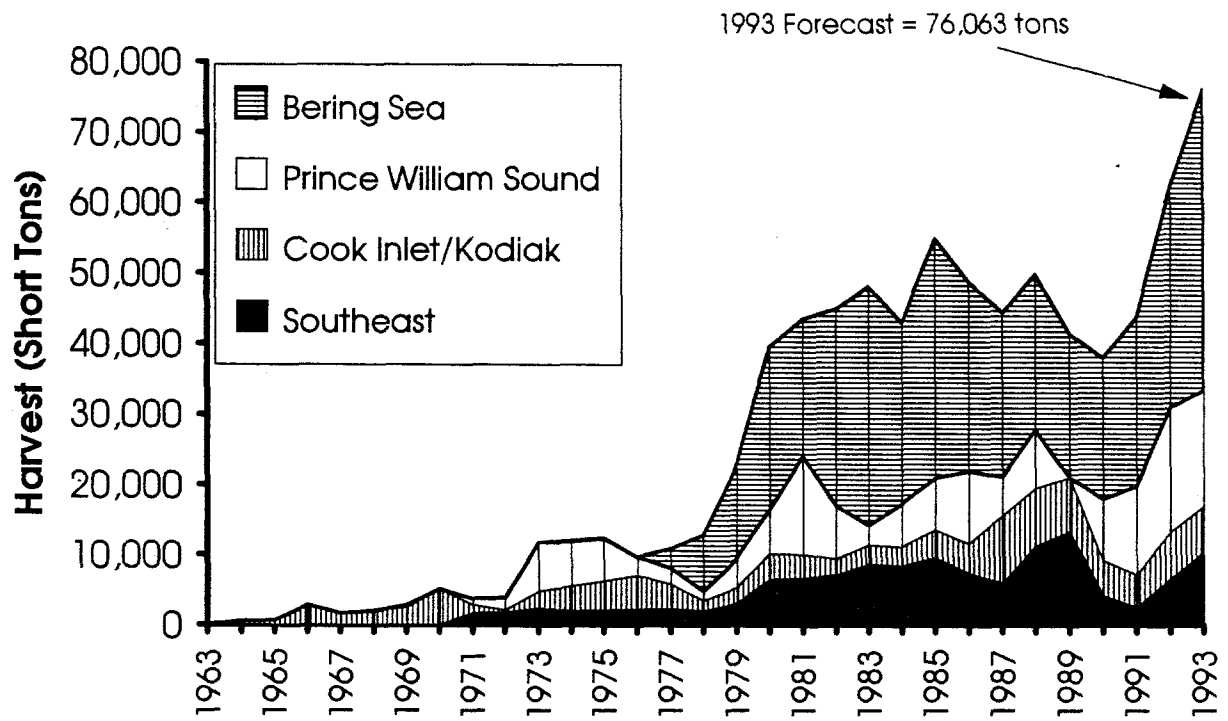


Figure 4. Alaska sac roe herring harvests from all areas, 1978-1992, with the projected 1993 sac roe harvest.



Figure 5. Harvest policy for Southeast Alaska herring fisheries, showing the relationship between the allowable exploitation rate and the mature biomass, expressed as a multiple of the cutoff threshold level.

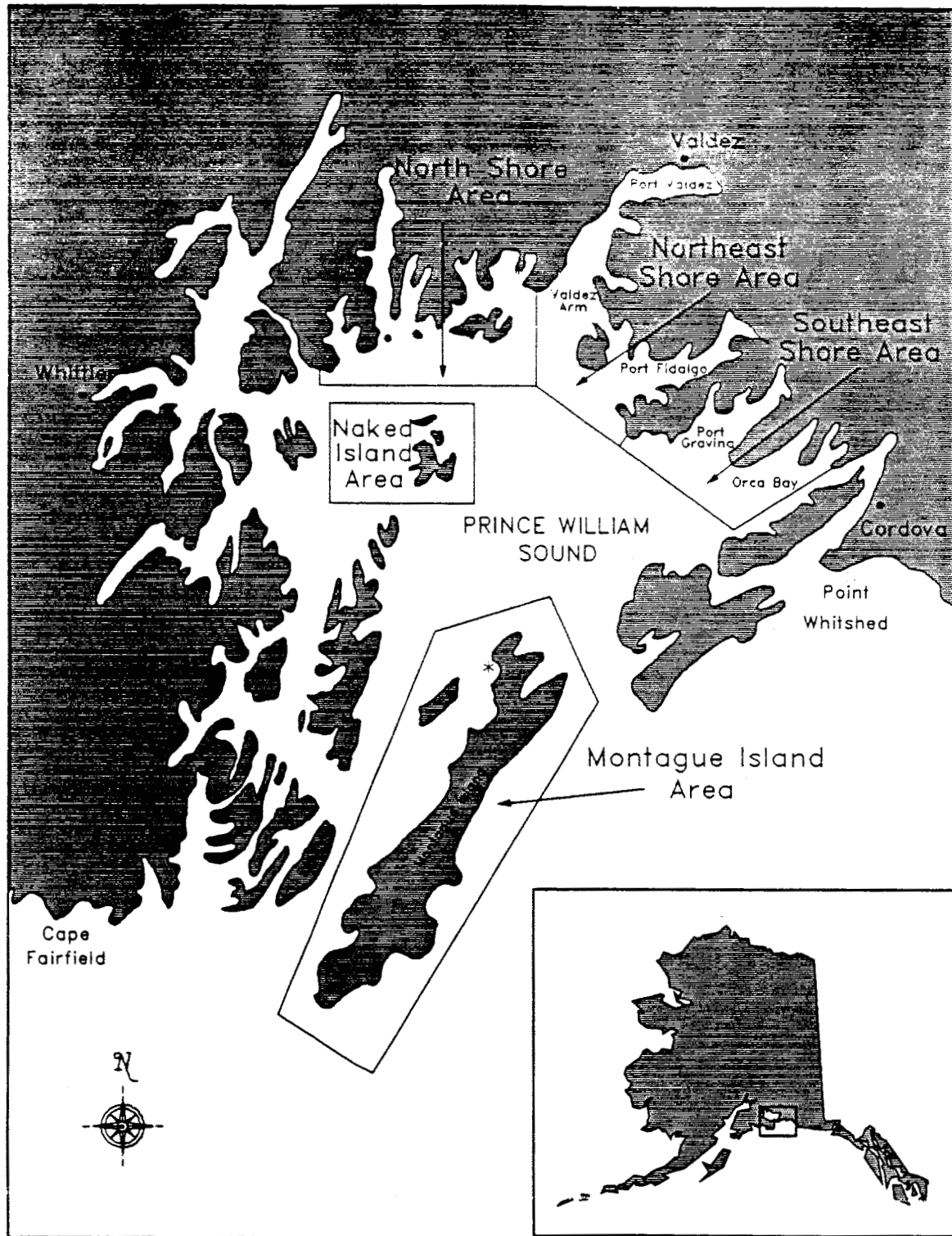


Figure 6. Map of Prince William Sound, Alaska and the major herring spawning areas.

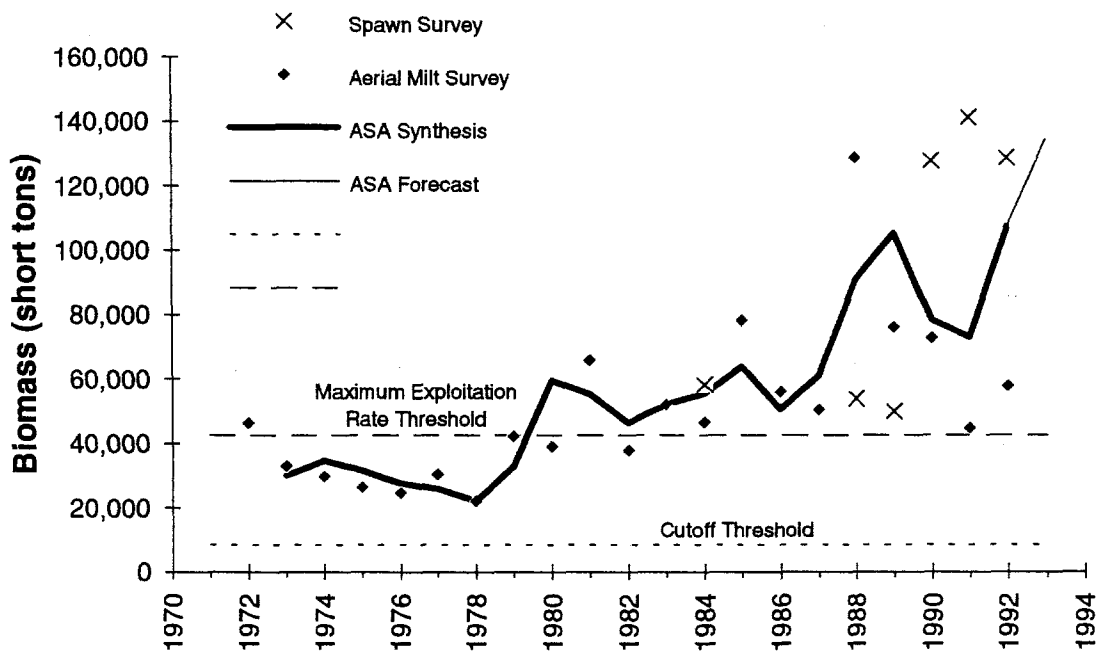


Figure 7. Abundance estimates and thresholds for Prince William Sound herring, 1973-1993.

