Regional Information Report No. 5J98-04

Run Forecasts and Harvest Projections for 1998 Alaska Salmon Fisheries and Review of the 1997 Season

Edited by
Deborah Hart
David Petree
and
Harold J. Geiger

June 1998

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

Frank Rue
Commissioner

The Regional Information Report Series was established in 1987 to provide an information access system for all unpublished divisional reports.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

Run Forecasts and Harvest Projections for 1998 Alaska Salmon Fisheries and Review of the 1997 Season

Edited by
Deborah Hart
David Petree
and
Harold J. Geiger

Regional Information Report No. 5J98-04

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

June 1998

Authors

Deborah Hart and David Petree are fishery biologists and Harold J. Geiger is the principal salmon biometrician with the Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division, P.O. Box 25526, Juneau, AK 99802-5526.

Acknowledgments

This report is based on information contributed by Commercial Fisheries Management and Development Division biologists located in field offices throughout the state. Individual credit for forecast material is contained in area forecast discussions in the Appendix. Area biologists throughout the state supplied reviews of the 1997 fishing season.

Table of Contents

List of Tables

List of Figures

List of Appendices

Executive Summary

The Alaska Department of Fish and Game is expecting an overall increase in commercial salmon harvests in 1998. The 1998 commercial catch projection of 146 million is distributed as 598 thousand chinook, 36.5 million sockeye, 6.26 million coho, 85.6 million pink, and 17.4 million chum salmon. Table 1 shows specific projection numbers by species and fishing area.

This 1998 projected harvest is somewhat higher than the 1997 actual all-species commercial harvest of 123 million salmon. In 1997 the commercial catches were generally below preseason projections. Chinook salmon catches were an exception to this rule, while coho runs were far lower than expected in most areas. Even so, the overall level of commercial catch is still quite high by historical standards. We suspect that last year's shortfall was due to unobserved changes in ocean conditions. If these conditions continue, this year's projections could be too high as well. The 1997 commercial harvest is broken down as 628 thousand chinook[1], 31.1 million sockeye, 3.15 million coho, 71.9 million pink, and 16.2 million chum salmon. Table 2 shows harvest numbers by species and fishing area, in units of fish harvested, and Table 3 provides this information in units of pounds harvested.

The exvessel value of the 1997 commercial harvest continued its downward trend. The preliminary estimate for 1997's harvest is $274 million — well below the estimates of $378 million for 1996, $466 million for 1995, and $489 million for 1994.

The 1997 Bristol Bay sockeye run was considerably under forecast. The 1997 forecast was for a return of 35.8 million, with an in-Bay catch of 24.8 million. The actual run was 20.1 million, with an in-Bay catch of 12.3 million. Because of this forecast error, the department reviewed its forecasting methods and looked at using additional information that might improve this year's forecast. However, we were unable to provide a convincing explanation for last year's shortfall and therefore did not change our procedures. The forecast for 1998 is for a run of 32.1 million and an in-Bay catch of 20.6 million.

Biologists in Southeast Alaska are expecting a STRONG run of pink salmon with catches in the range of 36 to 50 million. Biologists in Prince William Sound are forecasting a run of 26.0 million pink salmon and a commercial catch of 23.3 million. The forecast for the Copper River sockeye run is 2.74 million and a catch of 2.14 million. Biologists in Upper Cook Inlet forecast a sockeye run of 4.0 million and a catch of 2.5 million. Biologists in Kodiak are forecasting a pink run of 10.8 million and a catch of 6.3 million.

Look for inseason harvest information, postseason statistics, and preseason outlooks on the World Wide Web at *http://www.cf.adfg.state.ak.us/cf_home.htm*.

Introduction

The Alaska Department of Fish and Game's (ADF&G) four major fishery management regions (Southeast, Central, Arctic-Yukon-Kuskokwim, and Westward) are shown in Figure 1. These regions supersede any references to the department's former statistical regions.

Forecasts of runs (catch + escapement) for major salmon fisheries and projections of the statewide commercial salmon harvest have been published every year by ADF&G since 1969 (ADF&G 1969–1973, 1975–1983; Eggers 1985, 1986; Eggers and Dean 1987, 1988; Geiger and Savikko, 1989–1993; Geiger and Simpson 1994, 1995; Geiger and Frenette 1996–1997; and Geiger et al. 1997). Though the department does not produce formal run size forecasts for all salmon runs in the state, local salmon biologists prepare harvest projections or harvest outlooks for all areas. Projections are based on formal forecasts, when available. When the formal forecasts are not

[1] This value has been corrected from the earlier short forecast, Regional Information Report 5J98-01.

available, local biologists use average historical catches and local knowledge of recent events to develop these outlooks. Projections for the 1998 Alaska commercial salmon harvest, by species and area, are found in Table 1. Harvest outlooks for the Arctic-Yukon-Kuskokwim (AYK) Region are developed as ranges; these ranges are listed in Appendix B. Trends in total statewide salmon harvests and catch projections in numbers of fish, by species, are found in Figures 2–6. Tables 2–7 provide detailed information on the 1997 harvest. A forecast of a catch index of AYK summer chum salmon is provided in Appendix C. Starting with the 1998 season, the Alaska Board of Fisheries tied a guideline harvest level of chum salmon in the June "False Pass" fishery to this forecast index.

This report contains a detailed review of Alaska's 1997 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.

Predominate ages and brood years for 1998 salmon runs, by species, are as follows:

	Age of Returning Salmon in Years				
Species	2	3	4	5	6
Pink	1996				
Chum		1995	1994	1993	
Coho		1995	1994		
Sockeye			1994	1993	1992
Chinook			1994	1993	1992

The common and scientific names of 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*

Definitions of Terms

Biological escapement goal — The number of salmon in a particular stock that ADF&G has determined should be allowed to escape the fishery to spawn to achieve the maximum yield for human use. This determination is based on biological information about the fish stock in question. (Also see *optimum escapement goal*.)

Commercial harvest — Harvests of fish that are used for commercial purposes. This includes fish caught by the commercial common property fishery (see below), by hatchery operators for cost recovery, and other harvests going

	into commercial channels; it excludes sport, subsistence, and personal use harvests.
Commercial common property harvest	Harvests taken by traditional, competitive commercial fisheries (gillnet, purse seine, and troll), as opposed to commercial harvests resulting from hatchery cost recovery, fishing derbies, and sale of 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.
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 broodstock	The portion of a salmon run that 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.
Optimum escapement goal	The number of salmon in a particular stock that should be allowed to spawn to achieve sustainable runs based on biological needs of the stock, as well as social and allocative implications when managing for this level or other relevant considerations.
Run forecast	Forecasts of a run (harvest + escapement) are estimates of the fish returning in a given year based on such information as parent-year escapements, subsequent fry abundance, spring seawater 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 1997 Alaska Commercial Salmon Fisheries

Southeast and Yakutat

The 1997 Southeast Alaska commercial salmon harvest, including hatchery cost recovery, totaled 45.4 million fish, the third lowest in the last ten years, but still above the "since-statehood" average of 30.7 million. With few exceptions, Southeast Alaska's salmon stocks are in excellent condition, and this year's return would only be described as disappointing if viewed from the recent ten-year-average perspective. While 1997 did not continue the trend of at least one species setting a new record every year, the all-salmon species harvest of 45.4 million was one of the top ten harvests during the first 111-year period of the fishery from 1878 to 1988. The exvessel value of the 1997 harvest was $76.1 million, slightly higher than last year's value of $70.4 million. A total of 2,071 permits (369 purse seine, 430 drift net, 142 set net, 387 hand troll, and 743 power troll) were fished in the 1997 Southeast salmon fisheries. Compared to last year, there were 1 fewer purse seiner, 15 fewer drift gillnetters, 23 fewer hand trollers, 2 more set gillnetters, and 5 more power trollers. Fish traps were not fished on the Annette Island Fishery Reserve for the fourth consecutive year. The chinook catch was 271 thousand, slightly below the since-statehood average of 291 thousand. Approximately 59 thousand of the chinook salmon harvested were of hatchery origin. The chinook harvest was constrained by U.S./Canada Salmon Treaty obligations. The regionwide escapement index goal was exceeded for the third time in five years, primarily due to the Taku and Stikine runs. The escapement was poorly distributed, however, with the Taku and Stikine Rivers greatly exceeding their goals, while the Alsek River and all index systems in the Behm Canal area fell well below desired escapement levels.

The 1997 sockeye harvest of 2.5 million was slightly above the ten-year average of 2.3 million. An estimated 131 thousand hatchery sockeye salmon were harvested. Sockeye escapements in Southeast Alaska were mixed. Ketchikan had average to slightly below-average escapements in those systems that were monitored. Petersburg had average to slightly above-average escapements in all monitored systems with the exception of Luck Lake, which experienced a record escapement. Sitka area systems were slightly below average, with the exception of Redoubt Lake, which was slightly above average. Necker Bay, which occasionally supports a commercial fishery, was not opened commercially and its escapement was still below average. Escapements of sockeye salmon into Sitkoh Lake were comparable to the 16 thousand estimated in 1996. In northern Southeast, sockeye salmon escapements were near management's goal in the Taku River, above goal in Chilkat Lake, and below goal in Chilkoot Lake.

This year's coho salmon harvest of 1.95 million fish was substantially below the most recent ten-year average of 3.08 million fish and was the lowest catch since 1988. Approximately 304 thousand of the coho harvest were of hatchery origin. Coho salmon runs ranged from very weak to below average throughout most of the region. Consequently, the troll fishery was closed for ten days at the peak of the season and further area closures were used to protect inside-area stocks in northern Southeast. Fall drift gillnet fishery openings were limited in most districts. These fishing restrictions effectively allowed passage of fish to spawning areas. Escapements were within acceptable ranges in all monitored systems. Coho runs were strong on the outer coast of Chichagof Island and north to Cape Suckling. The Yakutat area set gillnet fisheries had the third highest catch in history, behind only to years 1941 and 1994.

The 1997 pink salmon harvest of 29.0 million was well below the ten-year average harvest of 45.6 million and the lowest since the extremely poor harvests of 10 million in 1987 and 11 million in 1988. Hatchery fish were a relatively minor component of the total, with the hatchery harvest estimated at approximately 2 million. This year's harvest was only 3 million above the lower end of the preseason forecast range of 26–48 million.

The pink salmon escapement index was within the management's optimum range. The southern Southeast escapements were well-distributed, with Districts 101 through 104 and 106 escapement indices within their goal ranges. Only Districts 105 and 107 were outside their goal ranges, with District 105 being slightly above range. The escapement index in northern Southeast was the highest index obtained since the program was initiated in 1960. The only district that did not reach its goal in northern Southeast was District 110, which was at 75% of its index goal.

A total of 11.7 million chum salmon were harvested in 1997, the second largest harvest in history, surpassed only by the 1996 harvest of 15.7 million. The four highest chum salmon harvests in the 119-year history of the fishery have occurred during the last four years. Preliminary estimates indicate that 7.4 million or 75% of this year's chum harvest was of hatchery origin. Although formal escapement goals have not been set for Southeast Alaska chum salmon, an annual index is calculated by selecting a set of index streams. This year's chum salmon escapement index was the eighth largest since 1960, but well below the 1996 record. While most chum salmon stocks continue to exhibit strength, two areas remain weak. These are Fish Creek near Hyder and the Chilkat River near Haines. The Chilkat River had poor escapements despite early closures in the Lynn Canal gillnet fishery in an effort to reduce harvesting pressure on the fall chum salmon.

Prince William Sound

The 1997 Prince William Sound Area commercial salmon harvest of 32.3 million fish is the fifth highest on record. The harvest was composed of 25.8 million pink, 4.2 million sockeye, 2.2 million chum, 83 thousand coho, and 52 thousand chinook salmon. The majority of the catch, 21.4 million, was common property harvest and 10.9 million were sold for hatchery cost recovery (exclusive of roe/meal sales). The estimated exvessel value of the combined commercial salmon harvest is $45.2 million, including hatchery sales. During the 1997 season, 520 drift gillnet permit holders fished. The drift gillnet catch was valued at $25.2 million, setting the average earnings at $48.6 thousand. The set gillnet catch is valued at $1.04 million, setting the average earnings of the 26 participating permits at $40 thousand. The seine fishery was worth $9.2 million for an average exvessel value of $80.5 thousand for the 114 permit holders that participated. Revenues generated for hatchery operations (exclusive of roe/meal sales) was approximately $9.7 million.

Copper and Bering Rivers

The 1997 harvest forecast for the Copper River District was 46 thousand chinook, 1.5 million sockeye, and 335 thousand coho salmon. The Gulkana Hatchery, located north of Paxson Lake, was expected to contribute approximately 200 thousand sockeye salmon to the commercial catch. The 1997 sockeye harvest of 2.96 million is the largest on record, surpassing the 1996 record harvest of 2.35 million. The harvest of 51.3 thousand chinook salmon was the fifth largest harvest on record. This occurred even with the mandated area restrictions in the first commercial fishing period and a change in the typical harvest pattern due to the large sockeye return. The inriver goal past Miles Lake sonar of 592 thousand salmon was nearly doubled with an estimated 1.15 million salmon passing the sonar site. The sockeye aerial escapement index for the Copper River Delta systems was 23% below the index goal.

Sockeye harvest levels during the first two periods exceeded anything experienced before. Fish caught early in the season enter the fresh market. Managers reduced fishing periods to 12 hours and fished every other day to increase escapements into the Copper River and to keep harvest rates in line with processing capacity to avoid quality deterioration.

The Copper River District coho salmon harvest of 19 thousand was only 6% of the projected harvest of 335 thousand. The coho season officially began on August 11 with a single 24-hour period for the week. During the August 11 period, 180 permits were fished, which was average for that

time. Harvests were far below that projected, with only 2,100 coho salmon taken. With both catch and escapement estimates far below projected levels and poor coho salmon returns throughout the state, the Copper and Bering River Districts did not open for the second 24-hour period that week. The Copper River District remained closed following the August 11 fishery. The aerial survey index of coho salmon escapement within the lower delta systems was above the index goal for the surveyed systems.

The 1997 harvest for the Bering River District sockeye salmon was 10 thousand, slightly less than half the preseason projection and the lowest catch since 1990. Commercial fishing periods in the Bering River District generally coincide with the Copper River District. The Bering River District escapement index was nearly double the management's goal for sockeye salmon and about two-thirds of the goal for coho salmon.

As with the Copper River District, coho salmon harvests during the August 11 fishing period were far below expectations with only 97 coho salmon harvested; the anticipated harvest was 600 coho salmon. Escapement into the Bering River/Controller Bay systems, like the Copper River Delta, was behind at the beginning. However, by mid September the actual observed escapement exceeded that anticipated in all systems.

Prince William Sound Districts

Prior to July 21, management of Prince William Sound is concerned with how the gillnet fishery affects the return of sockeye salmon to Coghill Lake and the return of chum salmon to the Wally Noerenberg Hatchery. Later, management turns its attention to the large seine fishery, which targets the large pink salmon runs to Prince William Sound.

The total commercial harvest of sockeye salmon in the Coghill District was 227 thousand. The sockeye salmon return to Coghill Lake was stronger than forecast. Escapement past the weir was above the projection for most of the season. The weir was pulled on August 4 with a total enumerated escapement of 35.7 thousand sockeye salmon; Coghill Lake sockeye salmon are managed for an escapement goal of 25 thousand. The total of both the common property harvest and the corporate escapement for chum salmon was 1.60 million, slightly more then the preseason forecast. The common property harvest of early chum salmon was 690 thousand. The hatchery harvested 715.4 thousand chum salmon for sales and the broodstock goal of 160 thousand was achieved. The enhanced chum salmon runs were strong and the areawide chum harvest set a record in 1997. Overall, escapement by districtof wild chum salmon stocks mirrored the performance of pink escapements. The Eastern and Southeastern Districts exceeded their respective goals while other districts experienced escapement shortfalls.

The 1997 forecast of Main Bay Hatchery sockeye salmon was 500 thousand, composed of 330 thousand Coghill stock and 170 thousand Eshamy stock. The Eshamy wild stock return was forecasted at 58 thousand sockeye salmon: 40 thousand for escapement and 18 thousand for common property harvest. The common property harvest of sockeye salmon from all stocks was a record 672 thousand.

Prince William Sound Aquaculture Corporation changed its cost-recovery program in 1997 from the previous 40% of the return to a cost-revenue goal. For nonpink salmon species, the revenue goal was $2.4 million, $1.2 million coming from Main Bay Hatchery sockeye salmon. Their cost-revenue goal was met; however, based on preseason sales they fell short of the poundage presold by 24 thousand pounds. Hatchery broodstock goals for Eyak and Eshamy stock sockeye salmon were achieved. The Coghill stock is being discontinued at Main Bay Hatchery and all Coghill stock returns were harvested for sales.

This year 25.8 million pink salmon were harvested in Prince William Sound. Most fishing effort for chum and pink salmon was directed at the migration corridors used by hatchery fish. Open areas in the Eastern and Southeastern Districts outside these migration corridors attracted little seine effort. Consequently, escapement goals were met or exceeded in the Southeastern and Eastern

Districts. The Southeastern District pink salmon escapement was 44% above the season goal and the Eastern District was 2% above goal. In other districts, wild stock escapements did not fare as well.

