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Preliminary Run Forecasts and Harvest Projections for 1994 Alaska Salmon Fisheries and Review of the 1993 Season

Edited by

Harold J. Geiger

and

Ellen Simpson

April 1994

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

Carl Rosier
Commissioner

Front Cover

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inside front cover

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Commercial Fisheries Management
and Development Division
P.O. Box 25526
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This report is based on information contributed by Division of Commercial Fisheries biologists located in field offices throughout the state. Individual credit for forecast material is contained in the area forecast discussions in the Appendix. Area biologists throughout the state supplied reviews of the 1993 fishing season.

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EXECUTIVE SUMMARY

We are expecting a catch of 167 million salmon during the 1994 season, which is a decrease from the 1993 level. The current catch projections are found in Tables 1 and 2. When compared to the 1993 harvest levels, these projections call for approximately 20 thousand fewer chinook salmon, 9.1 million fewer sockeye salmon, nearly 1 million fewer coho salmon, 12.7 million fewer pink salmon, and 2.6 million fewer chum salmon. Last year's harvest projection was 172 million salmon, but we are currently estimating the total 1993 catch to be 193 million (see Table 3 which contains our preliminary harvest estimates for the season). Statewide, our 1993 harvest projection for sockeye salmon was approximately 17 million too low; harvests of other species were all within 3 million of the respective projections. Currently, the exvessel value of the 1993 salmon harvest appears near $390 million — down dramatically from our estimate of $575 million for the 1992 harvest.

Last year's all-species salmon catch set still another record, beating out the previous record of 190 million set in 1991. The record catch between 1939 and 1983 had been 126 million. Remarkably, salmon harvest records were broken seven times from 1983 to 1993.

The 1994 outlook for sockeye salmon is variable across regions of the state. The Bristol Bay sockeye salmon forecast is for another large run. Biologists in the Bay are expecting a sockeye run of 56.0 million with an inshore catch of 39.6 million — very similar to the actual 1993 catch. The sockeye forecast for Upper Cook Inlet is for a drop in run size, and the projected sockeye catch is 2.0 million. The outlook for sockeye salmon runs in the Kodiak area is similar to what the outlook was in 1993, although the 1994 catch projection is approximately 2 million less than the actual 1993 catch. A much stronger than expected run to Frazer Lake and several smaller systems resulted in more fish than expected in the Kodiak area last year. The sockeye catch in Chignik is expected to be slightly below the 1993 level.

News around the state about pink salmon is mixed. After a disastrous 1993 season in Prince William Sound, this year's forecast is 26.7 million pink salmon and projected catch is 24.1 million. The catch is expected to be distributed as 8.3 million for hatchery cost recovery needs, and 15.8 million to the common property harvest. While this may seem like good news, on closer inspection management of the pink salmon return in the Sound will be difficult at best. The salmon returning in 1994 are from parents that returned in 1992 — a year with a serious escapement shortfall for the wild salmon. Alternatively, the 1994 hatchery return will be from the second largest hatchery fry release in the history of Prince William Sound. Consequently, a harvest of only 620 thousand wild pink salmon is expected compared to 23.5 million hatchery pink salmon. Even if the total return is as good or better than forecasted, the fleet can expect congested fisheries managed conservatively in areas near the hatcheries. Other forecasters have produced numbers considerably smaller than ours. Using different methods, Prince William Sound Aquaculture Corporation biologists expect considerably fewer hatchery-produced pink salmon to be available for harvest in the Sound. Forecasters in Kodiak are expecting a run above average for the even-year line. Forecasters in Southeast Alaska characterize their pink salmon information as pointing toward a "strong" harvest in 1994 of 38 to 57 million.

The Alaska Department of Fish and Game does not produce formal run forecasts for any salmon runs in the Arctic-Yukon-Kuskokwim Region. The 1994 chum catch projections for this area are based on a qualitative evaluation of parental-year escapements and recent-year catch levels. The 1994 catch projection for the Arctic-Yukon-Kuskokwim Region is 600 thousand chum salmon. This catch projection is lower than all recent-year actual catches except for the disastrous 1993 season. Our 1993 catch projection for the Arctic-Yukon-Kuskokwim Region was 1,840 thousand chum salmon, yet only 360 thousand were actually caught. With the recent unexpected chum salmon production problems in mind, we are very uncertain as to what the 1994 season holds for the Arctic-Yukon-Kuskokwim Region.

Although statewide, the 1993 fishery took a record number of salmon, this past season will be remembered for unexpected run failures and the resulting painful fisheries closures. Chum salmon failed to return throughout western Alaska — resulting in economic disaster. Even subsistence fisheries had to be closed in the Yukon drainage and elsewhere in western Alaska. The chum salmon failure was considered the most important news story of 1993 by the Alaska Public Radio Network, and the second most important story in Alaska by the Associated Press. This story took on such importance because in much of the affected region people have few other resources they can use to earn money, and because of the cultural importance of the returning salmon to Alaska's native populations. In another area of the state, both hatchery and wild pink salmon failed to return in expected numbers to Prince William Sound. Both the run failures in western Alaska and in Prince William Sound are puzzling and still defy a good explanation, although there is no shortage of speculation.

The failure to the 1993 pink salmon run in Prince William Sound caught us completely by surprise. A few years ago we expected that by the 1990s the Prince William Sound pink salmon forecast would be the best in the state for several reasons. The work of Prof. R. Ted Cooney and his students had produced a greater understanding of the forces that shape pink salmon survival in Prince William Sound. In addition, most of the pink salmon production is now from pink salmon hatcheries where the number of juvenile salmon migrating into the sea is known. Yet, last year we forecasted a pink salmon run of 27.6 million, but the actual run was estimated to be only 8.0 million.

With some exceptions, Alaska's salmon runs are in excellent shape. The same cannot be said of the salmon industry in Alaska. The drop of approximately one-third in exvessel value from 1992 to 1993 stands in contrast to the fact that a record number of salmon were harvested. The outlook for 1994, in general, is very good for the salmon. We only hope it is nearly so good for the fishing industry.

INTRODUCTION

The major fishing areas within the Southeast, Central, and Western Statistical Areas are shown in Figure 1. These regions and areas are the ones used in the Department's statistical leaflet series and prior statistical reports.

Forecasts of runs (catch + escapements) for major salmon fisheries and projections of the statewide commercial salmon harvest have been published yearly by the Alaska Department of Fish and Game since 1969 (ADF&G 1969–1984; Eggers 1985, 1986; Eggers and Dean 1987, 1988; Geiger and Savikko, 1989–1993). The Alaska Department of Fish and Game does not produce formal run-size forecasts for all salmon runs in the state, but local salmon biologists do prepare harvest projections or harvest outlooks for all areas. These projections are based on formal forecasts, when available; when the formal forecasts are not available, local biologists use average historical catches and local knowledge of recent events to develop these outlooks. The projections for the 1994 Alaska commercial salmon harvest, by species and area, are found in Tables 1 and 2. The harvest outlooks for AYK Region are developed as ranges; a table of these ranges is found in Appendix B.1. Trends in total statewide salmon harvests and catch projections in numbers of fish by species are found in Figures 2–6.

This report contains a detailed review of Alaska's 1993 commercial salmon season. We normally release it before final catch figures are available to provide preliminary information to the Board of Fisheries, the fishing industry, and the public well before the next season begins.

Predominate ages and brood years for 1994 salmon runs by species are as follows:

Age of Returning Salmon in Years

Species	2	3	4	5	6
Pink	1992				
Chum		1991	1990	1989	
Coho		1991	1990		
Sockeye			1990	1989	1988
Chinook			1990	1989	1988

The common and scientific names for Alaska's Pacific salmon species are as follows:

Common (and Vernacular) Names	Scientific Name
chinook, (king)	*Oncorhynchus tshawytscha*
sockeye, (red)	*Oncorhynchus nerka*
coho, (silver)	*Oncorhynchus kisutch*
pink, (humpy, humpback)	*Oncorhynchus gorbuscha*
chum, (dog)	*Oncorhynchus keta*

DEFINITION OF TERMS

Commercial Harvest:	Harvests of fish that are used for commercial purposes. This includes fish caught by the commercial common property fishery (see below) and by hatchery operators for cost recovery; it excludes sport, subsistence, and personal use harvests.
Commercial Common Property Harvest:	Harvests taken by the traditional competitive commercial fisheries (gillnet, purse seine, and troll), as opposed to commercial harvests resulting from hatchery cost recovery, fishing derbies, and the sale confiscated fish.
Common Property Harvest:	Harvests taken by the commercial common property fisheries (see above), as well as the sport, subsistence, and personal use fisheries. This category excludes hatchery cost recovery harvests, etc.
Cost Recovery Harvest:	Harvests of salmon by hatchery operators in specially designated areas to fund the operation of hatcheries and other enhancement activities.
Enhancement of runs:	Hatcheries and other means of artificial propagation to create salmon runs or make existing salmon runs larger. Enhancement includes remote fish stocking, fertilization of lakes, and other techniques.
Escapement, spawning population or brood stock:	The portion of a salmon run which is not harvested and survives to reach the spawning grounds or hatchery.
Harvest projections or harvest outlooks	Harvest outlooks are the best available estimates of upcoming harvest levels. Prepared by local biologists, outlooks are based on formal run forecasts, when available. At other times outlooks are based on historical average catches, subjectively adjusted based on recent trends and local knowledge.
Run Forecast:	Forecasts of the run (harvests + escapement) are estimates of the fish returning in a given year based on information such as parent-year escapements, subsequent fry abundance, spring sea water temperatures, and escapement requirements. Run forecasts are generally thought to be more reliable than harvest outlooks, but run forecasts are provided only for selected areas.
Salmon Run:	The total number of mature salmon returning in a given year from ocean rearing areas to coastal waters.

PRELIMINARY REVIEW OF THE 1993 ALASKA COMMERCIAL SALMON SEASON

The 1993 Alaska commercial salmon harvest of 193 million salmon is the largest ever recorded and surpasses the previous record of 190 million salmon established in 1991. The preliminary exvessel value was approximately $390 million — only 68% of the exvessel value in 1992.

The 1993 season produced a record sockeye catch of 65 million fish worth $272 million, exvessel. Sockeye salmon made up 34% of the statewide harvest; this year's record catch was fueled by the largest sockeye catch in Bristol Bay's history. Commercial fishermen caught about 109 million pink salmon statewide, 56% of the total salmon harvest. The exvessel value of the pink harvest was only $43 million, less than one-third of the record value of $135 million set in 1989. Chum salmon harvests continued to decline and represented only 6% of the Alaskan harvest. Coho and chinook catches contributed 3% and less than 1%, respectively, to the statewide total.

A summary of the state's major commercial fisheries by area follows. The preliminary catch for the entire state, by species, is presented in Table 3 and, by specific area and species, in Tables 4 through 7.

Southeast and Yakutat

The 1993 Southeast Alaska commercial salmon harvest, including hatchery cost recovery, totaled 72.2 million fish, a new record. The harvest of 3.2 million sockeye salmon was the highest since statehood and the fourth highest since 1904. The harvest of 3.65 million coho salmon was second only to the 1992 harvest of 3.7 million and included the highest common property harvest on record. The harvest of 7.9 million chum salmon was the fifth highest on record and the highest since 1925. Approximately 1.5 million chum salmon were harvested in fisheries directed at enhanced returns to Deep Inlet and another 1.5 million were harvested in the Hidden Falls Hatchery terminal area. The exvessel value of the region's salmon harvest exceeded $88.3 million, compared to $92.3 million in 1992 and $71.8 million in 1991. Sales of sockeye, coho, and chum salmon accounted for two-thirds of the exvessel earnings.

The pink salmon harvest in Southeast Alaska totaled 57.2 million fish in 1993, almost three times the 1960–1992 average of 19.8 million, and the fourth largest on record. Returns to northern Southeast Alaska were generally strong, and a third of the pink salmon harvest was taken in northern Southeast Alaska waters. Both the harvest and the total return were close to expectations. The forecasted run of 84.1 million was only 5.5 million (6.1%) lower than the estimated run of 89.6 million. Pink salmon returns originating from Southeast Alaska hatcheries were relatively small in 1993 and are estimated to total less than 0.4 million. Purse seine fishermen took 93% of the pink salmon harvested in 1993. The exvessel price paid for seine-caught pink salmon averaged $0.14 per pound, similar to the price paid in 1991 and 1992 but half of the 1990 average of $0.31 per pound. Overall escapement goals for pink salmon were achieved in both southern and northern Southeast Alaska. However, escapements to some districts were below target goals.

Escapements of chinook, sockeye, coho, and chum salmon in the region were generally good to excellent. Chinook salmon escapements to Alaskan and transboundary river systems were a record 102,000 fish, but escapement goals were not achieved for the Alsek River and for most Behm Canal/Boca de Quada area systems. Escapement goals for sockeye salmon were met or exceeded in all systems with directed fisheries.

Escapements of coho and summer and fall chum salmon were also strong and well distributed throughout the region, with the exception of chum salmon in the Chilkat River.

Purse seine harvests of sockeye, pink, coho, and chum salmon in both southern (Districts 101–108) and northern (Districts 109–114) areas exceeded 1960–1992 averages. The Department generally managed openings with a two-days-on/two-days-off schedule. This schedule was consistent with requests by the industry and appeared to provide orderly harvesting, processing, and catch reporting. A record harvest of over 1.7 million sockeye salmon was driven by a harvest of over 0.9 million in District 104. Pacific Salmon Commission staff estimate that 191,000 Fraser River sockeye salmon, out of a total run of 22.7 million, were intercepted in District 104 in 1993.

Sockeye catches in Southeast Alaska drift gillnet fisheries were over twice the 1960–1992 average. Pink, coho, and chum salmon catches were also well above average. Record gillnet harvests of sockeye salmon were taken in Districts 101, 108, and 111. Exceptionally strong coho salmon catches were again recorded in District 106. Pink catches were well below average in Districts 111 and 115 as a consequence of extremely poor returns of pink salmon to Gastineau Hatchery and weak wild stocks in the area.

The 1993 Yakutat Area set gillnet harvest of about 599,000 salmon was almost twice the 1960 to 1992 average. Sockeye salmon composed 58% of the harvest and coho salmon 40%. Sockeye salmon runs were above average to the Situk-Ahrnklin, Dangerous, and East Rivers, about average to the Alsek and Lost Rivers, and below average to Akwe River. The East River sockeye salmon catch of 189,200 was a new record. Runs of coho salmon were above average to the Tsiu, Situk-Ahrnklin, Lost, and Dangerous Rivers, about average in the Italio and East Rivers, and below average in the Alsek, Akwe, and Kaliakh Rivers. Harvests of coho salmon in the Situk-Ahrnklin (136,900 fish) and Tsiu (56,700 fish) fisheries accounted for 82% of the coho salmon harvest in the Yakutat area.

Prince William Sound

The 1993 Prince William Sound Area commercial salmon harvest of 9.3 million fish was the smallest since 1978. The harvest was composed of 5.8 million pink, 1.9 million sockeye, 1.2 million chum, 0.4 million coho, and 32,000 chinook salmon. The majority of the catch, 6.43 million, was taken in commercial common property fisheries and 2.84 million were sold for hatchery cost recovery and test fisheries.

The Copper and Bering River districts had strong sockeye salmon returns and produced a drift gillnet catch of 1.4 million fish. This catch set a new record, eclipsing the previous record of 1.2 million set in 1991. Escapement for some of the Copper River Delta systems fell short of escapement goals but the upper Copper River goal was exceeded by 317,000 sockeye salmon. The Copper and Bering River coho harvest of 397,000 salmon was below the preseason projection of 434,000 salmon.

Gillnet fisheries in Prince William Sound targeted salmon runs of varied strengths. The chum salmon run to the Wally Noerenberg Hatchery exceeded preseason projections; the commercial harvest, including cost recovery, was 1.1 million fish. Although there was no directed fishery on the Coghill Lake sockeye stock, escapement to the lake was only 8,570 fish, the lowest since statehood. The commercial sockeye harvest from the Eshamy District, including hatchery cost recovery, was 292,000 fish. This is well below preseason expectations. However, sockeye brood stock goals at the Main Bay Hatchery were met, and the Eshamy Lake escapement goal was achieved. In the Unakwik District 14,700 sockeye were harvested.

The Prince William Sound pink salmon harvest of 5.8 million fish was the lowest since 1978. The total pink salmon return, including commercial catches, hatchery cost recovery, hatchery brood stock, and wild stock escapements, was 7.7 million fish. Escapement goals were not met in any district, even though fishing was restricted to areas immediately adjacent to the hatcheries. Escapement goals for wild chum salmon were not achieved in 1993 even though there was no directed fishing on these stocks. The purse seine chum salmon harvest was 9,500 fish, the lowest catch ever recorded.

A preseason agreement between ADF&G, the Valdez Fisheries Development Association (VFDA), and fishermen directed the ADF&G to manage the VFDA pink return for a cost recovery revenue goal of $2.5 million. The pink salmon return to the Solomon Gulch Hatchery was weak. As a result, this revenue goal was not met and there was no common property fishery. The pink salmon brood stock goal was achieved, however.

Prince William Sound Aquaculture Corporation (PWSAC) began collecting pink salmon for corporate escapement in late July and catches were only a fraction of preseason expectations. To ensure pink salmon were not milling in the general waters of Prince William Sound, the Department initiated a purse seine test fish program in late July. Test fish catches did not indicate a large volume of fish entering the Sound. Although PWSAC was behind in cost recovery sales, the Department was obligated to provide a common property fishery. A 24-hour period on August 5 yielded 145,000 pink salmon from the Port San Juan Subdistrict and 53,000 from the Esther Subdistrict. The run peaked several days later than the odd-year average at each hatchery site. Intermittent openings throughout the remainder of the season allowed the common property fishery to harvest a total of 3.5 million pink salmon. PWSAC harvested 1.8 million pink salmon for cost recovery.

The total value of the combined commercial salmon harvest, including hatchery sales, was estimated to be $24.5 million. The drift gillnet catch was valued at $18.8 million, resulting in the average earnings for 514 permits at $36,500. The set gillnet catch was $0.7 million, setting the average earnings of the 30 permits at $22,300. The seine fishery was worth $1.68 million for an average exvessel value of $11,700 for the 144 permit holders that participated this year. Revenue generated for hatchery operations through fish sales was approximately $3.4 million

Cook Inlet

Upper Cook Inlet

The harvest of 5.3 million salmon in 1993 exceeded the long-term annual average harvest by more than a million fish, but was approximately half of the previous season's catch. The drop in the sockeye salmon harvest accompanied by lower overall prices resulted in a preliminary exvessel value of $30.4 million, about a third of the previous year's.

