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PRINCE WILLIAM SOUND MANAGEMENT AREA

HERRING REPORT

TO THE ALASKA BOARD OF FISHERIES

By:

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INTRODUCTION

The Prince William Sound (PWS) herring management area encompasses all coastal waters of the Gulf of Alaska between Cape Suckling and Cape Fairfield, extending offshore to 59° N. latitude. Five herring fisheries occur during the year.

During the spring season two fisheries target herring for sac roe using either seine or gillnet gear. Two spawn-on-kelp fisheries harvest either naturally occurring spawn on kelp or spawn on kelp produced by impounding herring and kelp. In the fall a food and bait fishery occurs. Of the five herring fisheries only the wild spawn on kelp and food and bait fishery are open entry.

For management purposes, all herring fisheries target on what is treated as a single major stock of herring that spawns during the mid-April to early May period. The Prince William Sound Herring Management Plan, 5 AAC 27.365, allocates the projected available surplus to the five fisheries based on a 0 to 20 percent harvest rate when stock size is between 8,400 and 42,500 tons, and the maximum harvest rate of 20 percent is applied when stock size is greater than 42,500 tons. The sac roe seine fishery is allocated 58.1 percent of the available surplus; the food and bait fishery 16.3 percent; the pound spawn-on-kelp fishery 14.2 percent; the wild spawn-on-kelp fishery 8.0 percent and the gillnet sac roe fishery 3.4 percent.

Currently, no fishing can occur if the estimated spawning biomass is below 8,400 tons. The department is proposing to increase the minimum spawning biomass threshold from 8,400 tons to 22,000 tons. The proposed threshold is 25 percent of the potential spawning biomass from an unfished stock. The higher threshold will allow harvest levels that are more manageable.

The 1993 spawning biomass was projected to be a record 134,133 tons and dominated by age-5 fish from the 1988 year class. The exploitation rate for the 1992-93 management year was set at 20 percent. Allocation by fishery was; seine sac roe 15,586 tons, gillnet sac roe 912 tons, 3,809 tons of pound spawn-on-kelp biomass, and 2,146 tons of wild spawn-on-kelp biomass. The 1993 food and bait fishery was the first fishery of the 1993-94 management year. The guideline allocation of 978 tons was based on a 15 percent exploitation rate of the preliminary spawning biomass estimate of 40,000 tons.

A summary of the major spawning areas, timing of spawn, and areas utilized in the 1993 commercial fishery are shown in Figure 1. Fishery harvests are presented in Table 1. The herring fisheries utilized 4,748 tons of herring, the lowest since 1983. The estimated exvessel value for all fisheries was $2.8 million. The gillnet sac roe fishery harvested 1029.9 tons valued at $0.412 million, setting the average earnings for the 24 permit holders at $17,165. The pound spawn-on-kelp fishery utilized 1,330.5 tons of herring valued at $2.0 million, setting the average earnings for the 52 permit holders producing product at $38,462. The wild spawn-on-kelp fishery utilized 1,300.7 tons of herring valued at $0.18 million, setting the average earnings for the 83 permit holders at $2,155. The food and bait fishery harvested 1,087 tons, valued at $0.22 million, setting the average earnings of the 8 permit holders at $27,175. There was no seine sac roe opening during 1993.

SAC ROE SEINE FISHERY

There are 103 permanent and 4 interim purse seine permits in Prince William Sound. Purse seines can be 150 fathoms in length and 1000 meshes deep. Mesh size is not regulated. The department proposes to change the length of seines from 150 to 100 fathoms to help control the rate of harvest. The historic seine sac roe harvest is given in Table 3.

The management goal for sac roe fisheries is to enhance the value of the harvest by providing a high quality product to the industry. Quality for PWS is roughly defined as average fish size of 120 grams or larger and a mature roe recovery of 10 percent or greater. The department announced its intentions to conduct the fishery to enhance value in the preseason fishery outlook. After a record statewide harvest of sac roe in 1992 and a predicted record harvest in 1993 quality was paramount to conducting a successful fishery in 1993.

To obtain the highest quality sac roe from the spawning biomass requires a rigorous sampling program. Sampling identifies a location with large average fish size. Sampling also estimates mature roe recovery and helps to identify when roe recovery is expected to be near optimum. Aerial surveys help control harvest within processing capacity. Due to limited processing capacity for the 15,586 ton guideline harvest, the department notified the industry that an effort would be made to divide the harvest into several openings. Several seine openings would allow the catch to be quickly processed. Quick processing helps maintain the shape of the roe, and prevents dehydration and uneven curing.

Aerial survey biomass estimates and documentation of spawn activity began on April 1. The sac roe seine fleet was placed on the standard 48-hour advance notice. On April 3 one mile of spawn was seen at Port Gravina, a typical early spawning location, and 12,000 tons of herring, primarily at Montague Island. Sampling for size and roe maturity began on April 5 at Montague Island. The Montague Island samples averaged 114 grams, with 4% mature roe and 3% immature roe.

Spawning was minimal until April 7 when two and one half shoreline miles of spawn was sighted in the Northeast area and two shoreline miles at Montague Island. Samples on April 7 from Montague Island averaged 112 grams with 5.4 percent mature roe. The advance notice period for the seine fleet was reduced to 24-hours on April 7.

Fishing vessels and tenders stationed in Cordova or in the Northeast area of PWS where the fleet hoped to target on larger, higher quality fish. Montague Island has a reputation for having smaller fish of a given age than the Northeast area. The Montague area also tends to have more recruit fish (age-3 and 4) than other locations of the Sound. Herring in the Northeast area typically stage and spawn before the biomass at Montague Island. These factors directed the fleet away from Montague Island; however, the department requested that vessels base at Montague Island as there was no appreciable biomass elsewhere in the Sound.

On April 8 Montague Island samples averaged 107 grams with 7.3% mature roe and 2.3% immature roe. That same day spawn was beginning at the head of Rocky Bay on Montague Island. On April 10 sampling continued on the northwest shore of Montague Island, however all sets were extremely poor quality. Spawning continued along the outer coast between Montague Point and Graveyard Point and near the head of Rocky Bay.

Sampling effort increased on April 11 in hopes of isolating an area with high quality fish. On April 11 samples in the middle of Rocky Bay on Montague Island looked promising with an average weight of 114 grams with 9.3% mature roe and 1% immature roe. Another sample at Montague Point, taken in active spawn had an average size of 99 grams, with 3.0% mature roe and 2.5% immature roe.

Weather prevented test fishing and aerial surveys on April 12. The department contacted all processors stationed in Cordova and scheduled a meeting on April 12 to discuss the results to date. Considering the small biomass, timing and location of spawn, processors were advised that the biomass at Montague Island may provide the only opportunity to conduct a seine fishery in 1993. Processors were also notified that the department intended to conduct an open competitive fishery; however, if the industry wanted a cooperative style fishery openings would be scheduled to suit this type of effort. Although interest in Montague Island fish was extremely low those fish presented the only opportunity for a harvest.