In the Northern/Unakwik Districts, index escapements were 60% below the season goal. The Northwestern and Coghill Districts were 39% and 67% below their respective index escapement goals. The Southwestern District was only 6% below its index escapement goal for the season, while the Montague District was 19% below and the Eshamy District finished the season 66% below its pink salmon index escapement goal. During the harvest of late-timed pink salmon, a majority of common property seine openings took place in hatchery subdistricts or terminal areas. Most seine harvests had enhanced pink salmon contributions of 90% or more. The ratio of enhanced pink salmon to wild pink salmon in the 1997 total return is estimated at 10:1.

In 1990 and 1991, as part of *Exxon Valdez* Oil Spill studies, researchers applied coded wire tags to wild pink salmon at six streams in the western Sound. Stream surveys in 1991 and 1992 indicated that significant straying, both by hatchery fish and wild stocks, was occurring in some streams. However, one hypothesis was that the tags themselves were causing straying. In 1997 hatchery pink salmon were marked with a new kind of physiological mark in their ear crystals, or *otoliths*. These otolith marks, in conjunction with coded wire tags, provided an opportunity to study the relationship between coded wire tagging and straying. A total of 14 streams were surveyed for coded-wire-tagged fish during the spawning season. Otolith samples were simultaneously collected. Preliminary results from these studies was that significant numbers of hatchery pink salmon are straying into the wild populations in the studied streams. In most cases, the hatchery strays exceeded the wild component of the escapement. Coded wire tag recoveries from these same streams provided similar straying results, indicating that tag-induced straying by pink salmon may be negligible. The timing of the influx of hatchery fish into streams indicated that as the spawning season begins to wane in late August to mid-September, the hatchery component of the escapement increases.

Cook Inlet

Upper Cook Inlet

The 1997 all-species commercial salmon harvest of 4.41 million salmon is slightly above the 1954–1997 average of 4.05 million. Roughly 93% of the total salmon harvest was composed of higher-value sockeye salmon, which resulted in an exvessel value of $30.5 million, the 11th highest exvessel value since 1960. The commercial season in all of Upper Cook Inlet ended by emergency order on August 7 due to poor coho salmon run strength.

The 1997 harvest of 13 thousand chinook salmon was 3 thousand fish below the long-term average and valued at $325 thousand, exvessel. Consistent with the management strategy outlined for the Alaska Board of Fisheries, the directed chinook salmon fishery in the Northern District was initially limited to a single period to aid in rebuilding a number of stocks where escapement levels had been below desired levels in recent years. As a result of escapement goals being achieved or exceeded in most of the monitored systems during the last period, the fishery was reinstated along with reopening of sport fisheries in the affected areas.

The Central District eastside set gillnet fishery harvest of 11 thousand chinook salmon was slightly above the long-term average harvest. An estimated 54 thousand chinook salmon passed the sonar on the Kenai River. With an estimated 10 thousand fish harvested in the recreational fishery, that left an estimated escapement of 44 thousand, well in excess of the goal of 22.3 thousand.

The Upper Cook Inlet harvest of 4.09 million sockeye salmon was the eighth highest catch on record and approximately 1.7 million fish higher than the long-term average. The harvest was 1.2 million fish below forecast of 5.3 million due primarily to Kenai River stocks that were weaker than forecast. Sockeye salmon prices at the beginning of the season were $0.65 to $0.75 per pound, but by

the end of the season most processors were paying $1.10 to $1.15 per pound, paid retroactively to the beginning of the season. This resulted in an exvessel value for sockeye salmon of $29.6 million or 97% of the total exvessel value.

The 1997 coho salmon harvest of 144 thousand was nearly half the average long-term harvest in Upper Cook Inlet and the lowest harvest in 23 years. With few exceptions, the coho salmon harvest throughout Upper Cook Inlet was poor, period after period, with little improvement as the season progressed. Escapements into monitored systems were also lagging far behind desired levels. Coho salmon run strength remained so weak that after the commercial period on August 4 the entire commercial fishery in all of Upper Cook Inlet was closed for the remainder of the 1997 season for coho salmon conservation. In conjunction with this commercial closure, bag limits in the recreational fishery were reduced from three fish to one fish with a prohibition on the use of bait.

The 1997 harvest of 71 thousand pink salmon was nearly half the long-term average for an odd year in Upper Cook Inlet. As with chum salmon, management actions restricting the drift fleet and Northern District fisheries for Yentna sockeye salmon contributed to this poor pink harvest. Pink salmon escapements are not monitored in Upper Cook Inlet. However, it appears that escapements to most river systems were normal for odd-year runs. Prices paid for pink salmon were $0.06 to $0.09 per pound, resulting in an exvessel value for this species of $12.5 thousand.

The 1997 harvest of 89 thousand chum salmon was the lowest harvest on record. Again, management of the drift fleet and Northern District fisheries for Yentna sockeye salmon affected this harvest. However, since the flood of 1986, chum production in much of southcentral Alaska has been poor. In addition, the chum salmon return to Chinitna Bay, judged subjectively to be fairly strong, was essentially unexploited, as the local set gillnet fishery was inactive due to poor prices and no tendering service from any processor. Fishermen were paid $0.15 to $0.25 per pound for chum salmon, producing an exvessel value of $120 thousand or just 0.4% of the overall fishery value in Upper Cook Inlet.

Lower Cook Inlet

The commercial salmon harvest of 3.07 million fish in Lower Cook Inlet was the fourth highest in the last 20 years. However, over 82% of the total salmon harvest was taken by Cook Inlet Aquaculture Association (CIAA) and Port Graham Hatchery Corporation (PGHC) to support private nonprofit hatchery stocking programs. Although sockeye and pink salmon catches fell short of the preseason forecast, both substantially exceeded the recent 20-year average. The total harvest of all species resulted in a preliminary exvessel value of $2.42 million, slightly exceeding last year's $2.29 million.

As in previous years, hatchery cost recovery continued to play a dominant role in the Lower Cook Inlet fishery, accounting for approximately 51% of the total exvessel value. Cost recovery harvest of sockeye salmon occurred on hatchery production from the English Bay Lakes, Kirschner Lake, Bear Lake, and Grouse Lake. Hatchery harvests at the four locations composed 15% of the total Lower Cook Inlet sockeye salmon landings, while cost recovery for pink salmon in the Tutka Bay and Port Graham Subdistricts made up 87% of the total Lower Cook Inlet pink harvest.

The chinook salmon, although a nontargeted species for Lower Cook Inlet commercial fishermen, were harvested near the 20-year average catch level. The catch was near 1.26 thousand chinook salmon. Over 90% of the catch came from set gillnets, again due to enhanced production in Halibut Cove Lagoon and Seldovia Bay.

The total sockeye catch of 240 thousand exceeded the preseason projection of 228 thousand fish and was 30% greater than the 20-year average. Sockeye salmon only accounted for 8% of the landings in 1997, but due to the price differential, composed 46% of the total value of the Lower Cook Inlet fishery. Once again, most of this year's sockeye harvest came from enhancement projects.

In the Southern District, the China Poot Subdistrict produced a catch of 42 thousand sockeye salmon, substantially exceeding the expected 3.5 thousand fish. Catches in Neptune Bay, generally assumed to be mostly hatchery returns to nearby Hazel Lake, amounted to 73 thousand fish. Sockeye returns to the English Bay Lakes system, now supplemented by the Nanwalek salmon enhancement project, were strong enough to support a commercial harvest for a third consecutive year after nearly a decade of continuous closures.

The preliminary coho salmon harvest of 9 thousand fish fell short of the long-term average of 13.9 thousand. By all indications hatchery returns appeared to be relatively strong, while wild stocks of coho salmon throughout Lower Cook Inlet appeared to be about average. This was in sharp contrast with Upper Cook Inlet where coho runs were reported to be extremely poor.

Pink salmon returns, normally the dominant species in numbers of fish, composed 92% of the Lower Cook Inlet harvest. The catch of 2.81 million pink salmon was about 10% less than the preseason forecast but over double the recent 20-year average of 1.18 million. Nearly the entire harvest came from Tutka Bay Hatchery cost recovery operations with an additional 216 thousand fish taken for broodstock.

Wild stocks of pink salmon were generally strong in keeping with Lower Cook Inlet odd-year dominance. Although escapement goals were achieved or exceeded in nearly all index streams, pink salmon were notably late this season. This probably can be attributed to the severe lack of precipitation, low water levels, and warm temperatures in the streams. Throughout the month of July ground-survey crews reported many stream levels were so low as to preclude fish migrations altogether. Where there was sufficient water to allow fish passage, fish seemed reluctant to move upstream out of the intertidal area.

The chum salmon harvest of 6 thousand fish was one of the lowest on record in Lower Cook Inlet and only 6% of the long-term average. Although several chum runs were strong enough to meet escapement goals and could have sustained some limited harvests, many other systems again fell below desired levels. Because of the weak returns and poor prices in recent years, fishermen ignored chum salmon and focused on the higher-priced sockeye salmon. The low catches continued a declining trend in Lower Cook Inlet chum landings that began in 1989. One notable exception was McNeil River where a season-long closure resulted in an estimated escapement of 27,500 fish. The escapement goal of 20,000–40,000 fish was achieved for the first time in eight years.

Bristol Bay

The inshore run of sockeye salmon totaled approximately 19 million fish and was the second lowest inshore return in the last 20 years (1977–1996). It was approximately 44% less than the preseason forecast of 33.6 million fish. The actual runs throughout the Bay were significantly less than forecast with the exception of Wood River, which came in slightly above forecast. The commercial harvest of 12.3 million sockeye salmon was the lowest harvest since 1978 and below the average harvest for all years (1893–1996) of 13.6 million. A total escapement of approximately 6.7 million sockeye salmon was achieved. Three river systems, Kvichak, Nushagak, and Igushik, were significantly under the escapement goal. Naknek, Branch, Egegik and Wood were the only river systems to exceed their escapement goals. Of all the Bristol Bay Districts, Egegik had the largest fleet with over 600 drifters on an average day. There were approximately 1,890 drift permits active in 1997.

The Naknek-Kvichak District sockeye harvest of approximately 604 thousand fish was the lowest harvest for this district since 1974 and well below the 10 million recent 20-year average (1977–1996). The Egegik District sockeye harvest of 7.5 million fish was close to the 20-year average of 7.0 million but well below the previous 10-year (1987–1996) average of 11.1 million. The Ugashik District sockeye harvest of approximately 1.4 million sockeye was 1.1 million below its 20-year (1977–1996) average of 2.5 million. The Nushagak District harvest of 2.6 million sockeye salmon was

1.1 million less than the (1987–1996) 10-year average. The Togiak District sockeye harvest of approximately 144 thousand fish was below the recent 20-year (1977–1996) average of 435 thousand.

The 1997 season appeared to be normal until late June. Sockeye salmon inshore run abundance developed steadily until late June, when runs throughout the Bay appeared to be lagging behind. Using average run timing as a guide, managers closed the Naknek-Kvichak District after escapement began to lag on July 4. This closure then resulted in a movement of the Egegik District western boundary inward toward shore, from Loran C Line 9990-Z-45135 to Loran C Line 9990-Z-45110. The Naknek-Kvichak District reopened for an inriver fishery in the Naknek River on July 9. Fishing continued in the Naknek River until July 25 in order to direct fishing on Naknek-bound fish. In the Nushagak District, when the Nushagak sockeye stocks appeared weak and Wood River sockeye strong, a special Wood River Special Harvest Area was opened to utilize the surplus of sockeye salmon. Commercial fishing in the Wood River Special Harvest Area began on July 9 and continued until July 29. Peak catches occurred on July 5 when over 1 million fish were harvested. During the 1997 season, daily harvest totals only exceeded 1 million fish on one day. The 1997 Bristol Bay inshore sockeye salmon run timing appeared average.

The commercial chinook salmon harvest of approximately 76 thousand fish was slightly above the most recent 10-year average of 72.8 thousand but well below the recent 20-year (1977–1996) average harvest of 117.1 thousand fish. Chinook salmon escapement indices were slightly below average in Ugashik District but above average in all other areas. The 1997 season of low water and little precipitation made aerial survey conditions for chinook salmon optimal.

The chum salmon harvest totaled approximately 307 thousand fish and was well below the (1977–1996) 20-year average harvest of 1.1 million.

The coho salmon harvest of approximately 50 thousand fish was equal to the 1995 harvest and well below the recent (1977–1996) 20-year average harvest of 208 thousand fish. Coho salmon run strength is unknown for the Naknek-Kvichak District because there was not a directed coho salmon fishery. The last reported catch of coho salmon was incidental to the sockeye catch on August 1. The Egegik District coho salmon catch of 36 thousand was less than the most recent (1987–1996) 10-year average catch of 42 thousand coho salmon. The Ugashik District harvest of 7.6 thousand coho salmon was the second lowest harvest in the more recent (1987–1996) 10-year average harvest. The 1997 Ugashik District coho season had reduced effort, which probably resulted in the decreased harvest. The Nushagak District harvest was 3.1 thousand coho salmon and the Togiak District was 3.0 thousand. The Nushagak District had a preseason expectation of poor coho salmon run performance. When Nushagak River escapement lagged, restrictions were put in place for all user groups. Togiak District had a severely restricted fishing schedule during the 1997 season.

Pink salmon return in strength to Bristol Bay during even-numbered years. The 1997 run produced a commercial harvest of only 0.1 thousand fish.

The total Bristol Bay chum salmon harvest of 307 thousand fish was well below the recent 20-year average of 1.2 million. All districts had below-average catches. Chum escapement into the Branch River appeared slightly above average but other river systems throughout the Bay appeared below average.

Kuskokwim

The total 1997 commercial salmon harvest for the Kuskokwim area was 405 thousand fish, the lowest since 1975. Fishing time during the season was well below average due to critically low chum and coho salmon returns. The chinook salmon harvest of 48 thousand fish was 14% below the recent 10-year average. A below-average sockeye harvest of 123 thousand fish was recorded. Fishermen harvested 67 thousand chum salmon, 88% below the recent 10-year average. The coho salmon harvest was 167 thousand fish, the lowest harvest since 1976 and 75% below the recent 10-year average.

In the Kuskokwim River, fishing time in June and July was limited due to an extremely weak chum salmon run. The chum salmon harvest was 97% below the recent 10-year average. Chinook and sockeye salmon harvests, taken incidentally during the chum fishery, were well below average because of the reduced fishing time. The coho salmon harvest was 77% below the recent 10-year average and the lowest since 1976.

The Quinhagak District opened on June 13 and commercial fishing occurred on a regular schedule in June and July due to strong chinook and sockeye salmon harvests. The chinook salmon harvest was 85% above the recent 10-year average. The sockeye salmon harvest was 32% above the recent 10-year average. The incidental chum salmon harvest was 26% below the recent 10-year average. Fishing time was below average in August due to weak coho salmon harvests. The total coho salmon harvest was 49% below the recent 10-year average.

The Goodnews Bay District was opened in late June to provide for a directed harvest of sockeye salmon and to protect earlier-running chinook salmon, which continue to be a conservation concern because of weak runs. Due to lack of tendering capacity and poor coho salmon harvests, commercial fishing time was well below average in this district. The chinook salmon harvest was 27% below the recent 10-year average, while Middle Fork Goodnews River escapement was 16% below the goal of 3.5 thousand fish. The sockeye salmon harvest was 20% below the recent 10-year average. Sockeye salmon escapement was excellent and the Middle Fork Goodnews River escapement goal was exceeded. The incidental chum salmon harvest was 37% below the recent 10-year average, although the Middle Fork Goodnews River chum salmon escapement goal was met. The coho salmon harvest was the third lowest on record, 89% below the recent 10-year average.

Only 702 of the 832 Kuskokwim area permit holders participated in the commercial fishery in 1997. The exvessel value of the harvest was $1.1 million, 81% below the recent 10-year average of $5.5 million. The average exvessel earnings for each permit holder was $1.5 thousand, well below the most recent 10-year average value of $6.8 thousand.

Yukon Area

The 1997 Yukon area commercial harvest was 435 thousand salmon. Sales were composed of 113 thousand chinook, 95 thousand summer chum, 57 thousand fall chum, and 35 thousand coho salmon sold in the round. Additionally, 3 thousand pounds of chinook salmon roe, 83 thousand pounds of summer chum salmon roe, and 1 thousand pounds of fall chum salmon roe were sold. The total estimated commercial harvest, including the estimated number of fish harvested to produce the roe sold, was 114 thousand chinook, 228 thousand summer chum, 58 thousand fall chum, and 35 thousand coho salmon. The 1997 estimated chinook salmon harvest was 4% above the recent (1992–1996) 5-year average of 109 thousand fish. The 1997 estimated summer chum salmon harvest was 53% below the recent 5-year average of 489 thousand fish. The 1997 estimated fall chum salmon harvest was 30% below the recent 5-year average of 83 thousand fish. The 1997 estimated coho salmon harvest was 53% above the recent 5-year average of 23 thousand fish. The exvessel value of the Yukon area commercial salmon fishery was an estimated $5.9 million or 12% below the recent 5-year average of $6.7 million. Poor salmon markets continued to affect sales of summer chum salmon flesh. Salmon roe markets, which had remained fairly stable in recent years, were very disappointing in 1997. The average price paid for summer chum salmon roe of $1.08 per pound in 1997 was the lowest on record since 1975, and approximately 35% of the average price of $3.05 per pound in 1996. Lower Yukon area fishermen harvested 106 thousand chinook, 78 thousand summer chum, 52 thousand fall chum, and 34 thousand coho salmon in the round. Because of declining salmon markets, no salmon were sold in District 3. The estimated average price paid per pound in the Lower Yukon area was $2.46 for chinook, $0.10 for summer chum, $0.22 for fall chum, and $0.32 for coho salmon. The exvessel value of the Lower Yukon area commercial fishery was $5.7 million. The average income for

the 640 Lower Yukon area fishermen that participated in the 1997 commercial fishery was $8.9 thousand.