The harvest of 4.7 million sockeye salmon was the seventh highest catch on record, but only half of the 1992 catch. This harvest was nearly double the preseason forecast of 2.5 million and was valued at $28.4 million or 93% of the total value of the fishery. The disparity in sockeye stock strengths between the Susitna and Kenai Rivers was expected to be reduced this year as a substantially diminished return was expected for the Kenai River. Once stocks had separated spatially, management efforts focused on reducing the exploitation of Susitna River stocks while harvesting the Kenai River surplus along the east side of the Central District. Harvest area restrictions and an apparently strong sockeye return to the Susitna River, resulted in an excellent Yentna River escapement of 141,000, close to the upper end of the desired range. Despite an intense east-side fishery, the strong early entry into the Kenai River and the extremely

long duration of modest daily counts resulted in an escapement of 811,000, exceeding the high end of the goal range of 400,000 to 700,000. The Kasilof River sockeye return showed good strength early but tapered off in the latter stages. The resulting escapement of 152,000 only slightly exceeded the minimum goal. The Crescent River return was very poor, and despite a prolonged closure of the fisheries in that area, only 39,000 fish were counted at the sonar site, well below the desired range of 50,000 to 100,000.

A strong, early showing of Fish Creek sockeye salmon in Knik Arm resulted in a harvest of nearly 46,000 sockeye, the highest on record.

The 1993 harvest of 121,000 chum salmon was the lowest on record for Upper Cook Inlet. All local chum stocks were much weaker than normal, following a pattern of poor chum salmon runs throughout much of Alaska. A lack of any directed effort and major restrictions of the drift gillnet fishery produced an average escapement index at the Yentna River site. Chinitna Bay chum stocks were protected by a prolonged closure of the area but escapements remained below desired levels. The chum salmon harvest was valued at $381,000.

The 1993 harvest of 103,000 pink salmon was about average for an odd-year return. In this area, the even-year line of pink salmon are generally the stronger run, and the odd-year line much weaker. In 1993, small numbers of fish and low prices resulted in no directed effort on pink salmon. Escapement levels in the Susitna River were average for an odd-year return. The 1993 pink salmon harvest was valued at just $43,000.

The Upper Cook Inlet coho salmon harvest of 289,000 was slightly below average, and the strength of most runs appeared to be average to slightly above average. The fishing pattern imposed on the driftnet fishery for sockeye management during the peak of the Susitna coho salmon run and closure of the Northern District setnet fishery during the same time, contributed to reducing the exploitation rate of Susitna-bound coho. Freshwater abundance was generally good but not exceptional. Freshwater abundance of the early run of Kenai River coho salmon appeared average, even though the early portion of the run was subjected to intense commercial fishing pressure. Minor stocks of coho throughout the Northern District and the western Central District were generally average in run strength. The exvessel value of the commercial coho salmon harvest was estimated at $1.1 million.

The chinook salmon harvest of 18,700 fish was slightly below the long-term average but roughly equal to the average catch under the present regulatory structure. The Northern District directed chinook salmon fishery suffered from a late opening, poorly timed to tidal cycles, and inclement weather. The harvest of 3,000 chinook salmon was the lowest in the eight-year history of this fishery.

The return of late-run Kenai River chinook salmon was well above average, and throughout the season escapement projections remained well above the level needed to avoid conservation restrictions in either the recreational or the commercial fishery. The final chinook spawning escapement of 32,700 fish was well above the optimum level despite the intense east side setnet fishery, an above average inriver harvest rate, and an extended sport fishery. The estimated exvessel value of the Upper Cook Inlet chinook salmon harvest was $472,000.

Lower Cook Inlet

The total 1993 salmon catch of 1.1 million fish in Lower Cook Inlet (LCI) was nearly double the 1992 harvest but did little to reverse the downward economic trend this fishery has experienced the last four

seasons. The harvest was 88% of the preseason forecast, but low prices resulted in a preliminary exvessel value of only $1.1 million, the lowest since 1976.

Hatchery cost recovery continues to play a significant role in the LCI fishery. Approximately 39% of the total salmon harvest was taken by the Cook Inlet Aquaculture Association (CIAA) to support the sockeye lake stocking program and Tutka Hatchery operations. This was 16% of the total exvessel value of the LCI fishery. Cost recovery harvests of sockeye salmon were expanded this year to include three more special harvest areas. In addition to Chenik Lake and China Poot Bay, harvests were conducted on the enhanced returns to Hazel Lake, Kirschner Lake, and Bear Lake. Hatchery harvests at the five locations were 8.8% of the total LCI sockeye landings, and cost recovery pink salmon catches in the Tutka Bay Subdistrict made up 47% of the total LCI pink harvest.

The total sockeye harvest of 231,000 was 19% less than the preseason projection of 284,000 fish and just slightly less than the 1983–92 LCI average. Sockeye salmon only accounted for 20% of the landings in 1993 but still composed 70% of the total value of the LCI fishery. Once again, most of this year's sockeye catch came from enhancement projects. Enhanced sockeye returns generally exceeded preseason expectations, but these had been adjusted downward to reflect recent production trends. Returns to Chenik Lake, Leisure Lake, Hazel Lake, and Kirschner Lake exceeded preseason forecasts, but the returns to Bear Lake and Bruin Lake failed to materialize.

Natural sockeye production once again fell short of expectations. The sockeye salmon run to Mikfik Creek in the Kamishak Bay District was very weak with less than 1,000 fish harvested and an estimated escapement of 6,350 fish. Sockeye runs to Delight/Desire Lakes in East Nuka and Aialik Lake in the Eastern District were again weak although escapement goals were achieved. A small surplus at Desire Lake allowed the harvest of 3,500 fish.

Sockeye returns to the English Bay Lake system were monitored again with a weir operated by North Pacific Rim, Inc. Complete closures of the commercial and sport fisheries, and a lengthy closure of the subsistence fishery during the sockeye migration resulted in a total escapement of 8,940 fish, nearly equal to the most recent 10-year average for this system.

Pink salmon composed 78% of the LCI harvest. The catch of 867,000 pink salmon exceeded the recent 10-year average but was 11% less than the preseason forecast. Returns to the Southern District were notably weaker than those in the Outer and Kamishak Bay Districts, although hatchery fish apparently experienced better survival than did the wild stocks. Tutka Hatchery returns, projected to produce 524,000 pink salmon from Tutka Bay and a secondary fry release site, Halibut Cove Lagoon, contributed 638,000 fish to the LCI catch this season. However, cost recovery harvests made up the bulk of the landings (409,000 fish), and after another 110,000 were taken for brood stock, only 121,000 fish were harvested by the common property fishery.

Outer District pink returns were only fair, with a total catch of 159,000 fish. Only 27,000 fish were landed from the Port Dick Subdistrict, which typically accounts for the bulk of the pink salmon production in that district. On a positive note, Nuka Island, Windy Bay, and Rocky River, three systems with historically weak returns, experienced relatively strong runs this season, and escapement goals were actually exceeded in those systems.

In the Eastern District many fishermen anticipated good catches in the Aialik Subdistrict for a third straight year, after learning that Prince William Sound pink salmon are often intercepted in the area. However, the harvest of 9,900 pink salmon proved to be insignificant, presumably due to the weak return to Prince William Sound.

Pink salmon abundance in the Kamishak Bay District exhibited the same weak pattern as that was observed in the other districts, producing a cumulative harvest of only 4,200 this season. Poor prices again discouraged the fleet from targeting pink salmon in the Kamishak Bay District. This served to protect the weak runs, as pink salmon escapement goals were achieved or exceeded in most systems.

The chum salmon harvest of 4,300 fish was the lowest ever recorded in LCI. The catch was only 4% of the long-term average and continued a dramatic decline in the LCI chum harvest for a fifth straight year. Although weak chum salmon runs were apparently a statewide phenomenon, the poor return to LCI was particularly disappointing in that a strong 5-year age class was anticipated. Lengthy closures were necessary in the Outer and Kamishak Bay Districts to protect chum salmon. As a result, maintenance level escapements were achieved, although some west-side systems still fell below desired levels.

The preliminary coho harvest was 6,000. Based on catch-per-unit effort information from the Kachemak Bay personal use setnet fishery, natural coho runs in the Southern District appeared to be weak, as well as late by about 10–14 days. Since the personal use fishery lasted only one week, the delayed run timing apparently helped bolster escapement into the Fox River drainage where aerial surveys produced another relatively strong index in Clearwater Slough.

The chinook salmon harvest was 2,200 fish. This exceeded the highest catch on record, again due to enhanced production in Halibut Cove Lagoon and Seldovia Bay. The catch was equally split between set gillnet and purse seine gear.

Bristol Bay

The 1993 Bristol Bay total salmon harvest was 41.7 million fish. Sockeye salmon made up 40.8 million of that total, the largest sockeye harvest on record, exceeding the previous high harvest of 37.4 million in 1983. The estimated exvessel value of the 1993 Bristol Bay salmon fisheries totaled $154.4 million, the fifth largest exvessel value on record but well below the $202.3 million record value of 1990. It was above the 1973–1992 average value of $102.9 million. The 1993 figure should be viewed as a minimum estimate because the final exvessel value will reflect future price adjustments, loyalty bonuses, and other compensation.

The 1993 inshore sockeye run exceeded the preseason forecast by 10.3 million fish. Sockeye runs were larger than anticipated in all districts, except the Naknek-Kvichak. All rivers except the Kvichak met or exceeded escapement point goals. The Kvichak River escapement of 4.02 million sockeye salmon did not meet the point goal of 5.0 million but fell within the escapement goal range. The Naknek, Branch, Egegik, Ugashik, and Igushik Rivers all exceeded escapement point goals by substantial margins.

The Egegik District sockeye harvest of approximately 21.8 million fish is a new record for that district, exceeding the previous high of 15.7 million set in 1992. A new peak bay-wide, single-day sockeye salmon harvest record was also set this year when approximately 5.3 million fish were landed on July 2. And, another record was set when 1,044 drift gillnet vessels registered to fish in the Egegik District on June 25.

The commercial chinook harvest was approximately 85,000 fish, well below the 1973–1992 average harvest of 108,000, but an improvement over the 69,000-fish harvest of 1992. This marks the eighth consecutive year that commercial chinook harvests from Bristol Bay have been below average. Catches were below average in all districts except the Naknek-Kvichak. Chinook escapements were variable by system; however, escapement objectives were reached for most districts except the Ugashik District.

The total chum harvest in Bristol Bay of 724,000 fish was the smallest since 1975 and well below the 20-year average of 1.2 million. Except in the Ugashik District where a slightly above-average harvest was taken, all other districts produced catches well below the 1973–1992 averages. Escapements in all districts appeared to be well below normal levels.

The pink harvest was less than 1,000 fish, normal for an odd-year return. Pink salmon return in strength to Bristol Bay only during even-numbered years.

The 1993 coho salmon harvest totaled 72,000 fish, less than half the 1973–1992 average harvest of 196,000. Harvests were so poor in three districts that they were closed to the commercial harvest of coho salmon early in the season. A reduced fishing schedule was in effect for the Togiak District until late in the season, and then the district was closed. The Egegik District was the exception to this trend in the Bay, yielding a harvest of approximately 41,000 fish, versus the recent 10-year average harvest of 43,000 fish. The Nushagak sonar counter was operated at Portage Creek through August 25, and the coho escapement was estimated at 43,000 fish. This was less than half the desired inriver point goal of 100,000 fish. Because the Nushagak coho run was well below desired levels, the sport fishery and even the subsistence fishery were closed to the taking of coho salmon. This was the first closure of a subsistence salmon fishery in the Bristol Bay area.

Kuskokwim

The total commercial salmon catch of 975,000 salmon for the Kuskokwim Area was composed of 26,600 chinook (38% of the recent ten year average), 167,000 sockeye (above average), 94,900 chum (82% below average), 71 pink, and 687,000 coho salmon (the fourth highest on record).

The preliminary exvessel value was estimated at $4.0 million, 28% below the recent 10-year average. The 1993 chinook salmon price of $0.62 per pound was well below the $0.80 average. Sockeye salmon prices of $0.70 per pound were $0.14 below average. Coho salmon prices were $0.05 below average at $0.58 per pound. Chum salmon prices increased to $0.40 per pound, $0.08 higher than 1992 prices and higher than the average of $0.28 for Kuskokwim fishermen in recent years. The average price of pink salmon was $0.25 per pound, $0.17 above average.

Three of the five species had below-average weights in 1993. Chinook salmon averaged 14.3 pounds, well below the recent 10-year average of 16.0 pounds. Chum and coho salmon both weighed in at an average of 6.6 pounds, 0.4 pounds below the 7.0 pound average for the fishery. The average weight of sockeye salmon at 7.1 pounds and pink salmon at 3.4 pounds equaled the historical average.

Commercial salmon fisheries occur in four districts in the Kuskokwim Area: two within the Kuskokwim River, one in the coastal waters near the village of Quinhagak, and one inside Goodnews Bay.

The total salmon catch in the Kuskokwim River was 8,710 chinook, 27,000 sockeye, 611,000 coho, 64 pink, and 42,700 chum salmon. The coho salmon catch was 107,000 fish above average, the fourth largest harvest in the history of the fishery. Due to the extremely weak return of both 4- and 5-year-old chum salmon, there was only one commercial opening prior to the coho season. As a result, the chum salmon catch was 91%, chinook 78%, and sockeye 69% below average. The total catch of 689,000 fish was 40% below average for the river fishery.

In the Kuskokwim Bay Quinhagak District fishery, the chinook salmon catch of 15,800 fish was 36% below average. In the Goodnews Bay District, the chinook harvest of 2,120 fish was 58% below the recent average catch.

The Quinhagak District sockeye salmon catch of 80,900 fish was the second highest on record, twice the average catch. The Goodnews Bay District harvest of 59,300 sockeye salmon was a record and also greater than twice the average catch.

In the Quinhagak District, the coho salmon harvest was 55,800, which is about average. The coho salmon catch of 20,000 was below average in the Goodnews Bay District. This is the fourth consecutive year of poor coho salmon catches in the Goodnews Bay District.

No pink salmon were sold in the Goodnews Bay District, although 7 pink salmon were landed in the Quinhagak District.

The Quinhagak District chum salmon catch of 41,000 fish was slightly above average. The Goodnews Bay chum catch was 29% below average with 10,700 fish landed.

Yukon Area

The 1993 Yukon Area commercial harvest was 234,000 salmon. Sales were composed of 93,500 chinook and 96,500 summer chum salmon sold in-the-round. In addition, fishermen sold 2,000 pounds of chinook roe and 23,000 pounds of summer chum salmon roe. The total estimated commercial salmon harvest, including the estimated harvest to produce the roe sold, was 94,000 chinook and 140,000 summer chum salmon. The 1993 estimated chinook catch was 11% below the recent 5-year average of 105,000 fish and the lowest harvest since 1976. The summer chum catch was 85% below the recent 5-year average of 957,000 fish and the lowest since 1972. The decreasing trend in commercial summer chum harvests since 1990 continued in 1993. No commercial fishing was allowed for fall chum and coho salmon in 1993. The exvessel value of the salmon fishery was an estimated $5.4 million, approximately one-half the recent 5-year average of $10.2 million.

Lower Yukon River fishermen harvested 88,000 chinook and 93,000 summer chum salmon. The estimated average price per pound was $2.70 for chinook and $0.38 for summer chum salmon. The exvessel value of the Lower Yukon Area fishery was $5.1 million. A total of 682 fishermen participated in the 1993 lower river fishery.

The commercial salmon harvest in the Upper Yukon Area, including the estimated harvest to produce roe sold, was 6,000 chinook and 47,000 summer chum salmon. Estimated average prices per pound in the Upper Yukon Area were $1.06 for chinook salmon, $5.52 for chinook roe, $0.35 for summer chum salmon, and $8.53 for summer chum roe. The exvessel value of the Upper Yukon Area fishery was $0.3 million. A total of 143 fishermen participated in the 1993 upper river fishery.

The 1993 chinook run was slightly larger than expected. Chinook salmon escapement objectives for all surveyed index streams in the Alaskan portion of the drainage and the stabilization escapement goal for the Canadian portion of the mainstem Yukon were achieved.

The Yukon River chum runs were much smaller than expected primarily because of the poor return of 4-year-old fish. Postseason analysis revealed that the summer chum and fall chum salmon runs were only half as large as projected. In order to provide for summer chum escapement and subsistence needs, commercial fishing time targeting summer chum salmon was very limited. Because of the poor fall chum salmon run, commercial fishing was not allowed, and in mid-August subsistence salmon fishing was restricted to 48-hours per week and sport and personal use fisheries were closed. Subsistence fishing for fall chum salmon was closed throughout the Yukon Area on September 3 when it became apparent that escapement goals would not be met.

Only two chum salmon escapement goals were achieved in 1993, the Anvik and Delta Rivers. The fall chum passage estimate at the Pilot Station sonar site was the lowest on record, only 40% of the preseason projected run size. Escapements to other summer and fall chum spawning areas were very disappointing with escapements well below escapement objectives.

The 1993 coho salmon run to the Yukon River appeared to below average to average in abundance. The only spawning escapement objective identified in the drainage was achieved.

Norton Sound

The 1993 Norton Sound commercial salmon harvest of 264,000 fish was composed of 9,000 chinook, 279 sockeye, 43,300 coho, 158,000 pink, and 53,600 chum salmon. The chinook harvest was 53% above the previous 5-year average (1988-1992) and 11% above the previous 10-year average (1983-1992). The coho harvest was 43% below the previous 5-year average and 10% above the previous 10-year average. The pink salmon harvest, which is seldom a directed fishery, was 864% above the previous 5-yearaverage and 385% above the previous 10-year average. The chum salmon harvest was 31% and 57% below the previous 5- and 10-year averages, respectively.

A total of 153 permit holders made landings in 1993. Fishing effort was higher than recent years because of the increased market interest in Norton Sound pink salmon. Commercial fishermen received approximately $322,000 for their catch in 1993. These earnings rank as the lowest exvessel value since 1976 and were 35% below the previous 5-year average of $492,000. This low exvessel value is attributed to poor salmon returns, the lack of competitive markets, and low prices paid per pound for all salmon species.