On April 13 sampling efforts focused on Rocky Bay at Montague Island. Samples averaged 107 grams with a range from 98 to 120 grams. Mature roe averaged 9.0% with a range of 4.4 to 13 percent and immature roe averaged 1.8%. On the outer coast of Montague Island between Montague Point and Graveyard point, where active spawning was occurring, the average size was 106 grams with 2.5% mature roe and a significant number of spawnouts.

The advance notice period was reduced to 6-hours on April 13 and again to 2-hours effective 8:00 a.m. April 14. Although Rocky Bay had mixed quality it was hoped that continued sampling might identify an acceptable area. On April 14 results indicated an average size of 113 grams with a range of 103 to 118 grams. Mature roe averaged 8.9 percent with a range from 6.7 to 11.3 percent and spawnouts occurred in several of the test sets.

A meeting for processors was called at 10:30 a.m. on April 14 to discuss the sample results collected that morning in Rocky Bay. A vote among the seven processors attending (representing 91 percent of the fleet) resulted in an overwhelming majority deciding to forego the harvest opportunity. The department announced to the fleet that due to marginal roe recoveries and small fish size a harvest would not occur.

The seine fleet was placed on 6-hour advance notice and aerial surveys continued through April 23, however those surveys did not locate new fish of any significance. On April 23 the fleet was taken off advance notice status.

During the course of sampling at Montague Island abnormal behavior and surface hemorrhages on herring were noted. Pathology samples were taken at Montague Island and the Northeast area. Results indicate a viral infection, Viral Hemorrhagic Septicemia. It is unknown if the virus caused the poor quality herring this year.

The 1993 season can be characterized by an earlier than average spawning period, a biomass significantly less than the forecast, a lower than expected percentage of 5-year fish, low annual growth for all age classes, a tight market and low quality herring.

GILLNET SAC ROE FISHERY

There are 24 permanent gillnet permits in Prince William Sound. Gillnets are limited to 100 fathoms in aggregate length and 120 meshes in depth. Mesh size is regulated to a minimum of 2 1/8 to a maximum of 3 inches. The historic gillnet sac roe harvest is given in Table 3.

Quality is a primary consideration for the gillnet sac roe fishery. As in the seine fishery, test fishing occurs to identify an area with large average size and high mature roe content. Gillnets are selective for larger size fish than seine gear therefore targeting the fleet on quality herring is easier to achieve than in the seine sac roe fishery.

The gillnet sac roe herring fishery was placed on 48-hour advance notice on April 1 and reduced to 24-hours on April 7. Most of the biomass observed during aerial surveys was concentrated at Montague Island and on April 10, three and one-half miles of spawn were sighted in the northern Montague area. With increased spawning activity and an adequate herring biomass in the area, the advance notice period for the gillnet fleet was further reduced to 6-hours on April 14. Conditions in the northern Montague area appeared ideal for a gillnet fishery, however few fishing vessels were on the grounds. By April 15, all processors and fishing vessels were present on the grounds. Gillnet test fishing results from Rocky Bay yielded an average roe recovery of 9.75 percent. Samples obtained from the outside coast near Montague Point averaged 11.1 percent mature roe recovery and 151 grams. A 2-hour opening was announced, commencing at 4:00 p.m., April 15 on the outside coast of Montague Island from Graveyard Point to Middle Point, including Rocky Bay. The opening was extended until 9:00 p.m. after product quality was reported as acceptable, however the weather was poor with winds exceeding 40 knots in exposed areas and product quality deteriorated later during the period. The harvest from the April 15 opening was 132 tons, with an average roe recovery of 9.0 percent.

No new concentrations of herring had been observed by aerial survey flights, consequently, the fish at north Montague Island continued to provide the best opportunity for a gillnet harvest. Test fishing continued on April 17 with roe recoveries of 12.4% and average fish weight of 156 grams. A gillnet sac roe opening commenced at 12:00 noon that same day. The opening was initially 3-hours long but was extended to 9-hours after product quality was assessed and found to be good. This pattern was followed for all gillnet openings. The catch estimate for this open period was 430 tons.

Gillnet test fishing results from the morning of April 18 were again good. Roe recoveries averaged 12.4% and the average fish weight was 156 grams. An aerial survey reported that all of the accessible biomass was in Rocky Bay. A test fish boat surveyed this area with sonar and confirmed the aerial observations. The third gillnet sac roe opening was confined to the waters of Rocky Bay and lasted 11-hours. The catch estimate for this opening was 283 tons with an average roe recovery of 11.65%.

After the third open period, the cumulative harvest was 846 tons, 66 tons less than the guideline of 912 tons. No new herring biomass had moved into any area of Prince William Sound, including the north Montague Island area. Fishing had been scratchy the day before, with catch rates of 0.5 ton per boat hour at the close of the period. At this rate it was expected the gillnet fleet could achieve the guideline in 9-hours. The final gillnet sac roe opening commenced at 11:00 a.m. in Rocky Bay and was extended until 10:00 p.m. that evening when it appeared catch rates were even lower than expected. However, the catch estimate for this opening was 185 tons, bringing the total catch to 1,029.9 tons, 117.9 tons greater than the guideline harvest level. This overage is attributed to increased catch rates in the last 2-

hours of the fishery. Roe recovery for the entire harvest averaged 11.0 percent. The exvessel value for the gillnet sac roe fishery is estimated at $411,960.

POUND SPAWN-ON-KELP FISHERY

There are 128 permanent pound permits in Prince William Sound. Seine specifications are the same as in the seine sac roe fishery, however there are no specifications on pound size. In addition to the limited entry permit, a Commissioner's permit, issued by the Cordova office, is also required. The Commissioner's permit stipulates gear, method of operation, production limit, and harvest requirements. There were 124 Commissioner's permits issued for the 1993 season. The historic pound fishery harvest is given in Table 4.

The pound spawn-on-kelp fishery is unique when compared to other herring fisheries. Participants import *Macrocystis* kelp from Southeast Alaska as a substrate for herring to spawn upon, although local kelp such as *Laminaria* is also authorized. The blades of kelp are individually hung on lines near the surface of the pound. Mature herring are captured by purse seine and transferred into the pound structure where they can be held for up to eight days. After herring and kelp are introduced spawning occurs and the spawn on kelp is harvested.

Beginning in 1991 the Board of Fisheries directed the department to limit the number of kelp blades that can be utilized by each permit holder. This action was taken to help control the utilization of herring. The Prince William Sound Herring Management Plan allocates herring for the pound fishery, however, in practice there is no definitive measure of assessing the actual biomass utilized by this fishery short of pumping each pound in operation. Allocation of the harvest guideline is based on the goal of one ton of spawn-on-kelp product for every 12.5 tons of herring allocated to this fishery. That harvest quota is then distributed to each individual permit holder by a specified number of kelp blades.

The pound spawn-on-kelp fishery is usually the first spring herring fishery to open. The opening occurs after an adequate biomass has been sighted and sample results indicate mature fish are available. The 1993 fishery occurred in the traditional location of Valdez Arm and Port Fidalgo. During the season some permit holders relocated their pound when the fishery was only opened in limited locations due to the small show of herring.