Upper Yukon area fishermen harvested 7 thousand chinook, 17 thousand summer chum, 5 thousand fall chum, and 1 thousand coho salmon in the round. The estimated average price paid per pound in the Upper Yukon area for fish in the round was $0.97 for chinook, $0.07 for summer chum, $0.17 for fall chum, and $0.20 for coho salmon. Additionally, 3 thousand pounds of chinook salmon roe, 83 thousand pounds of summer chum salmon roe, and 1 thousand pounds of fall chum salmon roe were sold by Upper Yukon area fishermen. The estimated average price paid per pound was $1.62 for chinook salmon roe, $1.08 for summer chum salmon roe, and $1.75 for fall chum salmon roe. The exvessel value of the Upper Yukon area commercial fishery was $0.2 million. The average income for the 85 Upper Yukon area fishermen that participated in the 1997 commercial fishery was $2.5 thousand.

The 1997 chinook salmon run was above average in abundance. Chinook salmon escapements were very good throughout the drainage with minimum escapement goals achieved in all but one surveyed tributary.

The abundance of summer and fall chum salmon was below average in 1997. A majority of summer chum salmon escapement goals appeared to be met in 1997. Fall chum salmon escapement goals were met for the Sheenjek River and the mainstem Yukon River in Canada in 1997, but not met for the Fishing Branch River, Toklat River, and Delta River. The overall fall chum salmon run was below the preseason projection.

The coho salmon run appeared average in abundance.

Norton Sound

The commercial salmon harvest totaled 79 thousand fish that was composed of 13 thousand chinook, 32 thousand coho, and 34 thousand chum salmon. There were 102 permit holders that participated in the fishery and received $364 thousand for their harvest, which was 22% below the previous 5-year (1992–1996) average. The chinook salmon total harvest for 1997 was the highest since 1985 and was 93% above the previous 5-year average. The coho salmon harvest was the lowest since 1987, and 56% below the previous 5-year average. No directed pink fishery was conducted in 1997. The Norton Sound chum salmon commercial harvest was 18% below the previous 5-year average. This low chum harvest can be attributed primarily to the combination of a low harvestable surplus in the northern subdistricts and poor markets in the southern subdistricts.

The Norton Sound Salmon District has 201 limited entry salmon permits, of which 102 were actually fished during the 1997 season. The number of participating fishermen this season was 11% below the previous 5-year average. There has been a significant drop in effort in recent years due primarily to poor market conditions. The 1997 season ended with the second lowest number of commercial fishermen participating on record.

Two primary salmon buyers operated in Norton Sound during the 1997 season. The average price paid per pound was $1.00 for chinook, $0.47 for coho, and $0.11 for chum salmon.

Kotzebue

The commercial harvest in the Kotzebue District during 1997 consisted of 143 thousand chum salmon and 3 thousand Dolly Varden. The chum salmon harvest was well below the 18-year (1979–1996) average of 272 thousand fish. There were 68 permits fished this year. The last two years represent the fewest number of participants since the late 1960s. Because of the low salmon prices, fishermen concentrated their efforts close to Kotzebue (Statistical Area 331-01) to minimize the costs of fuel and oil. Sixty percent of the fish were harvested from this statistical area.

Average prices paid per pound in 1997 were $0.16 for chum salmon and $0.20 for Dolly Varden. The total exvessel value was $188 thousand to Kotzebue area fishermen with an average of $2.8 thousand for each participating permit holder.

Kodiak

The 1997 Kodiak commercial salmon fishery occurred over a ragged 116-day period beginning with the initial opening on June 9 and ending when the last delivery was made on October 2. This year's fishery was unusual in that price disputes between the processors and permit holders led to two "strikes." The first, for sockeye salmon, ran from June 8 through June 23. The second "strike," for pink salmon, ran from July 26 through August 7. Also unusual this year was the much less than expected production from specific pink and sockeye systems while other pink and sockeye systems produced as good or better than expected. Anomalies in run timing (mostly later than normal) and the weather (unusually sunny and warm) resulted in very low stream flows that in turn delayed the entry of salmon to the spawning grounds in many systems within the Kodiak area.

Of the 611 eligible permit holders, only 440 participated this season. By gear type, a total of 5 beach seine, 174 set gillnet, and 261 purse seine permit holders fished. This year's purse seine effort was once again one of the lowest on record since limited entry has been in effect. Throughout the season 12 different buyers operated 13 processing plants (all of which were shorebased).

The estimated exvessel value of the 1997 fishery was approximately $18.8 million. This was the lowest value since 1985 ($20.4 million) and well below the recent 10-year average of $44.9 million. Average earnings by gear type and by permit fished are estimated at $48.8 thousand for purse seine, $34.6 thousand for set gillnet, and $7.1 thousand for beach seine. Final exvessel values will not be available until the final price adjustments are made. In addition, a portion of the pink salmon returning to Kitoi Bay Hatchery, the Westside and Southend of Kodiak Island, and a portion of the sockeye salmon returning to Kitoi Bay, Hidden Lake, Waterfall Lake, Frazer Lake, Upper Station Lakes, Afognak Lake, Telrod Cove, and Karluk Lake where harvested in a limited fishery directed by the United Seiners Association. Revenues generated in this fishery were "donated" to the United Seiners Association, which utilized the money to pay for vessel charters and support the price negotiations.

This year's chinook salmon harvest was 19 thousand fish, slightly below average. The largest chinook salmon harvest on record (42 thousand fish) occurred in 1993. The average weight was 10.0 pounds.

The sockeye salmon harvest of 2.5 million was the lowest since 1987. The last 10-year average harvest was 3.9 million sockeye salmon. The highest sockeye harvest on record (5.7 million fish) occurred in 1991. This year's sockeye harvest included an estimated 400 thousand fish produced by supplemental and enhancement projects sponsored by the Kodiak Regional Aquaculture Association. The average weight for sockeye salmon was 5.3 pounds.

The coho salmon harvest of 381 thousand is the highest on record. This is mainly due to supplemental production from Kitoi Bay Hatchery, which was estimated at 110 thousand fish. The last 10-year average harvest was 268 thousand coho salmon. The second highest harvest on record occurred in 1982 when 344 thousand fish were caught. The average weight for coho salmon was 8.0 pounds.

The pink salmon harvest of 11 million was below the last 10-year average of 14.6 million fish and well below the last 5-odd-year average of 21.1 million pink salmon. The all-time record harvest of 42.8 million pink salmon occurred in 1995. Included in this year's harvest are approximately 1.2 million pink salmon that were caught near the Kitoi Bay Hatchery. The average weight for pink salmon was 3.4 pounds.

The chum salmon harvest, of 520 thousand was the lowest since 1985 when 430 thousand fish were caught and well below the last 10-year average harvest of 891 thousand fish. Approximately 11

thousand chum salmon were caught near Kitoi Bay Hatchery this year. The highest chum salmon harvest on record occurred in 1970 when 1.54 million fish were caught. The average weight for chum salmon was 8.0 pounds.

Salmon-counting weirs were operated on 12 different spawning systems in 1997. All major sockeye and chinook salmon systems were monitored. Weirs were operated from late May to late September. Aerial surveys, and to a lesser degree foot surveys, were used to estimate escapements into most pink, chum, coho, and minor sockeye salmon systems.

A total of 28.5 thousand chinook salmon were counted as escapement through fish weirs into the Ayakulik, Karluk, and Dog Salmon Rivers. Escapement counts were 13.4 thousand chinook salmon into the Karluk River and 14.4 thousand chinook salmon into the Ayakulik River. An additional 0.66 thousand chinook salmon entered the Dog Salmon River. The escapement goal range for chinook salmon is 11.1 thousand to 19.3 thousand fish. Sockeye salmon escapements were excellent overall with 1.79 million fish counted as escapement. Approximately 1.65 million sockeye salmon (92% of the total escapement estimate) were counted into systems with fish weirs. The escapement goal range for sockeye salmon is 1.4 to 2.1 million fish. Areawide coho salmon escapements were excellent. Pink salmon escapements, overall, were excellent. The indexed pink salmon escapement was just slightly above the high end of the desired range. Chum salmon escapements varied considerably depending on geographic location. Chum salmon escapements were relatively poor for the Sturgeon and Kukak Rivers.

Chignik

The 1997 harvests for all salmon species were smaller than forecasted primarily because of the weakness or late timing of the runs. The catch of sockeye salmon was only 770 thousand, which fell below the expected catch of 1.55 million and below the 1988–1997 average of 1.50 million sockeye salmon harvested in the Chignik management area. Chinook catches were at the 3 thousand level — less than half the preseason catch projection. Pink catches were at the 844 thousand level, below the expected catch of 1.0 million. Chum catches were at the 156 thousand level, somewhat less than the preseason catch projection of 230 thousand. Coho catches, as in most areas of the state, were far below preseason projections. The 1997 coho catch in the Chignik management area was 91 thousand; the preseason projection was 220 thousand, while the 1998 to 1997 average was 208 thousand.

Escapement to the Chignik management area in 1997 for all species, except perhaps for coho salmon, met or exceeded established escapement goals. Coho escapements were undetermined because of inadequate surveys. Inseason and postseason sockeye salmon scale pattern estimates indicated the first run was far below average (peak late June) with a 50/50 mixture of Black Lake and Chignik Lake sockeye salmon between July 11 to July 15. The hatchery beach portion of the Chignik Lake run that usually travels through the fishery mid July to early August was weak, but the Clark River portion of the run was stronger than expected as evidenced by sockeye volume in September and the high percentage (80%) of age-2.3 sockeye salmon.

The general flow of both pink and chum salmon escapements began slow and spotty and then increased toward the end of the season. The early July openings in the Western and Perryville Districts were delayed, first because early chum escapement was weak and later because pink escapement was spotty and low. Later in the season escapement increased but salmon were dark and the canneries could not utilize them.

The 1997 harvests for all salmon species were smaller than forecasted primarily because of the weakness or late timing of the runs.

Catches in 1997 in the Chignik management area for all salmon species combined were mostly (83%) from the Chignik Bay and Central Districts. Approximately 53% of the sockeye salmon were caught in Chignik Bay while 38% were caught in the Central District. There was a higher percentage

of blushed or reddened sockeye salmon with hooked mandibles caught on the capes than observed in most years.

There were only two openings in the Western and Perryville Districts during the 1997 season. Primarily because of low chum salmon escapement, the first opening did not occur until August 1, the latest opening date since 1987. Slow pink and chum salmon escapements and mediocre pink catches during the first opening delayed the next opening until August 17. No openings after August 18 were allowed in the Western and Perryville Districts because of low coho catches during openings in early and mid August.

Alaska Peninsula — Aleutian Islands

South Peninsula

The total salmon harvest for the 1997 South Peninsula fishery was below average for the previous 10 years. The chinook catch of 7 thousand was 67% of the 1987–1996 average. The sockeye catch of 2.24 million was near the 1987–1996 average of 2.41 million. The coho salmon harvest of 112 thousand was nearly one-third the previous 10-year average of 325 thousand. The pink salmon harvest of 2.30 million was also nearly a third of the previous 10-year average catch of 7.64 million, while the chum salmon catch of 606 thousand was 43% of the 1987–1996 average harvest of 1.42 million. The harvest of all species was affected by strikes, primarily the July-August strike. The lateness of the pink salmon run in the Southeastern District also resulted in that district receiving less fishing time due to the weak run size in late July and early August.

Sockeye salmon allocations for the June fishery in the South Unimak and Shumagin Islands were again based on the Alaska Department of Fish and Game's forecast of the Bristol Bay sockeye run. The allocations were 1.84 million the South Unimak and 406 thousand for the Shumagin Islands, bringing the combined South Unimak-Shumagin Islands guideline harvest level to 2.246 million fish. The total South Unimak harvest was 1.18 million sockeye and 196 thousand chum salmon. Drift gillnet gear harvested 76% of the sockeye and 65% of the chum harvest. Purse seiners caught 15% of the sockeye salmon and 30% of the chum salmon. Set gillnetters accounted for 9.2% of the sockeye and 4.8% of the chum salmon. The total Shumagin Islands harvest was 449 thousand sockeye and 126 thousand chum salmon. Purse seine gear harvested 76% of the sockeye and 94% of the chum salmon. Set gillnet gear harvested the balance.

At the end of the season, the Southeastern District Mainland (including Northwest Stepovak) had recorded harvests of 289 thousand chinook, 388 thousand sockeye, 22.8 thousand coho, 84.1 thousand pink, and 20.3 thousand chum salmon. Both the early and late Chignik River system sockeye salmon runs were much weaker than forecasted. Consequently, there was no directed fishery targeting Chignik stocks in the Southeastern District Mainland. The Northwest Stepovak Section is managed based on local stocks beginning July 1. In 1997 the Orzinski sockeye salmon escapement was estimated to be 35.5 thousand fish, surpassing the escapement goal of 20 thousand adult salmon. Extensive fishing time was allowed to harvest Orzinski sockeye salmon during July. Catches were reported during 18 days from July 6 through July 26; the total harvest reached 316 thousand sockeye, of which 43 thousand were caught in Orzinski Bay. Based on methods described in the Board of Fisheries-adopted management plan, the estimated interception of Chignik-destined sockeye salmon in the Southeastern District Mainland through July 25 was zero.

Test fishing in the Shumagin Islands prior to the July 20 general fishing period indicated that although immature salmon were present, they were not abundant enough to warrant closure of the South Peninsula fisheries to purse seine gear. The fishery opened on July 20. However, after July 26 nearly all fishermen went on a strike that lasted until August 13. Before the strike was settled, the Southeastern District was closed due to low pink salmon escapements and remained closed through

August except for an August 15–16 fishing period in Beaver and Balboa Bays. Fishing by ADF&G chartered vessels also indicated weak pink salmon run strength in early August.

The pink salmon price was finally settled at a base price of $0.12 per pound. However, for dark pink salmon fishermen only received $0.06 per pound, and for badly watermarked fish fishermen received nothing, although the buyers took the fish. Fishermen received a base price of $0.15 per pound for bright chum salmon and only $0.05 for dark chum salmon. By the time the strike was settled on August 13, many of the salmon had deteriorated to low quality and escapements in some streams were much larger than needed.

The July 20 through August 28 South Peninsula harvest (excluding Northwest Stepovak) totaled 2.26 million salmon, of which 1.135 thousand were chinook, 234 thousand were sockeye, 73.9 thousand were coho, 270 thousand were chum, and 1.68 million were pink salmon. From September 1 through September 17, the catch totaled 102 thousand salmon, of which 56.6 thousand were sockeye and 35.6 thousand were coho salmon. The entire post-June South Peninsula harvest, including the Southeastern District Mainland, resulted in a catch of 2.70 million salmon of which 1.35 thousand were chinook, 607 thousand were sockeye, 111 thousand were coho, 284 thousand were chum, and 1.70 million were pink salmon.

The South Peninsula indexed total sockeye escapement was within the range of escapements considered optimal and was above the average for the previous 10 years. The South Peninsula indexed total pink salmon escapement was the second highest on record. The South Peninsula indexed total chum salmon escapement was a new record high.

Aleutian Islands and Atka-Amila Islands Areas

In 1997 no salmon were commercially harvested in the Aleutian Islands and Atka-Amlia Islands areas. Escapement monitoring was confined to the Unalaska Bay vicinity where the pink salmon escapements seemed to be up from recent odd-year levels.

North Peninsula

Harvests for all species except pink salmon were below the recent 10-year average. Pink salmon have been the least important species in the commercial fishery on the North Peninsula and had a harvest above the 10-year average. The chinook harvest of 10 thousand was below the 1987–1996 average of 13.1 thousand. The sockeye harvest of 2.15 million was also below the 1987–1996 average of 2.46 million. The coho salmon catch of 95 thousand was 51% of the previous 10-year average of 185 thousand. The pink salmon harvest of 51 thousand was over eight times the 1987–1996 odd-numbered year average of 5.9 thousand. The chum salmon catch of 97 thousand was only half the 1987–1996 average of 196 thousand. That portion of the North Peninsula harvest taken by Area T fishermen in the Cinder River and Inner Port Heiden Sections was 3.713 thousand chinook, 4.94 thousand sockeye, 41.8 thousand coho, and 36 chum salmon.

The 1997 coho salmon run was below average and a little later than normal. The only systems surveyed had fish numbers above met escapement goals. These systems were Ilnik and Nelson (Sapsuk) Rivers. Weather and budget constraints prevented close monitoring of coho salmon escapements.

Preliminary Forecasts of 1998 Salmon Runs to Selected Alaska Fisheries

ADF&G prepares forecasts for salmon runs that affect 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 1998 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
Copper and Bering Rivers	—	coho salmon
Upper Cook Inlet	—	sockeye salmon
Lower Cook Inlet	—	pink salmon
Kodiak	—	pink salmon
Upper Station Lakes	—	sockeye salmon
Frazer Lake	—	sockeye salmon
Ayakulik River (early and late)	—	sockeye salmon
Spiridon Lake	—	sockeye salmon
Karluk Lake (early and late)	—	sockeye salmon
Chignik	—	sockeye salmon
Bristol Bay	—	sockeye and chinook salmon
Alaska Peninsula, Bear Lake	—	sockeye salmon
Alaska Peninsula, Nelson River	—	sockeye 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 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. Please see the appendices for further details.