Kotzebue

The 1993 commercial harvest in the Kotzebue District was 71,100 chum salmon and 55 chinook salmon. This was the lowest commercial catch since 1969 and was less than half of the preseason projection. This catch was 23% of the 14-year (1979–1992) average of 306,000. Only 114 permits fished this year, the lowest number of participants since 1972. This low fishing effort is largely attributed to local employment opportunities in the construction industry, although salmon prices were higher than in recent years.

The total exvessel value was $231,000 or an average of $2,000 for each participating permit holder. Four buyers participated in the fishery this year. The entire harvest was iced in the round and flown out of the area for processing.

Only 7 out of the normal 15 openings were fished for a total of 168 hours of fishing in 1993. This was the lowest number of hours since 1962 and was 31% of the recent 14-year (1979–1992) average of 529 hours. Although catch rates were average or above average at the beginning of the season, they quickly dropped to below average. The age composition of the catch reflected low numbers of 4-year-old fish. Because 4-year-old fish make up approximately 65 percent of the run, closures were necessary to attain escapement goals.

The 1993 expected return of 60,000 Sikusuilaq Hatchery chum salmon failed to materialize. By mid-August managers had revised their assessment of the hatchery run and were calling for roughly one-half of the earlier estimate. Because of the early closure of the commercial fishery, only an estimated 4,000 of the expected 30,000 run of hatchery-produced chum salmon had been harvested. At that time, Department biologists expected the hatchery stocks migrating into the river to be far in excess of the brood stock requirements. To deal with this the lower Noatuk River was opened for a special fishery to harvest the surplus fish. The Northwest Arctic Borough solicited bids from interested processors, with the proceeds to be distributed evenly between all participants in the 1993 commercial fishery. However, only 2,300 chum salmon were sold, and approximately 20% of the harvest was wild stock chum salmon. In all, the hatchery return was probably near 20,000 chum salmon.

Kodiak

The 1993 Kodiak commercial salmon harvest of 39.3 million set a new record, shattering the previous high of 23.7 million set in 1991. This year's harvest included 4.38 million sockeye salmon, the fourth largest on record. Preseason expectations were for a 2.2 million sockeye catch.

The pink salmon harvest of 34.0 million fish established a new record harvest by almost doubling the previous high catch of 17.3 million fish in 1980. Preseason expectations were for a 21.6 million catch. Thirty-seven percent (12.1 million) of the harvest was taken in fisheries targeting pink salmon returning to the Kitoi Bay Hatchery.

The chum salmon harvest of 588,000 fish was about half the preseason harvest expectations of 1.2 million. This was the lowest chum harvest since 1985 and well below the recent 10-year average harvest of 853,000.

A total of 313,000 coho salmon were also harvested this season, ranking as the third largest on record. Preseason expectations were for a 290,000 coho catch.

Chinook salmon are harvested incidentally during directed sockeye and pink salmon fisheries. A total of 42,200 chinook salmon were harvested this year surpassing the preseason harvest expectations of 21,000 fish and the previous record harvest of 24,300 chinook salmon set in 1992.

Although record numbers of salmon were harvested in 1993, the estimated exvessel value of the salmon harvest was $33.0 million, $7.0 million less than last year and well below the record $104 million value of 1988. By species, the sockeye harvest was worth $17.9 million (55%), chum salmon $880,000 (2.0%), pink salmon $12.8 million (39%), coho salmon $1.1 million (3%), and chinook salmon $252,000 (1.0%).

Five hundred and nine permit holders participated in the 1993 fishery, making a record 21,600 deliveries. By gear type, a total of 9 beach seines, 176 set gillnet, and 324 purse seine permit holders fished. Beach seiners averaged $6,400 per permit holder, purse seiners, $79,000, and set gillnetters, $41,100.

Escapement goals for all species except chum salmon were generally met or exceeded. The indexed chum salmon escapement of 234,000 fish was about 50% below the low end of the indexed escapement goal of 0.5 million fish.

Chignik

The 1993 Chignik salmon fishery harvested 4.15 million salmon including 1.70 million sockeye salmon. Although the season opened June 10, fishermen were on strike for higher prices until June 19. The exvessel value of salmon harvested within the Chignik Management Area was estimated at $9.9 million, considerably less than the recent 20-year average of $14.9 million.

There is an overlap in the run timing of Black Lake (first run) and Chignik Lake (second run) sockeye salmon stocks returning to the Chignik system. Assessing the strength of the second run is the primary management objective during the transition period of June 26 to July 9. A major indicator of the transition from first-run to second-run stocks is the age composition of the commercial harvest. Typically, the first run is dominated by age-1.3 and -1.2 fish, whereas the second run is composed of primarily age-2.3 and -2.2 fish. In 1993, the transition occurred about July 4. Management priority shifted to second-run fish on July 7. The harvest for June 17 through July 7 (first run) was 902,000 sockeye salmon.

Escapement goals for both run segments were achieved in 1993. The first run escapement was approximately 370,000 sockeye salmon, and the preliminary estimate for the second run was 245,000 fish.

The 1993 chinook salmon harvest of 20,000 fish was the highest since statehood. The catch was well above the 5,000 fish harvest prediction. The escapement totaled a minimum of 1,950 fish (chinook greater than 650 mm in length), excluding inriver sport and subsistence harvests.

At 1.65 million pink salmon, this year's catch was above the 1.30 million projected harvest. More pink salmon could have been harvested, but fishermen targeted sockeye salmon instead of pink salmon because of low pink salmon prices. Total pink escapement for the Chignik Management Area was approximately 1.18 million fish.

The 1993 chum salmon catch was 122,000 fish, considerably below the projected catch of 213,000. The low harvest was consistent with other low chum salmon harvests across the state. Total chum escapement for the Chignik Management Area was approximately 225,000.

The 1993 Chignik Area coho salmon harvest totaled 230,000 fish. This was about 61,000 fish more than the harvest projection of 169,000 salmon. Fishing for coho salmon continued through September 15. No estimates of coho escapement in the Chignik Lakes system are available because the weir was removed prior to start of the coho run.

Alaska Peninsula - Aleutian Islands

In 1993 the South Unimak-Shumagin Islands (False Pass) June fishery was allocated 2.9 million sockeye salmon provided the incidental catch of chum salmon did not exceed 700,000 fish. By June 22, the combined South Unimak-Shumagin Islands harvest was 2.6 million sockeye and 409,000 chum salmon. At 6.3:1, this was considered a high sockeye to chum ratio. However, the chum salmon abundance dramatically increased in the Shumagin islands on June 26 when 37,800 chum salmon and 64,500 sockeye salmon were harvested for a sockeye to chum ratio of only 1.7:1. The ratio was again 1.7:1 on June 28, the last fishing period in the Shumagin Islands during June. At South Unimak weather prevented fishing in most of the fishery during June 26-27. The majority of the boats that arrived at Cape Lutke during June 27 departed after discovering an abundance of chum salmon. Catches were small during the last fishing period at South Unimak on June 29, and the sockeye to chum salmon ratio was only 1.3:1. The total South Unimak-Shumagin Island sockeye catch was 3.0 million; the chum salmon catch of 532,000 was 168,000 under the established limit.

The South Peninsula post-June harvest of 9.58 million pink salmon was the third largest in the previous 50 years, exceeded only by the 1984 and 1991 harvests. The indexed total escapement of 2.99 million was within the target range of 1.87 to 3.72 million. Pink salmon escapement goals were met or exceeded in all South Peninsula districts.

The post-June South Peninsula harvest of 472,000 chum salmon was slightly less than half of the recent 10-year average. It was the smallest post-June chum harvest since 1979. District chum salmon escapement goals were reached in all South Peninsula districts except the Southeastern District. The total South Peninsula coho catch was 212,000. Of the total, 1,000 coho salmon were caught during June, 121,000 in July, 75,000 in August, and 15,000 in September. The total harvest was well below the recent 10-year average of 306,000

The South Peninsula indexed total sockeye escapement was estimated at 100,000, within the desired range of 68,000 to 136,000. This was above the recent 10-year average of 73,000.

No fishing occurred in the Aleutian Islands Management Area during 1993. Unalaska Island, where most fishing occurs, normally produces large salmon runs only during even-numbered years. Pink salmon runs were also very weak at Atka where set gillnet fishermen harvested only 9 sockeye, 4 coho, 110 pink, and 523 chum salmon.

The North Peninsula sockeye salmon harvest of 3.87 million fish set a new harvest record. The previous record was 3.58 million sockeye salmon set in 1992. The recent 10-year average is 2.17 million. The area between Port Moller and Strogonof Point accounted for most of the harvest this year. The North Peninsula sockeye salmon escapement goals were met in all systems.

The chum salmon harvest on the North Peninsula totaled 130,000 fish. This was far below the previous 10-year average of 367,000 and was the second lowest chum salmon harvest since 1979. The indexed total escapement of 402,000 was strong in some systems while weak in others.

The North Peninsula coho salmon harvest totaled 61,000 fish. This was the lowest harvest since 1977 and was only one-third of the recent 10-year average of 186,000 fish. Because of funding limitations and fall survey conditions, very little coho escapement information was collected.

The chinook salmon harvest along the North Peninsula was much stronger than anticipated. The harvest of 24,000 fish was well above the previous 10-year average of 16,400 and was the largest North Peninsula chinook salmon harvest since 1983. The indexed total escapement of 13,700 chinook salmon was slightly above the previous 10-year average of 11,600 fish.

PRELIMINARY FORECASTS OF 1994 SALMON RUNS TO SELECTED ALASKA FISHERIES

The Alaska Department of Fish and Game prepares forecasts for salmon runs that affect the major fisheries around the state. Salmon runs to be forecasted are selected using several criteria, including economic importance, feasibility, compatibility with existing programs, and management needs. For the 1994 fishing year, forecast fisheries are as follows:

Southeast	-	pink salmon
Prince William Sound	-	pink, chum, sockeye, coho, and chinook salmon
Copper River	-	sockeye and chinook salmon
Upper Cook Inlet	-	sockeye salmon
Lower Cook Inlet	-	pink salmon
Kodiak	-	pink salmon
Ayakulik River	-	sockeye salmon
Upper Station Lakes	-	sockeye salmon
Frazer Lake	-	sockeye salmon
Karluk Lake	-	sockeye salmon
Chignik	-	sockeye salmon
Bristol Bay	-	sockeye and chinook salmon

A variety of information was used to make salmon run forecasts. In most cases the principal indicator of future abundance is the escapement magnitudes of the parental stocks. Other information that might have been considered includes spawning stock distribution, egg deposition, survival to intermediate life stages, environmental conditions, and historical age composition. A range of run possibilities are predicted for

each forecasted fishery. In general, based on past experience, the actual run can be expected to fall within the range (between the lower and upper limits) less than half the time.

Please see the appendices for further details. Table 8 provides run forecast, harvest projection, and forecast ranges for all runs with a formal forecast in 1994. The 1993 forecast, together with information on forecast accuracy for 1993, is provided in Table 9.

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Table 1. Preliminary projections of 1994 Alaska commercial salmon harvests by fishing area and species, in units of thousands of fish.

	SPECIES					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeast Region	278 1/	1,960	2,600	47,000	3,700	55,500
Cordova Area	44	1,180	590	24,100	1,090	27,004
Upper Cook Inlet	15	2,000	400	600	250	3,265
Lower Cook Inlet	1	272	13	595	111	992
Bristol Bay Area	76	39,600	157	1,140	1,040	42,013
Central Region	136	43,000	1,160	26,400	2,490	73,200
Kodiak Area	25	2,430	325	13,700	610	17,090
Chignik	7	1,900	200	1,300	200	3,607
South Peninsula	10	4,000	300	7,000	1,600	12,910
North Peninsula	16	2,500	200	100	250	3,066
Aleutian Islands	0	5	0	300	0	305
Westward Region	58	10,830	1,020	22,400	2,660	36,900
A.Y.K. Region	156	134	625	553	600	2,060
TOTAL ALASKA	**628**	**55,900**	**5,410**	**96,300**	**9,450**	**167,000**

1/ Based on the 1984-1993 average harvest. The harvest quota for 1994 has yet to be set by the Alaska Board of Fisheries and the Pacific Salmon Commission.

Columns do not total exactly due to rounding

Revised Janurary 6, 1994

See Tables 4,5,6, and 7 for definition of management regions

Table 2. Preliminary projections of 1994 Alaska commercial salmon harvests by statistical region and species, in units of thousands of fish.

	SPECIES					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeast Statistical Region	278 1/	1,960	2,600	47,000	3,700	55,500
Cordova Area	44	1,180	590	24,100	1,090	27,004
Upper Cook Inlet	15	2,000	400	600	250	3,265
Lower Cook Inlet	1	272	13	595	111	992
Kodiak Area	25	2,430	325	13,700	610	17,090
Chignik	7	1,900	200	1,300	200	3,607
South Peninsula	10	4,000	300	7,000	1,600	12,910
Central Statistcial Region	102	11,700	1,820	47,200	3,860	64,800
North Peninsula	16	2,500	200	100	250	3,066
Aleutian Islands	0	5	0	300	0	305
Bristol Bay Area	76	39,600	157	1,140	1,040	42,013
A.Y.K. Region	156	134	625	553	600	2,067
Western Statistical Region	248	42,200	980	2,090	1,890	47,400
TOTAL ALASKA	**628**	**55,900**	**5,410**	**96,300**	**9,450**	**167,000**

1/ Based on the 1984-1993 average harvest. The harvest quota for 1994 has yet to be set by the Alaska Board of Fisheries and the Pacific Salmon Commission.

Columns do not total exactly due to rounding.

Revised Janurary 6, 1994

See Tables 4,5,6, and 7 for definition of management regions

Table 3. Preliminary 1993 Alaska commercial salmon harvests by fishing area and species, in thousands of fish.

	SPECIES					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeast Region	281	3,190	3,650	57,200	7,870	72,200
Prince William Sound	32	1,850	446	5,760	1,190	9,280
Upper Cook Inlet	19	4,730	289	103	121	5,260
Lower Cook Inlet	2	231	6	867	4	1,110
Bristol Bay	85	40,800	72	1	724	41,700
Central Region	138	47,600	812	6,730	2,040	57,300
Kodiak Area	42	4,380	313	34,000	588	39,300
Chignik	20	1,700	230	1,650	122	3,720
South Peninsula	14	3,650	212	9,670	1,000	14,500
North Peninsula	24	3,870	61	6	130	4,090
Aleutian Islands	0	0	0	0	1	1
Westward Region	100	13,600	816	45,300	1,840	61,700
AYK Region	129	167	730	158	360	1,543
TOTAL ALASKA	**648**	**65,000**	**6,010**	**109,000**	**12,100**	**193,000**

Columns do not total exactly due to rounding.

Revised March 22, 1994

Table 4. Preliminary 1993 Southeast Alaska commercial salmon harvests by fishing area and species, in thousands of fish.

	SPECIES					
Fishing Area	Chinook 1/	Sockeye	Coho	Pink	Chum	Total
Tree Point Drift Gillnet	1	394	32	481	383	1,290
Prince of Wales Gillnet	1	206	231	538	135	1,110
Stikine River Gillnet	2	77	14	40	23	155
Southern Districts Seine	6	1,530	358	36,400	1,560	39,900
Annette Island Fisheries	1	95	33	1,520	75	1,730
Southern Southeast Total	10	2,300	668	39,029	2,180	44,190
Taku-Snettisham Gillnet	7	172	65	17	166	427
Lynn Canal Gillnet	1	173	60	11	307	552
Yakutat Set Net	1	346	237	10	4	599
Northern Districts Seine	1	148	101	14,900	1,070	16,200
Northern Southeast Total	9	839	464	14,900	1,550	17,800
Southeast Troll 2/	227	25	2,390	903	526	4,070
Hatchery Terminal Area Fisheries						
Gillnet	7	0	14	0	388	410
Seine	2	17	13	2,100	1,970	4,100
Private Hatchery Fishery	24	8	97	294	1,250	1,672
Miscellaneous	2	5	2	27	10	46
SOUTHEAST REGION	281	3,190	3,650	57,200	7,870	72,200

1/ Excludes catch of four thousand small (<21") chinook salmon harvested by purse seine gear.

2/ Includes chinook salmon caught by troll gear from October 11, 1992 to September 30, 1993.

3/ Includes salmon that were confiscated, caught sport fish derbies, or commercial test fisheries and sold.

Columns do not total exactly due to rounding

Compiled January 16, 1994

Table 5. Preliminary 1993 Central Region, Alaska, commercial salmon harvests by fishing area and species, in thousands of fish.

	SPECIES					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Bering River	0	34	116	0	0	150
Copper River	30	1,400	281	10	13	1,730
PWS General	0	28	4	2,880	6	2,920
PWS Hatcheries	1	114	3	2,210	475	2,810
Coghill District /1	1	73	40	494	639	1,250
Unakwik District /1	0	15	0	7	1	22
Eshamy District	0	183	2	131	47	362
PWS Miscellaneous /2	0	7	0	26	5	38
Prince William Sound	32	1,850	446	5,760	1,190	9,280
Southern District	2	157	4	693	3	858
Kamishak District	0	68	0	4	1	73
Outer District	0	5	0	159	1	165
Eastern District	0	2	2	11	0	14
Lower Cook Inlet	2	231	6	867	4	1,110
Central District	15	4,580	191	93	96	4,980
Northern District	3	145	97	10	25	281
Upper Cook Inlet	19	4,730	289	103	121	5,260
Naknek-Kvichak	7	8,870	2	0	39	8,910
Nushagak District	62	5,330	14	0	415	5,820
Egegik District	1	21,800	41	0	49	21,900
Ugashik District	3	4,290	2	0	68	4,360
Togiak District	12	543	13	0	153	721
Bristol Bay Total	85	40,800	72	1	724	41,700
CENTRAL REGION	138	47,600	812	6,731	2,040	57,300

/1 Includes both seine and gillnet catches.

/2 Educational permits, confiscated fish, test fish, etc.

Columns do not total exactly due to rounding

Revised January 17,1994

Table 6. Preliminary 1993 Westward Region, Alaska, commercial salmon harvests by fishing area and species, in thousands of fish.

	SPECIES					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Kodiak Area	42	4,380	313	34,000	588	39,300
Chignik Areas	20	1,700	230	1,650	122	4,150
South Peninsula	14	3,650	212	9,670	1,000	14,500
North Peninsula	24	3,870	61	6	130	4,090
Alaska Peninsula Total	38	7,520	273	9,670	1,130	18,600
Aleutian Islands	0	0	0	0	1	1
WESTWARD REGION	100	13,600	816	45,300	1,840	62,100

Columns do not total exactly due to rounding

Updated March 22, 1994

Table 7. Preliminary 1993 Arctic-Yukon-Kuskokwim Region, Alaska, commercial salmon harvests by fishing area and species, in thousands of fish.