Aerial surveys in early April documented little herring biomass or spawning activity in the traditional pounding location of northeast Prince William Sound. The pound fishery was placed on 24-hour advance notice on Wednesday, April 7.

The first test fish samples from the Northeast area were collected on April 7 from various locations around Port Fidalgo. Samples collected from Two Moon Bay had an overall average weight of 126 grams and an average mature roe of 7.0 percent. Samples from Snug Corner Cove averaged 129 grams and 5.5 percent mature roe. Landlocked Bay samples averaged 92 grams with 4.9 percent mature roe. Herring collected from two sets in Boulder Bay were small, averaging 92 and 97 grams with 1.3 and 3.2 percent mature roe recovery. The advance notice for the pound fishery was reduced to 4-hours effective 6:30 p.m. Thursday, April 8. An aerial survey on April 8 observed 2,300 tons in the Northeast area.

On April 9 sample results indicated mixed quality herring. One set averaged 127 grams with 8.8 percent mature roe, another set averaged 97 grams and one percent mature roe and yet another sample averaged 111 grams with 6.7 percent mature roe. Permit holders in the Landlocked Bay/Two Moon Bay area were ready to fish on April 10. With several test sets indicating mature fish in Landlocked Bay and Two Moon Bay and permit holders with kelp hung in their pounds, the pound fishery opened for the seining of herring for introduction into pounds at 6:00 a.m. Saturday, April 10. The area open included only those waters of Port Fidalgo east of a line from Porcupine Point to Bidarka Point.

Test fishing continued on April 10 in the area that was not opened with mixed results. No fish were spotted in the Galena Bay area, however fish of acceptable quality were located in Tatitlek Narrows. With mature herring located in areas closed to the introduction to pounds and permit holders in those areas ready to fish, the waters open to the seining of herring for the introduction to pounds was expanded effective 3:00 p.m. April 10 to include those waters east of a line from Rocky Point to Porcupine Point.

The peak aerial biomass estimate for the Northeast area occurred on April 8 with 2,300 tons observed. From the peak estimate, biomass decreased due to natural spawning and utilization by the fishery. No new fish entered the Northeast area and no fish, of significance, were seen in Galena Bay where 69 permit holders waited for herring to show.

On April 20 the department announced its intentions to close the fishery if new fish were not observed on the next survey. This action was due to the paucity of the herring biomass in the Northeast area, no indication of fish moving into the area, and sets capturing spawnouts and juvenile herring. The department also wanted to inform permit holders of this closure because some permit holders were planning to import more *Macrocystis* kelp blades from Southeast Alaska. On April 21 the department announced that the seining of herring for introduction to pounds would close at noon on Thursday, April 22.

After the announcement, 19 permit holders from Galena Bay introduced herring into their pounds (from 1 to several dozen fish). After herring were introduced, permittees moved the pound structures and kelp to areas where fish were located such as Landlocked Bay or Two Moon Bay. Kelp was reintroduced and the web surrounding the pound was dropped to release the fish. By dropping their web, which is the accepted practice for releasing herring from the pound, herring in the area were able to swim into their pounds and add eggs to the suspended kelp. Although the department does not condone open pounding there is currently no regulation to prohibit a permit holder from dropping web after herring have been introduced. This was done by 31 permit holders of which 24 permit holders produced product.

The harvest of spawn on kelp began on April 19 and finished on April 28 with 106.4 tons of untrimmed product harvested short of the 305 tons of product allocated to the fishery. The quality of the product produced in 1993 was higher than 1992 with 61% of the product grade three or higher as compared to 1992 when 54% was grade three or higher. Only 40 percent of the permit holders produced product in 1993. The fleet received an average of $10.00 per pound for processed product, placing the value of the fishery at about $2.0 million.

There are several proposals that address the pound fishery. The department and the Cordova District Fishermen United, Pound Division are proposing to add open pound as a gear type for this fishery. Permittees would have the option to operate an open or closed pound. The department also proposes to eliminate the Commissioner's permit and adopt permit terms into regulation. Lastly, the Board is asked

to decide how many permit holders may operate a pound structure and clarify when a permit holder is required to be at the pound site.

WILD SPAWN-ON-KELP FISHERY

The wild spawn-on-kelp fishery utilizing native Prince William Sound kelp occurs after a major spawning event on marketable species of kelp receiving adequate egg coverage. Wild spawn on kelp is taken by divers or by hand picking depending upon the type of kelp available for harvest and the market demand. The historic wild spawn-on-kelp fishery harvest is given in Table 5.

The 1991 fishery was the first year *Fucus* kelp (popweed) was the species in demand in Prince William Sound. A survey of processors before the season indicated they had a market for both *Fucus* and ribbon kelp, but good quality product was important. *Fucus* kelp, a predominately intertidal species, doesn't always occur in harvestable quantities with the traditional subtidal kelp species (ribbon, sieve, and hair kelp). Given adequate spawning, openings in two different areas to harvest both *Fucus* and the traditional species of kelp was possible. This harvest strategy would satisfy the market demand for both types of kelp.

Current regulation requires kelp to be cut four inches above the stem to allow for plant regeneration. It is not practical to harvest *Fucus* or hair kelp according to regulation. The department proposes to modify the existing regulation for *Fucus* and hair kelp.

The fishery was placed on 48-hour advance notice on April 14 after five shoreline miles of spawn had been observed on Montague Island. As only seven miles of spawn had been observed in other areas of Prince William Sound, the northern Montague Island area was the only area under consideration for a wild spawn-on-kelp opening. Spawning was first observed in this area April 5 and continued to increase in distribution and intensity. Montague Island has a diverse composition of kelp species including most of the species found in other areas of Prince William Sound, however *Fucus* is the only marketable species found in any quantity in this area; very little of the traditional subtidal species, ribbon, hair, or sieve kelp occur here. Tatitlek Narrows is the historic area for harvesting the traditional species of wild spawn on kelp. A survey conducted by department personnel indicated that spawn deposition was spotty with some areas receiving marketable coverage. With this level of deposition, the department expected that the demand for quality product would be greater than the availability. The kelp was free of grit and sand. Processors examined samples of the available product and indicated that it was acceptable.

The first open period for the wild harvest fishery commenced at noon on April 19 and continued for 9-hours. The Montague Island area north of Graveyard Point to Middle Point, including Rocky Bay, was open. Five buyers had registered and an effort survey indicated 43 participants. The estimated harvest for the first period was 18 tons of spawn on kelp.

After two more openings, one on April 20 for 17-hours and another on April 21 for 18-hours, the cumulative harvest was 82 tons of product. This was less than the harvest level established for this fishery. Effort remained low and buyers were still receiving quality product. The next day, April 22 the open period was extended continuously until further notice. On April 23, four buyers notified the

department that they were leaving the area and would no longer be accepting deliveries. The remaining buyer indicated he would leave the next day. The fishery closed at noon on April 24. The total wild harvest was 162.6 tons of product. All of the product harvested was *Fucus* kelp. The exvessel value for the wild harvest fishery is estimated to be $178,860 and 83 permit holders participated.