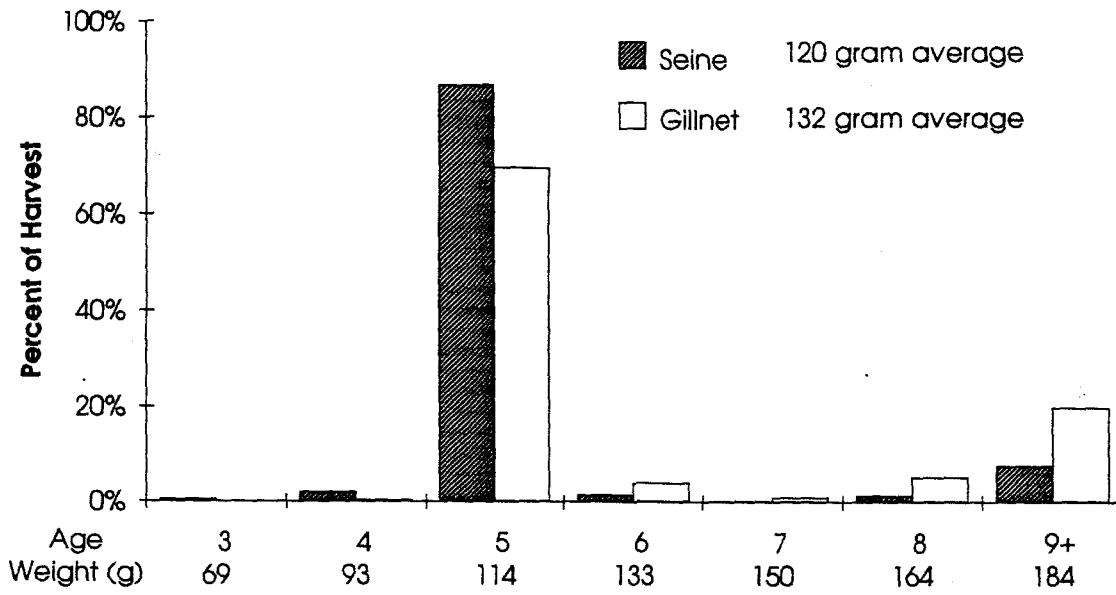


Figure 8. Forecast age distribution and average weight in the purse seine and gillnet harvests in Prince William Sound for 1993.

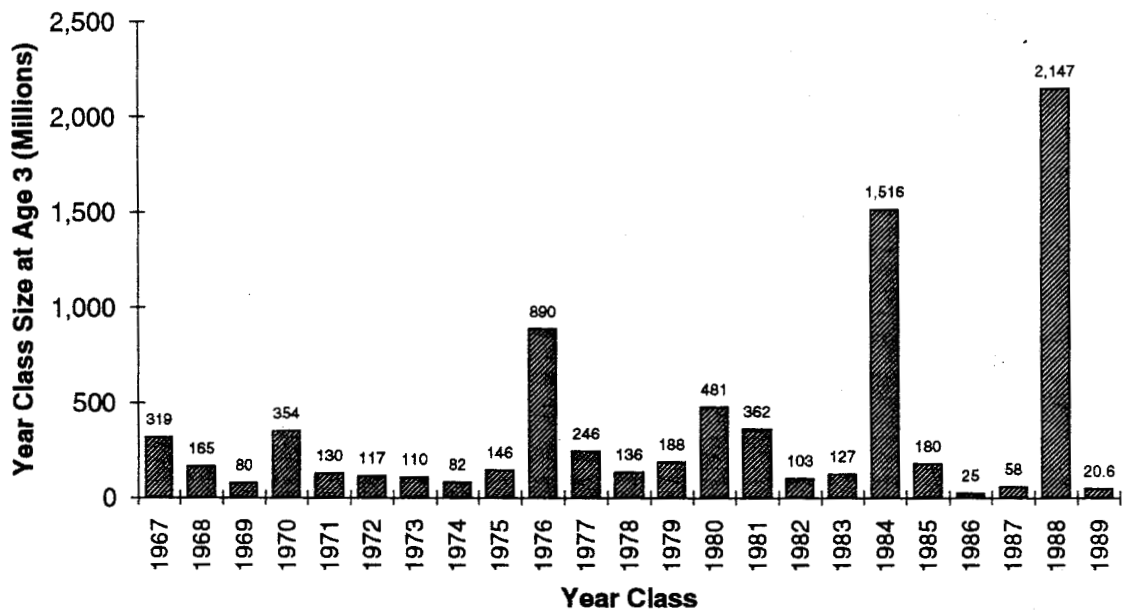


Figure 9. Recruitment time series (year class size at age 3) for Prince William Sound.

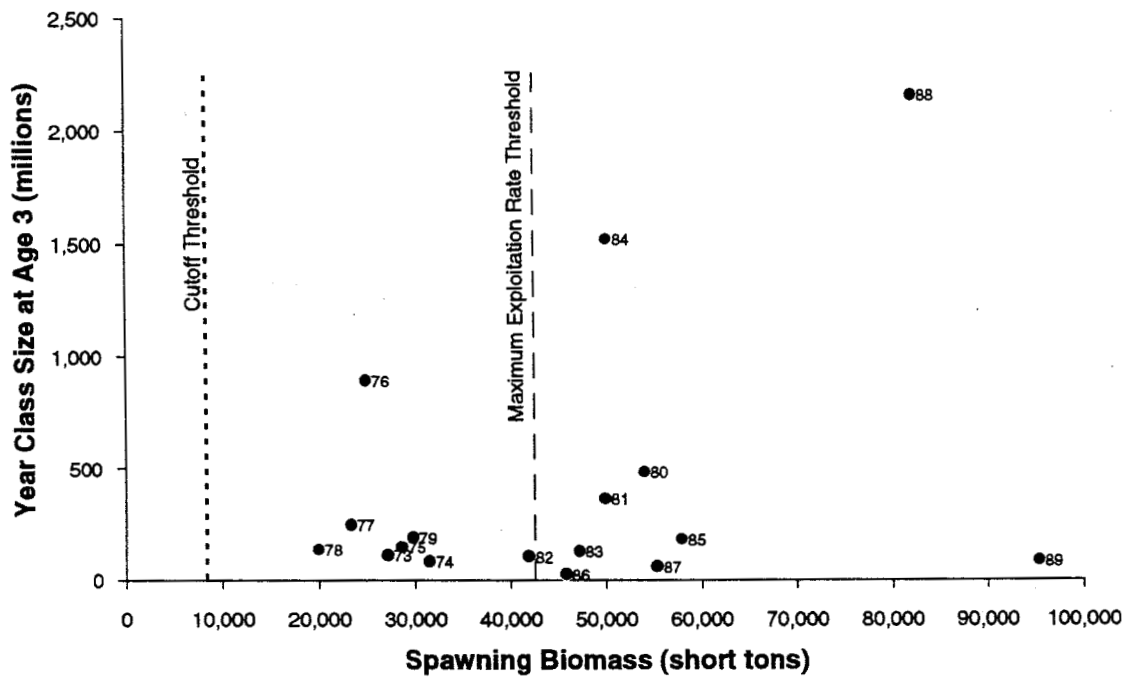


Figure 10. Spawner-recruit information for Prince William Sound herring.