	SPECIES					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Kuskokwim River	9	27	611	0	43	689
Kuskokwim Bay	18	140	76	0	52	286
Kuskokwim Area Total	27	167	687	0	95	975
Lower Yukon River	88	0	0	0	93	181
Upper Yukon River 1/	6	0	0	0	47	53
Yukon River Total	94	0	0	0	140	234
Norton Sound	9	0	43	158	54	264
Kotzebue Area	0	0	0	0	71	71
AYK REGION	129	167	730	158	360	1,543

1/ The Upper Yukon River catch includes the estimated harvest to produce roe sold.

Columns do not total exactly due to rounding

Updated March 22, 1994

Table 8. Preliminary forecasts of salmon runs and commercial harvests of some Alaskan fisheries in 1994, expressed in units of millions of fish.

Area	Species	Forecast Run	Escapement Goal	Forecast Harvest	Forecast Run Range
Southeast	Pink	77	31	46	38 - 57
S.E. Hatchery	Pink	1.2	0.2	0.9	
		78.2	31.2	46.9	
Prince William Sound	Pink	26.7	2.6	24.1	15.9 -- 38.7
	Chum	1.46	0.37	1.09	1.03 -- 2.20
	Sockeye	0.566	0.071	0.495	0.356 -- 0.846
	Coho	0.161	0.003	0.158	0.041 -- 0.284
	Chinook	0.0093	0.0004	0.0089	0.0023 -- 0.0162
Copper River	Sockeye	1.35	0.67	0.68	0.75 -- 0.194
	Chinook	0.0496	0.0150	0.0346	0.0279 -- 0.0714
Upper Cook Inlet 1/	Sockeye	3.3	1.3	2.0	0.0 -- 8.5
Lower Cook Inlet	Pink	1.00	0.40	0.60	0.44 -- 2.09
Kodiak	Pink	17.9	4.2	13.7	16.4 - 22.0
Upper Station, Early	Sockeye	0.120	0.060	0.060	0.090 -- 0.170
Upper Station, Late	Sockeye	0.425	0.175	0.250	0.300 -- 0.550
Frazer Lake	Sockeye	0.700	0.175	0.525	0.500 -- 0.900
Ayakulik River	Sockeye	0.425	0.250	0.175	0.275 - 0.575
Karluk, Early	Sockeye	0.600	0.200	0.400	0.500 -- 0.700
Karluk, Late	Sockeye	0.650	0.475	0.175	0.400 0.900
Chignik 2/	Sockeye	3.10	0.65	2.45	2.14 -- 4.00
Bristol Bay 3/	Sockeye	56.0	12.8	43.2	41.3 -- 70.7
Nushagak	Chinook	0.151	0.075	0.076	0.113 -- 0.188
Total		193	56	137	

Updated April 1, 1994.

1/ Escapement goal reflects an anticipated 0.04 million escapement shortfall.

2/ Includes intercepted Chignik bound salmon.

3/ Bristol Bay harvest includes 2.4 million South Peninsula quota.

Table 9. Comparison of actual and forecast 1993 salmon runs, with errors and relative errors for some major Alaskan salmon fisheries, in millions of fish.

Area	Species	1993 Estimated Run 1/	1993 Escape-ment	1993 Harvest	Forecast Run	Forecast Harvest	Error 2/	Relative Error 3/
Southeast Total	Pinks	89.2	32.0	57.2	84.1	53.2	-5.10	-5.7%
Prince William Sound	Pinks	6.8	1.07	5.8	27.6	25.2	20.8	304.1%
	Chums	1.32	0.13	1.19	1.00	0.658	-0.32	-24.2%
	Sockeye	0.843	0.0714	0.412	0.854	0.783	0.011	1.3%
	Coho	0.162	0.005	0.157	0.299	0.295	0.137	84.6%
	Chinook	0.00258	0.00048	0.0021	0.0033	0.0029	0.001	26.7%
Prince William Sound	Sockeye	0.334	0.070	0.264	0.854	0.783	0.520	155.7%
Copper River	Sockeye	2.34	0.84	1.50	1.62	0.92	-0.71	-30.5%
	Chinook	0.058	0.021	0.037	0.042	0.027	-0.016	-27.6%
Upper Cook Inlet	Sockeye	6.5	1.8	4.7	4	2.50	-2.53	-38.7%
Lower Cook Inlet	Pinks	1.64	0.77	0.87	1.40	0.86	-0.24	-14.5%
Kodiak	Pinks	38.3	4.30	34.00	24.9	21.6	-13.400	-35.0%
Upper Station, Early	Sockeye	0.087	0.035	0.052	0.098	0.0355	0.011	12.6%
Upper Station, Late	Sockeye	0.445	0.187	0.258	0.585	0.41	0.140	31.5%
Frazer	Sockeye	0.75	0.198	0.552	0.43	0.26	-0.320	-42.7%
Ayakulik	Sockeye	0.639	0.286	0.353	0.48	0.130	-0.159	-24.9%
Chignik	Sockeye	2.40	0.70	1.70	2.59	1.94	0.192	8.0%
Bristol Bay	Sockeye	55.1	11.4	43.7	44.7	34.9	-10.400	-18.9%
Nushagak	Chinook	0.218	0.138	0.080	0.138	0.063	-0.080	-36.7%
Total		207.2	54.0	152.8	195.7	144.5		

Updated April 1, 1994.

1/ Run is Harvest plus Escapement

2/ Error is Forecast Run minus Run

3/ Relative Error is Error divided by Run times 100%

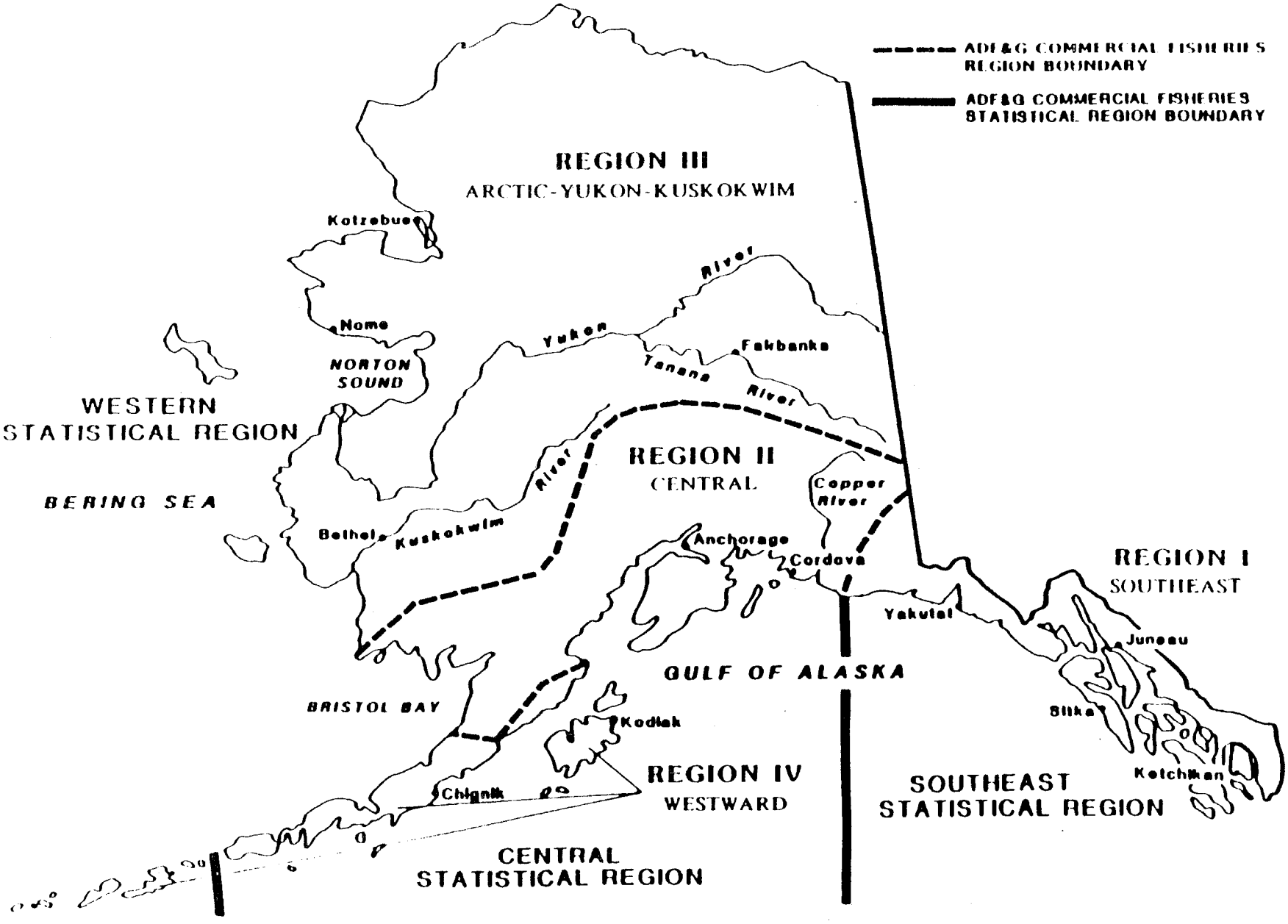

Figure 1. The three statistical regions (Western, Central, Southeastern) and the four fisheries regions (Westward, AYK, Central, Southeastern) of the Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division.

Figure 2. Relationship between actual catch (thousands) and projected catch (thousands) for Alaskan chinook salmon from 1970–1993, with the 1994 projection.

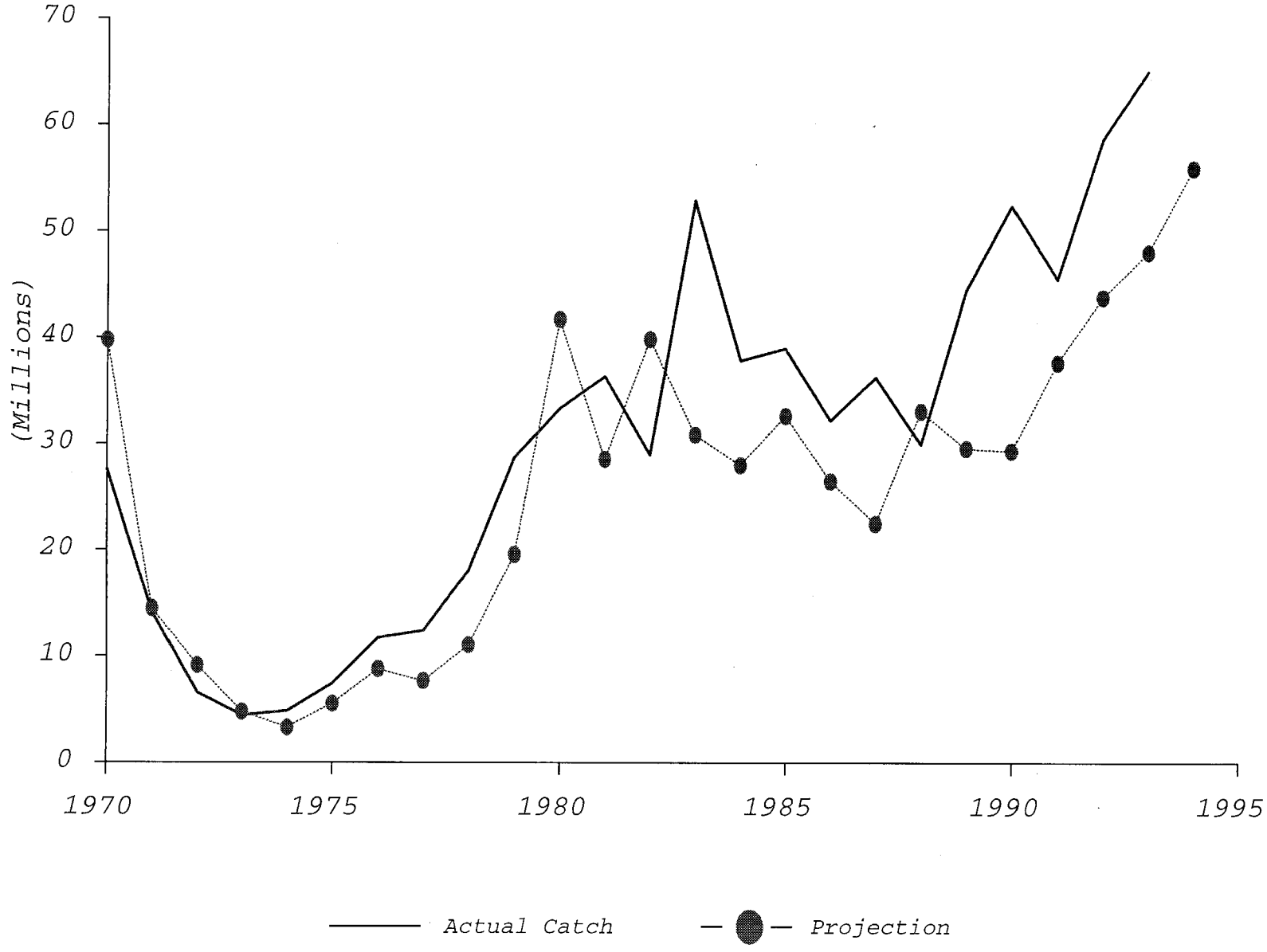

Figure 3. Relationship between actual catch (millions) and projected catch (millions) for Alaskan sockeye salmon from 1970–1993, with the 1994 projection.

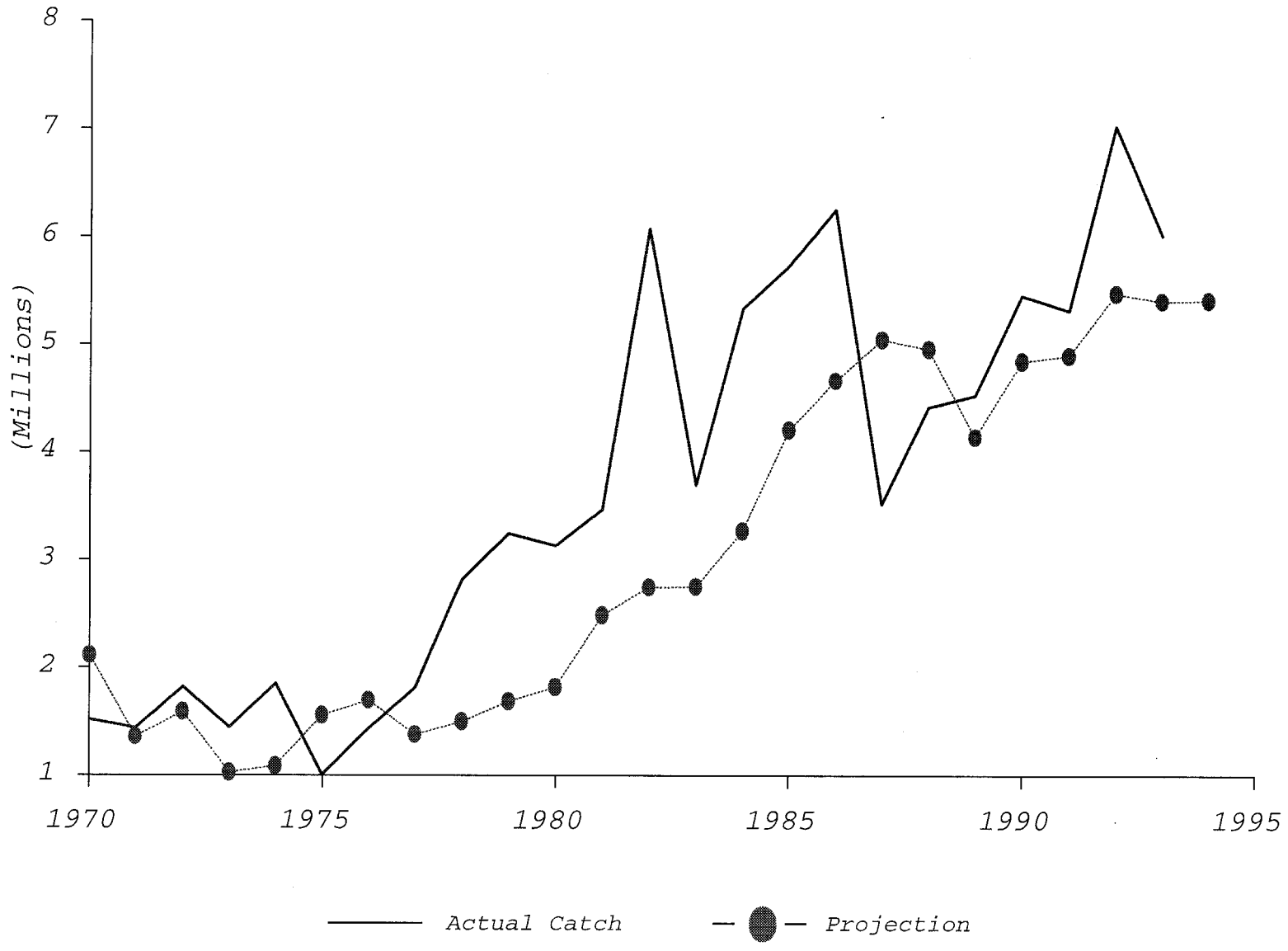

Figure 4. Relationship between actual catch (millions) and projected catch (millions) for Alaskan coho salmon from 1970–1993, with the 1994 projection.