Wild spawn on kelp is also taken by subsistence users in Prince William Sound. Current regulation only allows the subsistence harvest to occur during commercial wild spawn-on-kelp fishery openings. The department is proposing to allow the gathering of subsistence kelp above tide line from March 15 until June 15.

Of concern to processors, fishermen and the department is the waste of harvested product. Waste occurs due to the large number of harvesters, the number of new participants, and harvest locations contribute to the difficulty of advising the fleet of processor requirements for good quality product. Some trimming is traditional to enhance product salability. In 1992 processors turned away boat loads of spawn on kelp. These fishermen may have delivered to another processor or they may have dumped their catch overboard. Currently there is no reporting requirement for discarded product, however the department proposes to require both fishermen and processors to record on a fish ticket the quantity of kelp harvested but not purchased.

FOOD-AND-BAIT FISHERY

The food-and-bait season may run from September 1 through January 31, however, industry concerns for product quality usually result in a delay of the season opening. The Prince William Sound food-and-bait herring season opened by emergency order at noon October 7, 1993. Participating processors and fishermen were canvassed and all wanted to postpone the September 1 opening. Current market demand is for crab and longline bait. The oil content and subsequent bait quality improves later in the fall and winter. Larger fish begin to show and become vulnerable to purse seine gear later in the fall as well. Quality longline bait is a larger sized herring with firm flesh and a high oil content. Several processors had stringent size requirements for specialized markets again this year and would have preferred an opening later than October 7, however the season opening was a compromise. The historic food-and-bait fishery harvest is given in Table 6.

The open area included the Montague Herring District and the waters of the General Herring District west of 147°0.0' W.longitude. This is the fourth year the fleet has fished the Montague/Green Island area. By regulation, only the General Herring District is open to this fishery. The food-and-bait harvest has occurred in the Knowles Head area, however, opening the western portion of the General District and the Montague Herring District was justified, as the majority of older, larger herring have been found here recently and this area had the potential of producing a catch of the highest quality. The closure of the eastern portion of the General Herring District was necessary to protect a small sub-stock of young small herring.

The guideline harvest level (GHL) of 978 tons was based on the preliminary 1993 spring spawning biomass of 40,000 tons and a harvest rate of 15 percent. Competition for fish was expected to be intense; the GHL for the past few years had been approximately 4,000 tons and fishermen have developed markets for that amount. Department personnel were on the grounds to monitor the catch and collect biological

samples. Although the fishery opened October 7 poor weather delayed any fishing until the next day. Approximately 750 tons of herring were reported taken before poor weather made fishing impossible. Fishing resumed early in the morning of October 10. Only small catches were made until just after daylight when three boats made sets and the catch was projected to exceed the GHL. The fishery was closed at 9:10 a.m., October 10 by field announcement.

Samples collected from the catch were approximately 65 percent 5 year old fish. Three year old fish comprised approximately 14 percent of the samples. The overall average fish weight ranged from 138 to 144 grams. Processors were pleased with the fish size and the quality of the catch.

The final catch, as reported on fish tickets, is 1,087 tons. Five processors purchased herring and eight fishermen made deliveries this year; all used purse seine gear. The estimated value of the harvest is $217,400 with an average price of $200 per ton.

1993 STOCK ASSESSMENT

The 1993 spring spawning biomass of herring was dramatically lower than forecast. Possible causes include high over-winter mortality, unusually low spawning recruitment, or extensive spawning in locations not observed in aerial surveys. The herring spawning population was dominated by the 1988 year class, as expected, which returned as five year olds. Five year olds represented about 65% of the spawning population samples. All age classes showed low annual growth.

The aerial survey program was conducted from early April through late April. Herring biomass and spawning activity was documented throughout the season, and is summarized in Table 7. The peak aerial biomass estimate was 20,375 tons, the lowest since 1986. Approximately 70 percent of the peak aerial estimate was sighted at Montague Island. The total spawning biomass as estimated from age structured analysis is 30,004 short tons. Historical biomass indices are listed in Table 8.

The spawning season was earlier than average. The total linear miles of shoreline spawn was 20.4, the lowest ever recorded and the total mile-days of spawn was 40.8 the third lowest on record. A total of 13.2 miles of spawn occurred in the Montague area; 5.5 miles of spawn in the Northeast area; and 1.7 miles of spawn in the Southeast area. The Montague Island area accounted for approximately 65 percent of the shoreline spawning. There was no spawning activity on the North Shore or at Naked Island.

1993-94 HERRING SEASON OUTLOOK

The management year for herring is from July 1 through June 30. In regulation, the guideline harvest level for all fisheries is established before the fall food and bait season, based upon the final biomass spawning estimate from the previous spring, cohort analysis, and projected recruitment. In practice the department has not been able to produce a final spring biomass estimate prior to the fall food and bait fishery. During the past several years the fall food and bait fishery guideline harvest level was set based

on a preliminary biomass estimate. The guideline harvest for the spring fisheries has been set in early winter after a final analysis is complete.

The preliminary 1993 food and bait fishery harvest guideline was set at 978 tons. The guideline was established in August based on an assessment of the 1993 spawning stock of 40,000 tons. At the given stock size the harvest rate was set at 15 percent.

Due to the loss of the spawn deposition survey after the 1992 spawning season, the forecast method changed to an Age Structured Analysis model. The model incorporates previous spawn survey egg deposition estimates, miles of spawn, growth, and age compositions from the spawning stock, gillnet and seine sac roe fisheries. Natural mortality is estimated by the ASA model whereas in prior years natural mortality was taken from the literature. The model hindcasted the 1993 spawning biomass at 30,004 tons. Accounting for growth and mortality the ASA model projects the 1994 spawning stock to be 29,786 tons. The spawning biomass should be dominated by age-6 herring.

At the given stock size a harvest rate of 15 percent will be allowed and the following allocations have been made to the five herring fisheries for the 1993-94 management year: 733 tons for the 1993 food and bait fishery; 360 tons of wild spawn-on-kelp biomass or 45 tons of spawn on kelp to be harvested, 639 tons of pound spawn-on-kelp biomass or 51 tons of pound spawn on kelp to be harvested, 2,615 tons of herring to be harvested by the sac roe seine fishery, and 153 tons to be harvested by the sac roe gillnet fishery. The total guideline harvest allocation for the 1993-1994 management year is 4,500 tons of herring.