Literature Cited

ADF&G (Alaska Department of Fish and Game). 1969. A summary of preliminary 1970 salmon forecasts for Alaskan fisheries (W. H. Noerenberg and M. C. Seibel, *editors*). Division of Commercial Fisheries, Informational Leaflet 136, Juneau.

ADF&G (Alaska Department of Fish and Game). 1970. A summary of preliminary 1971 forecasts for Alaskan salmon fisheries (M. C. Seibel, *editor*). Division of Commercial Fisheries, Informational Leaflet 149, Juneau.

ADF&G (Alaska Department of Fish and Game). 1971. A summary of preliminary 1972 forecasts for Alaskan salmon fisheries (M. C. Seibel, *editor*). Division of Commercial Fisheries, Informational Leaflet 155, Juneau.

ADF&G (Alaska Department of Fish and Game). 1972. A summary of preliminary 1973 forecasts for Alaskan salmon fisheries (M. C. Seibel, *editor*). Division of Commercial Fisheries, Informational Leaflet 160, Juneau.

ADF&G (Alaska Department of Fish and Game). 1973. A summary of preliminary 1974 forecasts for Alaskan salmon fisheries (M. C. Seibel, *editor*). Division of Commercial Fisheries, Informational Leaflet 164, Juneau.

ADF&G (Alaska Department of Fish and Game). 1975. A summary of preliminary 1975 forecasts for Alaskan salmon fisheries (M. C. Seibel and C. P. Meacham, *editors*). Division of Commercial Fisheries, Informational Leaflet 167, Juneau.

ADF&G (Alaska Department of Fish and Game). 1976. A summary of preliminary 1976 forecasts for Alaskan salmon fisheries (D. L. Waltemyer and S. C. Lindstrom, *editors*). Division of Commercial Fisheries, Informational Leaflet 169, Juneau.

ADF&G (Alaska Department of Fish and Game). 1977. Preliminary forecasts and projections for 1977 Alaskan salmon fisheries (J. A. Carson and I. Frohne, *editors*). Division of Commercial Fisheries, Informational Leaflet 171, Juneau.

ADF&G (Alaska Department of Fish and Game). 1978. Preliminary forecasts and projections for 1978 Alaskan salmon fisheries. Division of Commercial Fisheries, Informational Leaflet 173, Juneau.

ADF&G (Alaska Department of Fish and Game). 1979. Preliminary forecasts and projections for 1979 Alaskan salmon fisheries. Division of Commercial Fisheries, Informational Leaflet 177, Juneau.

ADF&G (Alaska Department of Fish and Game). 1980. Preliminary forecasts and projections for 1980 Alaskan salmon fisheries. Division of Commercial Fisheries, Informational Leaflet 183, Juneau.

ADF&G (Alaska Department of Fish and Game). 1981. Preliminary forecasts and projections for 1981 Alaskan salmon fisheries. Division of Commercial Fisheries, Informational Leaflet 190, Juneau.

Literature Cited (continued)

ADF&G (Alaska Department of Fish and Game). 1982. Preliminary forecasts and projections for 1982 Alaskan salmon fisheries. Division of Commercial Fisheries, Informational Leaflet 197, Juneau.

ADF&G (Alaska Department of Fish and Game). 1983. Preliminary forecasts and projections for 1983 Alaskan salmon fisheries. Division of Commercial Fisheries, Informational Leaflet 209, Juneau.

ADF&G (Alaska Department of Fish and Game). 1983. Preliminary forecasts and projections for 1984 Alaskan salmon fisheries. Division of Commercial Fisheries, Informational Leaflet 229, Juneau.

Eggers, D. M. 1985. Preliminary forecasts and projections for 1985 Alaska salmon fisheries. Division of Commercial Fisheries, Informational Leaflet 244, Juneau.

Eggers, D. M. 1986. Preliminary forecasts and projections for 1986 Alaska salmon fisheries. Division of Commercial Fisheries, Informational Leaflet 253, Juneau.

Eggers, D. M., and M. R. Dean. 1987. Preliminary forecasts and projections for 1987 Alaska salmon fisheries. Division of Commercial Fisheries, Informational Leaflet 259, Juneau.

Eggers, D. M., and M. R. Dean. 1988. Preliminary forecasts and projections for 1988 Alaska salmon fisheries. Division of Commercial Fisheries, Regional Information Report 5J88-1, Juneau.

Geiger, H. J., and H. M. Savikko. 1989. Preliminary forecasts and projections for 1989 Alaska salmon fisheries. Division of Commercial Fisheries, Regional Information Report 5J89-01, Juneau.

Geiger, H. J., and H. M. Savikko. 1990. Preliminary forecasts and projections for 1990 Alaska salmon fisheries. Division of Commercial Fisheries, Regional Information Report 5J90-03, Juneau.

Geiger, H. J., and H. M. Savikko. 1991. Preliminary forecasts and projections for 1991 Alaska salmon fisheries and summary of the 1990 season. Division of Commercial Fisheries, Regional Information Report 5J91-01, Juneau.

Geiger, H. J., and H. M. Savikko. 1992. Preliminary forecasts and projections for 1992 Alaska salmon fisheries and summary of the 1991 season. Division of Commercial Fisheries, Regional Information Report 5J92-05, Juneau.

Geiger, H. J., and H. M. Savikko. 1993. Preliminary forecasts and projections for 1993 Alaska salmon fisheries and summary of the 1992 season. Commercial Fisheries Management and Development Division, Regional Information Report 5J93-04, Juneau.

Geiger, H. J., and E. Simpson. 1994. Preliminary run forecasts and harvest projections for 1994 Alaska salmon fisheries and review of the 1993 season. Commercial Fisheries Management and Development Division, Regional Information Report 5J94-08, Juneau.

Geiger, H. J., and E. Simpson. 1995. Preliminary run forecasts and harvest projections for 1995 Alaska salmon fisheries and review of the 1994 season. Commercial Fisheries Management and Development Division, Regional Information Report 5J95-01, Juneau.

Literature Cited (continued)

Geiger, H. J., and B. Frenette. 1996. Run forecasts and harvest projections for 1996 Alaska salmon fisheries and review of the 1995 season: the short version. Commercial Fisheries Management and Development Division, Regional Information Report 5J96-05, Juneau.

Geiger, H. J., and B. Frenette. 1997. Run forecasts and harvest projections for 1997 Alaska salmon fisheries and review of the 1996 season: the short version. Commercial Fisheries Management and Development Division, Regional Information Report 5J97-01, Juneau.

Geiger, H. J., B. Frenette, and D. Hart. 1997. Run forecasts and harvest projections for 1997 Alaska salmon fisheries and review of the 1996 season. Commercial Fisheries Management and Development Division, Regional Information Report 5J97-10, Juneau.

Hart, D., D. Petree, and H. J. Geiger. 1998. Run forecasts and harvest projections for 1998 Alaska salmon fisheries and review of the 1997 season: the short version. Commercial Fisheries Management and Development Division, Regional Information Report 5J98-01, Juneau.

Table 1. Preliminary projections of 1998 Alaska commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeast Region	247	2,500	3,500	43,000	11,300	60,500
Prince William Sound						
Common Property	50	2,210	546	11,000	600	14,400
Cost Recovery	0	181	16	12,300	440	12,900
Upper Cook Inlet	17	2,500	300	300	200	3,320
Lower Cook Inlet	1	323	15	2,790	11	3,140
Bristol Bay	84	20,600	90	400	700	21,900
Central Region	152	25,800	967	26,800	1,950	55,700
Kodiak Area	20	2,350	300	6,350	650	9,670
Chignik	7	1,070	235	1,100	270	2,680
South Peninsula	10	2,460	255	6,800	1,600	11,100
North Peninsula	10	2,100	180	200	150	2,640
Aleutian Islands	0	5	0	500	1	506
Westward Region	47	7,990	970	15,000	2,670	26,700
AYK Region	152	185	822	815	1,470	3,440
Statewide Total	598	36,500	6,260	85,600	17,400	146,000

Columns and rows do not total exactly due to rounding.

Revised January 30, 1998

Table 2. Preliminary 1997 Alaska commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeast Region	271[a]	2,500	1,950	29,000	11,700	45,400
Prince William Sound	52	4,200	83	25,800	2,200	32,300
Upper Cook Inlet	13	4,090	144	71	89	4,410
Lower Cook Inlet	1	240	9	2,810	6	3,070
Bristol Bay	76	12,300	50	0	307	12,700
Central Region	143	20,800	287	28,700	2,600	52,500
Kodiak Area	19	2,500	381	11,000	520	14,400
Chignik	3	770	91	844	156	1,860
South Peninsula	7	2,240	112	2,300	606	5,260
North Peninsula	10	2,150	95	51	97	2,400
Aleutian Islands	---	---	---	---	---	0
Westward Region	39	7,660	678	14,200	1,380	24,000
						0
AYK Region	175	123	234	0	530	1,060
						0
Total Alaska	628	31,100	3,150	71,900	16,200	123,000

Missing data indicates no harvest, and zeros indicate harvest activity but <1,000. Columns and rows do not total exactly due to rounding.

[a] Total commercial harvest of chinook salmon for the October 1, 1996 to September 30, 1997 catch acounting period. (This value has been corrected from the earlier version of this document.)

Revised March 30, 1998

Table 3. Preliminary 1997 Alaska commercial salmon harvests, by fishing area and species, in thousands of pounds.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Southeast Region	4,600 [a]	16,200	15,600	116,000	99,400	247,000
Prince William Sound	1,250	27,200	623	97,100	18,900	145,000
Upper Cook Inlet	213	26,800	936	213	596	28,800
Lower Cook Inlet	21	1,580	62	8,440	40	10,100
Bristol Bay	1,250	72,600	330	0	2,000	76,200
Central Region	2,730	128,000	1,950	106,000	21,500	260,000
Kodiak Area	187	13,300	3,050	37,500	4,160	58,200
Chignik	47	4,850	709	2,790	1,230	9,630
South Peninsula	113	12,900	877	7,600	4,250	25,700
North Peninsula	161	12,400	744	168	680	14,200
Aleutian Islands	—	—	—	—	—	0
Westward Region	508	43,500	5,380	48,100	10,300	108,000
AYK Region	3,370	873	1,730	0	3,970	9,940
Total Alaska	7,860	188,000	23,000	270,000	131,000	620,000

Missing data indicates no harvest, and zeros indicate harvest activity but <1,000. Columns and rows do not total exactly due to rounding.

[a] This value has been corrected from the earlier version of this document.

Revised March 30, 1998

Table 4. Preliminary 1997 Southeastern Region commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Tree Point Drift Gillnet	2	169	26	381	351	929
Prince of Wales Gillnet	1	169	78	789	186	1,220
Stikine River Gillnet	3	93	2	66	39	202
Southern Districts Seine	3	1,520	114	13,000	1,740	16,400
Annette Island Fisheries	1	41	28	410	163	643
Southern Southeast Total	9	1,990	247	14,600	2,480	19,400
Taku-Snettisham Gillnet	3	95	4	51	177	329
Lynn Canal Gillnet	1	111	15	33	274	433
Yakutat Set Net	3	110	314	94	1	522
Northern Districts Seine	0	47	65	11,200	1,340	12,700
Northern Southeast Total	7	362	398	11,400	1,790	14,000
Southeast Troll [a]	214	39	1,170	545	312	2,280
Hatchery Terminal Area Fisheries						
Gillnet	2	9	7	65	661	743
Seine	7	6	4	615	2,690	3,320
Private Hatchery Fishery	30	59	122	1,570	3,720	5,500
Miscellaneous [b]	2	4	0	64	20	91
Total Southeast Region	271	2,500	1,950	29,000	11,700	45,400

Missing data indicates no harvest and zeros indicate harvest activity but <1,000.
Columns and rows do not total exactly due to rounding.

[a] Includes chinook salmon caught by troll gear from October 1, 1996 to September 30, 1997.
[b] Includes salmon that were confiscated or taken in sport fish derbies or commercial test fisheries.

Revised March 30, 1998

Table 5. Preliminary 1997 Central Region commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Purse Seine						
Eastern	0	5	48	4,530	447	5,030
Northern	0	2	0	3,160	5	3,170
Coghill	0	6	1	1,880	33	1,920
Southwestern	0	15	5	5,930	7	5,960
Montague [a]	0	0	0	65	185	251
Southeastern	0	0	0	28	3	31
Drift Gillnet						
Bering River [b]	0	10	0	0	0	10
Copper River [a,b]	51	2,960	19	8	2	3,040
Unakwik	0	3	0	0	0	4
Coghill	1	227	6	155	690	1,080
Eshamy	0	475	0	146	35	657
Set Gillnet						
Eshamy	0	196	0	77	8	281
Hatchery [c]	0	266	3	9,850	811	10,900
Miscellaneous Prince William Sound [d]	0	0	0	0	0	0
Prince William Sound Total	52	4,200	83	25,800	2,200	32,300
Southern District	1	187	5	2,680	4	2,877
Kamishak District	0	12	0	0	0	12
Outer District	0	6	1	128	2	137
Eastern District	0	27	3	0	1	31
Lower Cook Inlet Total	1	240	9	2,810	6	3,070
Central District	1	95	36	4	8	144
Northern District	12	4,000	108	66	82	4,260
Upper Cook Inlet Total	13	4,090	144	71	89	4,410
Naknek-Kvichak	3	604	1	0	9	617
Nushagak District	64	2,620	3	0	181	2,870
Egegik District	2	7,540	36	0	53	7,630
Ugashik District	1	1,410	8	0	16	1,440
Togiak District	6	144	3	0	48	201
Bristol Bay Total	76	12,300	50	0	307	12,700
Central Region Total	143	20,800	287	28,700	2,600	52,500

Missing data indicates no harvest and zeros indicate harvest activity but <1,000.
Columns and rows do not total exactly due to rounding.

[a] Totals include discarded pink and chum salmon.

[b] Does not include salmon taken for home use as reported on fish tickets.

[c] Hatchery sales for operating expenses. Includes meal production/roe salvage sales, processor discards. Excludes post egg-take roe sales at hatcheries.

[d] Some of these fish were donations landed by Coghill District and Copper River District drift gillnet permit holders.

Revised January 30, 1998

Table 6. Preliminary 1997 Arctic-Yukon-Kuskokwim Region commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Kuskokwim River	10	22	131	0	17	180
Kuskokwim Bay	38	101	36	0	50	225
Kuskokwim Area Total	48	123	167	0	67	405
Lower Yukon River	106	0	34		130	270
Upper Yukon River [a]	8	0	1		156	165
Yukon River Total [a]	114	0	35	0	286	435
Norton Sound Total	13	0	32	0	34	79
Kotzebue Area Total	0	0	0	0	143	143
Arctic-Yukon-Kuskokwim Region Total	175	123	234	0	530	1,060

Missing data indicates no harvest and zeros indicate harvest activity but <1,000.
Columns and rows do not total exactly due to rounding.

[a] The Upper Yukon River catch includes the estimated harvest to produce roe sold.

Revised January 30, 1998

Table 7. Preliminary 1997 Westward Region commercial salmon harvests, by fishing area and species, in thousands of fish.

	Species					
Fishing Area	Chinook	Sockeye	Coho	Pink	Chum	Total
Kodiak Area Total	19	2,500	381	11,000	520	14,400
Chignik Area Total	3	770	91	844	156	1,860
South Peninsula	7	2,240	112	2,300	606	5,260
North Peninsula	10	2,150	95	51	97	2,400
Alaska Peninsula Total	17	4,390	207	2,350	703	7,670
Aleutian Islands Total						
Westward Region Total	39	7,660	678	14,200	1,380	24,000

Missing data indicates no harvest and zeros indicate harvest activity but <1,000.
Columns and rows do not total exactly due to rounding.