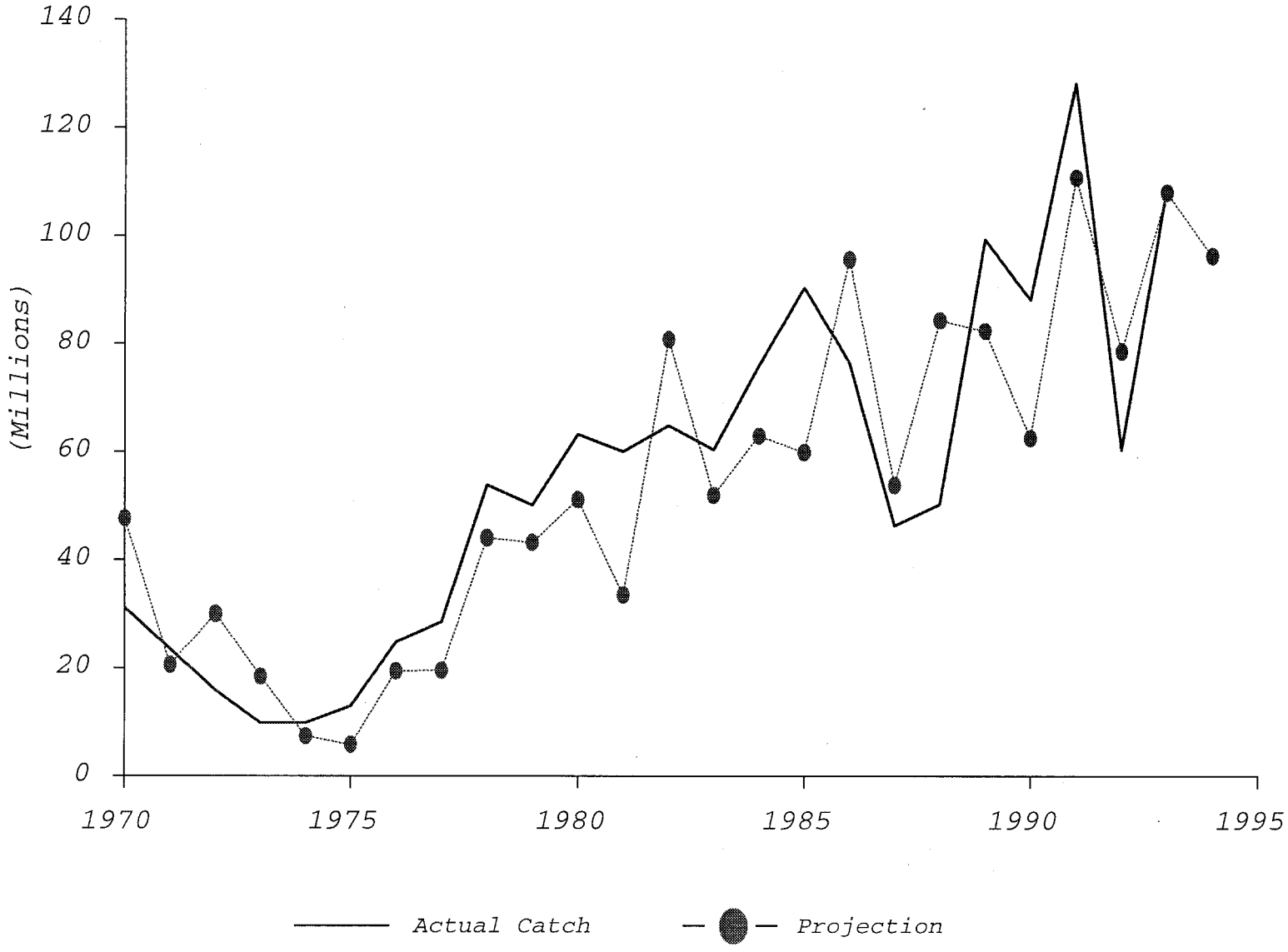

Figure 5. Relationship between actual catch (millions) and projected catch (millions) for Alaskan pink salmon from 1970–1993, with the 1994 projection.

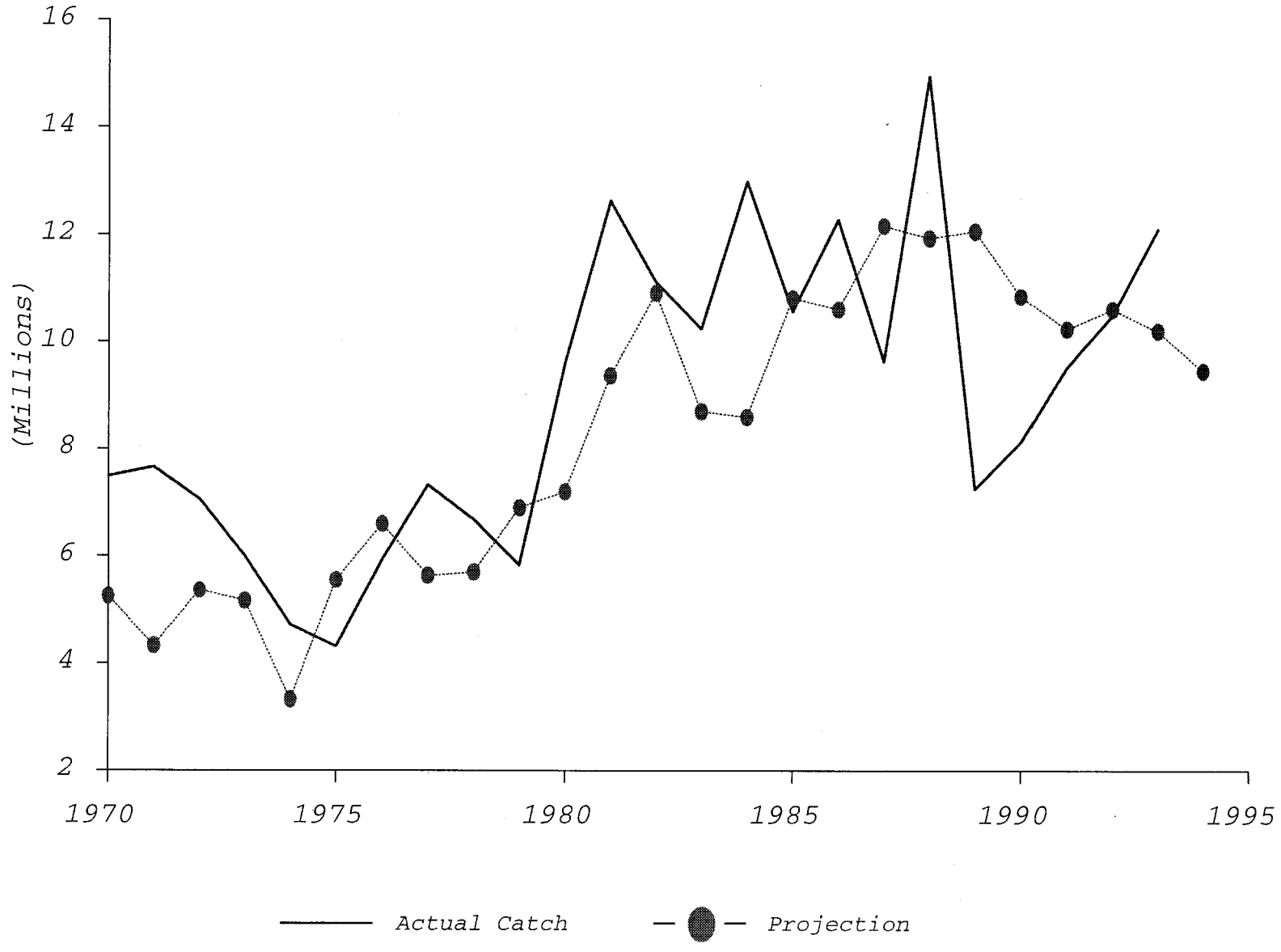

Figure 6. Relationship between actual catch (millions) and projected catch (millions) for Alaskan chum salmon from 1970–1993, with the 1994 projection.

APPENDIX

FORECAST AREA: **Southeast Alaska**

SPECIES: **Pink Salmon**

PRELIMINARY FORECAST OF 1994 RUN:

	Forecast Estimate (millions)
NATURAL PRODUCTION:	
Natural Run	77.0
Escapement Goal	31.0[1]
Commercial Common Property Harvest	46.0
HATCHERY AND SUPPLEMENTAL PRODUCTION:	
Hatchery Run	1.2
Broodstock Needs	0.2
Commercial Common Property Harvest[2]	1.0
TOTAL PRODUCTION:	
Total Run	78.2
Escapement Goal	31.2
Commercial Common Property Harvest[2]	47.0

[1] An expansion factor of 2.5 was applied to the escapement index to convert the index to an estimate of total escapement. In addition the escapement index goal for southern Southeast was changed from a point goal of 6.0 million to a range of 6.0 to 9.0 million.

[2] Includes commercial common property and hatchery harvests.

INTRODUCTION

Programs designed specifically for collecting data relevant to estimating the magnitude of Southeast Alaska's pink salmon returns have been eliminated. Consequently, we have deemed it inappropriate to

make predictions based solely on formal statistical models. However, information available from other sources (NOAA temperature data, management escapement data, management and fleet field observations) allows us to provide an estimate which we feel is more informative than a simple historic average. As a result, the 1994 Southeast Alaskan pink salmon harvest estimate is a subjective combination of a model forecast, historic average harvests, and expert opinion. We hope to refine this forecasting method in the future as we learn how to better weight the various inputs.

FORECAST METHODS

This year's prediction is based on selecting one of five different harvest magnitude categories. The categories were obtained by calculating the 20, 40, 60, 80, and 100th percentile of Southeast Alaska's pink salmon harvest during the 1980 through 1993 time period. The categories are:

DISASTER	14 MILLION OR LESS
WEAK	15 TO 25 MILLION
AVERAGE	26 TO 37 MILLION
STRONG	38 TO 57 MILLION
EXCELLENT	58 MILLION OR MORE

Category selection is made by subjective weighting of the following information:

1. Multiple linear regression analysis. Independent variables used in the regression included: (1) brood year escapement index, (2) average daily minimum winter (November 1 through February 29) air temperatures from NOAA weather stations throughout Southeast Alaska, and (3) sum of the previous two brood year escapement indices. These are the same variables which were used in last year's forecast model. As with last year, the years 1987 and 1988 were considered outliers and were removed from the model. The 1994 forecast from this model is 46 million with a 95% prediction interval of 29 to 63 million.

2. General observations made by Area Management Biologists during routine herring surveys indicated fewer fry rearing in the estuaries of southern Southeast during the spring of 1993 than the previous year. Reports from northern Southeast indicated higher pink fry abundance during the spring of 1993 than the previous year.

3. During the 1980 to present time period, the mean harvest for even years has been less than the mean harvest for odd years (27 compared to 41 million). There has been only one even year since statehood (1986) in which the harvest fell in the STRONG category. In all other even years, harvests were in the AVERAGE to DISASTER categories. The harvest in 1992 was 35 million (AVERAGE).

4. No anomalous drought or flood conditions occurred during the time when the 1994 returning pinks were in freshwater.

5. Winter air temperatures were below average, although slightly higher than those which influenced 1992's harvest.

6. The brood year escapement was near optimum at 30.5 million (the historic record pink salmon harvest in 1991 of 62 million occurred from a brood year escapement of 32.5 million). The distribution of the 1992 escapement was good with goals met or exceeded in all except Districts 105, 106, 107, 113, and 114.

7. Unprecedented numbers of Jack and Chum Mackerel were reported captured by seiners of southern Southeast Alaska during the 1993 season. Although Mackerel have been captured in previous years, they have never been present in such large numbers (up to 100 Mackerel per seine day in some areas). Mackerel are known as gluttonous feeders, their diet consisting of crustaceans, squid, and small fishes. It is not clear at this time if pink fry outmigrating in 1993 experienced additional predation due to the unusual concentration of Mackerel.

FORECAST DISCUSSION

Based on a subjective evaluation of the above points, we believe that the 1994 harvest will be **STRONG**. Furthermore, if the 1994 harvest is not STRONG, we believe that the harvest will more likely be AVERAGE rather than EXCELLENT.

The number of fry released from pink hatcheries in Southeast Alaska was not available at the time this report was prepared. Hatchery production is estimated by assuming an 81% survival from eggs to fry, and a 1% survival from release to return (145,000,000 green eggs x .81 survival to fry stage x .01 survival to return = 1.2 million adults returning.

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FORECAST AREA: **Prince William Sound**

SPECIES: **Pink Salmon**

PRELIMINARY FORECAST OF 1994 RUN:

	Forecast Estimate (millions)	Forecast Range (millions)
NATURAL PRODUCTION:		
Prince William Sound General Districts		
Natural Run	1.97	0.91–4.30
Escapement Goal[1]	1.35	
Commercial Common Property Harvest	0.62	
HATCHERY AND SUPPLEMENTAL PRODUCTION:		
Valdez Fisheries Development Assoc. - Solomon Gulch Hatchery		
Hatchery Run	5.15	3.57–6.74
Broodstock Needs	0.35	
Cost Recovery Needs[2]	3.33	
Commercial Common Property Harvest	1.47	

[1] This is based on aerial surveys and is intended only as an index.

[2] VFDA sales are not based upon a percentage of the return hence the lower and upper bound are the same regardless of the run size.

FORECAST AREA: **Prince William Sound**

SPECIES: **Pink Salmon**

PRELIMINARY FORECAST OF 1994 RUN (continued):

	Forecast Estimate (millions)	Forecast Range (millions)
Prince William Sound Aquaculture Corp. - Cannery Creek Hatchery		
Hatchery Run	6.31	2.11–10.51
Broodstock Needs	0.30	
Cost Recovery Needs	1.59	
Commercial Common Property Harvest	4.42	
Prince William Sound Aquaculture Corp. - W.H. Noerenberg Hatchery		
Hatchery Run	7.80	4.75–10.84
Broodstock Needs	0.33	
Cost Recovery Needs	2.01	
Commercial Common Property Harvest	5.46	
Prince William Sound Aquaculture Corp. - A.F. Koernig Hatchery		
Hatchery Run	5.43	4.59–6.27
Broodstock Needs	0.22	
Cost Recovery Needs	1.41	
Commercial Common Property Harvest	3.80	
TOTAL PRODUCTION		
Total Run	26.66	15.93–38.66
Natural Escapement Goal	1.35	
Broodstock Needs	1.20	
Cost Recovery Needs	8.34	
Commercial Common Property Harvest[1]	15.77	

[1] The lower bound of the common property harvest is greater than the total return minus natural escapement, brood, and sales needs because the lower bound of the total wild return is less than the escapement goal and hatchery fish cannot be used to make up a wild escapement deficit.

FORECAST METHODS

The natural returns are predicted from a linear regression of the logarithm of adult returns on an alevin index for wild spawning streams. The alevin index is calculated using alevin density estimates from a systematic Spring sampling program in 31 streams which are representative of all pink salmon spawning streams in Prince William Sound. The 80% confidence interval for the forecast of natural returns was estimated from cross validation of the regression using jackknifing procedures.

The forecast for hatchery returns is the sum of hatchery specific forecasts. The forecast for each hatchery is the product of the number of fry they release and their historic mean marine survival rate. The 80% confidence interval around the forecast is derived from the confidence interval around the mean of the marine survival data.

The projected broodstock needs for each facility are fairly accurate but sales harvest (cost recovery) numbers are preliminary. Prince William Sound Aquaculture (PWSAC) brood and sales are currently limited to 30% of their total return by corporate policy but will vary depending upon inseason estimates of their return. The confidence interval about the projected sales need for each PWSAC facility is simply 30% of the lower and upper bounds of the total return estimate less the stated brood stock goal. Valdez Fisheries Development Association projected sales need of 3.3 million fish in 1994 is a fixed number of fish based upon some price and average weight assumptions. The lower and upper limits about this sales need are not statistically derived. They are based upon possible variations in average weight or price. The bounds about the common property harvest are the lower or upper bounds for total return minus the escapement or brood requirements and the corresponding lower or upper bound of the sales harvest requirement.

FORECAST DISCUSSION:

The 1992 pink salmon spawning escapement in Prince William Sound was only 40 percent of the desired goal and was the second smallest in the last 30 years. The 1993 alevin index which resulted from this poor spawning escapement was only 60 percent of the 32 year average, the seventh lowest for all years, and the third lowest for even years. The regression of the logarithm of return on the alevin index continues to out perform other models as a forecast tool for the even year returns (R^2 = .6). From data collected in recent years, Cooney and Willette (1991)[2] has evidence to support a correlation between poor marine survival in PWS pink salmon and the coincidence of cool April through July temperatures and low zooplankton (forage for fry) abundance. This correlation seems to explain some of the variability in our traditional forecast for odd year returns based solely upon the pre-emergent fry index but does not appear to explain much of the variability around the even year forecast. On this basis we opted not to depart from the traditional even year forecasting method. The difference in the effect of sea surface and zooplankton abundance between even

[2] Cooney R. and Mark Willette 1991. Regional-level investigations of pink salmon production responses to inter-annual variations in ocean temperatures: Cooperative Fisheries and Oceanographic Studies. 1991 Pink and Chum Workshop, Parkersville, British Columbia.

and odd years is puzzling. Forecasts based on the alevin index have always been less variable for the even years than for the odd years and paired sea surface temperature and zooplankton data are only available from the early 1980's to the present. The failure of these new variables to improve the even year forecast may simply be a function of small sample sizes for this data.

The release of 568 million pink salmon from hatcheries in Prince William Sound in 1993 was the second largest in the history of aquaculture program and the point estimate of 24.7 million fish returning to hatcheries in 1994 is the fourth largest forecasted hatchery return. Hatcheries in Prince William Sound reached peak production capacity for pink salmon in the late 1980's. Marine survival estimates for each facility have been based upon coded-wire tag results since 1987 and are considered to be very reliable. The projected return from the 1993 fry release is slightly lower than for comparable releases in the past because the average marine survival used to forecast hatchery returns has decreased following recent run failures.

Despite their low predictive power for hatchery returns and even year wild returns, it is worth noting that sea surface temperatures were considerably warmer than average in 1993 but this thermal regime which was conducive to good fry growth was offset by the second lowest zooplankton abundances since the inception of the sampling program in 1981. It is also worth noting that the 1993 returns of both hatchery and wild pink salmon to Prince William Sound were considerably below expected despite consideration of the low temperatures and zooplankton abundances experienced by the fry in 1992 when compiling the 1993 forecast. The departure from a 1993 forecast which included temperature and forage variables is indicative of other sources of variability which may also be effecting marine survival of pink salmon fry. Predation is one possibility and there is at least anecdotal evidence of increases in predators such a juvenile pollock and cod in the Sound in the last two or three years. If predation is higher now than in the past, the present forecast model cannot account for it and predictions for 1994 returns may be too high.

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PWS Salmon Research Project Leader
Cordova

FORECAST AREA: **Prince William Sound**

SPECIES: **Chum Salmon**

PRELIMINARY FORECAST OF 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
NATURAL PRODUCTION:		
Prince William Sound General Districts		
Natural Run	276.86	114.02–736.33
Escapement Goal[1]	225.00	
Commercial Common Property Harvest	51.86	
HATCHERY AND SUPPLEMENTAL PRODUCTION:		
Valdez Fisheries Development Assoc. - Solomon Gulch Hatchery		
Hatchery Run	48.96	37.94–59.99
Broodstock Needs	24.12	
Cost Recovery Needs	0.00	
Commercial Common Property Harvest	24.84	
Prince William Sound Aquaculture Corp. - W.H. Noerenberg Hatchery		
Hatchery Run	1135.10	879.84–1391.43
Broodstock Needs	119.00	
Cost Recovery Needs	221.53	
Commercial Common Property Harvest	794.57	

[1] This is based on aerial surveys and is intended only as an index.