FIGURES

1993 Prince William Sound Herring Spawning

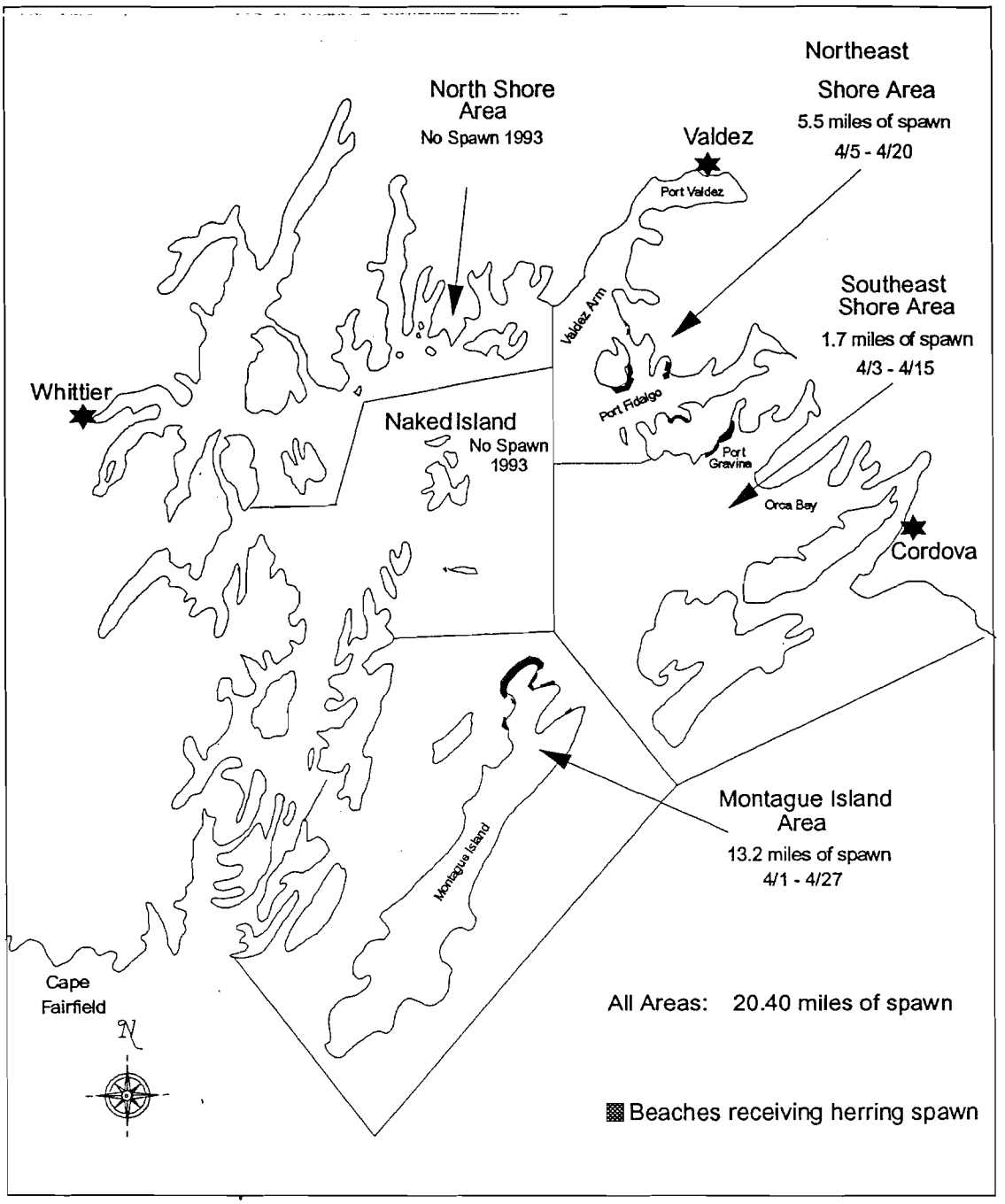

Figure 1. Prince William Sound herring spawn, shoreline mileage, and dates mapped during aerial surveys, 1993.

TABLES

Table 1. Commercial Pacific herring harvest summary with fishing locations and effort by gear type, Prince William Sound, 1993.

Fishery		Fishing Information				Harvest (tons)	
		Area	Date	Duration	Effort	Spawn on Kelp	Pacific Herring
Sac Roe and Spawn-on-Kelp Fisheries	Sac Roe Purse Seine						
		Total					0.0
	Sac Roe Gill Net	Montague I.	15 April	5.0 h	23 permits		132.4
		Montague I.	17 April	9.0 h	24 permits		429.8
		Montague I.	18 April	11.0 h	24 permits		283.3
		Montague I.	19 April	11.0 h	24 permits		184.5
		Total		36.0 h	24 permits		1,029.9
	Wild Spawn-on-Kelp a	Montague I.	19 April	9.0 h	19 permits	17.8	142.3 b
		Montague I.	20 April	17.0 h	22 permits	23.3	186.1 b
		Montague I.	21 April	18.0 h	35 permits	40.8	326.4 b
		Montague I.	22 April	24.0 h	51 permits	50.2	401.3 b
		Montague I.	23 April	24.0 h	36 permits	27.3	218.6 b
		Montague I.	24 April	12.0 h	4 permits	3.3	26.1 b
		Total		114.0 h	83 permits	162.6	1,300.7 b
	Pound Spawn-on-Kelp c	Northeast	10-22 April		52 permits	106.4	1,330.5 d
		Total				106.4	1,330.5 d
	1993 Harvest and Equivalent Use - Total					269.0	3,661.1
Food-and-Bait Fishery		Montague I.	7-10 October	69.3 h	8 permits		1,087.0
		Total					1,087.0
Harvest and Equivalent Use - Total						269.0	4,748.1

a The harvest of naturally occurring herring spawn on native kelp species in Prince William Sound.

b The equivalent harvest of herring due to the removal of reproductive capacity from the population based on the assumption that the average herring spawn recovery is 10%, and 80% of the spawn on kelp harvest weight consists of eggs.

c The harvest of herring spawn-on-kelp produced in net pens or pounds.

d The equivalent harvest of herring due to stress mortality and the removal of reproductive capacity of the population based on the assumption that 12.5 tons of herring are used to produce one ton of spawn on kelp.

Table 2. Mean price and estimated exvessel value of the commercial Pacific herring harvest by gear type based on verbal post season estimates from processors and fishermen, Prince William Sound, 1978-1993.

Harvest Management Year	Sac Roe Fisheries				Spawn on Kelp Fisheries				Food-and-Bait Fishery		
	Purse Seine		Gillnet		Wild Spawn on Kelp		Pounds		Mixed Gear		
	Price per ton	Total Value	Price per ton	Total Value	Price per lb	Total Value	Price per lb a	Total Value	Price per ton	Total Value	TOTAL VALUE
1978	$720	$956,800		$0	$1.25	$175,000		$0	$380	$489,820	$1,621,700
1979	$1,260	$5,213,880		$0	$1.74	$821,280		$0	$300	$196,800	$6,231,960
1980	$320	$1,933,760		$0	$1.09	$667,080		$0	$300	$424,800	$3,025,640
1981	$400	$5,508,000	$580	$135,720	$1.00	$122,000		$0	$260	$328,120	$6,093,840
1982	$380	$2,716,240	$640	$251,520	$1.29	$397,320		$0	$220	$194,260	$3,559,340
1983	$600	$1,634,400	$1,040	$109,200	$2.10	$634,200		$0	$260	$70,980	$2,448,780
1984	$760	$4,435,360	$640	$218,880	NO HARVEST		$3.50	$176,439	$260	$265,460	$5,096,139
1985	$760	$5,380,800	$900	$371,700	$0.48	$19,200	$7.09	$569,058	$250	$279,500	$6,620,258
1986	$820	$8,058,960	$920	$412,160	$1.70	$159,800	$8.00	$1,155,200	$180	$229,680	$10,015,800
1987	$1,100	$5,480,200	$960	$511,680	$1.70	$299,200	$15.00	$1,836,000	$300	$356,700	$8,483,780
1988	$840	$6,600,000	$1,400	$537,000	$1.20	$232,000	$18.00	$4,500,000	$300	$400,590	$12,236,500
1989	SEASON CLOSED		SEASON CLOSED		SEASON CLOSED		SEASON CLOSED		$300	$193,830	$193,830
1990	$640	$5,351,744	$640	$323,456	$0.90	$213,840	$11.40	$2,305,080	$300	$605,130	$8,799,250
1991	$600	$7,153,800	$600	$445,200	$0.80	$172,160	$9.00	$2,880,000	$250	$1,064,625	$11,715,785
1992	$400	$6,713,680	$800	$752,480	$0.46	$232,116	$8.00	$3,875,200	$200	$780,060	$12,353,536
1993	No Harvest		$400	$411,960	$0.55	$178,860	$10.00	$2,000,000	$200	$217,400	$2,808,220