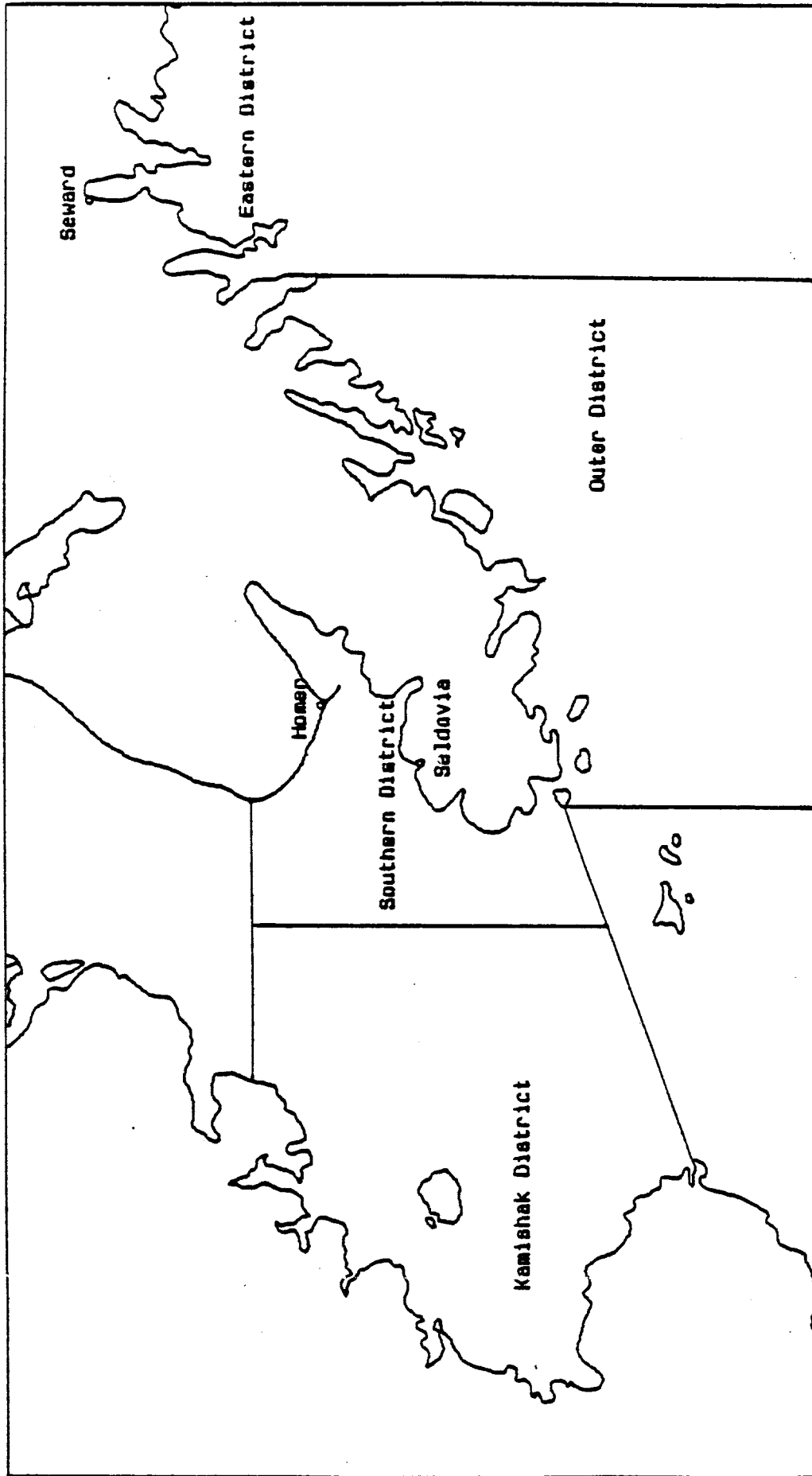


Figure 11. Kamishak Bay, Southern, Outer, and Eastern Districts of the Lower Cook Inlet management area.

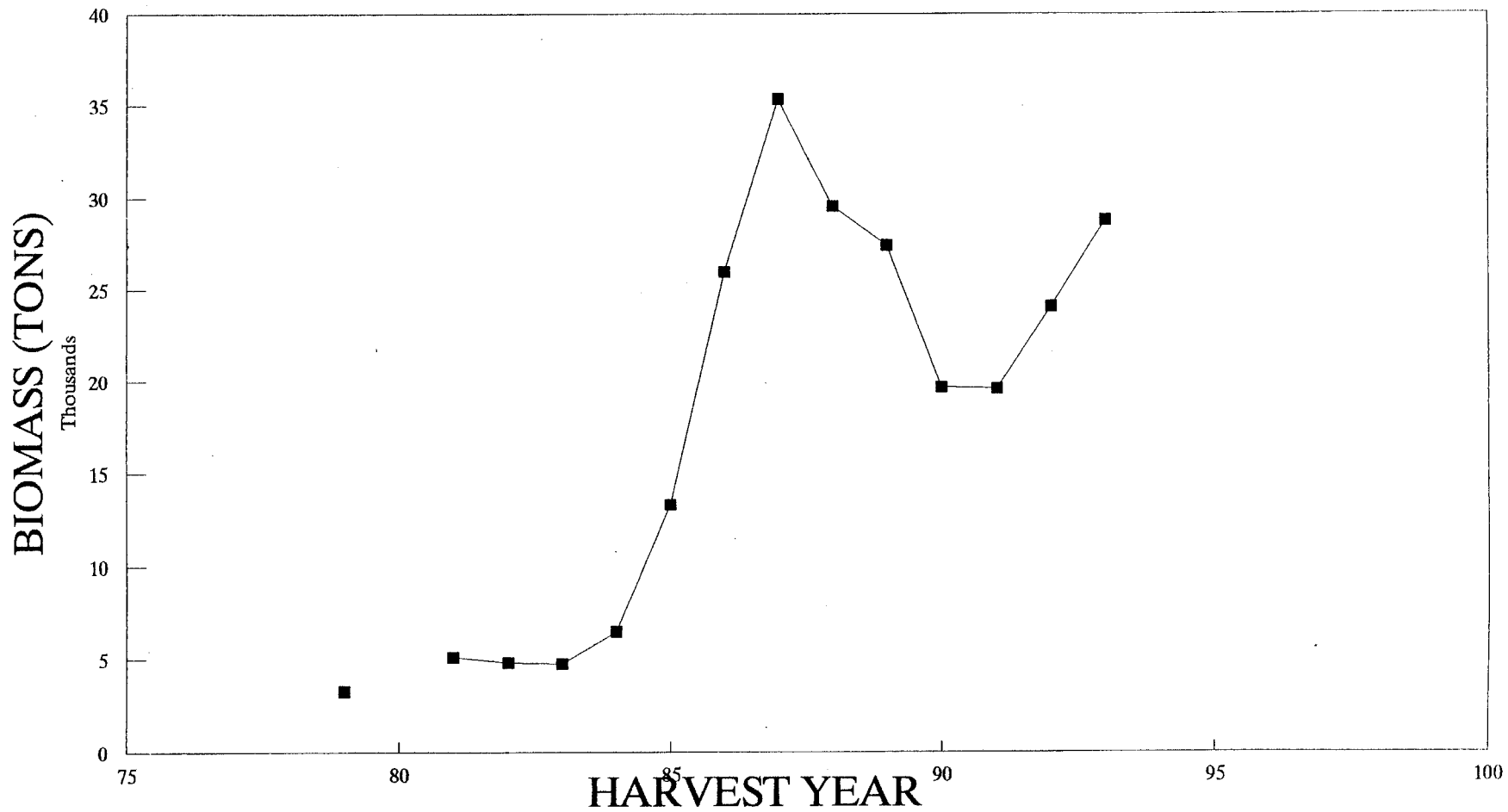


Figure 12. Kamishak District herring biomass by year, 1979, 1986-1993.

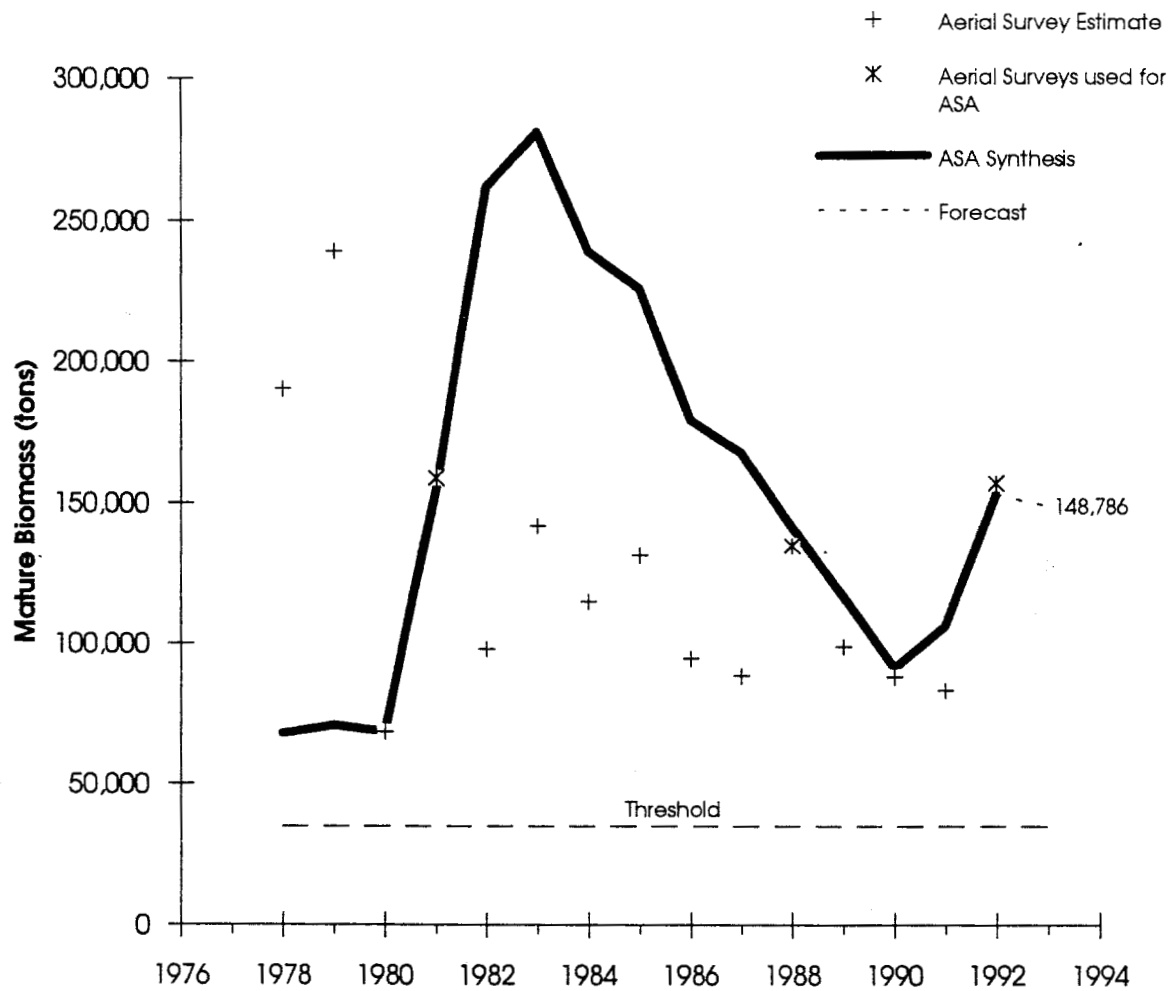


Figure 13. Estimates of abundance for Togiak District herring from aerial surveys and from the age-structured assessment (ASA) model, showing the threshold level below which fishing is not allowed.