FORECAST AREA: **Prince William Sound**

SPECIES: **Chum Salmon**

PRELIMINARY FORECAST OF 1994 RUN (continued):

	Forecast Estimate (thousands)	Forecast Range (thousands)
TOTAL PRODUCTION		
Total Run	1460.92	1031.80–2187.75
Natural Escapement Goal	225.00	
Broodstock Needs	143.12	
Cost Recovery Needs	221.53	
Commercial Common Property Harvest	871.27	

FORECAST METHODS

The natural stock forecast is the pooled results of three separate regressions in which the returns of 3- and 4-year-old fish are predicted from pink returns from the same brood year and 5-year-old fish are predicted from sibling 4-year-old returns in 1993. Jackknife procedures were used on returns for years 1974 through 1991 to crossvalidate the forecast model and estimate confidence intervals for each age specific forecast. The predicted total return for all age groups and the associated 80% confidence interval are the sums of the predictions for individual ages.

The hatchery returns for 1994 are projected from fry releases in 1990, 1991, and 1982, and estimated marine survival of 1.82%, and average age composition data for natural chum returns from brood years 1978 through 1986. The marine survival rate is based on six years of fry release and adult return data from the ADF&G Main Bay hatchery. This is the only hatchery for which formal quantitative methods (coded wire tagging results) were used to estimate the portion of the adult returns intercepted in the commercial harvest, hence the only one with reliable total return estimates.

The projected broodstock needs for each facility are fairly accurate but sales harvest (cost recovery) numbers are preliminary. Prince William Sound Aquaculture (PWSAC) brood and sales are currently limited to 30% of their total return by corporate policy but will vary depending upon inseason estimates of their return. The confidence interval about the projected sales need for each PWSAC facility is simply 30% of the lower and upper bounds of the total return estimate less the stated brood stock goal. Valdez Fisheries Development Association (VFDA) does not sell any of their small chum salmon return.

FORECAST DISCUSSION

The forecast for natural chum returns in 1994 is the fifth lowest since 1965. This predicted return is largely driven by the disastrous returns of pink salmon from the 1990 and 1991 brood years and the very low abundance of four year old chums in 1993. Forecast based on "siblings" of another species may seem suspect but in most years are corroborated by similar albeit less reliable predictions based on regressions between chum salmon sibling age groups.

Projected wild returns in 1994 are not significantly higher than escapement needs and it is unlikely that there will be fisheries directed at these fish. Despite the poor projection for wild returns the overall harvest of chums in 1994 should exceed the 1965–1993 average. The majority of the harvestable surplus will be from returns to the WHN facility which is now near peak production capacity for early run timing chum salmon. The brood years which will contribute most to the 1994 return (1989 and 1990) were reared in freshwater prior to release. Based upon the strong return of 1989 brood year fish in 1993, this rearing strategy appears to boost marine survival and should contribute to a good hatchery return of both 3- and 4-year-old fish in 1994. A stock of chums having a late season run timing have been maintained at Solomon Gulch Hatchery and returns of that stock will contribute approximately 25 thousand fish to the total chum harvest in 1993.

The confidence in the prediction of hatchery chum returns is low. The database for marine survival is limited to a few years of tagged returns to the Main Bay Hatchery. Average age at return data is similarly lacking for hatchery returns and there are at least some indications that it may not follow trends observed in wild stocks.

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FORECAST AREA: **Prince William Sound**

SPECIES: **Sockeye Salmon**

PRELIMINARY FORECAST OF 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
NATURAL PRODUCTION:		
Prince William Sound - Coghill Lake		
Natural Run	34.49	12.93–104.44
Escapement Goal[1]	25.00	
Commercial Common Property Harvest	9.49	
Prince William Sound - Eshamy Lake		
Natural Run	77.65	9.87–145.43
Escapement Goal[1]	40.00	
Commercial Common Property Harvest	37.65	
Prince William Sound - Unakwik District		
Commercial Common Property Harvest	11.64	0.00–25.95
HATCHERY AND SUPPLEMENTAL PRODUCTION:		
PWSAC - Main Bay Hatchery (Coghill Stock On-Site Returns)		
Hatchery Run	252.59	200.00–305.17
Broodstock Needs	4.60	
Cost Recovery Needs	78.73	
Commercial Common Property Harvest	169.26	
PWSAC - Main Bay Hatchery (Coghill River Returns)		
Hatchery Run	18.77	6.76–32.86
Broodstock Needs	0.00	
Cost Recovery Needs	0.00	
Commercial Common Property Harvest	18.77	

[1] This is based on aerial surveys and is intended only as an index.

FORECAST AREA: **Prince William Sound**

SPECIES: **Sockeye Salmon**

PRELIMINARY FORECAST OF 1994 RUN (continued):

	Forecast Estimate (thousands)	Forecast Range (thousands)
HATCHERY AND SUPPLEMENTAL PRODUCTION:		
PWSAC - Main Bay Hatchery (Eshamy Stock On-Site Returns)		
Hatchery Run	78.11	56.99–99.23
Broodstock Needs	1.80	
Cost Recovery Needs	48.80	
Commercial Common Property Harvest	27.51	
PWSAC - Main Bay Hatchery (Eshamy Bay Remote Returns)		
Hatchery Run	90.56	68.09–122.20
Broodstock Needs	0.00	
Cost Recovery Needs	0.00	
Commercial Common Property Harvest	90.56	
PWSAC - Main Bay Hatchery (Other Remote Returns)[1]		
Hatchery Run	2.45	1.00–10.90
Broodstock Needs	0.00	
Cost Recovery Needs	0.00	
Commercial Common Property Harvest	2.45	

[1] These include 5-year-old fish returning from the brood year 1989 releases of fry originating from Eshamy Lake stock into Pass and Esther Pass lakes on Esther Island and 3-year-old fish returning from brood year 1991 releases of fry originating from Coghill Lake stock into Marsha Bay Lake on Knight Island.

FORECAST AREA: **Prince William Sound**

SPECIES: **Sockeye Salmon**

PRELIMINARY FORECAST OF 1994 RUN (continued):

	Forecast Estimate (thousands)	Forecast Range (thousands)
TOTAL PRODUCTION		
Total Run	566.26	354.64–846.18
Natural Escapement Goal	65.00	
Broodstock Needs	6.40	
Cost Recovery Needs	127.53	
Commercial Common Property Harvest	367.33	

FORECAST METHODS

The forecast for the natural returns to Coghill Lake returns is the pooled results of four separate regressions. The returns of four 4-year-old fish aged 1.2 are predicted from a sibling model using returns of fish aged 1.1 from the prior year. The same sibling model is used to predict returns of fish aged 1.3 from returns of fish aged 1.2, returns of fish aged 2.2 from returns of fish aged 1.2 and returns aged 2.3 from fish aged 1.3. Although catch and escapement at age data exist for the Coghill sockeye returns from as far back as 1962, escapement data prior to the installation of the full weir in 1974 are unreliable. Escapement and catch at age data in the regressions are from 1974 to the present. To calculate an 80% confidence interval the returns for years 1979 through 1993 were predicted by crossvalidation using a jackknife procedure with these same models. The predicted total return for all age groups and the associated 80% confidence interval is the sum of the predictions for individual ages.

The forecast for wild returns to Eshamy Lake is the mean of returns since 1965 and the 80% confidence interval is the confidence interval about the mean. The harvest projection for wild stocks in the Unakwik District is the mean of purse seine and gillnet catches in that district since 1968. The 80% confidence interval is the 80% confidence interval around the mean.

The forecast for Main Bay Hatchery on-site returns which originate from the Coghill stock are based on age specific marine survival rates from brood years 1987 and 1988 hatchery returns. These are the first series of brood year survival data available since the conversion of the hatchery to a sockeye salmon facility in 1986. They are based on fry releases, catch contribution estimates from coded wire tag recoveries, and brood stock data. In the absence of survival data from multiple brood years, the age specific survival

estimates for sixteen separate release groups from the two complete brood years were treated as independent. The mean and variance of the estimates were used to predict the 1994 on-site return and it's associated confidence interval.

Releases of smolt originating from Eshamy Lake stock and remote releases of smolt at the mouths of Coghill and Eshamy Rivers did not begin until 1991 hence, the only survival data for these releases are from 3- and 4-year-old returns. The survivals of these age groups differ significantly from the survivals for comparable on site returns of 3- and 4-year-old fish from the Coghill Lake stock. Given the differences it did not seem likely that returns of Eshamy stock fish to Main Bay or Coghill and Eshamy stock fish to remote release sites could be accurately predicted using survival data for the on-site releases of Coghill stock. Instead, the one year of age specific survival data for 3- and 4-year-old fish from on-site Eshamy stock releases and remote releases were used to predict 3- and 4-year-old returns in 1994. A survival estimate for 5-year-old fish was derived from the proportion of 5-year-old fish in brood year 1987 and 1988 returns of Coghill stock to Main Bay. The coefficients of variation for age specific survival estimates from these same Coghill stock returns were used to approximate an 80% confidence interval about the forecasts for on-site Eshamy stock returns and returns to remote release sites.

The projected brood stock needs for each stock are fairly accurate but sales harvest (cost recovery) numbers are preliminary. Prince William Sound Aquaculture (PWSAC) brood and sales are currently limited to 30% of their total return by corporate policy but will vary depending upon inseason estimates of their return. The only area currently designated for sales harvest is in Main Bay, consequently all sales harvests are taken from on site returns. Sales harvests are divided between the Coghill and Eshamy stocks based upon the relative sizes of their projected returns. The confidence interval about the projected sales need for each stock is simply 30% of the lower and upper bounds of the total return estimate less the stated brood stock goals.

FORECAST DISCUSSION:

The forecasted total return of approximately 34 thousand sockeye salmon to Coghill Lake in 1994 is the third lowest forecast in the last 20 years. The poor forecast for the natural stock in Coghill Lake is largely due to the extremely poor returns of 3- and 4-year-old fish age in 1993. The majority (70%) of returns to Coghill have historically been 5-year-old fish aged 1.3. The returns of 4-year-old fish in 1993 were well below average and based on the sibling model, this bodes poorly for 5-year-old returns aged 1.3 in 1994. The returns of fish aged 1.1 were also very small in 1993 and a very weak return of 4-year-old fish aged 1.2 is likely in 1994.

The poor returns of wild Coghill sockeye salmon in recent years appear to be due in part to limnological conditions in the lake. Based on some recent limnological data the escapement goal for Coghill Lake has been temporarily lowered to allow plankton populations to recover but given the likelihood that several thousand Coghill Lake sockeye will be intercepted in the fisheries directed at early returns of chum salmon

to the WHN and Main Bay hatcheries, it is still extremely unlikely there will be any directed fishery for sockeye salmon in the Coghill District in 1994.

The Eshamy Lake stock is by far the single largest wild stock contributor to the harvests of sockeye salmon outside of the Coghill District. Many of these fish have historically been intercepted incidentally in the purse seine fishery in the Southwest District. The extent of these interceptions is not precisely known but can be estimated based upon run timing and age composition data. Weir counts of the escapement to Eshamy River are available for the last 50 years and in recent years, age, sex and size data has been systematically collected for the escapement to Eshamy Lake, the catch in the Eshamy District and, the incidental mixed stock catches in the Southwest District. Catch composition data, escapement data, and catch and escapement age composition data, can now be used to construct brood tables and in a few years it may be possible to forecast these returns using something better than the mean.

The 1994 returns of 4- and 5-year-old fish to Main Bay Hatchery will be the fourth significant adult returns originating from the Coghill brood stock. Although most (approximately 80%) of the releases of this stock have returned as 4-year-old fish, approximately 50 percent of the on-site returns in 1994 will be 5-year-old fish from the very large release in 1991. The 4-year-old fish from the smaller on-site release of Coghill fish in 1992 will comprise approximately 34% of the 1994 on-site return. Conversely 4-year-old fish will dominate the returns to the remote release sites at the mouths of Coghill and Eshamy Rivers because releases at those in 1992 were comparable or larger than in 1991.

The small returns forecasted for other remote release sites include those to Pass, Esther Pass, and Marsha Bay lakes. Fry from the Main Bay/Eshamy stock were planted in Pass, and Esther Pass Lakes in the Coghill District in 1989 and again in Pass and Esther Pass Lakes in 1990. Returns of 4-year-old fish from the 1991 releases were estimated from coded wire tag recoveries. They were quite small and it is unlikely that significant numbers of 5-year-old fish will return in 1994. Sockeye salmon fry from the Main Bay/Coghill stock were planted in Marsh Bay Lake on Knight Island in 1993. A few 3-year-old fish from that release may return in 1994.

Samuel Sharr
Fisheries Biologist III
PWS Salmon Research Project Leader
Cordova

FORECAST AREA: **Prince William Sound**

SPECIES: **Coho Salmon**

PRELIMINARY FORECAST OF 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
NATURAL PRODUCTION:		
Prince William Sound General Districts		
Commercial Common Property Harvest	11.43	0.00–24.45
HATCHERY AND SUPPLEMENTAL PRODUCTION:		
Valdez Fisheries Development Assoc. - Solomon Gulch Hatchery		
Hatchery Run	35.40	17.88–52.91
Broodstock Needs	2.65	
Cost Recovery Needs	7.97	
Commercial Common Property Harvest	24.78	
Prince William Sound Aquaculture Corp. - W. Noerenberg Hatchery		
Hatchery Run	115.01	23.43–206.59
Broodstock Needs	1.30	
Cost Recovery Needs	33.20	
Commercial Common Property Harvest	80.51	
TOTAL PRODUCTION:		
Total Run	161.84	41.31–283.95
Natural Escapement Goal	—	
Broodstock Needs	3.95	
Cost Recovery Needs	41.17	
Commercial Common Property Harvest	116.72	

FORECAST METHODS

The harvest projection for wild fish is the mean of the historic harvest of wild stocks of coho salmon in PWS from 1968 to 1992. The harvest projection range is the 80% confidence interval about the 1968–1992

harvest mean. The 1993 harvest numbers are not included in the average because only a portion of the hatchery return was tagged and the true wild contribution is unknown.

The forecasts for hatchery returns are the product of the number of smolt released from each facility in 1993 and the average marine survival for each facility. The forecast range is based on the 80% confidence interval about the mean of marine survival.

FORECAST DISCUSSION:

The mean marine survival rates for Solomon Gulch and WHN Hatcheries are 7.2% and 9.6% respectively. The time series of survival rates is short, 7 years of data for one hatchery and 6 years for the other, but

the variance is small. Estimated survival rates for the hatchery coho returns were not originally based on tagging data but natural stock production in PWS is small, harvests of coho are mostly in hatchery terminal areas and total return estimates, hence marine survival estimates, for hatchery stocks are probably fairly reliable.

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PWS Salmon Research Project Leader
Cordova

FORECAST AREA: **Prince William Sound**

SPECIES: **Chinook Salmon**

PRELIMINARY FORECAST OF 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
HATCHERY AND SUPPLEMENTAL PRODUCTION:		
Prince William Sound Aquaculture Corp. - W.H. Noerenberg Hatchery		
Hatchery Run	9.27	2.32–16.22
Broodstock Needs	0.38	
Cost Recovery Needs	2.40	
Commercial Common Property Harvest	6.49	
TOTAL PRODUCTION		
Total Run	9.27	2.32–16.22
Natural Escapement Goal	—	
Broodstock Needs	0.38	
Cost Recovery Needs	2.40	
Commercial Common Property Harvest	6.49	

FORECAST METHODS

The prediction for the hatchery return is the sum of predicted returns to the hatchery and remote sites including Whittier, Valdez, and Cordova. These are from the product of the number of smolt released from each site and an estimated average marine survival of 4% based on data from on brood cycle and experience at other chinook hatcheries. In the absence of a time series of data for chinook salmon, the forecast 80% confidence interval is based upon the coefficient of variation of survival estimates for hatchery coho salmon.

FORECAST DISCUSSION

There are a few tiny populations of wild chinook salmon in PWS but they do not contribute significantly to area fisheries. WHN Hatchery is still in the brood stock building phase for this species. The largest

hatchery releases are at Wallace Noerenberg Hatchery. The remote releases are smaller and are designed to contribute mostly to sport fisheries near the larger communities in PWS.

Samuel Sharr
Fisheries Biologist III
PWS Salmon Research Project Leader
Cordova

FORECAST AREA: **Copper River**

SPECIES: **Sockeye Salmon**

PRELIMINARY FORECAST OF 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
NATURAL PRODUCTION:		
Natural Run	1114	538–1690
Escapement Goal	576	
Commercial Common Property Harvest	53	
SUPPLEMENTAL PRODUCTION:		
Gulkana Hatchery		
Hatchery Run	235	217–253
Broodstock and Stream Escapement	94	
Commercial Common Property Harvest	141	
TOTAL PRODUCTION:		
Total Run	1,349	755–1,940
Natural Escapement Goal	576	
Broodstock and Surplus	94	
Commercial Common Property Harvest	679	

FORECAST METHODS

Natural production was predicted using historical return per spawner data and parent year escapement weighted by age class (4-, 5-, and 6-year-olds) for the Copper River Delta and Upper Copper River independently. Return per spawner estimates since 1966 for the 5 years that were most similar in magnitude to the age-5 parent year (1989) were used to estimate an average return per spawner. The 1994 predicted run was influenced heavily by the 1989 and 1990 brood years and age-5 returns from the 1989 brood year are expected to be the strongest for both the Copper River Delta and Upper Copper River. The 80% confidence interval for the forecast of natural production was calculated from the mean square error of forecasts for the previous eleven years using the same forecast methods.

Supplemental production from Gulkana hatchery was predicted using survival estimates based on CWT recoveries in enumerated escapements to Crosswind Lake and Summit Lakes. Survival of Paxson Lake releases was assumed to be intermediate between these estimates. An assumed harvest rate of 60% was used to estimate contribution to the commercial catch. The 80% confidence interval for the forecast of supplemental production was calculated using the mean square error estimates from natural production.