Revised January 30, 1998

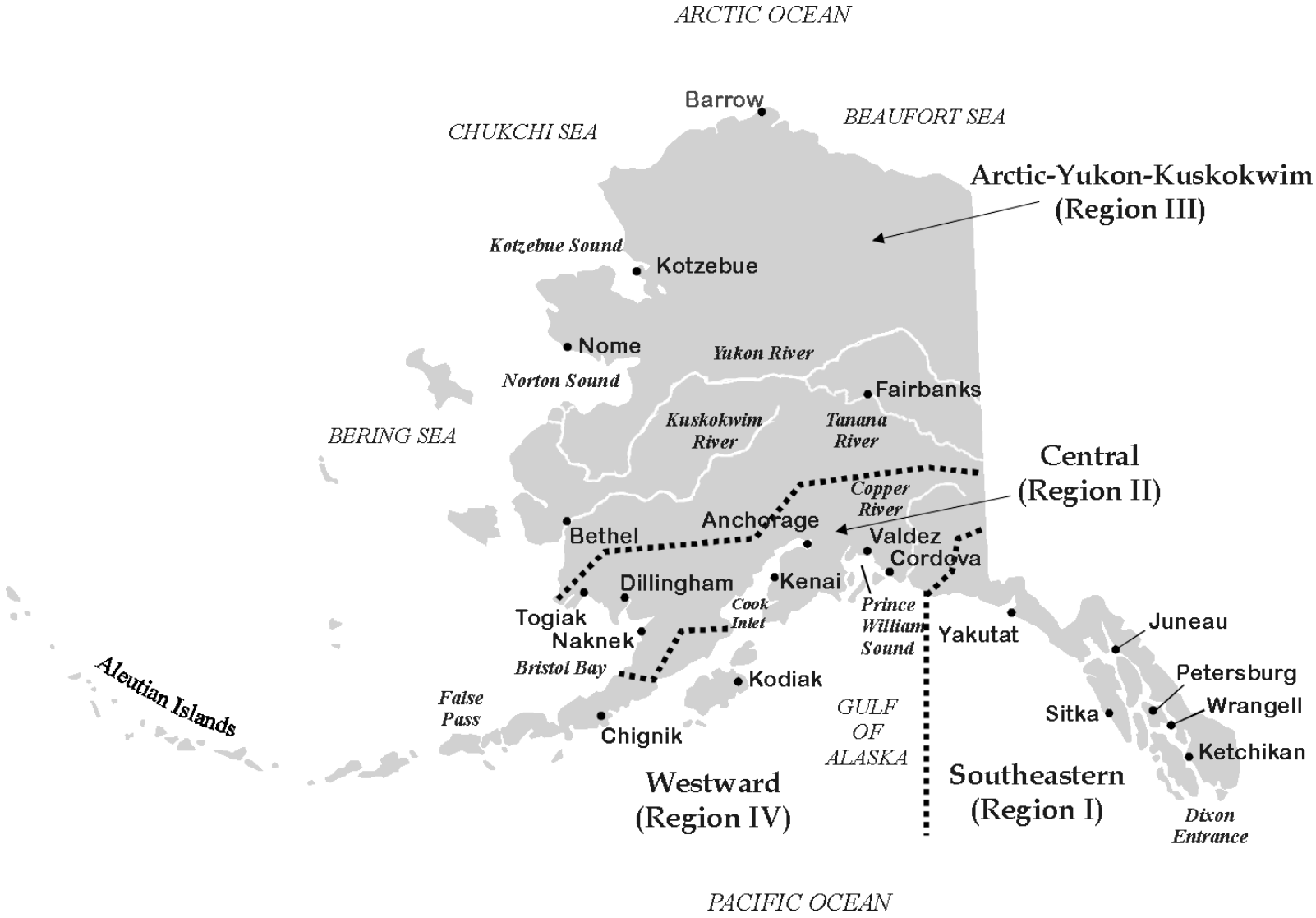

Figure 1. The four fishery management regions (Southeastern, Central, Arctic-Yukon-Kuskokwim, and Westward) of the Alaska Department of Fish and Game, Commercial Fisheries Management and Development Division.

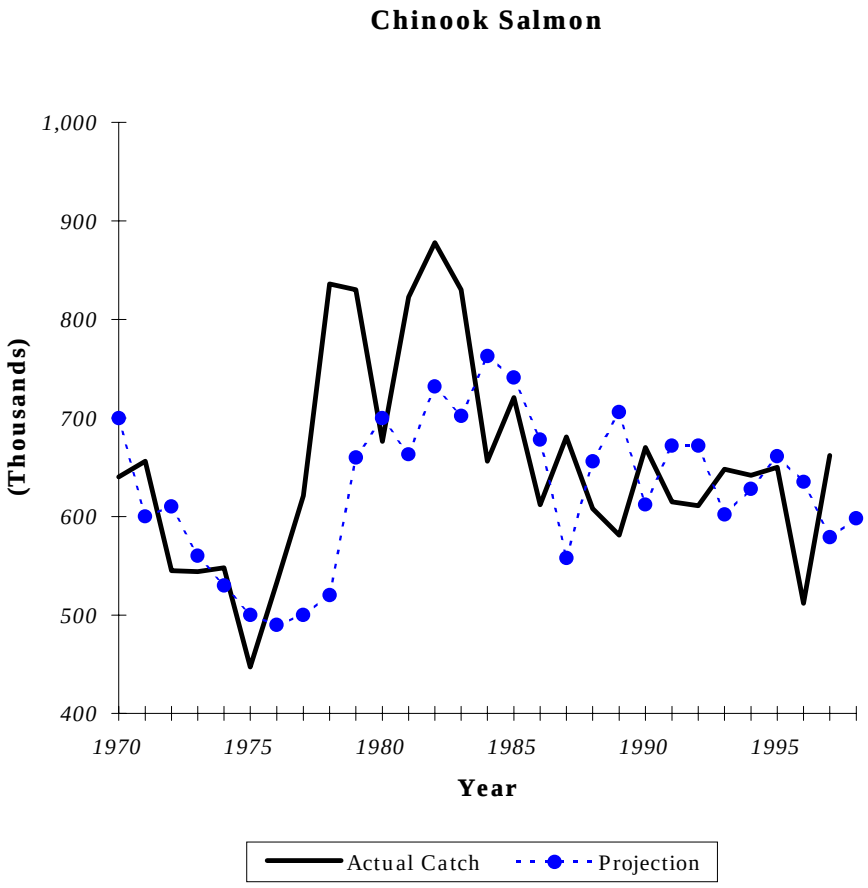

Figure 2. Relationship between actual catch and projected catch, in thousands, for Alaska chinook salmon from 1970 to 1997, with the 1998 projection.

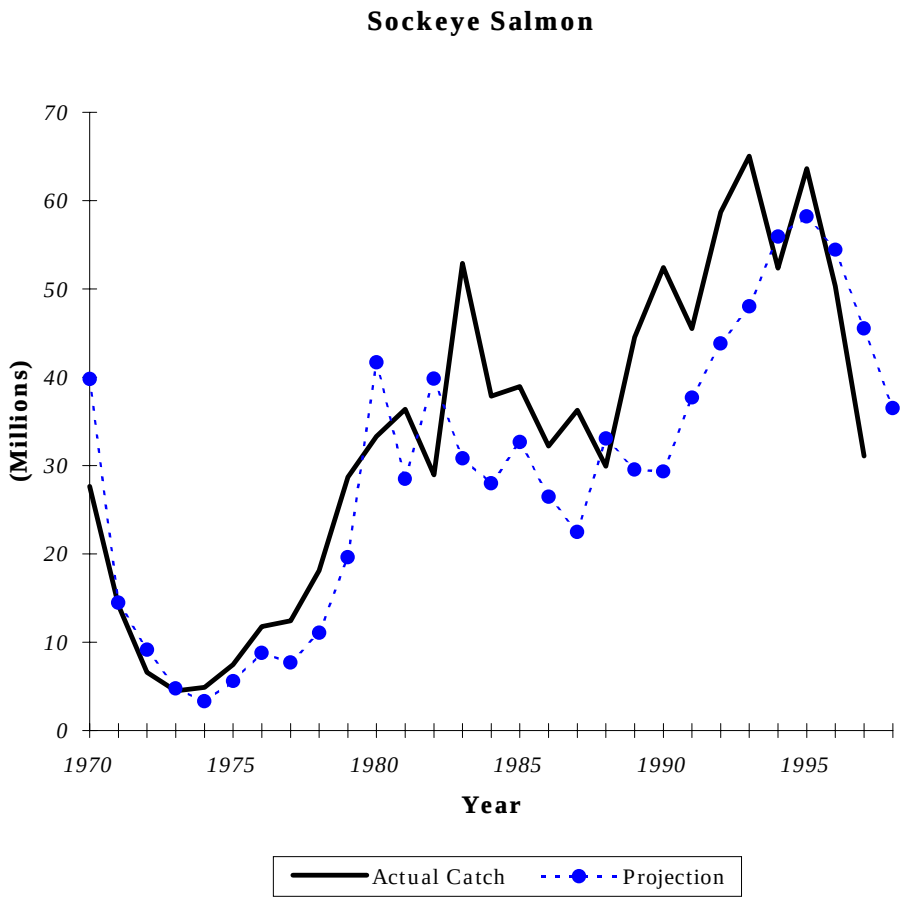

Figure 3. Relationship between actual catch and projected catch, in millions, for Alaska sockeye salmon from 1970 to 1997, with the 1998 projection.

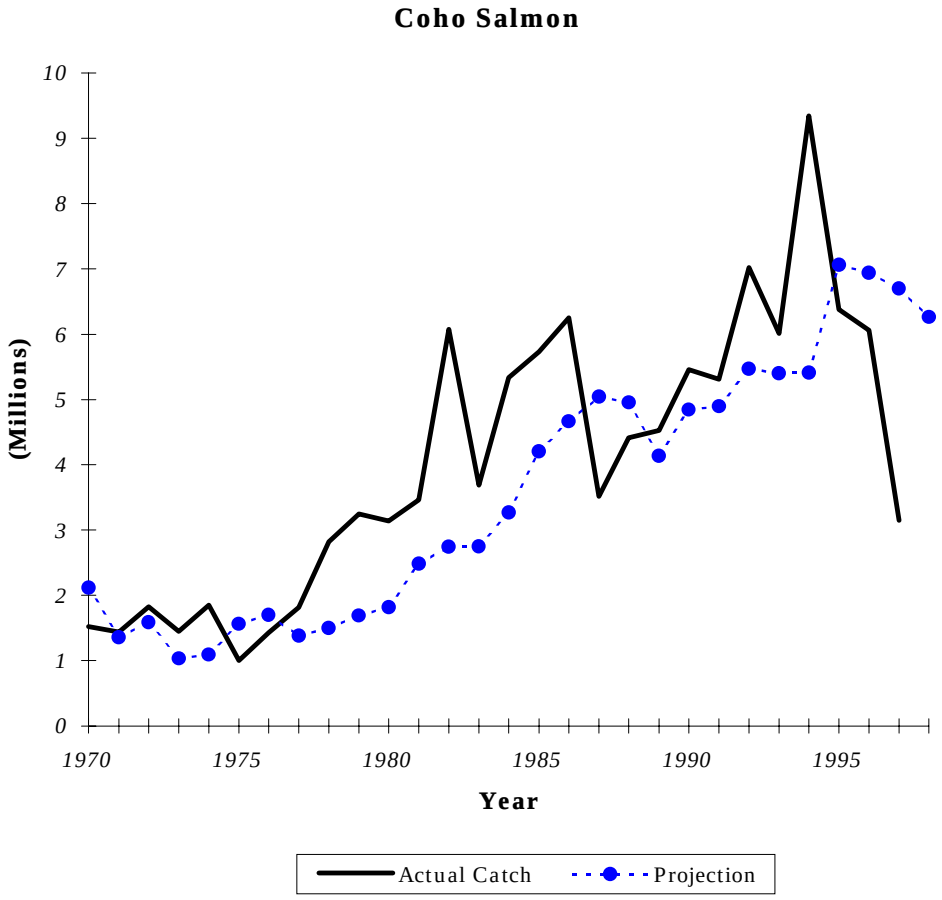

Figure 4. Relationship between actual catch and projected catch, in millions, for Alaska coho salmon from 1970 to 1997, with the 1998 projection.

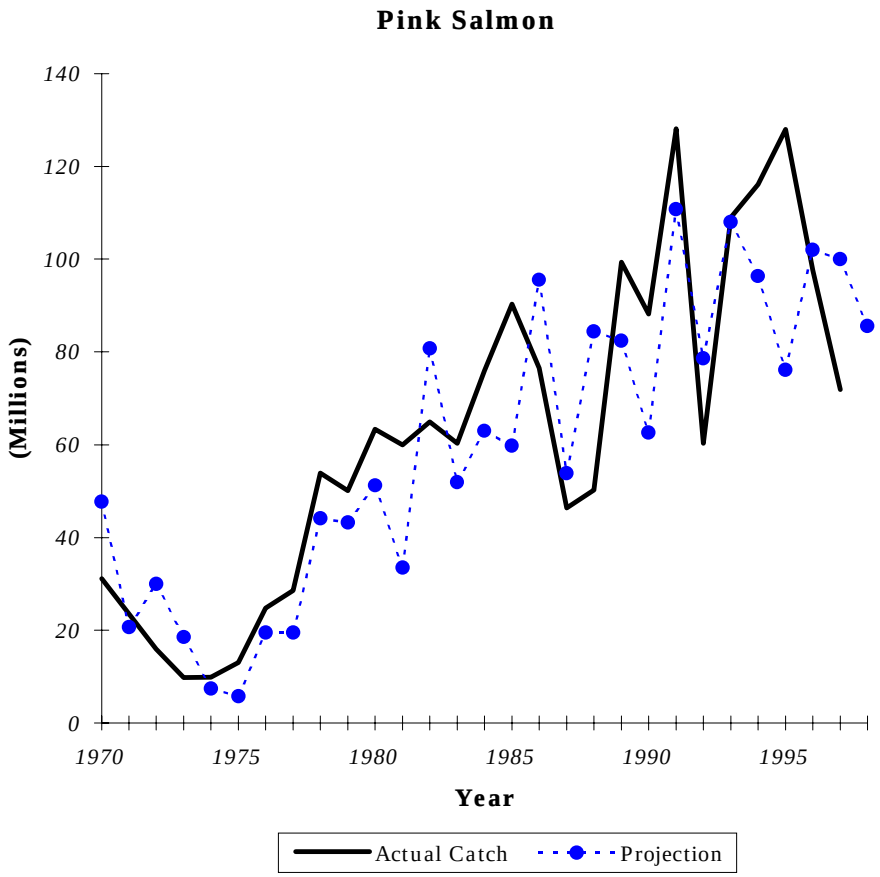

Figure 5. Relationship between actual catch and projected catch, in millions, for Alaska pink salmon from 1970 to 1997, with the 1998 projection.

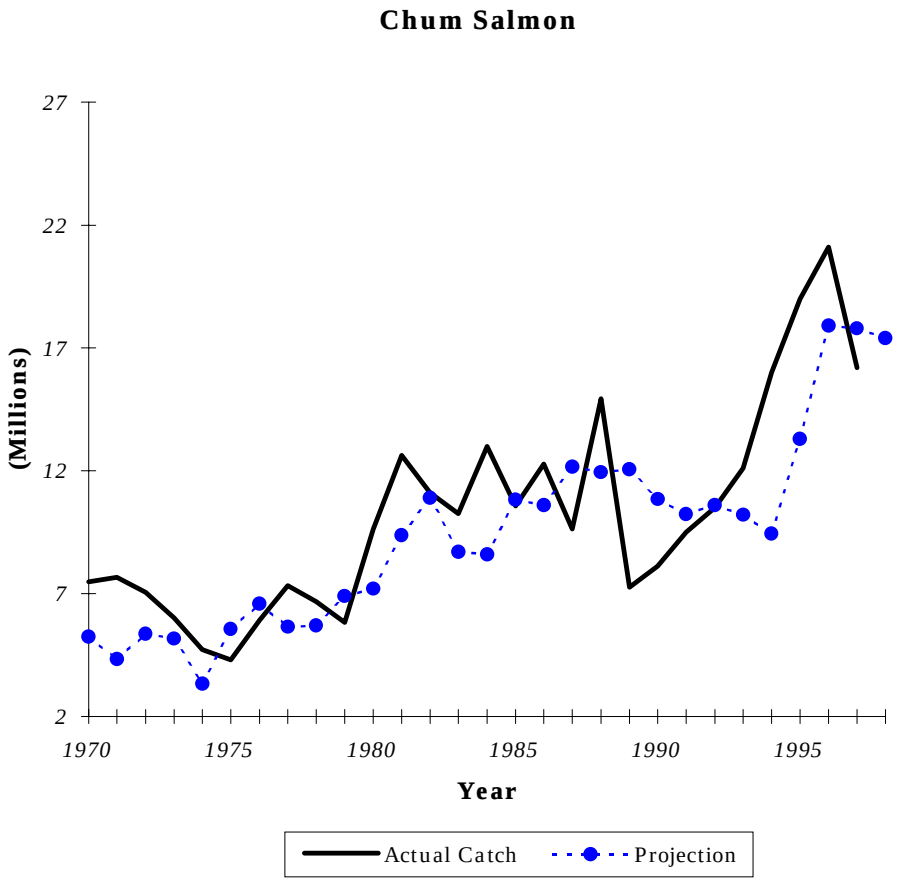

Figure 6. Relationship between actual catch and projected catch, in millions, for Alaska chum salmon from 1970 to 1997, with the 1998 projection.

Appendix

Forecast Area: Southeast Alaska

Species: Pink Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (millions)
• Natural Production	
Natural Run	71.2
Escapement Goal	30.0 [a]
Commercial Common Property Harvest	41.2
• Hatchery and Supplemental Production	
Hatchery Run	2.0
Broodstock Needs	0.2
Commercial Common Property Harvest [b]	1.8
• Total Production	
Total Run	73.2
Escapement Goal	30.2
Commercial Common Property Harvest [b]	43.0

[a] 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 million–9.0 million. The index goal for northern Southeast remains unchanged at 4.5 million.

[b] Includes commercial common property and hatchery cost recovery harvests.

Introduction

Programs designed specifically for collecting data relevant to estimating the magnitude of Southeast Alaska 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 [National Oceanic and Atmospheric Administration] temperature and precipitation data, management escapement data, management and fleet field observations) allows us to provide an estimate that we believe is more informative than a simple historic average. As a result, predictions made since 1992 have been a subjective combination of statistical forecast models, historic average harvests, and expert opinion.

Forecast Methods

This year's prediction is based on selecting one of five different harvest magnitude categories.

Category	Range
DISASTER	< 10 Million
WEAK	10–20 Million
AVERAGE	21–35 Million
STRONG	36–50 Million
EXCELLENT	> 50 Million

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

1. The brood year escapement index for both Southeast Alaska overall (22.2 million) and southern Southeast (15.6 million) were the highest observed since the index program was initiated in 1960. The escapement index for northern Southeast (6.6 million) was the third highest since 1960.