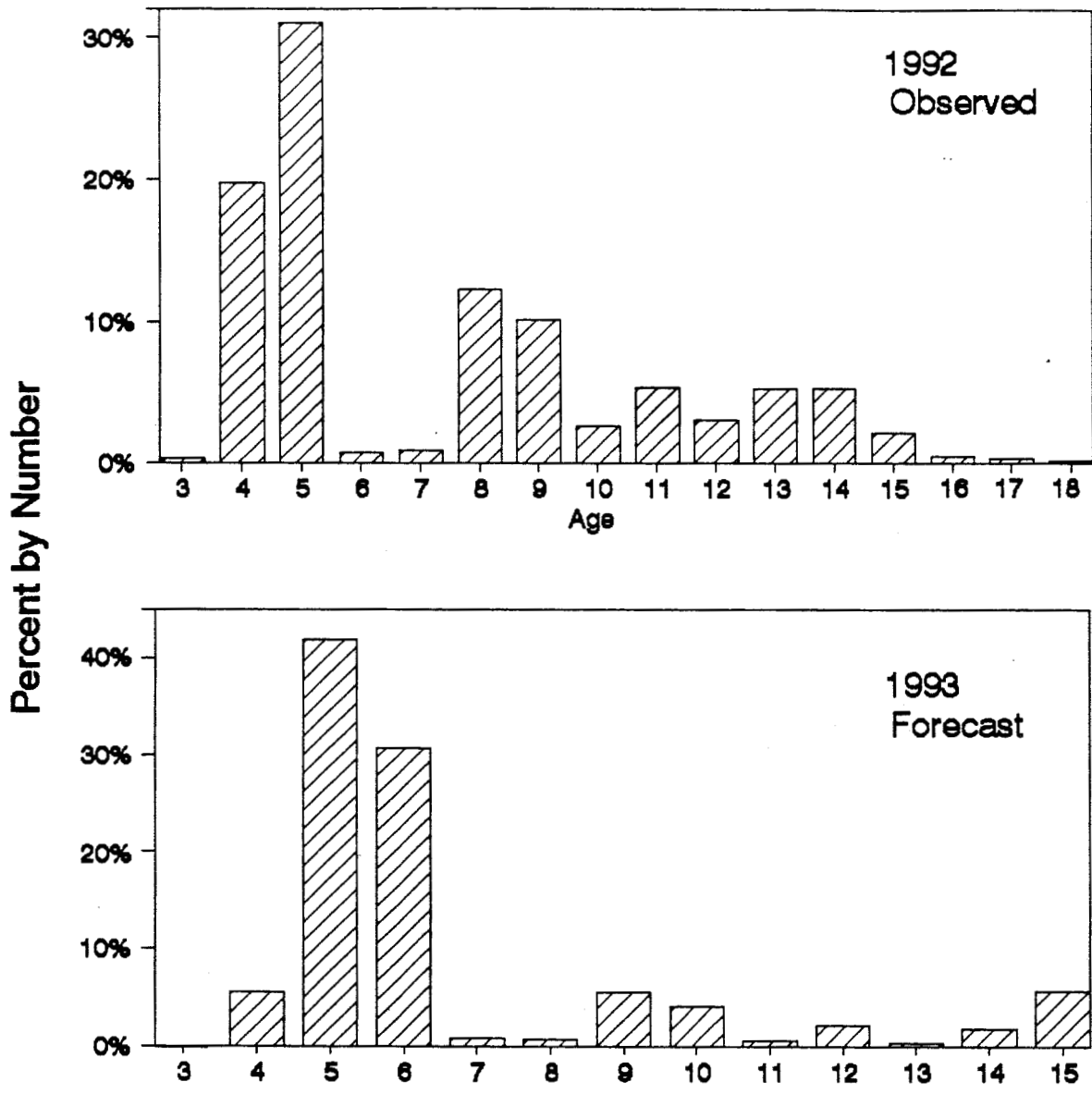


Figure 14. Age distribution of the Togiak District herring population by number, in 1992 (top) and projected for 1993 (bottom).

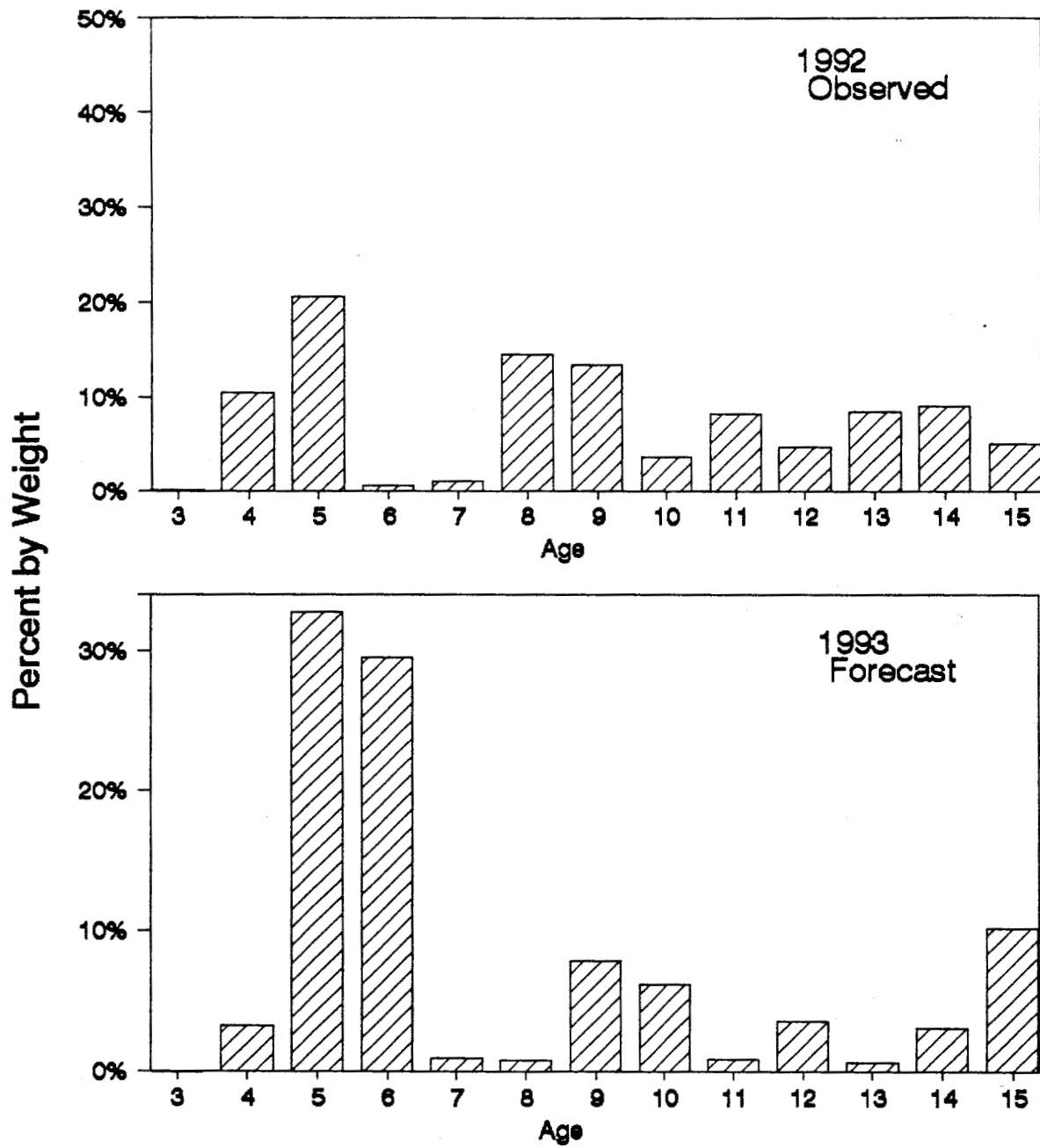


Figure 15. Age distribution of the Togiak District herring biomass by weight, observed in 1992 (top) and projected for 1993 (bottom).