DISCUSSION OF THE 1994 FORECAST

Copper River sockeye salmon return per spawner estimates since 1966 appear to be somewhat cyclic and the current trend is toward a period of increasing returns per spawner. This relationship is theorized to be correlated with El Niño Southern Oscillation (ENSO) events. If this is true and the trend continues, return per spawner estimates for 1994 may be higher than the average used to calculate the forecast resulting in a stronger than predicted run in 1994.

John Wilcock
Fisheries Biologist III
CBR Salmon Research Project Leader
Cordova

FORECAST AREA: **Copper River**

SPECIES: **Chinook Salmon**

PRELIMINARY FORECAST OF 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
NATURAL PRODUCTION:		
Total Run	49.6	27.9–71.4
Escapement Goal	15.0	
Commercial Common Property Harvest	34.6	

FORECAST METHODS

The 1994 chinook salmon forecast utilized historical aerial index data and estimated contributions of parent year ages 4, 5, 6, and 7 to the parent year escapement indices. The sum of these parent year age-specific contribution estimates was multiplied by the ratio of historical average escapement indices to average commercial catches. In effect, the expected run is a return per spawner calculation which does not consider relative density, climate conditions or distribution of spawners. The 80% confidence interval of the predicted harvest was calculated from the mean square error of forecasts for the previous eleven years using the same forecast methods.

DISCUSSION OF THE 1994 FORECAST

During the past 12 years, chinook salmon runs to the Copper River have tended to be above average and have established several of the top catches on record. Escapements have generally been maintained at high levels. No climate condition or other event is believed to have significantly affected any of the brood years involved.

John Wilcock
Fisheries Biologist III
CBR Salmon Research Project Leader
Cordova

FORECAST AREA: **Copper and Bering Rivers**

SPECIES: **Coho Salmon**

PRELIMINARY FORECAST OF 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
HARVEST PROJECTION FOR NATURAL RUN:		
Copper River District	308	144–430
Bering River District	124	0–225

FORECAST METHODS

The harvest projection for the 1994 run of coho salmon to the Copper and Bering River areas is based on the average catch of the commercial fishery for 1980–1993. The range is the 80% confidence interval about the mean.

FORECAST DISCUSSION

Although there were occasional departures from long-term averages for temperature, snow cover, and water level, weather conditions during the freshwater residency of the two major brood years (1990 and 1991) were generally within normal ranges and survival is expected to be average.

Return per spawner and sibling return relationships have not yielded satisfactory results for predicting run strength. Possibilities for forecast improvements include reexamination of historic catch scale samples to remove known reader inconsistencies, collection of escapement age data, inclusion of environmental data for freshwater residency years, and inclusion of overwinter survival data from USFS spawning channels.

John Wilcock
Fisheries Biologist III
CBR Salmon Research Project Leader
Cordova

FORECAST AREA: **Upper Cook Inlet**

SPECIES: **Sockeye Salmon**

PRELIMINARY FORECAST OF 1994 RUN:

	Forecast Estimate (millions)	Forecast Range (millions)
NATURAL PRODUCTION:		
Total Run	3.3	0.0–8.5
Escapement Goal	1.3	
Commercial Common Property Harvest	2.0	

FORECAST METHODS

The major sockeye salmon systems in Upper Cook Inlet (UCI) are the Kenai, Kasilof, Susitna and Crescent Rivers, Packers Creek, and Fish Creek. Spawner, sibling, and smolt data, if available, were examined for each system. Forecasts for Crescent and Susitna River systems were made from two models: one using spawner/return data and the other using sibling data. Forecasts for Kenai and Kasilof Rivers, and Fish Creek were made using smolt data for the predominant age class. Other age classes were estimated from the spawner/return or sibling data. The mean squared sum (MSE) of the total run forecast was calculated from total run predictions made from 1982 through 1993 and was based on the same methods used for the 1994 forecast. The MSE was then used to estimate the standard error for an 80% confidence bounds which represents the forecast range.

FORECAST DISCUSSION

The actual total run of sockeye salmon to UCI in 1993 was 6.2 million fish, while the preseason forecast was only 4.0 million. The difference between the preseason forecast and the actual run was almost entirely due to a much greater than expected return of age-2.3 sockeye salmon to the Kenai River system as well as a much greater return of all ages to the Susitna River system.

The 1994 forecasted total return to the Kenai River was based on smolt data for the age-1.3 component but did not use smolt data for the other age classes. A dilemma existed when making this forecast. Smolt numbers estimated in 1991 indicated a major mortality of juvenile sockeye salmon had taken place in the Kenai River during the previous winter. Unfortunately, the number of smolt caught in the smolt traps was insufficient to make a precise estimate. In addition, there is a strong possibility that the traps cannot be used to estimate number of age-2 smolt. Therefore, we have the potential for significant error in the Kenai River forecast. If the smolt data are incorrect, the forecast most likely will be low (by up to 1.5 million fish returning to the Kenai River). In contrast, if the smolt data are correct for all age classes the Kenai River forecast could be .5 million fish too high. This contrast is the direct result of a limited time series of data associated with the smolt program begun in 1989. Lastly, we have only two estimates of marine survival to forecast age-1.3 returns.

System	Run
Crescent River	138,000
Fish Creek	94,000
Kasilof River	568,000
Kenai River	1,489,000
Packer Creek	219,000
Susitna River	767,000

Kenneth E. Tarbox
Research Project Leader
Upper Cook Inlet

FORECAST AREA: **Lower Cook Inlet**

SPECIES: **Pink Salmon**

PRELIMINARY FORECAST OF THE 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
NATURAL PRODUCTION		
Total Run	408	140–1,191
Escapement Goal[1]	372	275–470
Commercial Common Property Harvest[2]	115	
SUPPLEMENTAL PRODUCTION		
Total Run	600	300–900
Brood Stock	120	
Commercial Common Property Harvest[3]	480	
TOTAL AREA PRODUCTION		
Total Run	1,008	440–2,091
Brood Stock and Escapement	492	
Commercial Common Property Harvest[4]	595	

[1] Escapement goal for systems included in the formal forecast. The total Lower Cook Inlet pink salmon escapement goal, including systems without a forecast, is 489,000.

[2] Port Graham, Windy Bay, Rocky Bay, Resurrection Bay, Bruin Bay, and Ursus-Rocky Coves areas expected to be 80,136 below their combined escapement goals. Therefore, harvest (120,516) plus the escapement goal of (372,500) minus the escapement shortfall (80,136) equal the total run forecast (412,880).

[3] Common property plus cost recovery.

[4] Additional harvests may be expected in systems not included within the forecast.

FORECAST METHODS

The forecast of wild pink salmon runs to 11 harvest areas in the Lower Cook Inlet Management area was based on log-log regression and Ricker curve analysis using 19 to 32 years of escapement observations. The projected harvest was obtained by subtracting both escapement goals and escapement shortfalls from the forecast. The forecast range was developed from cross-validation errors. The forecast of supplemental pink salmon production was based on moving average of ocean survival rates, 1.2% for Tutka Bay and 1.5% for Halibut Cove Lagoon. The projected harvest was obtained by subtracting brood stock goals from the supplemental production forecast.

FORECAST DISCUSSION

The natural production model was tested with cross-validation methods. During the simulation tests, the model was able to correctly forecast 22 out of 31 directions of change in annual run size. Accordingly, we have some confidence that the 1994 run will continue the odd year cycle; that is, smaller sized runs during even numbered years. However, the model has performed poorly in forecasting the magnitude of the change in run size. Even though all 11 systems with a forecast in 1993 had runs within the forecast range, we have less confidence in the magnitude of the forecast. If realized, a natural production run of the size being forecast would be below the 1962–1993 median run size (609,800). Pink salmon escapement levels in 1992 were below the lower range of escapement goals throughout the Lower Cook Inlet area.

In the Southern District, harvests are projected to be 9 thousand in Humpy Creek and 4 thousand in Seldovia. Additional harvests are expected in China Poot Bay and the Barabara Creek area. Southern District supplemental production of pink salmon have made significant contributions to the total lower Cook Inlet commercial harvest. Contribution has ranged from 24-90% in recent years. However, recent hatchery cost recovery requirements have reduced the harvest available for the common property fishery. Short term rearing enhancement projects are expected to produce harvests of 90 thousand fish in Halibut Cove Lagoon and 510 thousand pink salmon in Tutka Bay and Lagoon. No harvest is expected in Port Graham.

In the Outer District, harvests are projected to be 9 thousand in Port Chatham, 50 thousand in Port Dick, and 42 thousand in Nuka Bay. No harvest is expected in Windy and Rocky Bays.

In the Eastern District, no harvest is expected in Resurrection Bay.

In the Kamishak Bay District, no harvest is expected in Bruin Bay and in Ursus and Rocky Coves.

Henry Yuen
CFMD Research Biologist
Lower Cook Inlet Management Area

Nick Dudiak
CFMD Area Biologist

FORECAST AREA: **Kodiak**

SPECIES: **P**ink Salmon

PRELIMINARY FORECAST OF THE 1994 RUN:

	Forecast Estimate (millions)	Forecast Range (millions)
NATURAL PRODUCTION:		
Natural Run	16.2	14.7–17.6
Escapement Goal[1]	3.9	3.9
Commercial Common Property Harvest	12.3	10.8–13.7
HATCHERY PRODUCTION:		
Hatchery Run[2]	1.7	1.7–4.4
Broodstock Needs	0.3	0.3
Commercial Common Property Harvest	1.4	1.4–4.1
TOTAL PRODUCTION:		
Total Run	17.9	16.4–22.0
Escapement Goal[1]	4.2	4.2
Commercial Common Property Harvest	13.7	12.2–17.8

[1] With the exception of hatchery production all escapement values represent indexed escapement.
[2] Kitoi Bay Hatchery production forecast was prepared by Tim Joyce. See Afognak District for details.

FORECAST METHODS

The forecast for the 1994 natural or wild pink salmon run to the Kodiak Management Area (KMA) was determined as follows: A point estimate for the total return to the KMA was calculated from a stepwise multiple regression analysis of the past 27 years preemergent pink salmon sampling data. Variables used in the analysis were the indexed live fry densities for Kodiak and Afognak, the March and April ambient air temperatures taken in Kodiak, and these temperature's departure from average. Eight combinations of variables were tested, and the model with the lowest error and highest R^2 value was chosen. The upper and lower ranges are the 80% confidence intervals. Additionally, this year a point estimate of the

expected harvest was calculated using the same variables, and compared to the total run estimates. The model utilizing the unweighted live fry index for Kodiak and Afognak and the average April temperature was chosen for the 1994 forecast.

Even year survival rates from 1978–1992 brood years were used to forecast the 1994 Kitoi Bay hatchery pink run. The low range estimate was calculated by using the average survival rate of the two lowest even-year returns, and the high range was calculated by using the average survival rate of the two highest even-year returns. Due to the poor early marine rearing conditions, the Kitoi Bay Hatchery manager recommended using the low end of the range as an actual estimate of the 1994 return.

DISCUSSION OF THE 1994 FORECAST

Preemergent pink salmon fry sampling of the Kodiak Management Area index streams conducted during March and April of 1993 indicated generally good over-winter survival of the eggs and sac fry. These fry were from a fair brood year escapement in 1992; the indexed escapement estimate was 3.5 million pink salmon. Sampling resulted in an unweighted live fry index of 205.84 live fry per square meter of spawning area. This live fry index is the sixth highest even year index on record. Early spring conditions in 1993 may not have been entirely favorable for outmigration and rearing in the nearshore ocean environment. Ambient air temperatures, as measured in Kodiak, were well above average from March through June, but cloudy and rainy conditions predominated on the east side of Kodiak and Afognak Islands during April and May. Kitoi Bay Hatchery manager Tim Joyce noted that cloudy weather and cool water temperatures delayed the spring plankton bloom, and so negatively affected marine survival. *For planning purposes, the actual 1994 harvest is likely to approach the lower end of the combined range at 12.2 million pink salmon and likely will not exceed the combined point estimate of 13.7 million pink salmon.*

Winter conditions for the eggs spawned in 1992 led to some concern for the 1994 return. Early winter conditions were fair, with low water in the creeks, low snowfall, and generally mild temperatures. For a week in mid January, and again for a week at the beginning of February, temperatures fell to just above 0° F, with windchill driving the temps down to - 20° to - 50° F. There was very little snow cover and low water levels in the streams near town, so some freezing damage to the pink salmon eggs was expected. Conditions during the early March were generally cold and blizzardy turning to cool rainy days in late March and April. April storms delayed helicopter travel and raised creek levels to the point that many streams could not be sampled. During the sampling period all the index streams were open, though there was some shore ice. All lakes, including Karluk Lake, were ice covered during the project. There were a few breaks in the ice on Karluk Lake, and open water was present on the south end of Camp Island and on the north end of the lake at the outlet. Though signs of flooding and scouring were seen, good survival was documented.

The 1994 forecast is broken down by district as follows:

Afognak District: The preemergent fry index for this district was only about average for an even year return. Rains in late March and early April raised the stream water levels so high that less than half of the standard sites could be sampled. Fry production from Portage Creek (Perenosa) was much higher than average, while East Arm Paramanof and Big Danger Creek were both below average. Due to the poor early marine conditions, a harvest of only 700,000 pink salmon is expected. The escapement goal is 250,000 pink salmon, and the total return is expected to be approximately 950,000 pink salmon.

Afognak District Supplemental Production: The Kitoi Bay Hatchery pink salmon return estimate is 1.7 million fish from a release of 137.8 million reared fry and 31.8 million emergent fry. Only 270,000 pinks are needed for escapement and brood stock requirements, leaving 1.4 million pink salmon available for harvest. Due to the poor early marine rearing conditions the hatchery manager used the two lowest even year survival rates for the return estimate.

Westside Districts: Overall, the live fry density for these districts were average for an even year return. There were good numbers of live fry found in the Uyak, Zachar, and Uganik Rivers, as well as Brown's Lagoon and Baumann's Creeks. The large systems, Karluk and Red River, both had below average survival. There were signs of freezing damage and localized flooding, but overall this was not a factor. Fair escapement of pink salmon in 1992 combined with mild spring conditions and fair early marine rearing conditions lead to a forecast of 7.25 million pink salmon expected to return to these districts. The escapement goal is 2.25 million pink salmon, leaving 5.0 million pink salmon available for harvest.

Alitak District: Live fry densities for this district were above the even return year average. Heavy scouring was evident on lower Humpy River, but the fry held and survived exceptionally well, and fry densities were well above average. Again, the mild spring should have enhanced early marine fry survival. As a result of high fry densities and favorable early marine conditions, a run of 2.5 million pink salmon is expected for this district. The escapement goal is 500,000 pink salmon for the Alitak District, leaving about 2.0 million pink salmon available for harvest.

Eastside Districts: The overall live fry index for these districts was again slightly above average. There were very high fry densities on some eastside streams, notably Seven Rivers, Kiliuda, and Barling. Freezing damage was evident in both Kaiugnak and the Buskin, and both had poor indices. American, Sid Olds, and Saltery Creeks all had average to below average live fry densities. It is suspected that the poor spring conditions noted along the eastside may lead to lower survival of outmigrating fry. Approximately 4.0 million pink salmon are forecasted to return to these districts, and subtracting the escapement goal of 500,000 pink salmon, this leaves 3.5 million pink salmon available for harvest.

Mainland District: Fry sampling in this district was incomplete due to adverse weather conditions. Heavy rains delayed sampling and most streams showed signs of flooding. Kashvik and Alinchak streams were completely blank, with no live fry or eggs, and only few dead eggs, found. Kukak, Missak, and Kinak

streams all had poor live fry indices. Only Geographic and Dakavak had good fry indices, and the overall index for the Mainland District was well below average. Factoring in fair to good early marine conditions, about 1.5 million pink salmon are forecasted to return to this district in 1994. Escapement requirements for this district are 400,000 pink salmon, so approximately 1.1 million pink salmon should be available for harvest.

Prepared by: Kevin Brennan
Assistant Area Management Biologist
Kodiak Management Area

FORECAST AREA: **Kodiak, Upper Station Lakes**

SPECIES: **Sockeye Salmon,** Early Run

PRELIMINARY FORECAST OF THE 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
TOTAL PRODUCTION:		
Total Run	120	90–170
Escapement Goal	50–75	
Commercial Common Property Harvest	60	

FORECAST METHODS

The 1994 Upper Station run forecast is the pooled results of four separate regressions derived from the relationships of age specific returns for post 1978 brood years. The age 1.2 predication was determined from parent escapement; age 1.3 from age 1.2-siblings; age 2.2 from age-2.1 late-run siblings, and age 2.3 from age-2.1 siblings. The forecast range is the sum of the 80% confidence intervals for the four age class estimates.

FORECAST DISCUSSION

In 1994, there should be about 40% more early run Upper Station fish in the Alitak Bay District than in 1993 providing similar fishing patterns occur on the west side of Kodiak Island and the forecast is accurate. The Alitak Bay District catch of early run Upper Station sockeye salmon should be about 60,000 fish.

The 1994 run is expected to be approximately 75% 2-ocean age fish and 25% 3-ocean age fish. Age 2.2 fish should be dominant, comprising about 70%.

Confidence in the forecast is only fair because the sibling relationships used were generally not strong. In the Alitak Bay District, the early Upper Station sockeye run extends from early June to mid-July; the peak is usually about mid-June. Early run Upper Station sockeye salmon are a bycatch component of the targeted fishery on the Frazer Lake sockeye run.

Prepared by: Bruce Barrett, Patricia Nelson, and Ivan Vining
Commercial Fisheries Management and Development Division

FORECAST AREA: **Kodiak, Upper Station Lakes**

SPECIES: **Sockeye Salmon,** Late Run

PRELIMINARY FORECAST OF THE 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
TOTAL PRODUCTION:		
Total Run	425	300–550
Escapement Goal	150–200	
Commercial Common Property Harvest	250	

FORECAST METHODS

The 1994 Upper Station late run forecast represents the sum of three age-specific estimates from regressions equations developed from sibling and escapement-return relationships for the post-1974 brood years and two age-specific estimates derived from smolt abundance indices. Age 0.2 return was determined from brood year age 0. smolt numbers; age 0.3 from age-0.2 siblings; age 1.3 from age-1.2 siblings; and age 2.2 from age-1.2 siblings. Age-1.2 return was estimated from brood year age-1. smolt numbers. The forecast range is the approximate 80% confidence interval of the estimate.

FORECAST DISCUSSION

The 1994 late sockeye run to Upper Station Lakes should be slightly better (10%) than the 1993 run. Two-ocean age fish are expected to comprise 70% of the run, 3-ocean age fish 30%.