2. A strong positive linear relationship exists between brood year escapement indices and harvests up to a brood year index of approximately 16 million. During the 1960 to present time period, there have only been two returns from brood year escapement indices in excess of 16 million: years 1987 and 1988, both of which were extremely weak. The standard two-parameter Ricker model, including winter temperature and the sum of the previous two brood year escapement indices predicts a harvest of 47 million (STRONG category). A three-parameter Ricker model (as described by Paulik), results in a harvest prediction of only 5 million (DISASTER category). If 1987 and 1988 are excluded from the prediction model, the relationship between brood year escapement and harvest becomes almost linear, and an unrealistically high harvest prediction of 85 million (EXCELLENT category) results.

3. The winter temperature parameter (average minimum daily air temperature November 1 through February 28) of 29.8ºF was very close to the study period average of 29.0ºF.

4. Early marine fry surveys conducted in Smeaton Bay and Boca De Quadra during the spring of 1997 indicated fry densities similar to or slightly less than those observed the previous year. Biologists participating in spring herring fisheries did not note any unusual fry densities, either high or low. Most commercial fishermen contacted also felt that fry concentrations were about average. The one exception was West Behm Canal, which had reports of large numbers of fry. It is possible those sightings were influenced by a release of approximately 80 million hatchery chum salmon fry from Neets Bay.

5. The juvenile pink salmon CPUE during the National Marine Fisheries Service juvenile salmon trawling study was the lowest observed since the program was initiated in 1993. The low pink salmon CPUE may have been influenced by two major changes in the study's design. The first is the trawl type was changed and the second is the study area was reduced in size from sampling in both northern and southern Southeast to sampling only in northern Southeast. However, this was the first year since trawling was initiated that the CPUE for chum fry was higher than for pink fry (J. Orsi, NMFS, Auke Bay Laboratory, personal communication). Since there is no reason to suspect a dramatic increase in chum fry abundance, the relative CPUE strongly suggests a reduced pink fry abundance in the study areas of Chatham Strait, Icy Strait, and Cross Sound.

Forecast Discussion

Based on a subjective evaluation of the above points, we believe the 1998 harvest will be STRONG. However, if overescapement is a real factor, the harvest could be anything less than STRONG, including WEAK**.** Because overescapement is potentially a factor only in the south, it is very unlikely that both north and south will have disastrous returns. On the other hand, if overescapement is not a factor, there is potential for an EXCELLENT harvest. The above rather extreme uncertainty is largely the result of a lack of understanding over the cause or causes of the poor returns in 1987 and 1988. The above uncertainty will remain until it can be determined whether the pink salmon population of Southeast Alaska can best be described with a Beverton-Holt or Ricker-type model. The 1998 return

will provide valuable insights into this relationship and the optimum escapement index for Southeast Alaska. However, returns from these high escapements can be expected to vary widely with natural fluctuations in the environment. The record escapement index achieved in 1996 was not the result of conservative management decisions designed to evaluate this return-per-spawner relationship. Instead, it resulted from insufficient processor capacities, which resulted in most seiners being placed on limits during the majority of the month of August while the run was at its peak.

The escapements in most areas of Southeast were at or above desired levels. However, two areas were weak — the index in District 110 was the third lowest in the last 10 years and the index in District 114 was the second lowest in the last ten years. The northern Southeast inseason prediction program is based on CPUE from the District 114 troll fishery. Consequently, the northern Southeast inseason prediction program is likely to underestimate the actual return beginning about mid July, when the District 114 stocks become a significant part of the troll catch. The poor return expected to District 114 is further supported by the poor juvenile pink salmon catches reported by NOAA's trawling surveys in 1996.

The number of fry released from pink salmon hatcheries in Southeast Alaska was not available at the time this report was prepared. Hatchery production was estimated by assuming a 90% survival from green eggs to fry, and a 2% survival from release to return (111 million green eggs x 0.90 survival to fry stage x 0.02 survival to return = 2.0 million adults returning). The total number of green eggs reported above does not include the 28.7 million eggs collected by the Burnett Inlet Hatchery. The Burnett Inlet Hatchery went bankrupt and their fry were allowed to swim out in December. Consequently, no significant return is expected for that facility.

Karl Hofmeister
Fishery Biologist
Juneau

Jim Blick
Biometrician
Juneau

Forecast Area: Prince William Sound
Species: Pink Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (millions)	Forecast Range (millions)
• Natural Production		
Prince William Sound General Districts		
Total Run	5.9	1.5–22.3
Escapement Goal	1.4	
Harvest Estimate	4.5	0.1–21.9
• Hatchery and Supplemental Production		
VFDA [a] *— Solomon Gulch Hatchery*		
Hatchery Run	7.2	4.3–10.0
Broodstock Needs	0.5	
Cost Recovery Needs [b]	5.1	4.3–6.4
Limited Entry Harvest	1.6	0.0–5.7
Historical Survival for Odd Years: Range = 1.8%–8.9%; Mean = 3.8%		
PWSAC [c] *— Cannery Creek Hatchery*		
Hatchery Run	5.1	3.8–6.4
Broodstock Needs	0.3	
Cost Recovery Needs	2.4	2.0–3.0
Limited Entry Harvest	2.4	0.5–4.1
Historical Survival for Even Years: Range = 0.5%–6.6%; Mean = 3.7%		
PWSAC [c] *— A. F. Koernig Hatchery*		
Hatchery Run	2.5	1.4–2.5
Broodstock Needs	0.0	
Cost Recovery Needs	2.4	2.0–3.0
Limited Entry Harvest	0.1	0.0–0.5
Historical Survival for Even Years: Range = 1.4%–7.4%; Mean = 3.8%		
PWSAC [c] *— W. H. Noerenberg Hatchery*		
Hatchery Run	6.3	2.4–6.5
Broodstock Needs	0.5	
Cost Recovery Needs	2.4	2.0–3.0
Limited Entry Harvest	2.4	0.0–4.0
Historical Survival for Even Years: Range = 0.9%–8.4%; Mean = 4.2%		
• Total Production		
Run Estimate	26.0	13.4–47.7
Natural Escapement Goal	1.4	
Broodstock Needs	1.3	
Cost Recovery Needs	12.3	10.3–15.4
Limited Entry Harvest	11.0	0.6–36.2

[a] VFDA is an abbreviation for Valdez Fisheries Development Association.

[b] VFDA sales are based upon fixed revenue needs. The lower and upper bounds are based upon variations in salmon weight and price per pound.

[c] PWSAC is an abbreviation for Prince William Sound Aquaculture Corporation.

Forecast Methods

Natural runs of pink salmon are predicted from a linear regression of adult production from brood year escapement for indicator spawning streams. The total parent escapement is calculated using an area-under-the-curve analysis of 208 aerial survey indicator streams representative of all pink salmon spawning streams in Prince William Sound. The forecast range interval for the natural run forecast was estimated using cross validation.

The forecast for the total hatchery run is the sum of individual hatchery forecasts. The forecast for each hatchery is the product of the number of fry released and their historical mean marine survival rate at each hatchery subjectively adjusted for plankton abundance, degree days, and hatchery manager observations of site-specific parameters (e.g., predator abundance, fry growth rates, fry condition at time of release). The forecast range interval around the forecast is derived from the confidence interval around the mean of the marine survival data.

All cost recovery harvest estimates are preliminary, and projected broodstock needs will not change unless state-permitted changes occur in hatchery programs. Projected broodstock needs for each facility are based upon the expected number of eggs retrievable from each female and the expected percentage of females in the broodstock. Cost recovery harvests for the Prince William Sound Aquaculture Corporation (PWSAC) are based on 40% of the actual total hatchery run. The range is calculated as 40% of the upper and lower bounds of the run forecast minus the broodstock goal. Actual PWSAC cost recovery harvests will depend on the actual run realized by each facility. The ultimate goal is a total PWSAC cost recovery harvest for all of Prince William Sound that is 40% of the total PWSAC hatchery return. The Valdez Fisheries Development Association (VFDA) projected cost recovery harvest is based on a revenue goal using assumptions about pink salmon weight and price. The upper and lower bounds of the VFDA cost recovery harvest are based on possible variations of these two parameters.

Forecast Discussion

Previous forecasts for even-year runs employed surveys of preemergent eggs and juveniles. Because these surveys are no longer conducted, the current natural pink salmon forecast was calculated using a regression of the logarithm of return per spawner on parent year escapements for even years. The 1996 pink salmon spawning escapement into Prince William Sound was approximately 4% above the desired goal. However, parent year escapements account for only a small amount of the observed variability in return per spawner values (R^2 =0.066). Climatic conditions during the winter and spring after spawning appeared to be within normal limits and is not believed to have affected survival. However, the large predicted El Niño southern oscillation event (ENSO) currently underway is expected to have profound effects on global and regional climate over the coming months. If these environmental changes are realized, the effects on oceanic conditions could substantially alter survival of the 1998 pink salmon run. Pink salmon returns in the year after the previous ENSO event were considerably less than forecast. If that relationship continues, the return in 1998 could be much less than expected. Future projections of natural runs may incorporate smolt size, ocean temperatures, plankton abundance, and growth rate. Techniques developed to use this information for predictions of hatchery pink salmon returns provide improved forecast performance.

The release of 484.5 million pink salmon from hatcheries in Prince William Sound in 1997 was the smallest release since 1987. Marine survival estimates for each hatchery have been calculated since 1987 using coded wire tag recoveries and are considered reliable. Mean even-year survivals were used to initially calculate estimated runs, but these estimates were often adjusted to account for subjective observations on growing conditions and fry health. In the case of the A. F. Koernig Hatchery, nearly 70% of the release was composed of large fry that were fed and released later in the spring. Because the two previous releases of large fed fry resulted in very high survivals, the upper

limit of the confidence interval was used for the midpoint forecast estimate. The effects of predators are extremely hard to quantify and can greatly affect the survival of pink salmon juveniles. Our forecast does not account for changes in predation, and if, as suspected, predation rates are greater now than in past years, predictions may be too high. Another factor that could affect the accuracy of the forecast is the current ENSO event. If the effects are similar to the previous ENSO event, hatchery runs in 1998 could be much less than expected from this forecast. Work is nearing completion on a number of *Exxon Valdez* Oil Spill Trustee Council-funded projects that could improve our ability to predict hatchery pink salmon survivals. For example, project components within the Sound Ecosystem Assessment program will use information on smolt size, ocean temperatures, plankton abundance, and growth rate in bioenergetics models to estimate pink salmon ocean survival.

The midpoint forecast for the 1998 hatchery return of 20.1 million pink salmon would be the sixth largest hatchery return to Prince William Sound. Most of these pink salmon are expected to return to the Solomon Gulch, W. H. Noerenberg, and Cannery Creek Hatcheries. The small release from A. F. Koernig Hatchery will probably result in a small return to this facility, although survival is expected to be higher than normal.

Tim Joyce
Fishery Biologist III
Area Resource Development Biologist
Cordova

John Wilcock
Fishery Biologist III
PWS Research Project Leader
Cordova

Forecast Area: Prince William Sound
Species: Chum Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (millions)	Forecast Range (millions)
• Natural Production		
Prince William Sound General Districts		
Total Run	0.23	0.09–0.60
Escapement Goal	0.23	
Harvest Estimate	0.01	0.00–0.38
• Hatchery and Supplemental Production		
VFDA [a] *— Solomon Gulch Hatchery*		
Hatchery Run	0.06	0.03–0.08
Broodstock Needs	0.00	
Cost Recovery Needs	0.00	
Limited Entry Harvest	0.06	0.03–0.08
PWSAC [b] *— W. H. Noerenberg Hatchery (Onsite Returns)*		
Hatchery Run	0.81	0.60–1.6
Broodstock Needs	0.14	
Cost Recovery Needs [c]	0.44	0.39–0.51
Limited Entry Harvest	0.23	0.00–1.07
PWSAC [b] *— W. H. Noerenberg Hatchery (Port Chalmers Remote Returns)*		
Hatchery Run	0.30	0.16–0.45
Broodstock Needs	0.00	
Cost Recovery Needs [c]	0.00	
Limited Entry Harvest	0.30	0.16–0.45
• Total Production		
Run Estimate	1.40	0.88–2.73
Natural Escapement Goal	0.23	
Broodstock Needs	0.14	
Cost Recovery Needs	0.44	0.39–0.51
Limited Entry Harvest	0.60	0.19–1.98

[a] VFDA is an abbreviation for Valdez Fisheries Development Association.

[b] PWSAC is an abbreviation for Prince William Sound Aquaculture Corporation.

[c] Chum salmon cost recovery is pooled with the sockeye salmon cost recovery at Main Bay Hatchery to provide a revenue goal of $2.5 million.

Forecast Methods

The natural chum salmon forecast is the pooled results of four separate regressions. Returns of 3-year-old chum salmon are predicted from pink salmon returns from the same brood year, while returns of 4-, 5-, and 6-year-old chum salmon are predicted from returns in prior years of chum salmon from the same brood year. Cross validation was used to estimate 80% confidence intervals.

The predicted total run and its associated 80% confidence interval were calculated as sums of the predictions and 80% confidence intervals for individual ages.

The forecast for the total hatchery run is the sum of individual hatchery forecasts. The forecast for each hatchery is the product of the number of fry released and their historical mean marine survival rate subjectively adjusted for past sibling returns. Hatchery runs for 1998 are projected from fry releases made during 1992–1996 and multiplied by a mean marine survival of 1.44% (range: 0.77–2.13%). Mean survival was based on seven years of fry releases and adult return data from W. H. Noerenberg Hatchery. The average age composition of returning adults from 1992 to 1996 hatchery releases is assumed to be the same as the average age composition observed for previous chum returns from adult return years 1983–1997. The forecast range interval around the forecast is derived from the confidence interval around the mean of the marine survival data. The adjustment to the total forecast, based on sibling information, was made within the bounds of the 80% confidence interval. For example, if sibling predictions for major age classes were much less than mean survival predictions, the point estimate was shifted toward the lower end of the overall 80% confidence interval.

Projected broodstock needs for each facility are based on the expected number of eggs produced from each female and the expected percentage of females in the broodstock. Broodstock needs do not change unless hatchery program changes occur. The projected sales harvest for PWSAC is based on a revenue goal of $2.5 million for species other than pink salmon. PWSAC expects to achieve this revenue goal primarily from cost recovery sales split between hatchery-produced sockeye and chum salmon. The forecasted sockeye salmon return will not provide sufficient adults to provide half the total revenue goal for these species, and an additional 52 thousand chum salmon may need to be harvested for cost recovery. A revenue goal of $1.42 million for W. H. Noerenberg Hatchery chum salmon was based on an estimated price of $0.40/lb and average adult weight of 8 lbs. Under these assumptions, the corporation could harvest about 50% of the chum salmon return produced by PWSAC. Chum salmon should be available to the common property fishery at W. H. Noerenberg Hatchery and at Port Chalmers, but all cost recovery harvests will occur at the W. H. Noerenberg Hatchery site. Less than 100 chum salmon are expected to return to the A. F. Koernig Hatchery in 1998 from releases in 1997. Returns to the Port Chalmers remote release site will be composed of 3-, 4-, and 5-year-old chum salmon. Because age composition of the Port Chalmers return is unknown, historical age composition and survivals for W. H. Noerenberg Hatchery returns were used to estimate age composition of the returns from that release. VFDA does not operate a cost recovery fishery for their chum salmon run.

Forecast Discussion

Our ability to accurately forecast chum salmon runs is constrained by the limited database available to calculate survivals and examine sibling relationships. In addition, estimates of natural stock contributions to harvests are not available for recent years due to elimination of coded-wire tag recovery studies for this species. This is reflected in the wide 80% confidence interval for the natural chum salmon forecast. A natural chum salmon run of 0.23 million for 1998 would be smaller than the 1997 run and less than half the 1988–1997 average.

The forecast for W. H. Noerenberg Hatchery chum salmon is much lower than the previous two years due to the low average survival values used in the calculations. The sibling relationship used to produce the age-6 chum salmon forecast provides a much stronger return (50%) for that year class than calculations based on average survivals. However, age-6 chum salmon typically contribute only 3% to the total run. Age-5 chum salmon generally contribute about 40% to the run, but previous returns of age-3 and -4 siblings produced actual returns that were only about 80% of predicted returns. Age-4 chum salmon contribute heavily to the run (53%), and low returns of that age group are expected based on the number of age-3 chum salmon that returned in 1997. Further justification for subjectively reducing the age-4 and -5 and increasing the age-6 chum salmon forecast components

is provided by the relationship between chum and pink salmon survival for fish migrating to sea in the same year. Age-4 and -5 chum salmon migrated to sea under the same conditions as pink salmon in 1995 and 1994, respectively. Hatchery pink salmon returns from both the 1994 and 1995 migrants were below average. However, the 1993 release of pink salmon fry, the same year chum salmon returning as age-6 adults in 1998 were released as fry, produced near record returns of pink salmon. The midpoint forecast reflects these adjustments and projects the fifth largest return in the last nine years for W. H. Noerenberg Hatchery.

Returns from Port Chalmers releases of W. H. Noerenberg Hatchery chum salmon fry are expected to exceed the 1997 run because of the addition of another returning age class. The Port Chalmers run is expected to be 300 thousand adults composed of ages 3, 4, and 5 chum salmon. Together, the W. H. Noerenberg Hatchery onsite and the Port Chalmers remote returns should produce over 1.1 million adults.

The Solomon Gulch facility no longer produces chum salmon fry. The chum salmon return in 1998 is expected to be much reduced because the number of fry released each year has declined. The relationship between chum and pink salmon survivals from the same brood year were used to adjust the initial chum salmon forecast based on average chum salmon fry survival.