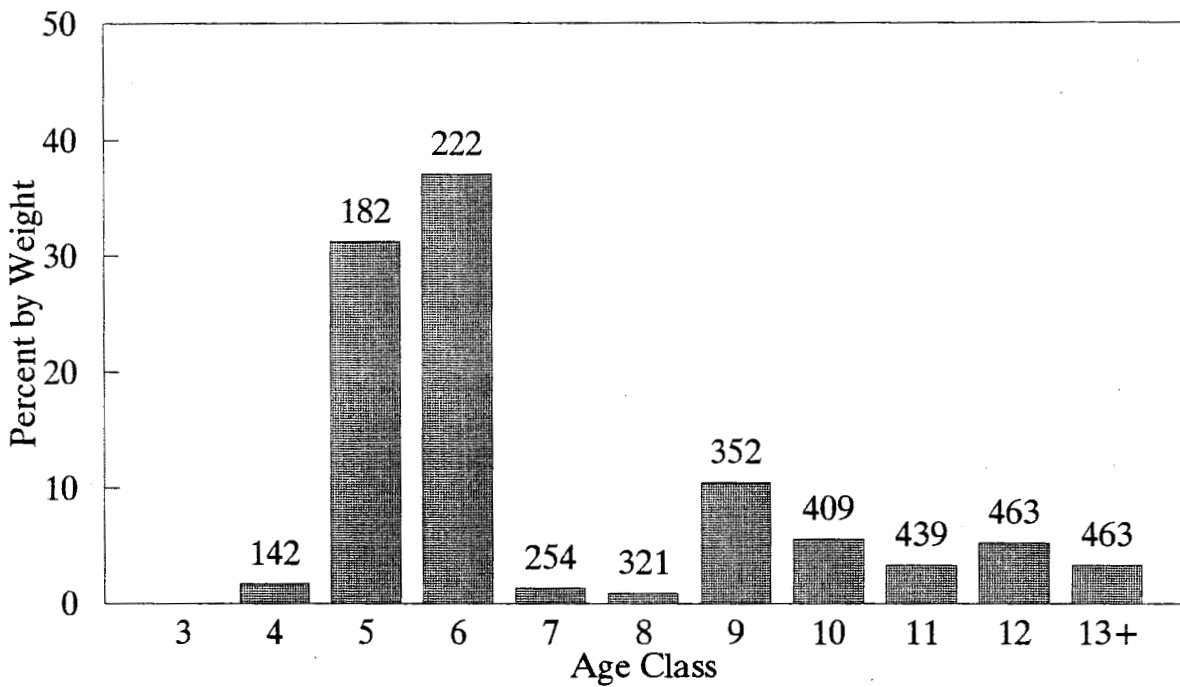
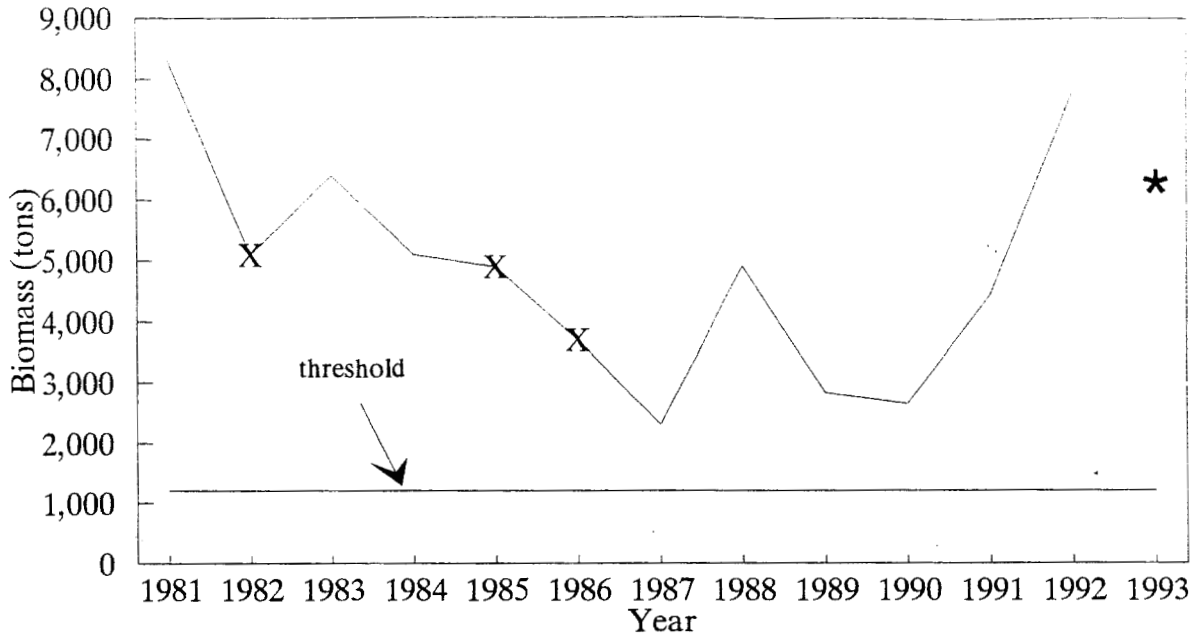


Figure 16. Security Cove District herring biomass, 1981-1992, with 1993 projected biomass (*) (top), and age composition by weight of the 1993 projected biomass (bottom), showing the projected average weight at age. In some years (X) it was not possible to obtain an aerial survey estimate of biomass; therefore the preseason projection or some other method was used to estimate biomass.

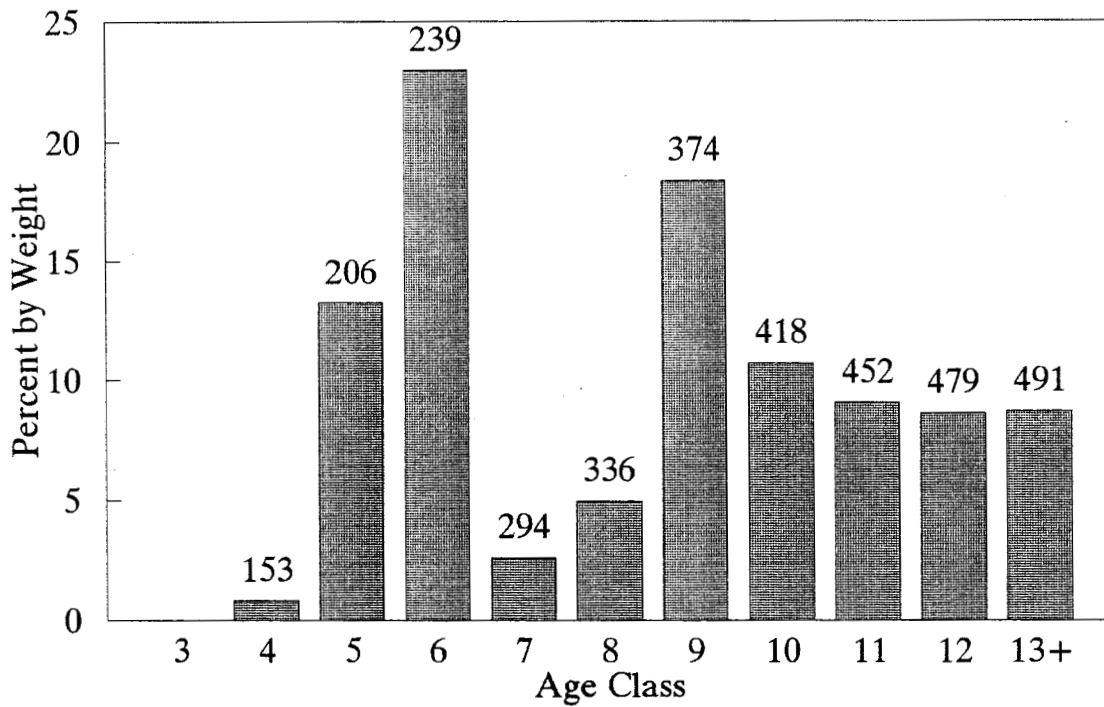
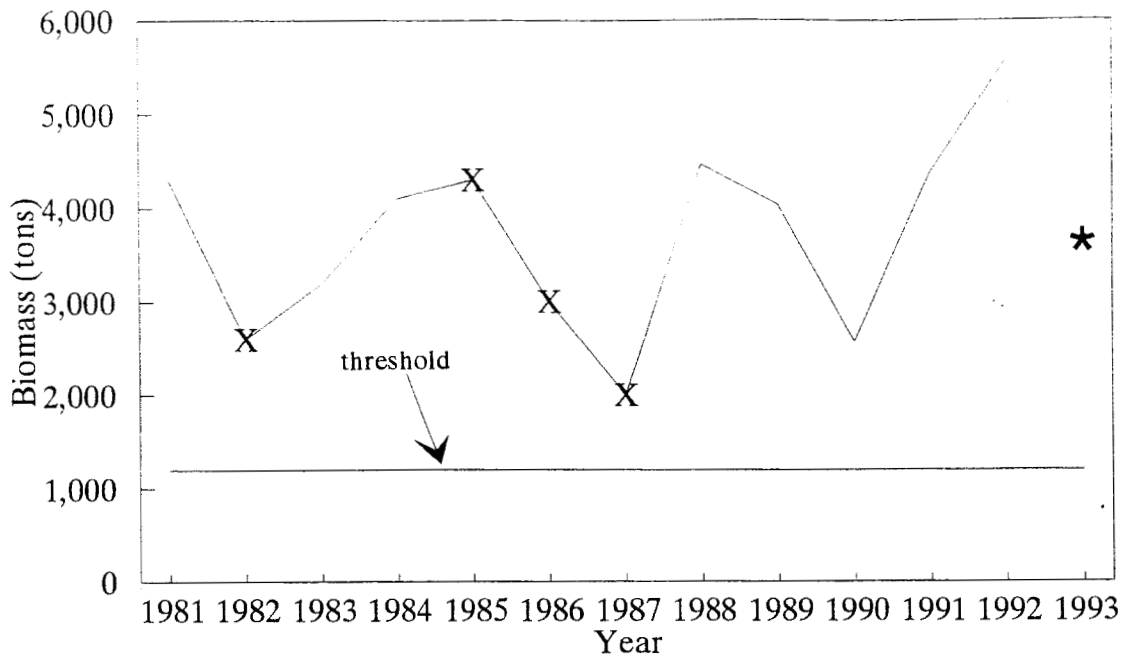


Figure 17. Goodnews Bay District herring biomass, 1981-1992, with 1993 projected biomass (*) (top), and age composition by weight of the 1993 projected biomass (bottom), showing the projected average weight at age. In some years (X) it was not possible to obtain an aerial survey estimate of biomass; therefore the preseason projection or some other method was used to estimate biomass.