a The price per pound for spawn on kelp in pounds is based on the final product weight, not harvest weight.

Table 3. Pacific herring sac roe seine and gillnet fishery effort, anticipated and actual harvest, Prince William Sound, 1969 - 1993.

	Seine Fishery							Gillnet Fishery							Total
Year	Opening Dates	Hours	Effort (Boats)	Guideline Harvest[a]	Harvest (tons)	CPUE (tons/Boat Hr)	Estimated Roe %	Opening Dates	Hours	Effort (Boats)	Guideline Harvest[a]	Harvest (tons)	CPUE (tons/Boat Hr)	Estimated Roe %	Harvest (tons)
1969	3/01 - 6/30		5		325.4										355.7
1970	3/01 - 6/30														
1971	3/01 - 6/30		12		919.2										919.2
1972	3/01 - 6/30		18		1,777.2										1,777.2
1973	4/23 - 5/09		31		6,991.9										6,991.9
1974	4/10 - 4/17		72		6,371.0			4/10 - 04/17		3		3.8			6,374.8
1975	4/15 - 4/22	14	76		5,853.8	5.50			14						5,853.8
1976	5/08 & 6/01	13	66		2,584.2	3.01			13						2,584.2
1977	4/09 - 4/10	38	58		2,265.6	1.03		4/09 - 04/10	38	1		1.6	0.04		2,267.1
1978	4/17 - 4/21[b]	106	75	5,000	1,329.5	0.17		4/17 - 04/21	106	38		61.7	0.02		1,391.2
1979	4/07 - 4/19	215.5	89	5,000	4,138.0	0.22		CLOSED[c]							4,138.0
1980	4/01 - 4/09	162	76	5,000	6,042.2	0.49		4/17 - 5/05		16		264.4			6,306.7
1981	4/01 - 4/09	60	106	5,000	13,768.2	2.16		4/16 - 4/18	53	18		234.5	0.25		14,002.8
1982	4/23	2	95	5,000	7,148.3	37.62	10-14%	4/24 - 4/26	54	18		393.9	0.41	12-15%	7,542.2
1983	4/13	1	103[d]	5,000	2,728.5	26.49	11.0%	4/21 - 4/22	24	22		105.4	0.20	11.0%	2,833.9
1984	4/14	3	105[e]	5,000	5,946.1	18.88	10-11%	4/18 - 4/22	59	23	250	342.7	0.25	8-14%	6,288.8
1985	4/28 - 4/29	4	103[f]	5,000	6,764.1	16.42	10-12%	4/29 - 5/01	34	21	250	413.3	0.58	10-12%	7,177.4
1986	4/17	3	106	5-7,000	9,828.1	30.91	11.0%	4/24 - 4/28	90	24	3-400	448.6	0.21	11.4%	10,276.7
1987	4/08 - 4/09	1.5	96	3-5,000	4,982.2	34.60	10.0%	4/10 - 4/11	24	24	2-300	533.3	0.93	9.5%	5,515.5
1988	4/21 - 4/22	2	105	4-5,000	7,977.3	37.99	10.5%	4/23	5.5	24	275	353.0	2.67	10.0%	8,330.3
1989[g]	Season Closed			6,400							375				0.0
1990	04/12	0.3	96	6,038	8,362.1	290.35	10.0%	04/13	4	24	353	505.4	5.26	10.6%	8,867.5
1991	4/09, 4/10, & 4/19	1.3	104	11,232.6	11,923.0[h]	85.32	10.5%	04/18	10.5	24	657.3	742.0	2.94	11.06%	12,665.1
1992	4/13, 4/17, & 4/21	2.0	104	14,100.0	16,784.2[i]	80.25	10.0%	4/23 - 4/24	11	24	825	940.6	3.56	10.8%	17,724.8
1993	No Harvest			15,586.0				4/15, 4/17-4/19	36	24	912	1,029.9	1.19	11.01%	1,029.9

a Guideline harvest based on pre-season harvest projections beginning in 1986.

b An additional opening on 6/14 for 6 hours resulted in no harvest.

c Gillnet fishery closed by Board of Fisheries action.

d Out of 103 boats participating, 72 actually made deliveries.

e Out of 105 boats participating, 101 actually made deliveries.

f Out of 103 boats participating, 62 made deliveries at Montague Island and 90 made deliveries in the north-shore area.

g All Pacific herring commercial sac roe and spawn-on-kelp fisheries in Prince William Sound were closed during the spring of 1989 due to the potential for contamination of catches from the T/V Exxon Valdez oil spill.

h Total for 1991 includes a 92.2 ton test fishing set made by ADF&G for aerial survey calibration.

i Total for 1992 includes a 192.5 ton test fishing catch made by ADF&G for aerial survey calibration.

Table 4. Pacific herring eggs on kelp produced in pounds, Prince William Sound, 1979 - 1993.

Year	Fishery Dates[a]	Effort: Permits Issued[b]	Effort: Pounds Built[c]	Effort: Producing Pounds[d]	Guidline Harvest (tons)	Blades Per Permit Holder	Spawn-on-Kelp Harvest[b] (tons): Ribbon	Spawn-on-Kelp Harvest[b] (tons): Macrocystis	Spawn-on-Kelp Harvest[b] (tons): Total	Herring Utilized (tons)[e]
1979		2	0							
1980	4/14	14	4	2	8		0.9	0.4	1.3	16.6
1981	4/14	18	18	7	16		8.6	1.1	9.7	120.7
1982	4/29-5/10	25	20	18	26		25.1	0.5	25.5	319.2
1983	4/30-5/04	47	38	26	26		17.7	10.1	27.9	348.8
1984	4/24-5/08	65	45	37	26		6.4	18.8	25.8	322.8
1985	4/25-5/07	81	59	50	40		12.1	28.1	40.2	502.1
1986	4/21-4/28	104	82	81	60		0	72.2	72.2	903.0
1987	4/10-4/21	111	111	108	85		0	61.2	61.2	765.1
1988	4/12-4/23	122	122	119	85		0	123.2	123.2	1,540.5
1989	Season Closed[f]									
1990	4/11-4/26	128	128	122	118		0	98.8	98.8	1,235.3
1991	4/07-4/20	126	126	119	220	1,200	0	202.4	202.4	2,530.5
1992	4/07-4/24	127	127	127	276	1,770	0	242.2	242.2	3,027.7
1993	4/10-4/22	128	124	52	305	1,950	0	106.4	106.4	1,330.5

a Dates that the fishery was opened to seines for the capture and placement of Pacific herring into pounds.