The A. F. Koernig Hatchery started releasing chum salmon fry in 1997. Because age-2 chum salmon returns are rare for this stock, few or no returns are expected in 1998.

While we are not very confident in our ability to accurately forecast chum salmon returns because the database used to calculate survivals is quite small, we feel the midpoint forecast is reasonable for both facilities.

Tim Joyce
Fishery Biologist III
Area Resource Development Biologist
Cordova

John Wilcock
Fishery Biologist III
PWS Research Project Leader
Cordova

Forecast Area: Prince William Sound
Species: Sockeye Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (thousands)	Forecast Range (thousands)
• Natural Production		
Prince William Sound — Coghill Lake		
Total Run	57.4	18.8–136.7
Escapement Goal	25.0	
Harvest Estimate	32.4	0.0–111.7
Prince William Sound — Eshamy Lake		
Total Run	63.8	15.7–190.3
Escapement Goal	40.0	
Harvest Estimate	23.9	0.0–150.3
Prince William Sound — Unakwik District		
Harvest Estimate	10.7	8.1–13.4
• Hatchery and Supplemental Production		
PWSAC [a] — Main Bay Hatchery (Eyak Stock Onsite Returns)		
Hatchery Run	4.6	4.0–5.3
Broodstock Needs	4.6	4.6–5.3
Cost Recovery Needs	0.0	
Limited Entry Harvest	0.0	0.0–0.0
PWSAC [a] — Main Bay Hatchery (Coghill Stock Onsite Returns)		
Hatchery Run	153.4	139.8–167.0
Broodstock Needs	0.0	
Cost Recovery Needs [b]	153.4	139.8–167.0
Limited Entry Harvest [b]	0.0	0.0–0.0
PWSAC [a] — Main Bay Hatchery (Coghill Stock Marsha Bay Lake Remote Returns) [c]		
Hatchery Run	4.4	3.8–5.0
Broodstock Needs	0.0	
Cost Recovery Needs [d]	4.4	3.8–5.5
Limited Entry Harvest	0.0	0.0–0.0
PWSAC [a] — Main Bay Hatchery (Eshamy Stock Onsite Returns)		
Hatchery Run	28.8	24.8–35.1
Broodstock Needs	6.0	
Cost Recovery Needs [b]	22.8	18.8–29.1
Limited Entry Harvest	0.0	0.0–0.0
• Total Production		
Run Estimate	323.1	209.0–381.8
Natural Escapement Goal	65.0	
Broodstock Needs	10.6	
Cost Recovery Needs [b]	180.6	162.4–201.1
Limited Entry Harvest	67.0	8.1–275.4

[a] PWSAC is an abbreviation for Prince William Sound Aquaculture Corporation.

[b] Any hatchery surplus would be harvested from Coghill stock production.

[c] Sockeye salmon returning from the release of 1996 brood year presmolts into Marsha Bay Lake on Knight Island.

[d] Cost recovery figures are derived from a revenue goal of $1.25 million using a price of $1.00/lb and an average size of 6 lbs.

Forecast Methods

The forecast for the natural sockeye salmon run to Coghill Lake is the total of estimates for five age classes. Returns of age-1.2 and -1.3 sockeye salmon are predicted from a sibling regression model using the return of sockeye salmon from the previous year that were 1-ocean-year younger than the predicted age. Sibling regression models are also used to predict returns of age-2.2 sockeye salmon from returns of age-1.2 sockeye salmon, and returns of age-2.3 sockeye salmon from returns of age-2.2 sockeye salmon. Finally, returns of age-1.1 sockeye salmon are predicted from the mean return of that age class. Although catch and escapement numbers as well as age-composition data are available for Coghill sockeye salmon runs since 1962, escapement numbers prior to the installation of the full weir in 1974 are considered unreliable. Therefore, only data collected since 1974 were used to calculate individual age-class forecasts and the forecast ranges, which were estimated using cross validation. The predicted total run to Coghill Lake and the associated 80% confidence interval is the sum of the predictions and 80% confidence intervals for all individual ages. Confidence intervals for individual age classes were calculated using cross-validation techniques.

The forecast for the natural run to Eshamy Lake is also the total of estimates for five age classes. Returns of age-1.2 sockeye salmon are predicted from the number of spawners in parent-year escapements. Age-1.3 sockeye salmon returns are predicted from a sibling regression model using the return of age-1.2 sockeye salmon from the previous year. Sibling regression models are also used to predict returns of age-2.2 sockeye salmon from returns of age-1.2 sockeye salmon, and returns of age-2.3 sockeye salmon from returns of age-2.2 sockeye salmon. Finally, returns of age-1.1 sockeye salmon are predicted from the mean return of that age class. Eshamy Lake escapements have been enumerated since 1950, except 1987, when the weir was not operated. Commercial catches are available for the same periods, but age-composition data for Eshamy sockeye salmon are only available for some years since 1962. Escapement numbers and age-composition data were not collected in 1987. Only available data collected since 1974, excluding 1987, were used to calculate individual age-class forecasts and the 80% confidence intervals, which were estimated using cross validation. The predicted total run to Eshamy Lake and the associated 80% confidence interval is the sum of the predictions and 80% confidence intervals for all individual ages. Confidence intervals for individual age classes were calculated using cross-validation techniques. Forecast methods differed from previous predictions that used the mean of runs achieved since 1965.

Only a harvest projection for wild stocks is made for the Unakwik District. This projection is the mean of purse seine and gillnet catches made in that district since 1968. The forecast range is the 80% confidence interval around the mean harvest.

Main Bay Hatchery, operated by PWSAC, is the only facility producing sockeye salmon in Prince William Sound. Three sockeye salmon stocks are used: Coghill, Eshamy, and Eyak Lakes stocks. Forecasts are made for each stock returning to the facility (onsite returns) as well as to remote release sites (remote returns). The predicted total run for each hatchery stock and the forecast ranges is the sum of the predictions and 80% confidence intervals for all individual ages.

The forecast of the Eyak Lake sockeye salmon onsite run is based on age-specific mean marine survivals obtained from hatchery returns from brood years 1990, 1991, and 1993 (0.24% for age-3 and 3.0% for age-4 sockeye salmon). Survival data are limited since this stock was only recently introduced into the hatchery. Survival estimates are based on fry releases, catch contribution estimates from coded wire tag recoveries, and broodstock data. Since a long-time series of survival data is not available for this stock, forecast ranges were estimated using coefficients of variation for age-specific survival

estimates from brood years 1987 through 1991. It is expected that all returning Eyak sockeye salmon will be used for broodstock.

The forecast of the Coghill sockeye salmon stock onsite run is based on age-specific mean marine survivals obtained from hatchery returns from brood years 1987 through 1992 (0.73% for age-3, 7.35% for age-4, and 2.44% for age-5 sockeye salmon). Survival estimates are based on fry releases, catch contribution estimates from coded wire tag recoveries, and broodstock data. Age-specific survival estimates were calculated separately for 24 separate release groups within four complete brood years. The means of these estimates were used to forecast ages 3, 4, and 5 sockeye salmon returns. The variance of each mean was used to estimate associated 80% confidence intervals.

Coghill stock remote smolt releases have been discontinued and no further adult returns are expected from past stockings. Adult return forecasts from stockings of Main Bay Hatchery presmolts into Coghill Lake are discussed in the natural stock forecast section.

The forecast of the Coghill stock return to Marsha Bay Lake, Knight Island, remote release site is based on the estimated proportion of age-4 sockeye salmon in returns from a 1991 release. All sockeye salmon returning in 1998 will be the result of a juvenile remote release in 1995. PWSAC is expected to harvest the entire return to Marsha Lake for cost recovery needs.

The forecast of the late-run Eshamy sockeye salmon onsite run is based on age-specific mean marine survivals from three complete brood year cycles of hatchery returns (0.25% for age-3, 11.01% for age-4, and 0.05% for age-5 sockeye salmon). Coefficients of variation for age-specific survival estimates from Coghill stock hatchery returns were used to estimate forecast ranges about forecasts of late-run Eshamy stock hatchery returns. Eshamy late-run smolt releases at Eshamy River have been discontinued and no further adult returns are expected from past releases.

Projected broodstock needs for each facility are based on the expected number of eggs produced by each female and the expected percentage of females in the broodstock. Broodstock needs do not change unless hatchery program changes occur. PWSAC cost recovery needs for sockeye salmon are based on a revenue goal of $2.5 million for species other than pink salmon. This revenue goal was divided between chum and sockeye salmon produced in hatcheries. The sockeye salmon portion of the revenue goal was expected to be $1.25 million, but the midpoint forecast does not provide sufficient adults to meet that goal using assumptions listed below. As a result, a revised revenue goal of $1.1 million has been used. The midpoint estimate of cost recovery needs was calculated using an expected price of $1.00/lb and an average weight of 6 lbs. The upper and lower bounds of the cost recovery midpoint estimate were calculated using estimated prices of $1.10/lb and $0.90/lb. The midpoint forecast does not provide enough sockeye salmon for cost recovery needs from this species. As a result, it is expected that PWSAC will harvest additional chum salmon to make up the sockeye salmon revenue shortfall.

Forecast Discussion

The natural Coghill sockeye salmon run appears to be recovering after a period of poor runs in the first half of this decade that may have been due to rearing conditions in Coghill Lake. The biological escapement goal for this system was temporarily lowered to allow plankton populations to recover, and fertilizers were added to the lake in a cooperative project with the U.S. Forest Service to improve the forage base for rearing sockeye salmon juveniles. Biological escapement goals were met in 1997 for the fourth time since 1990. Returns in 1996 and 1997 appear to indicate that production levels have increased, and good returns are again expected in 1998. The forecast for the natural run to Coghill Lake in 1998 of approximately 57.4 thousand sockeye salmon would be larger than four of the last eight years, but would still be only one-third of the 1962–1997 average run of 190 thousand sockeye salmon for this system.

The forecast for natural stocks was generated using spawner-recruit and sibling regression models, similar to methods used in previous years. However, spawner-recruit and sibling relationships do not account for the return of hatchery-reared juveniles released into Coghill Lake in

1994 and 1995. Since returns have not yet occurred for these releases, we were unable to predict survival or expected age composition of adults. In addition, no age-1.1 sockeye salmon were found in 1997 age samples during 1997, so we were unable to use a sibling regression model to estimate age-1.2 sibling returns in 1998. A forecast based on estimated smolt emigration in 1995 indicated the run could be closer to the upper 80% confidence limit of 136.7 thousand sockeye salmon for 1998. If smolt estimates are accurate, the forecast of 57.4 thousand natural Coghill sockeye salmon, the total run from natural spawners and hatchery presmolt releases, could be twice as large as forecasted.

The forecast for the natural run to Eshamy Lake is similar to the 1968–1997 average run of 67 thousand sockeye salmon. However, there are two indications that this forecast may be too high. First, the 1994 escapement was one of the latest on record. Many sockeye salmon matured completely in salt water before entering Eshamy Lake, and spawning success is believed to have been very low. Second, the Eshamy Lake natural stock appears to exhibit a four-year cycle of peak abundance. The 1998 run is between peak abundance years, and mean run size for nonpeak years during the period 1972–1997 is only 41 thousand sockeye salmon.

The Eshamy Lake natural stock is the only other large natural stock contributor to commercial harvests of sockeye salmon in Prince William Sound. A gillnet fishery is directed on this run, and the Southwest District purse seine fishery incidentally harvests this run. Although escapements into Eshamy River have been enumerated at a weir for 50 years, it has only been recently that age, sex, and size data have been collected from the escapement, the Eshamy District directed harvest, and the Southwest District incidental harvest. These data were used to construct brood tables that were used for the first time to calculate the 1997 forecast. Age-composition data and weir counts were not collected in 1987 due to budget shortfalls, creating a data gap that will continue to complicate predictions for several years. Contributions to western Prince William Sound commercial harvests of Main Bay Hatchery sockeye salmon have been estimated by recovery of coded wire tags. However, tag recovery efforts have not always been great enough to allow harvest contributions to be adequately estimated. This increases the uncertainty of total run estimates for natural and hatchery sockeye salmon stocks in western Prince William Sound, but future funding for the tag recovery remains uncertain.

Onsite returns of the Eyak hatchery stock will be small in 1998. The run will consist of age-3 and -4 sockeye salmon from brood years 1995 and 1994. Returns from the 1995 brood year were released as 1-check smolts and would be considered “jacks.” Releases in 1994 were released as 0-check smolts. A pipeline break in the winter of 1995–1996 killed much of the production for brood years 1995 and 1996.

The onsite hatchery return of the Coghill stock in 1998 is expected to be less than the return achieved in 1997. Age-4 sockeye salmon dominate hatchery returns of this stock, but few age-4 adults are expected to return in 1998 because most juveniles were released in January following the catastrophic pipeline failure. Since few tagged age-3 sockeye salmon occurred in past returns, and few were recovered in 1997, a forecast based on a sibling relationship was not made. This stock will not be used for broodstock in 1998 because PWSAC will continue to develop only early and late sockeye salmon runs to try to reduce overlap with natural runs.

Remote release of the Coghill hatchery stock in the Coghill system to supplement natural production ended with stocking of presmolts in 1995. Returns of Coghill system remote releases in 1998 will consist solely of adults released into Coghill Lake as presmolts in brood years 1994 and 1995. Survival data are not available because these are the first returns from that stocking strategy. Stocked presmolts are not included in the natural production forecast. Enhanced and natural smolts were counted at a weir on Coghill River during emigration, but contribution estimates for enhanced and natural smolts are not available for all years.

PWSAC harvested returns from 1992 remote releases of Coghill hatchery stock presmolts into Marsha Bay Lake for cost recovery needs in 1995 and 1996. The 1998 forecast return is composed entirely of age-4 sockeye salmon stocked into the lake as juveniles in November 1995. The forecast is based entirely on the predicted return of age-4 sockeye salmon produced from the 1992 stocking.

The onsite hatchery return of the Eshamy stock is expected to be composed mostly of age-4 sockeye salmon. The forecast is based on expected survival of smolts released in 1996 and is considerably less than the 1997 return because of the small number of smolts released. Since complete return data are available for only two brood years, it could not be used to develop forecasting models.

Remote release of the Eshamy hatchery stock into the Eshamy system ended with smolt releases in 1994 from the 1992 brood year. Since returns consist mostly of age-4 sockeye salmon, no further adults are expected from supplemental production.

Tim Joyce
Fishery Biologist III
Area Resource Development Biologist
Cordova

Steve Moffitt
Fishery Biologist II
Assistant Research Project Leader
Cordova

Forecast Area: Prince William Sound
Species: Coho Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (thousands)	Forecast Range (thousands)
• Hatchery and Supplemental Production		
VFDA [a] *— Solomon Gulch Hatchery*		
Hatchery Run	97.0	77.5–116.6
Broodstock Needs	1.5	
Cost Recovery Needs	16.0	
Common Property Harvest [b]	79.5	60.0–99.1
Historical Survival: Range = 0.9%–14.5%; Mean = 7.4%		
PWSAC [c] *— W. H. Noerenberg Hatchery (Onsite Releases)*		
Hatchery Run	7.8	6.1–9.5
Broodstock Needs	1.0	
Cost Recovery Needs	0.0	0.0–0.0
Common Property Harvest	6.8	5.1–8.5
Historical Survival: Range = 3.0%–14.3%; Mean = 7.4%		
PWSAC [c] *— W. H. Noerenberg Hatchery (Remote Releases)* [d]		
Hatchery Run	7.3	5.7–8.9
Broodstock Needs	0.0	
Cost Recovery Needs	0.0	
Common Property Harvest [b]	7.3	5.7–8.9
• Total Hatchery Production		
Run Estimate	112.1	89.6–135.0
Broodstock Needs	2.5	
Cost Recovery Needs	16.0	16.0
Limited Entry Harvest	93.7	71.1–116.5

[a] VFDA is an abbreviation for Valdez Fisheries Development Association.

[b] Includes recreational fishing harvest.

[c] PWSAC is an abbreviation for Prince William Sound Aquaculture Corporation.

[d] Includes remote releases at Whittier, Chenega, and Cordova.

Forecast Methods

No projection of natural coho salmon production is available for 1998. Harvest projections for natural coho salmon in Prince William Sound have typically been calculated as the mean of annual harvests. In recent years commercial harvests have primarily been directed at hatchery returns of this species, and no stock contribution estimates are available to assess the contribution of natural production. Estimates of sport harvests in 1997, which were directed at natural coho salmon runs, are not available until 1998.

The forecast for each hatchery return is the product of the number of smolts released from each facility in 1997 and the mean marine survival achieved for each facility (7.4% for Solomon Gulch

Hatchery and 7.4% for W. H. Noerenberg Hatchery). Forecast ranges are based on 80% confidence intervals about mean survivals.

Forecast Discussion

Fewer coho smolts were released from Solomon Gulch and W. H. Noerenberg Hatcheries in 1997 than in 1996. Recent changes in fish culture practices at W. H. Noerenberg Hatchery resulted in production of fewer, but larger and more vigorous, smolts. Marine survival estimates for coho salmon hatchery stocks were based on the assumption that all harvest taken in the vicinity of a hatchery is composed of production from that hatchery since coded wire tag recovery data were not available. Survival estimates for hatchery stocks could be too large if natural runs contribute to harvests in hatchery harvest areas. Return estimates to remote stocking locations in Whittier and Cordova are based on hatchery survival estimates, since little information is available on sport harvests of these returns. No direct cost recovery harvest is anticipated at the W. H. Noerenberg Hatchery because of the expected small return. However, some revenue could be generated from coho salmon excess of broodstock needs after the common property fishery ends.