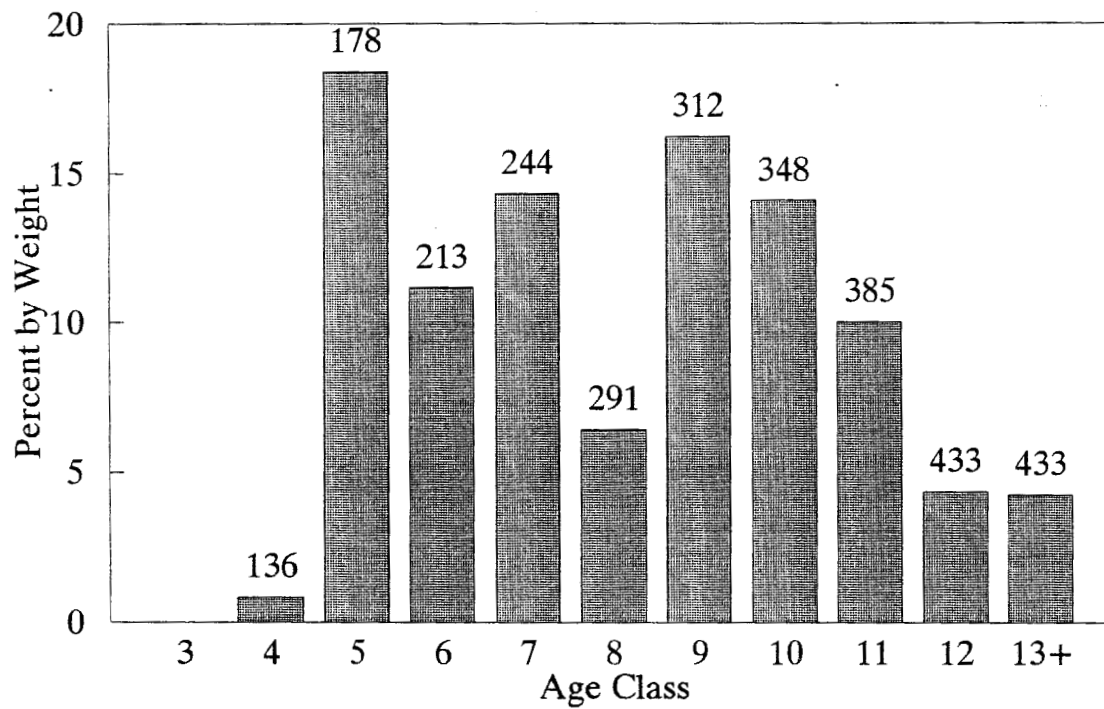
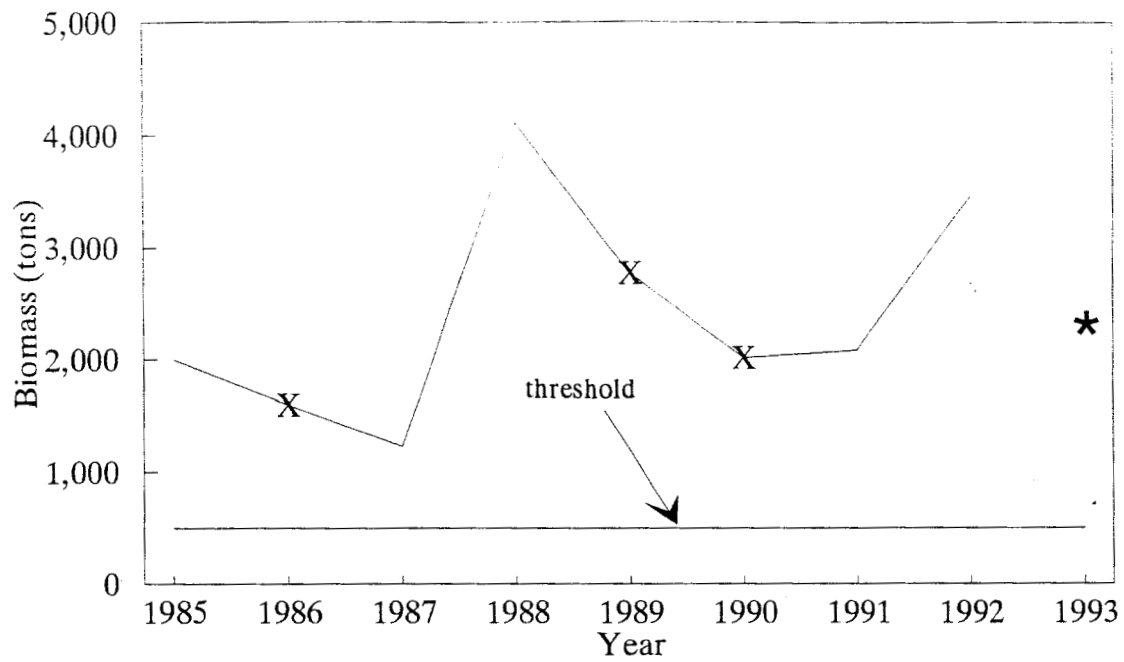


Figure 18. Cape Avinof District herring biomass, 1985-1992, with 1993 projected biomass (*) (top), and age composition by weight of the 1993 projected biomass (bottom), showing the projected average weight at age. In some years (X) it was not possible to obtain an aerial survey estimate of biomass; therefore the preseason projection or some other method was used to estimate biomass.

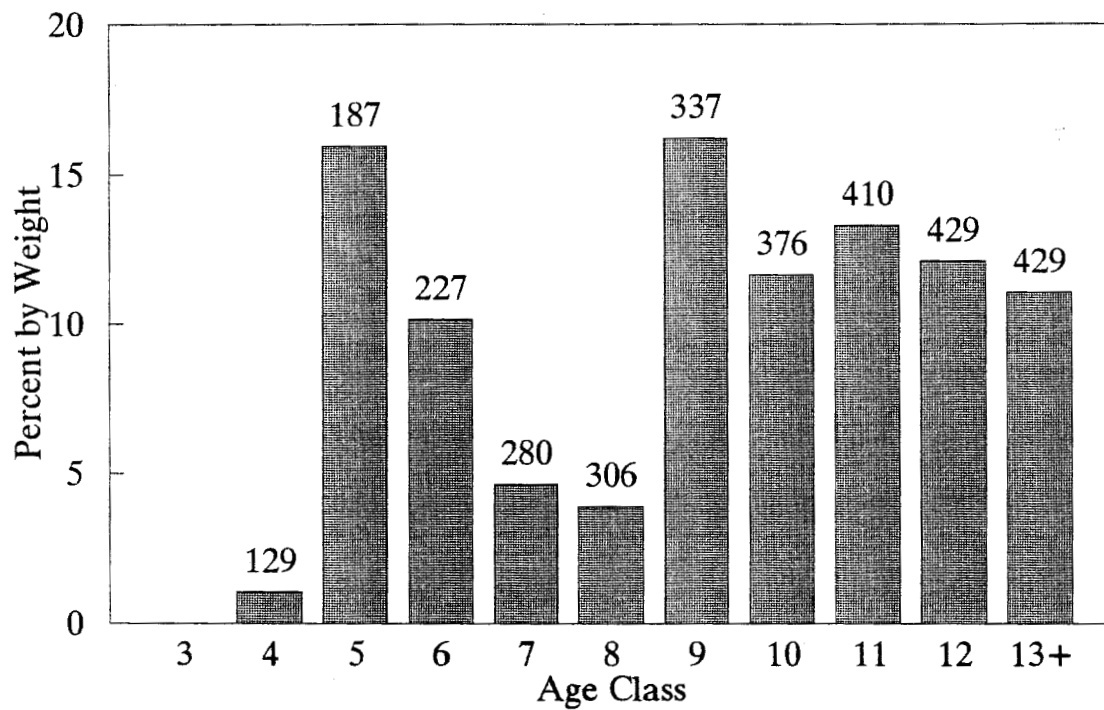
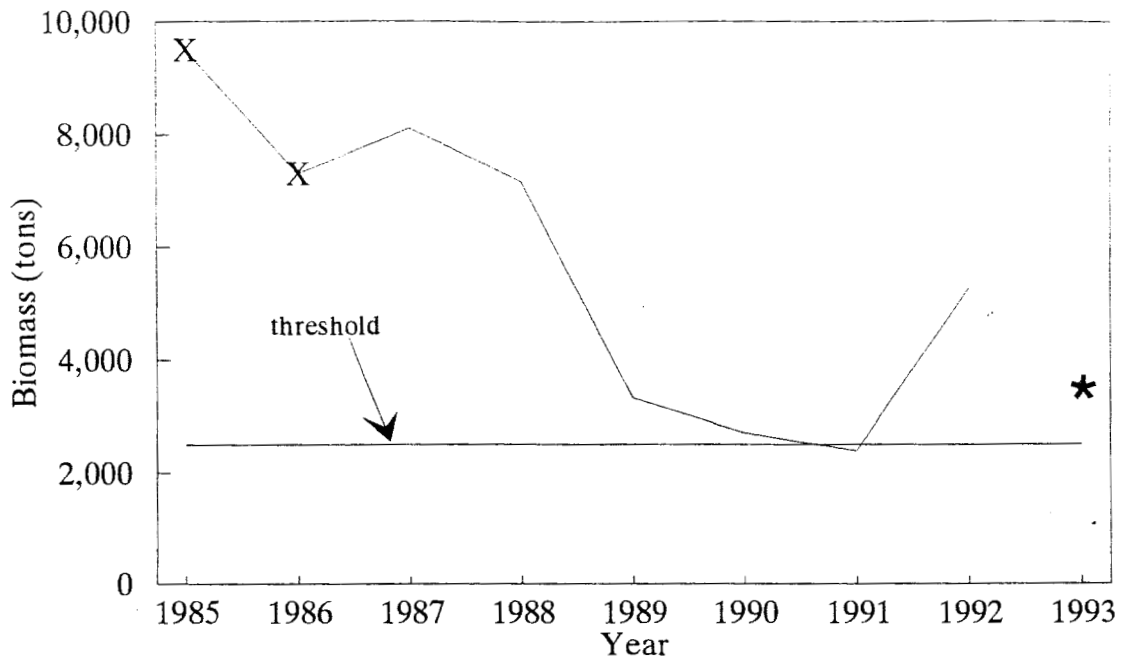