b Commssioner's permits issued to applicants on register prior to the March 1 deadline.

c Number of individual pounds constructed by the April 1 deadline, and consequently the number of individuals receiving an equal allocation of the guideline harvest.

d Number of pounds that were successful in producing spawn-on-kelp product. Due to the group cooperation in this fishery production is frequently reported for a few individuals whose pounds did not produce spawn-on-kelp product.

e The equivalent harvest of Pacific herring due to stress mortality and the removal of reproductive capacity of the population based on the assumption that 12.5 tons of Pacific herring are used to produce 1 ton of spawn-on-kelp product.

f All Pacific herring commercial sac roe and spawn-on-kelp fisheries in Prince William Sound were closed during the spring of 1989 due to the potential for contamination of catches from the T/V Exxon Valdez oil spill.

Table 5. Pacific herring eggs on kelp harvests from natural spawning, Prince William Sound, 1969 - 1993.

Year	Fishery Dates	Hours	Effort (Divers)	Guidleine Harvest (tons)	Harvest by Kelp Species and Grounds Price ($/lb)								Spawn-on-Kelp Harvest		Herring Utilized[a] (tons)
					Ribbon		Sieve		Fucus		Other				
					Percent	Price	Percent	Price	Percent	Price	Percent	Price	(lb)	(tons)	
1969	5/18-5/31		3										5,424	2.7	21.7
1970	4/19-6/06		34										190,374	95.2	761.5
1971	4/18-5/15		159										769,481	384.7	3,077.9
1972	4/30-5/20		397										600,453	300.2	2,401.8
1973	4/23-5/26		176										306,358	153.2	1,225.4
1974	4/22-5/04		143		Mostly Ribbon - Some Sieve and Hair				$0.60-0.75				580,588	290.3	2,322.4
1975	4/25-5/10		328										916,919	458.5	3,667.7
1976	4/21- ?		279										485,043	242.5	1,940.2
1977	4/27-12/31		104										417,000	208.5	1,668.0
1978	4/20-4/30		66	165	23%		50%				27% [b]		141,268	70.6	565.1
1979	4/25-5/03		97	200									474,242	237.1	1,897.0
1980	4/23-4/30	10	458	200	60%	$1.25	40%	$0.85					603,880	301.9	2,415.5
1981	4/25	12	196	200	38%	$1.25	60%	$0.85			2% [b]	$0.60	122,532	61.3	490.1
1982	5/05-5/08	73	152	187	83%	$1.42	11%	$0.95			6% [b]	$0.74	291,430	145.7	1,165.7
1983	4/27	12	185	187	51%	$2.00-2.45	35%	$1.50-1.70			14% [c]		298,362	149.2	1,193.4
1984	Season Closed [d]		225 [e]	187											
1985	5/06 & 5/08	20	106	169	51%	$1.25	49%	$0.50					60,832	30.4	243.3
1986	4/30-5/03	86	29	142	97%	$1.75		$0.80			[b]	$0.80	95,205	47.6	380.8
1987	4/15-4/17	44	59	103	90%	$1.70		$0.85			[b]	$0.80	176,485	88.2	705.9
1988	4/29 & 4/30	12	159	103	64%	$1.50	24%	$0.75-1.00			12% [b]	$0.75-1.00	194,762	97.4	779.0
1989	Season Closed [f]			110											
1990	4/21-4/22	16	134	104	37%	$0.99	6%	$0.52			57% [b]	$0.88	237,575	118.8	950.3
1991	5/11-5/17	95	48	195					100%	$0.75-0.85			215,147	107.6	860.8
1992	4/24-4/30	101	217	243	21%	$0.70			76%	$0.40	3%		504,663	252.3	2,018.7
1993	4/19-4/24	114	83	268					100%	$0.55			325,181	162.6	1,300.7

[a] Indicates the annual removal of reproductive capacity from the population based on the assumption that average fish roe recovery is 10% and 80% of spawn-on-kelp harvest weight consists of eggs.

[b] Hair kelp.

[c] Mostly Macrocystis spp. Some hair kelp.

[d] Season remained closed due to lack of suitable spawn.

[e] Permits issued.

[f] All Pacific herring commercial sac roe and spawn-on-kelp fisheries in Prince William Sound were closed during the spring of 1989 due to the potential for contamination of catches from the T/V Exxon Valdez oil spill.

Table 6. Commercial Pacific herring food-and-bait fishery effort and harvests, Prince WIlliam Sound, 1970-1993.

Harvest Management Year a	Fishing Dates		Guideline Harvest	Purse Seine		Pair Trawl		Mid-Water Trawl		Otter Trawl		Total Harvest (tons)
	Opened	Closed		Effort (Boats)	Harvest (tons)	Effort (Boats)	Harvest (tons)	Effort (Boats)	Harvest (tons)	Effort (Boats)	Harvest (tons)	
1969-1970	10/01/69	- 06/30/70 a		-	14.0							14.0
1970-1971	10/01/70	- 06/30/71 a										0.0
1971-1972	10/01/71	- 06/30/72 a		-	20.0							20.0
1972-1973	10/01/72	- 05/09/73 a		-	9.0							9.0
1973-1974	08/27/73	- 04/17/74 a	b	-	8.5							8.5
1974-1975	07/15/74	- 03/10/75	b									0.0
1975-1976	06/01/75	- 06/25/75 c	b	4	226.7							226.7
1976-1977	02/01/77	- 03/09/77	b									0.0
1977-1978	10/01/77	- 02/28/78	b	-	17.0	-	145.3					162.3
1978-1979	10/16/78	- ? d	b	-	195.4	7	988.7	-	9.4	-	81.0	1,274.4
1979-1980	09/16/79	- 02/28/80 e	1,400	-	510.8	4	145.1	-	103.2	-	2.6	761.7
1980-1981	09/15/80	- 11/07/80	1,400	-	1,030.4	6	275.7					1,306.1
1980-1982	09/15/81	- 09/30/81	1,400	7	1,189.4	-	73.1					1,262.5
1982-1983	09/15/82	- 01/31/83	1,400	6	797.3							797.3
1983-1984	09/15/83	- 01/31/84	1,400	-	257.6							257.6
1984-1985	09/15/84	- 01/31/85	1,400	-	936.2							936.2
1985-1986	09/01/85	- 02/15/86	1,400	6	1,118.1							1,118.1
1986-1987	09/01/86	- 10/24/86	1,400	6	1,276.2							1,276.2
1987-1988	09/02/87	- 11/12/87 f	1,400	7	1,189.4							1,189.4
1988-1989	11/01/88	- 11/05/88	1,400	8	1,335.3							1,335.3
1989-1990	11/01/89	- 01/31/90	1,694	-	646.1							646.1
1990-1991	09/21/90	- 11/24/90 g	3,151	5	1,955.0			-	60.8			2,015.9
1991-1992	10/01/91	- 10/14/91	3,956	14	4,258.5							4,258.5
1992-1993	10/01/92	- 10/22/92	3,416 h	17	3,900.3							3,900.3
1993-1994	10/07/93	- 10/10/93	978 j	8	1,087.0							1,087.0

a Openings set by regulation. Ending date coincides with regulatory ending of sac roe season.