Most (50%) of the 1994 Upper Station late run should be age 2.2 fish (5-yr. olds) produced from the 1989 brood year. The age 0.* component should comprise about 30% of the run, which is about average.

The 1994 Upper Station late run forecast is for the Alitak Bay District only; if the fishing patterns and intensity is about the same on the west side of Kodiak Island as in 1993, the expected 1994 harvest in the Alitak Bay District should be about 250,000 late Upper Station fish.

In the Alitak Bay District, the late Upper Station sockeye run extends from mid-July to early September and peaks in mid-August.

Our confidence in this forecast is fair.

Prepared by: Bruce Barrett, Patricia Nelson, and Ivan Vining
Commercial Fisheries Management and Development Division

FORECAST AREA: **Kodiak, Frazer Lake**

SPECIES: **Sockeye Salmon**

PRELIMINARY FORECAST OF THE 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
TOTAL PRODUCTION:		
Total Run	700	500–900
Escapement Goal	140–200	
Harvest Estimate	525	

FORECAST METHODS

The 1994 Frazer Lake run forecast represents the sum of four age-specific estimates from regression equations developed from sibling relationships for post-1979 brood years and two age-specific estimates derived from smolt abundance indices. The age-1.2 return was determined from age-1.1 siblings; age 1.3 from age-1.2 siblings; and age 2.2 from age-2.1 and -1.1 siblings. The age-2.1 and -3.2 returns were estimated using brood year smolt indices. The forecast range is the 80% confidence interval.

FORECAST DISCUSSION

The 1994 Frazer Lake run is expected to be slightly better (5%) than the 1993 run.
Two-ocean age fish are expected to comprise 50% of the run, 3-ocean age fish 45%.

The 1994 run should be dominated by age-2.2 (46%) and -2.3 (24%) fish.

The forecasted 1994 run of 700,000 fish is for the Alitak Bay District only. We assume that fishing time and intensity on the west side of Kodiak Island will be about the same as occurred in 1993. If this occurs, the Alitak Bay District catch should be about 525,000 sockeye salmon of Frazer Lake origin.

In the Alitak Bay District, the Frazer Lake run timing is from mid-June to mid-July; the peak is commonly in late June.

Our confidence in this forecast is fair.

Prepared by: Bruce Barrett, Patricia Nelson, and Ivan Vining
Commercial Fisheries Management and Development Division

FORECAST AREA: **Kodiak, Ayakulik River (Red River)**

SPECIES: **Sockeye Salmon**

PRELIMINARY FORECAST OF THE 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
TOTAL PRODUCTION:		
Total Run	425	275–575
Escapement Goal	200–300	
Commercial Common Property Harvest	175	

FORECAST METHODS

The 1994 Ayakulik sockeye run forecast represents the sum of six age-specific estimates determined from sibling relationships and smolt indices. Age-1.3 fish were estimated from age-1.2 siblings, while age-2.3 return from age-2.2 siblings. Ages-1.1, -1.2, -2.1, and -2.2 returns were estimated from brood year smolt numbers.

The forecast range is a subjective estimate of the 80% confidence interval.

FORECAST DISCUSSION:

The 1994 Ayakulik sockeye run should be about 50% less than the 1993 run and produce a west side terminal catch in the Outer and Inner Ayakulik Sections of about 175,000 fish.

Overall, our confidence in the 1994 Ayakulik run forecast estimate is fair; mainly because most of the estimate is derived from a limited smolt data set.

If the 1994 run materializes as projected, age-2.2 fish will comprise about 70% of the run. Two-ocean age fish should represent about 70% and 3-ocean age fish 30% of the run.

The majority of the 1994 Ayakulik catch should occur in June.

Prepared By: Bruce M. Barrett, Patricia Nelson, and Ivan Vining
Commercial Fisheries Management and Development Division
Kodiak

FORECAST AREA: **Kodiak, Karluk Lake**

SPECIES: **Sockeye Salmon**, Early Run

PRELIMINARY FORECAST OF THE 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
TOTAL PRODUCTION:		
Total Run	600	500–700
Escapement Goal	150–250	
Commercial Common Property Harvest	400	

FORECAST METHODS

The 1994 Karluk early run forecast represents the sum of four age-class estimates mainly determined by using sibling relationships. Age-2.2 fish were estimated from a regression of escapement to age-2.2 returns. The age-2.3 estimate was determined using the sibling relationship of age-1.2 returns to age-2.3 fish returns. The age-3.2 estimate was developed from an age-3.1 to -3.2 fish sibling relationship, while the age-3.3 estimate was based on a similar age-3.2 to -3.3 fish relationship. The forecast range is the sum of the 80% confidence intervals for the age-class estimates.

FORECAST DISCUSSION

This is the second year that a formal forecast has been prepared for the early Karluk sockeye run. All of the age-specific estimates were determined using 1985–93 run numbers by age that were assigned to the respective parent year escapements to create a brood table. While the data set is limited, the sibling relationships are statistically quite strong.

Overall, our confidence in the 1994 Karluk early run forecast estimate is good.

If the 1994 run materializes as forecasted, there should be about the same number of fish available for harvest as occurred in 1993. It is estimated that the 1994 run should provide a commercial harvest of 400,000 early run Karluk fish from Sturgeon Head north to Steep Cape.

The 1994 early Karluk sockeye run is expected to be about 55% 2-ocean age fish and 45% 3-ocean age fish.

Prepared By: Bruce M. Barrett, Patricia Nelson, and Ivan Vining
CFMD Division–Kodiak

FORECAST AREA: **Kodiak, Karluk Lake**

SPECIES: **Sockeye Salmon**, Late Run

PRELIMINARY FORECAST OF THE 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
TOTAL PRODUCTION:		
Total Run	650	400–900
Escapement Goal	400–550	
Commercial Common Property Harvest	175	

FORECAST METHODS

The 1994 Karluk late run forecast represents the sum of four age-class estimates determined by using sibling relationships. Age-2.2 return was estimated from age-1.2 siblings, while ages -2.3, -3.2, and -3.3 returns were calculated using age-1.3 siblings.

The forecast range is the sum of the 80% confidence intervals for the age-class estimates.

FORECAST DISCUSSION

This is the second year that a formal forecast has been prepared for the Karluk late run. All of the age-specific estimates were determined using 1985–93 run numbers by age that were assigned to the respective parent year escapements to create a brood table.

If the late run forecast is correct, there should be about the same number of fish available for harvest as in 1993. It is estimated that the 1994 run will provide a commercial harvest of 175,000 fish from Sturgeon Head north to Steep Cape.

The 1994 late run is expected to be about 70% 2-ocean age fish and 30% 3-ocean age fish. The dominant run component should be age-2.2 fish, comprising about 50% of the run.

Our confidence in this forecast is fair.

Prepared By: Bruce M. Barrett, Patricia Nelson, and Ivan Vining
CFMD Division–Kodiak

FORECAST AREA: **Chignik Management Area**

SPECIES: Sockeye salmon

PRELIMINARY FORECAST OF THE 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
TOTAL PRODUCTION:		
Early Run (Black Lake)		
Total Run	1,800	1,200–2,400
Escapement	400	
Commercial Common Property Harvest	1,400	
Late Run (Chignik Lake)		
Total Run	1,300	940–1,600
Escapement	250	
Commercial Common Property Harvest	1,050	
Total Chignik Run		
Total Run	3,100	2,140–4,000
Escapement	650	
Commercial Common Property Harvest	2,450	

FORECAST METHODS

The estimated run to Black Lake is the sum of a regression estimate for two major age classes (ages 1.3 and 2.3) and a 10-year average for minor age classes, while the Chignik Lake run is based on recruit per spawner relationships. The Black Lake forecast is based on the historical relationship between the number and length of prior year age-1.2 fish, and the parent year escapement number. All other age classes are predicted from a 10-year average. The Chignik Lake forecast accuracy has historically been quite variable, and developing a model such as the one used for the Black Lake run has been unsuccessful. The Chignik Lake run forecast for 1994 was derived using average return per spawner relationships for each year class for years post-1969.

DISCUSSION OF THE 1994 FORECAST

Early Run: The 1994 Black Lake sockeye salmon run is expected to be 1.8 million fish. This is approximately 0.1 million fish more than the 1984–92 average run of 1.7 million fish and 200,000 fish more than the 1993 forecast. This above average run is expected because in 1993 age-1.2 fish were about 50% more abundant than the 10-year average.

Late Run: The estimated 1994 Chignik Lake sockeye run is 1.3 million fish, 0.2 million more than the 1983–92 average of 1.1 million fish. The Chignik Lake run forecast accuracy has historically been quite poor when compared to actual returns. The major returning year classes are primarily age 5 and 6. For the 5-year-olds, the 1989 parent year escapement of 557,171 is 300,000 over the optimum of 250,000. Overescapements of this magnitude have historically resulted in low recruit per spawner relationships (<1). For the 6-year-olds, the 1988 parent year escapement of 255,180 was close to the desired goal. Returns at this level have been variable; the post-1969 average of 2.8 per spawner.

Prepared By:
Alan Quimby
Area Management Biologist
Chignik Area ADF&G

David Owen
Assistant Area Biologist
Chignik Area ADF&G

FORECAST AREA: **Bristol Bay**

SPECIES: **Sockeye Salmon**

PRELIMINARY FORECAST OF 1994 RUN:

	Forecast Estimate (millions)	Forecast Range (millions)
TOTAL PRODUCTION:		
Total Run	56.0	41.3–70.7
Escapement Goal	12.8	
South Peninsula Quota	3.6	
Commercial Common Property Harvest (Inshore)	39.6	

Forecasted sockeye harvests for inshore Bristol Bay fishing districts are as follows: Naknek-Kvichak = 13.0 million; Egegik = 17.8 million; Ugashik = 4.9 million; Nushagak = 3.6 million; and Togiak = 0.4 million.

FORECAST METHODS

The 1994 Bristol Bay forecast is the sum of individual predictions for nine river systems (Kvichak, Branch, Naknek, Egegik, Ugashik, Wood, Igushik, Nushagak-Mulchatna, and Togiak) and four age classes (age 1.2, 1.3, 2.2, and 2.3 sockeye salmon). In addition to the four major age classes, a prediction was also made for the return of age-0 freshwater fish to Nushagak-Mulchatna River because of their relative importance to the total run of that system. Predictions for each age class returning to a river system were calculated by averaging results from simple linear regression models based on the relationship between returns and either spawners or siblings. Also the relationships between returns and smolt outmigrants were examined with regression models for Kvichak, Egegik, and Ugashik. Results from each regression model were excluded from final forecast calculations if the slope of the line was not significantly different from zero ($P < 0.25$). The mean return of an age class to a specific river system was used to predict returns when none of the models could be used.

The data base used for the 1994 forecast of sockeye returns was similar to that used for the 1989–93 predictions. We used production data from recent years (since 1978) to predict returns for systems on the eastside of Bristol Bay (Kvichak, Branch, Naknek, Egegik, and Ugashik Rivers), while we used all years data (since 1956) for systems on the westside of Bristol Bay (Wood, Igushik, and Togiak Rivers). Because the number of returning adults produced from each spawner has shown a dramatic increase since

1978 for eastside rivers, we thought use of recent data would provide more accurate and less biased predictions of run size. Nushagak-Mulchatna predictions were based on all available production data (1980–93).

To estimate and compare forecasting errors of using recent versus all data, we made predictions for 10 years (1984–93). For eastside Bristol Bay predictions collectively, results from predicting 10 years in the past indicated that the use of recent data would increase accuracy (mean absolute percent error; 1984–93 was 29.9% using recent data and 46.4% using all data) and decrease bias (mean percent error; 1984–93 was -25.2% using recent data and -46.4% using all data). However, using recent data for westside predictions resulted in large over-forecasting errors which reduced accuracy (mean absolute percent error; 1984–93 was 52.8% using recent data and 25.0% using all data) and increased bias (mean percent error; 1984–93 was 38.8% using recent data and -23.4% using all data).

Although using recent production data rather than all data reduced prediction errors for eastside rivers during years (1984–93) tested, we still would have under forecasted eastside returns 8 out of 10 years. To further correct this tendency of under-forecasting, we increased the 1994 forecast for each river by its respective prediction error for the years 1984 to 1993. The 1994 adjustments by river resulted in an overall increase of 39.4% for the total Bristol Bay forecast. The 1984–93 predictions errors by river were: 30% for Kvichak, 19% for Branch, 25% for Naknek, 60% for Egegik, 33% for Ugashik, 26% for Wood, 94% for Igushik, and 39% for Togiak. The average prediction errors for years 1984 to 1993 were used because those were the years we were able to hindcast using recent years production data. We also investigated trends in predictions errors based on all years data with regression analysis but chose not to use these methods since results were similar to the simpler method of applying 1984–93 prediction errors.

The mean squared error (MSE) of the total run forecast was calculated from the deviations of actual runs from run predictions made for 1987 to 1993. Run predictions for 1987 to 1993 were based on the same methods used for the 1994 forecast (the use of recent years production data for eastside systems and all years production data for westside systems corrected by each individual river's average error rate). The MSE was then used to estimate the standard error and 80% confidence bounds.

FORECAST DISCUSSION:

Based on the method described above, 56.0 million sockeye salmon are expected to return to Bristol Bay in 1994. A run of this size would be the third highest run since 1956, the first year total run information is available. The 1994 prediction is 60% greater than the previous 20-year mean (34.9 million; range, 3.5 million to 66.3 million), and 40% greater than the previous 10-year mean (39.9 million; range, 24.0 million to 55.0 million). Runs are expected to exceed spawning escapement goals for all systems.

The inshore harvest is expected to be 39.6 million sockeye salmon. A harvest of this size would be the second largest in Bristol Bay history with only the 1993 harvest of 40.8 million being greater.

The previous 20-year mean is 20.2 million (range, 0.7 million to 40.8 million) and the previous 10-year mean is 25.4 million (range, 13.9 million to 40.8 million). An additional 3.6 million Bristol Bay sockeye salmon will be harvested during June in the Shumagin Islands and South Unimak fisheries under the current Alaska Board of Fisheries management plan (8.3% of the total projected 43.2 million harvest).
Differences in projections from the three linear regression models (spawner-return, sibling, and smolt) and out of range data suggest possible deviations in the 1994 forecast. The returns of age-2.2 sockeye salmon to the Kvichak River could be less than predicted because the smolt data base predicted fewer returns than either the spawner-return or the sibling data bases. Egegik River returns of age-2.2 and age-2.3 sockeye salmon could be less than predicted. Egegik River smolt data predicted less returns of age-2.2 sockeye salmon than either the sibling- or spawner-return models. In addition, greater than previously recorded sibling and smolt numbers were used in regression models to predict Egegik returns of age-2.3 sockeye salmon. There is a great amount of uncertainty in using data outside the range of the model, but based on hindcasting results, we felt that inclusion of these data would improve forecasting accuracy. Finally, age-1.3 and age-2.2 returns of sockeye salmon to Ugashik River could be less than predicted. Sibling-return data predicted less returns of these ages than spawner-return models. Also, there are no smolt data to predict returns of age-1.2 and age-2.2 sockeye salmon to Ugashik River in 1994 because the project was not operated in 1992.

Beverly Cross
Research Project Biologist
Anchorage

FORECAST AREA: **Bristol Bay, Nushagak District**

SPECIES: **Chinook Salmon**

PRELIMINARY FORECAST OF 1994 RUN:

	Forecast Estimate (thousands)	Forecast Range (thousands)
TOTAL PRODUCTION:		
Total Run	151	113–188
Inriver Run Goal[1]	75	
Commercial Common Property Harvest	76	

[1] The Nushagak inriver run goal is 75,000 chinook salmon which provides for a biological escapement goal of 65,000 spawners and an additional harvest of 10,000 chinook salmon by upriver subsistence and sport fisheries.

FORECAST METHODS

The 1994 chinook salmon forecast for Nushagak District is the sum of individual predictions for five age classes (ages-1.1, -1.2, -1.3, -1.4, and -1.5). The prediction for each age class was first calculated from a simple linear regression model based on the relationship between sibling returns in succeeding years (e.g., age-1.4 returns for 1994 based on age-1.3 returns in 1993). However, predictions from regression models were only used if the slope of the line was significantly different from zero ($p < 0.25$). If this criteria was not met, the mean return of an age class was used to predict 1994 returns.

Regression models were used to predict age-1.3, age-1.4, and age-1.5 returns. Mean returns were used to predict age-1.1 and age-1.2. In addition, the 1994 forecast was adjusted to account for over forecasting errors that have occurred for 9 out of the past 10 years. The 1994 prediction was reduced by the 1984–1993 average forecast error (17.26%). The average forecast error from 1984–1993 was used because the number of chinook salmon returning to Nushagak River has declined since 1984. However, chinook runs have shown increases from 1991-93. The mean squared error (MSE) of the total run forecast was calculated from the deviations of actual runs from hindcasts for the years 1987 to 1993. Hindcasts were based on the same methods used for the 1994 forecast. The MSE was then used to estimate the standard error and 80% confidence bounds.

FORECAST DISCUSSION

The age composition of the 1994 forecasted run is 0.3% (0.5 thousand) age 1.1, 13.6% (20.5 thousand) age 1.2, 38.2% (57.5 thousand) age 1.3, 43.9% (66.0 thousand) age 1.4, and 4.0% (6.0 thousand) age 1.5. The 1994 forecasted run of 150.6 thousand chinook salmon is 8% less than the long-term (1966–1993) mean run of 163.6 thousand, and 18% greater than the most recent five-year (1989–1993) mean run of 127.2 thousand. The projected harvest of 75.6 thousand is similar to the long term mean harvest of 73.2 thousand and 129% greater than the most recent five-year mean harvest of 33.0 thousand. The chinook salmon run to Nushagak District declined from 1984–1990, but increased somewhat in 1991, 1992, and 1993.

Beverly Cross
Research Project Leader

1994 COMMERCIAL HARVEST OUTLOOK FOR THE AYK REGION

(Projections given in thousands of fish.)

	SPECIES					
Management Area	Chinook	Sockeye	Coho	Pink	Chum	Fall Chum
Kuskokwim River	9–56	27–137	196–666	2–11	0–400	
Kuskokwim Bay	15–55	13–140	32–206	13–79	0–90	
Kuskokwim Total	24–111	40–277	228–872	15–90	0–490	
Yukon	67–99	0	0–50	0	0–400	0–73
Norton Sound	4–6	0	40–60	0–1,000	0–80	
Kotzebue Sound	0	0	0	0	0–150	

Inside back cover