Figure 19. Nelson Island District herring biomass, 1985-1992, with 1993 projected biomass (*) (top), and age composition by weight of the 1993 projected biomass (bottom), showing the projected average weight at age. In some years (X) it was not possible to obtain an aerial survey estimate of biomass; therefore the preseason projection or some other method was used to estimate biomass.

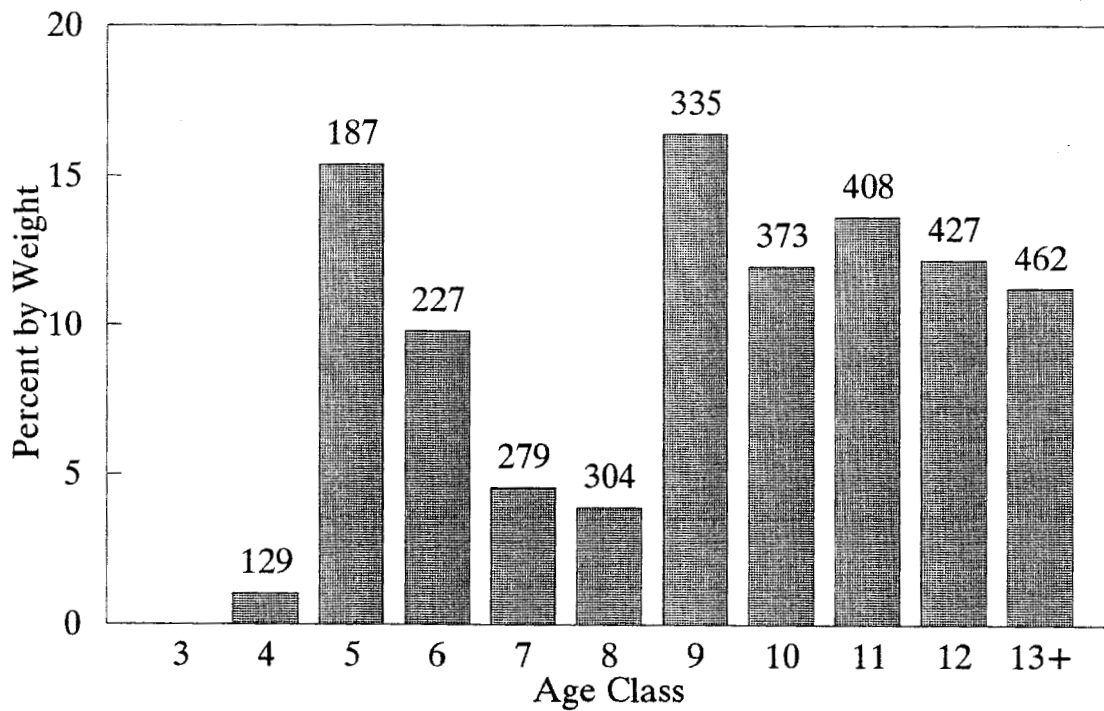
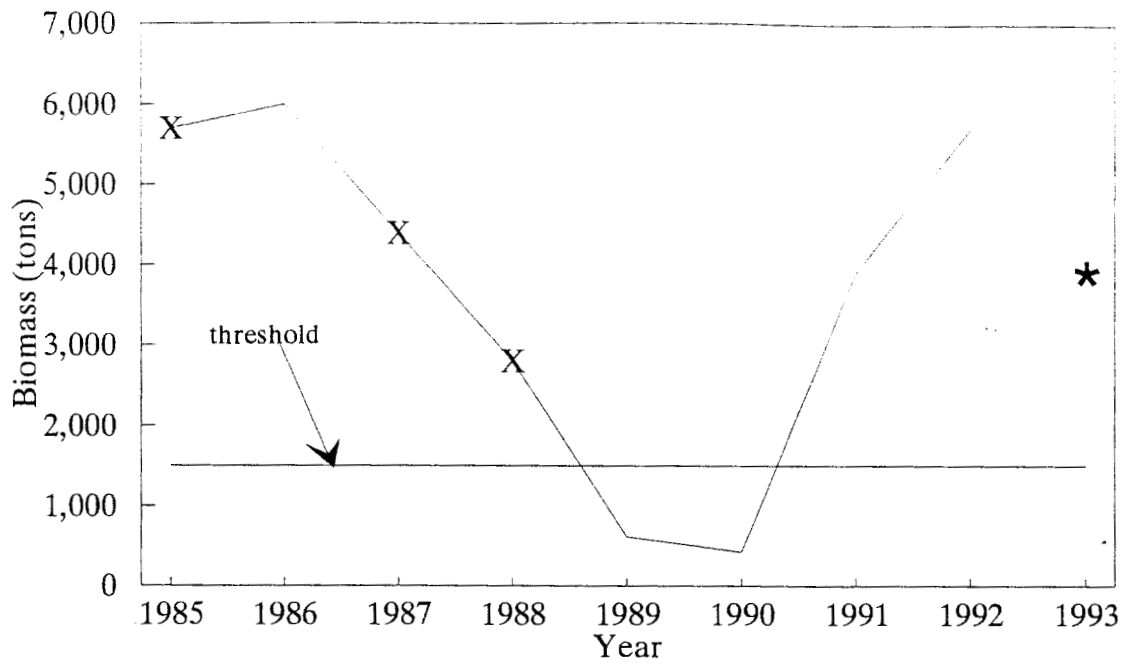


Figure 20. Nunivak Island District herring biomass, 1985-1992, with 1993 projected biomass (*) (top), and age composition by weight of the 1993 projected biomass (bottom), showing the projected average weight at age. In some years (X) it was not possible to obtain an aerial survey estimate of biomass; therefore the preseason projection or some other method was used to estimate biomass.