b No Official quota, but unofficial goal was 1,500 tons.

c Harvest from special June food-and-bait fishery opening. Although this harvest actually occured at the end of the 1975 management year, it is included in the 1976 harvest management year to be consistent with other food-and-bait harvests which occur after spring sac roe fisheries.

d Fishery closed from 1 January to 6 January 1979.

e Fishery closed from 1 January to 15 February 1980.

f Fishing season opened by regulation on September 1, 1987 in the General District. The north-shore and east-shore Pacific herring districts opened on September 23. The season was closed by emergency order on October 6 for a period of five weeks, reopened on November 9, and closed for the duration of the 1987-88 season on November 12, 1987.

g Fishery open from September 21 until November 24. The Montague Island area was open from September 24 until November 24.

h Preseason guideline harvest level based on spawn deposition biomass estimate. Final quideline harvest based on age-structured analysis was issued in January 1993 and was 4,373 tons.

j Preseason guideline harvest level based preliminary aerial survey biomass estimate of 40,000 tons.

Table 7. Peak aerial survey herring biomass, spawn deposition biomass esitmates, and miles of spawn by area, Prince William Sound, 1993.

Survey Area	Peak Aerial Survey Date	Spawning Biomass Estimates: Peak Aerial Survey (tons)	Spawning Biomass Estimates: Spawn Deposition (tons)	Mile-days of Spawning a	Miles of Spawning b	Biomass of Herring per Mile (tons): Aerial Survey Estimate	Biomass of Herring per Mile (tons): Spawn Deposition Estimate	Biomass Ratio c
Southeast-shore area								
Simpson and Sheep Bays	04/05	240.0						
Hinchinbrook Island	04/07	25.0						
Port Gravina	04/10	1,370.0						
Area Total		1,635.0	NS	2.6	1.7	961.8	0.0	0.00
Northeast-shore area								
Port Fidalgo	04/08	2,120.0						
Tatitlek Narrows	04/13 & 04/22	930.0						
Valdez Arm and Port Valdez	04/13 & 04/18	550.0						
Area Total		3,600.0	NS	8.2	5.5	654.5	0.0	0.00
North-shore area								
Pt. Freemantle-Granite Pt.		0.0						
Granite Pt. Esther Pass	04/08	840.0						
Area Total		840.0	NS	0.0	0.0	0.0	0.0	0.00
Naked Island area								
Naked Island		0.0						
Knight Island		0.0						
Area Total		0.0	NS	0.0	0.0	0.0	0.0	ERR
Montague Island area								
Montague Island	4/10 & 4/11	14,650.0						
Area Total		14,650.0	NS	30.1	13.2	1,109.8	0.0	0.00
Total - All Areas		20,725.0	NS	40.8	20.4	1,015.9	0.0	0.00

a The mile-days of spawning are measured and mapped during aerial surveys.

b The miles of spawning are measured during aerial surveys and corroborated during spawn deposition surveys. The miles of spawning will usually be smaller than the mile-days of spawning. However, there are instances when the miles of spawning may exceed the mile-days of spawning. This usually occurs because aerial surveys are not flown every day in all areas of Prince William Sound.

c The biomass ratio is the spawn deposition biomass estimate over the peak aerial survey estimate.

Table 8. Annual Pacific herring biomass indices, Prince William Sound, 1974-1993.

Year	Total Sac Roe Harvest [a] (tons)	Aerial Survey Estimates: Peak Biomass Estimate [b] (tons)	Aerial Survey Estimates: Maximum Possible Observed Biomass [c]	Aerial Survey Estimates: Miles of Spawn [d]	Aerial Survey Estimates: Mile Days of Spawn [e]	Unexploited Escapement Biomass: Spawn Deposition Surveys [f] (tons)	Unexploited Escapement Biomass: Age Structured Analysis (tons)	Pre-Fishery Run Biomass: Age Structured Analysis (tons)
1974	6,374.8	41,080	107,290	38.5	75.2		34,743.7	41,068.8
1975	5,853.8			34.2	42.4		31,592.2	37,772.9
1976	2,584.2	7,330	25,247	32.8	33.7		27,491.6	30,486.6
1977	2,267.1	16,830	17,460	39.3	73.5		25,703.7	27,986.5
1978	1,391.2	13,410	36,540	28.7	36.3		22,037.4	23,423.0
1979	4,138.0	42,100	107,390	54.5	73.2		32,899.5	37,044.2
1980	6,306.7	62,110	122,050	50.5	73.9		51,253.0	56,139.5
1981	14,002.8	77,810	161,690	85.4	140.1		51,707.2	65,446.3
1982	7,542.2	68,790	97,620	49.0	65.1		46,853.7	53,884.2
1983	2,833.9	41,850	107,710	67.4	99.8	22,000	59,080.5	61,862.7
1984	6,288.8	58,870	158,760	60.1	86.8	58,089	71,114.4	76,138.8
1985	7,177.4	20,830	60,954	101.2	149.5		85,809.3	93,275.3
1986	10,276.7	15,180	54,820	72.4	152.3		69,704.6	79,621.0
1987	5,515.5	26,580	52,192	65.3	155.9		80,886.4	86,166.5
1988	8,330.3	34,270	67,175	166.3	236.9	53,785	123,253.7	131,454.9
1989	[g]	56,915	186,708	98.4	185.8	49,914	133,235.1	133,235.1
1990	8,867.5	57,900	145,013	94.1	144.4	127,478	100,564.8	110,606.9
1991	12,665.1	42,765	141,375	58.0	64.8	140,964	74,319.9	88,976.3
1992	17,724.8	53,835	130,569	74.7	99.5	128,263	74,234.0	91,791.6
1993	1,029.9	20,725	109,865	20.4	40.8		30,004.9	32,048.6
1994 [h]								29,786.6

a Represents the combined seine and gillnet sac roe harvest in short tons.

b Largest single day aerial estimate of Pacific herring biomass in short tons. Peak estimates for different areas (ie. Valdez Arm vs. Montague) may occur on different days.

c The sum of all daily aerial biomass estimates for a given year.

d Total linear miles of spawn.

e The sum of the daily observed linear miles of Pacific herring spawn.

f Estimates are made from underwater surveys of spawn deposition; 1983 is a partial estimate of the spawning biomass, while 1984, and 1988-1991 estimates are of the entire spawning biomass.

g All Pacific herring commercial sac roe and spawn-on-kelp fisheries in Prince William Sound were closed during the spring of 1989 due to the potential for contamination of catches from the T/V Exxon Valdez oil spill.

h Projected run biomass estimate from age structured analysis, December 1993.

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