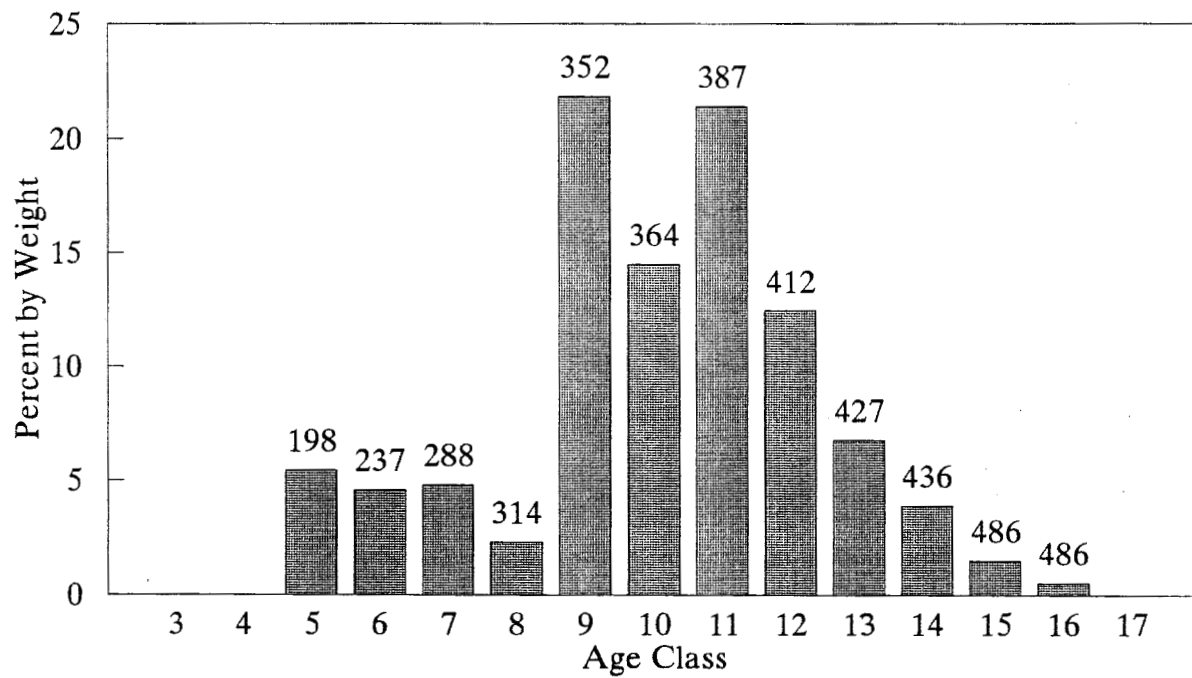
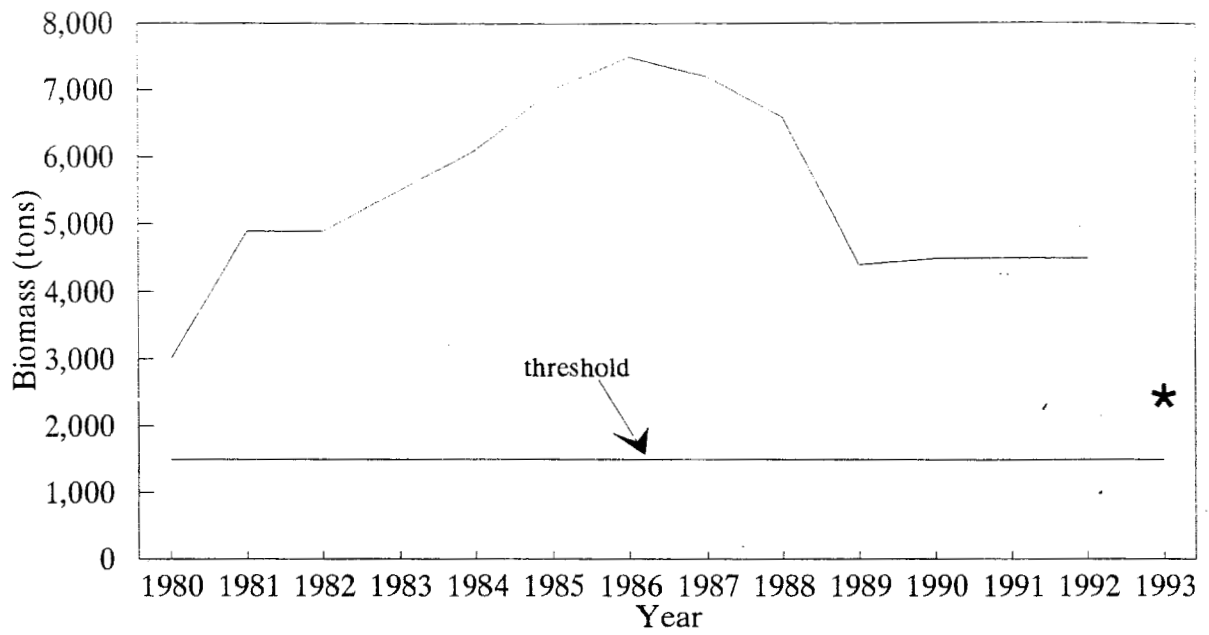


Figure 21. Cape Romanzof District herring biomass, 1980-1992, with 1993 projected biomass (*) (top), and age composition by weight of the 1993 projected biomass (bottom), showing the projected average weight at age.

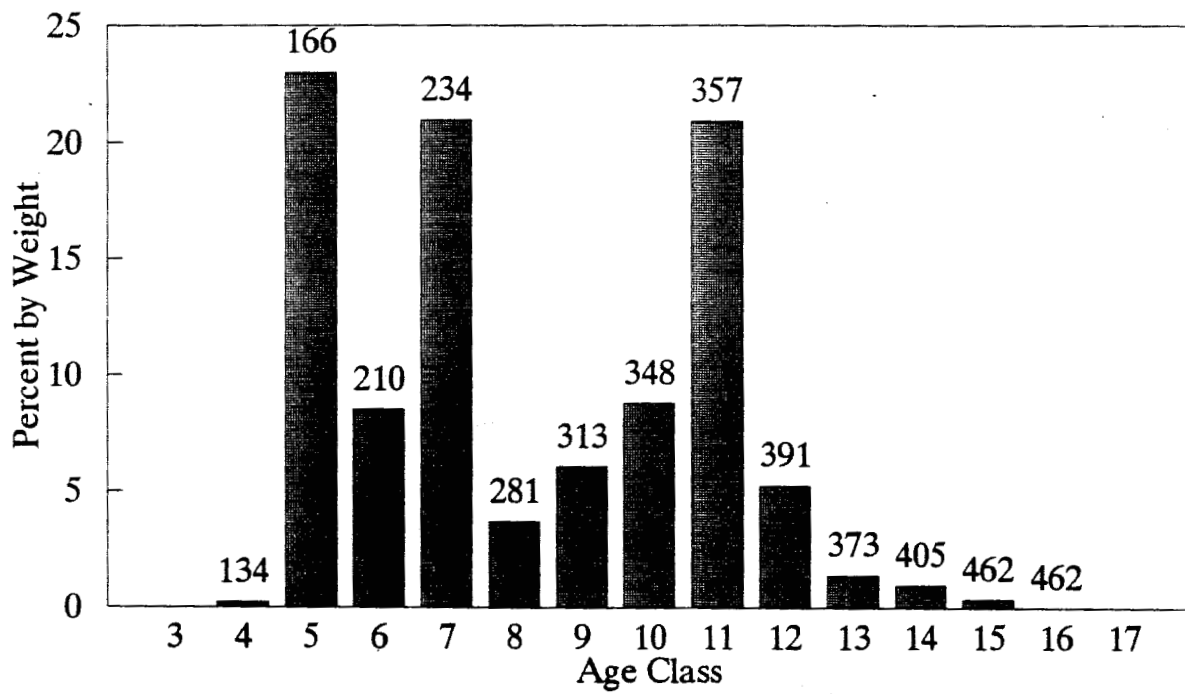
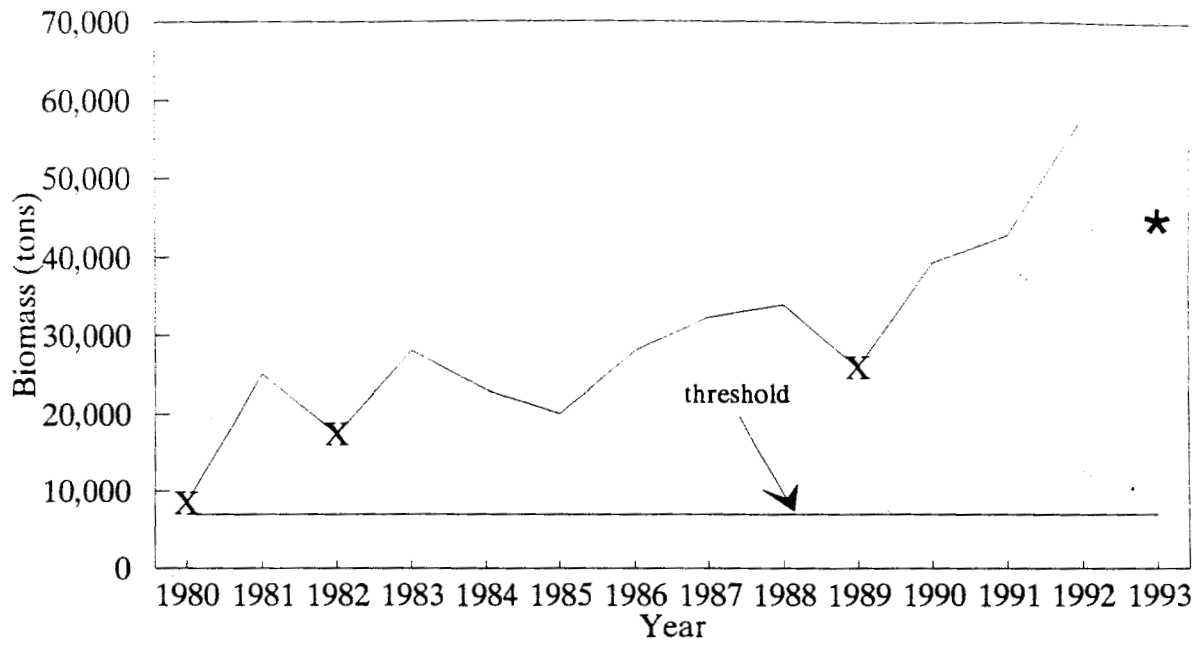


Figure 22. Norton Sound District herring biomass, 1980-1992, with 1993 projected biomass (*) (top), and age composition by weight of the 1993 projected biomass (bottom), showing the projected average weight at age. In some years (X) it was not possible to obtain an aerial survey estimate of biomass; therefore the preseason projection or some other method was used to estimate biomass.

The Alaska Department of Fish and Game receives federal funding. All of its public programs and activities are operated free from discrimination on the basis of race, religion, sex, color, national origin, age, or handicap. Any person who believes he or she has been discriminated against by this agency should write to: OEO, U.S. Department of the Interior, Washington, DC 20240.