Tim Joyce
Fishery Biologist III
Area Resource Development Biologist
Cordova

Forecast Area: Copper River
Species: Sockeye Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (millions)	Forecast Range (millions)
• Natural Production		
Total Run	2.23	1.27–4.57
Escapement Goal	0.48	
Common Property Harvest [b]	1.85	1.00–2.69
• Hatchery and Supplemental Production		
PWSAC [a] — Gulkana Hatchery		
Hatchery Run	0.41	0.23–0.59
Broodstock Needs	0.02	
Supplemental Escapement [c]	0.10	
Common Property Harvest [d]	0.29	0.16–0.43
• Total Production		
Run Estimate	2.74	1.50–5.17
Natural Escapement Goal	0.48	
Broodstock Needs	0.02	
Supplemental Escapement [c]	0.10	
Common Property Harvest [d]	2.14	1.16–3.12

[a] PWSAC is an abbreviation for Prince William Sound Aquaculture Corporation.

[b] Includes harvests from commercial, subsistence, personal use, and sport fisheries.

[c] Hatchery production that will not be harvested to ensure natural escapement into the Upper Copper River is achieved, since natural stocks cannot sustain the higher exploitation levels of hatchery stocks.

[d] Includes remote releases at Whittier, Chenega and Cordova.

Forecast Methods

The forecast of natural sockeye salmon is the sum of estimates for five age classes. Returns of age-1.2, -1.3, -2.2, and -2.3 sockeye salmon are predicted from a sibling regression model using the return of age-1.1, -1.2, -2.1, and -2.2 sockeye salmon the previous year. Returns of age-1.1 sockeye salmon are predicted from the mean return of that age class. The forecast range for the 1998 total forecast of natural production are the sum of 80% confidence bounds estimated from cross validation for each age class. The 80% confidence bounds for natural run harvests are calculated using mean-square-error estimates of previous harvest projections.

Forecasting methods for 1998 differ substantially from those used in the past. Previous forecasts were calculated as the product of mean return-per-spawner values and parent year escapements weighted by age class (age-4, -5, and -6 sockeye salmon). Mean return-per-spawner values were obtained from a linear regression of adult production on brood year escapements.

Supplemental production from Gulkana Hatchery is predicted from survival estimates calculated from coded wire tag recoveries in harvests and escapements into Crosswind and Summit Lakes. Survival of juveniles released into Paxson Lake is estimated as the mean of survivals for

Crosswind and Summit Lakes. The mean total harvest rate for 1995–1997 (70.9%) is used to calculate the total projected harvest of Gulkana Hatchery stocks. The forecast range for the forecast of supplemental production is calculated using mean-square-error estimates for natural runs.

Forecast Discussion

Visual inspection of return-per-spawner values for the period 1966–1996 suggests that they cycle, possibly in response to cyclic environmental conditions, although a Durbin-Watson test indicated this was not statistically significant. Recent runs to the Copper River have exceeded all previous documented runs, although spawning escapements were only slightly above average. Return-per-spawner values for the two dominant brood years (1991 and 1992) that returned in 1997 were very large, although returns for these brood years are only partially complete. Because mean return-per-spawner values would not capture a recent upturn in production, the 1998 forecast was based on linear regressions of sibling returns.

The 1998 run will be composed primarily of returns from the 1993 and 1992 brood years, with age-5 sockeye salmon expected to dominate Copper River Delta and Upper Copper River runs. Recent record-large runs suggest that environmental conditions have been unusually favorable during some or all of the life history for this species. Copper River Delta coho salmon also recently exhibited record-large returns for some of the same brood years. However, coho salmon then precipitously declined to a record-small run in 1997, and these brood years are the same ones that will account for most of the sockeye salmon run in 1998. The relationship between sockeye and coho salmon runs has not been rigorously explored, and few coho salmon rear in areas of the Upper Copper River where most sockeye salmon spawning and rearing occurs. However, this information may indicate that 1998 sockeye salmon runs may not be as large as forecast.

John Wilcock
Fishery Biologist III
PWS Research Project Leader
Cordova

Forecast Area: Copper River
Species: Chinook Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (thousands)	Forecast Range (thousands)
• Harvest Projection for Natural Run Copper River District	49.9	29.6–70.1

Forecast Methods

The harvest projection for the 1998 chinook salmon run to the Copper River area is the mean common property harvest for 1993–1997. The forecast range is the 80% confidence interval about the mean harvest.

Forecast Discussion

During the past 14 years, chinook salmon runs to the Copper River have tended to be above the long-term average, and several catch records have been set. Total harvest in all Copper River fisheries (commercial, subsistence, personal use, and sport) for the past three years have exceeded all annual harvests documented since 1890. Escapements appear to have been maintained at high levels, and environmental conditions generally appear to favor continued good production. Unfortunately, aerial surveys were not conducted on the Upper Copper River in 1993, and surveys in 1992 and 1995 are not thought to be indicative of actual spawner abundance. Without this information, it is not possible to forecast chinook total run abundance using previous methods, which assumed those survey counts approximated total run size. Performance of this forecast method has been poor. Chinook salmon appear to be in a period of increasing productivity, since all but two predictions made for the previous 13 years were less than actual runs.

John Wilcock
Fishery Biologist III
PWS Research Project Leader
Cordova

Forecast Area: Copper and Bering Rivers
Species: Coho Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (thousands)	Forecast Range (thousands)
• Harvest Projection for Natural Run		
Copper River District	317.3	79.1–555.5
Bering River District	135.1	0.0–288.7

Forecast Method

The harvest projection for the 1998 run of coho salmon to the Copper and Bering Rivers is the average limited entry commercial fishery harvest for 1980–1997. The forecast range is the 80% confidence interval about the mean harvest.

Forecast Discussion

The 1997 run of coho salmon to the Copper and Bering River areas was well below the 1980–1996 mean, and the 1997 commercial fishery harvests for these two districts were the lowest since 1939. These runs followed two years in which runs were very large: the 1994 run was the second and the 1995 run was the third (1995) largest commercial fishery harvests on record. Periods of extreme cold and low snow cover during winter, and periods of near-drought or high water during summer, have occurred regularly since 1990. The occurrence of extremely high and low brood year returns during this period probably reflect environmental conditions during years of freshwater residency. Collection of environmental data at indicator locations and coho salmon survival data from U.S. Forest Service spawning channels began in 1994. It is hoped this information can be used to improve forecast accuracy.

John Wilcock
Fishery Biologist III
PWS Research Project Leader
Cordova

Forecast Area: Upper Cook Inlet
Species: Sockeye Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (millions)	Forecast Range (millions)
• Natural Production		
Total Run	4.0	0.2-7.7
Escapement Goal	1.5	
Harvest Estimate	2.5	

Forecast Methods

The major sockeye salmon systems in Upper Cook Inlet 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 all systems, except Kenai River age 1.3, were made from two models: one using the relationship between adult returns and spawner data and the other the relationship between adult returns and sibling data. Forecasts for age-1.3 Kenai River sockeye salmon were made by averaging results from the relationship between adult returns and fall fry estimates and the relationship between adult returns and sibling data. A forecast range is an approximate 80% confidence interval, calculated using the squared deviation between past forecasts and actual returns as the forecast variance (mean square error).

Forecast Discussion

The total run of sockeye salmon to Upper Cook Inlet in 1997 was 6.3 million fish, while the preseason forecast was 6.8 million. Individual forecasts for most systems are within recent historical trends, so there are no reasons to suspect the individual forecasts are in error. However, the Crescent River and Packers Creek forecast have great uncertainty associated with them. The models used for these systems are relatively poor and the forecasts should be viewed accordingly. The sibling and fall fry models for Kenai River age-1.3 sockeye salmon were similar, unlike 1997. The sibling model predicted 1.047 million age-1.3 adults while the fall fry model predicted 1.084 million fish. Forecasted runs to individual freshwater systems are as follows:

System	Run
Crescent River	120,000
Fish Creek	248,000
Kasilof River	708,000
Kenai River	1,731,000
Packers Creek	113,000
Susitna River	537,000
Minor System	519,000

Kenneth E. Tarbox
Research Project Leader
Upper Cook Inlet

Forecast Area: Lower Cook Inlet
Species: Pink Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (thousands)	Forecast Range (thousands)
• Natural Production		
Total Run	652	153–2,830
Escapement [a]	329	121–478
Commercial Harvest [b]	323	
• Supplemental Production		
Total Run	2,464	880–3,780
Broodstock	155	
Commercial Harvest [b]	NA	
• Total Production		
Total Run	3,116	1,033–6,610
Broodstock and Escapement [a]	484	
Commercial Harvest [b]	≥323	

[a] Escapement values include an escapement goal shortfall of 54 thousand fish for systems with a forecast in 1998.

[b] Commercial Harvest = Total Run – Escapement/Broodstock. Commercial harvests of supplemental production include both common property and cost recovery harvests. Additional harvests may be expected in systems not included within the forecast.

Forecast Methods

The forecast of wild pink salmon returns to 11 harvest areas in the Lower Cook Inlet management area was based on spawner return regressions and Ricker spawner recruit analysis using 23 to 35 years of observations. The forecast range about the forecast of natural production was developed using cross-validation methods. Projected harvest from natural production was obtained by subtracting both escapement goals and escapement shortfalls from the overall forecast. Forecast range of supplemental production in Tutka Bay was based on ocean survival rates of 1–4%. Projected harvest from supplemental production was obtained by subtracting broodstock goals from the supplemental production forecast.

Forecast Discussion

The natural production forecast model was tested using cross-validation methods. The model correctly predicted 32 out of 35 changes in direction of annual run size. Accordingly, we have some confidence that the 1998 total return will continue the cycle of fewer fish returning in even-numbered years. In contrast, Resurrection Bay system runs are unusual in that they typically exhibit a strong even-year cycle. We have been less successful in correctly predicting the actual size of these runs, although forecasts have usually fallen within the 80% confidence interval. For example, in 1996, the last even-numbered year, eight of the ten systems for which a forecast was made had runs within the forecast range. The 1998 forecast for natural production of 652 thousand

pink salmon has an 80% confidence interval of 153 thousand to 2.83 million pink salmon. If realized, a natural run of 652 thousand pink salmon would fall slightly under the median run size of 667 thousand fish for even years between 1962 and 1996. The pink salmon escapement goal is 383 thousand for systems with a forecast but a combined escapement shortfall of 54 thousand fish is expected. The resulting escapement forecast is 329 thousand pink salmon.

In the Southern District, projected pink salmon harvests are 6.8 thousand fish in Seldovia and 13.3 thousand fish at Port Chatham. No harvest is expected in Humpy Creek or Port Graham, both of which failed to achieve their escapement goals in 1996. Supplemental production of pink salmon in the Southern District has contributed from 24% to 90% of the total Lower Cook Inlet commercial harvest in recent years. However, declining pink salmon prices concurrent with recent hatchery cost recovery requirements have reduced the harvest available for the common property fishery; only about 5% of the pink salmon harvested in Tutka Bay and Tutak Lagoon went to common property fishermen in 1997. The Tutka Hatchery released nearly 88 million fry in 1996. Assuming an ocean survival rate of 2.8%, about 2.5 million pink salmon are expected to return to Tutka Bay and Tutka Lagoon in 1998. Because cost recovery requirements are dependent upon inseason fish prices, the allocation of supplemental production salmon returns between common property and cost recovery fisheries cannot be determined at this time.

In the Outer District, harvests are projected to be 13.3 thousand pink salmon in Port Chatham, 195 thousand in Port Dick, and 37.3 thousand for Nuka Island. No harvests are anticipated in Rocky or Windy Bays.

In the Eastern District, a harvestable surplus of 24.4 thousand pink salmon is projected for Resurrection Bay. This would be the largest even-year harvest in the Eastern District since 1986.

In the Kamishak Bay District, a harvestable surplus of 30 thousand fish is projected in Bruin Bay. If realized, this would be the largest even-year harvest in Bruin Bay since 1986. No harvestable surplus is anticipated in Ursus and Rocky Coves.

Edward O. Otis
Lower Cook Inlet Research Biologist
Homer

Wes Bucher
Area Finfish Management Biologist
Homer

Forecast Area: Kodiak
Species: Pink Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (millions)	Forecast Range (millions)
• Natural Production		
Natural Run	9.7	7.9–11.5
Escapement Goal [a]	4.2	4.2
Commercial Common Property Harvest	5.5	3.7–7.3
• Hatchery Production [b]		
Hatchery Run	1.1	0.7–2.0
Broodstock Needs	0.3	0.3
Commercial Common Property Harvest	0.8	0.4–1.7
• Total Production		
Total Run	10.8	8.6–13.5
Broodstock and Escapement	4.5	4.5
Commercial Common Property Harvest	6.3	4.1–9.0

[a] Midpoint indexed escapement goal. The Kodiak management area pink salmon escapement goal ranges from 2.4 to 6.0 million for even-numbered years. The average even-year pink salmon escapement has been 4.0 million for the past 5 even-years (1988–1996), ranging from 3.2 to 6.0 million.

Forecast Methods

The forecast for the 1998 wild or natural pink salmon run to the Kodiak management area was calculated from a stepwise multiple regression analysis of the past 13 years of preemergent pink salmon sampling data. In past forecasts, all years of data were used (1965–present), but a higher correlation was found using only more recent data. In all regressions, 1989 and 1995 data were not included, as these two years are considered anomalous. Variables used in the analysis were the live-fry density indices for Kodiak and Afognak Islands (total and weighted by escapement into sample streams), the March and April ambient air temperatures in Kodiak, and the temperature deviation from average. Eight combinations of variables were tested, and the model with the lowest mean squared error and highest R^2 value was chosen. A point estimate for the total return to the Kodiak management area was determined, with the upper and lower ranges as the 80% confidence intervals. The model utilizing the unweighted live-fry index and the March and April temperatures was chosen as best for the 1998 forecast. Confidence in this forecast is good.

The forecast for the 1998 Kitoi Bay Hatchery pink salmon run was developed using survival rates from the 1978–1996 even-numbered brood years. The range estimates were calculated by using the average survival rate of the two lowest and two highest even-year returns.

Forecast Discussion

Preemergent pink salmon fry sampling of the Kodiak management area index streams conducted during March and April of 1997 indicated variable, but overall average overwinter survival of the eggs and sac fry. Sampling resulted in an unweighted live-fry index of 168.36 live fry per square

meter of spawning area. This live-fry index ranks as the ninth highest of the past 17 even-year indices on record.

These fry were from a 1996 brood year escapement of 3.35 million pink salmon, above the minimum Kodiak management area escapement goal of 2.4 million but below the recent 5 even-year average escapement of 4.0 million pink salmon. During the fall, weather conditions in the Kodiak management area were good, with moderate rain causing little flooding of streams. Conditions were cold in early winter but with good snow cover. Early January and most of February were warm with significant rainfall. During the sampling period most of the index streams were open, though there were periods of very cold weather. Karluk Lake was opened early in March, much earlier than in recent years. Signs of flooding and ice scouring were seen in only a few streams. Because of budget concerns there was no attempt to sample Mainland District streams.

Early spring conditions in 1996 were favorable for outmigration and rearing in the nearshore ocean environment. Ambient air temperatures, as measured in Kodiak, were near average in March and April (1.1°C below average in March and 0.7°C above average in April), and periods of heavy rain occurred in April and May. Spring plankton production, as noted by the Kitoi Bay Hatchery Manager in Kitoi and Izhut Bays, was better than in past years at the time of release of hatchery-produced fry and outmigration of wild pink fry. Late spring and summer weather conditions were warm and sunny with little rainfall.

Prior to 1989 Kodiak management area pink salmon returns were considered even-year dominant, with large returns occurring in even-numbered years followed by small pink salmon returns in odd years. Large even-year returns to the major Westside systems of Karluk and Ayakulik contributed heavily to even-year pink salmon dominance. Since 1989 dominance has switched, possibly due to environmental conditions, with odd-year returns of pink salmon becoming larger than even-year returns. There have been very low returns to Karluk and Ayakulik during this period. However, in 1996 minimum escapement requirements were exceeded in the Karluk and Ayakulik, as well as in Alitak District streams. Lower-than-average escapements occurred in streams of the Afognak and Eastside Kodiak Districts. In 1997 the hatchery released 105 million reared fry. Hatchery fry condition and size were excellent at release.

Regression of past fry indices and subsequent returns predict a point estimate of 9.7 million wild or natural pink salmon stocks returning in 1998, with a range of 7.9 to 11.5 million pink salmon. Kitoi Bay Hatchery is expected to produce an additional 1.1 million pink salmon, with a range of 0.7 to 2.0 million. Because of the favorable conditions for pink fry outmigration and spring and summer survival it is expected that at least the midpoint forecast return will be realized in 1998. Subtracting the midpoint escapement goal and the hatchery broodstock need (4.5 million pink salmon) produces a harvest forecast of 6.3 million pink salmon, with a range of 4.1 to 9.0 million pink salmon. The 1998 Kodiak management area pink salmon harvest forecast broken down by district is as follows:

- Afognak District: Brood year escapement to Afognak streams were below desired levels. Water levels were low in most streams during the sampling period with ice present in most streams. There was little sign of flooding or freezing, but presence of live fry was patchy, and significant numbers of recently hatched fry and live eggs were noted in some streams. The overall preemergent live-fry index is the fourth lowest even-year index on record. A total return of 550 thousand pink salmon is expected. The midpoint escapement goal is 296 thousand, so the harvestable surplus is expected to be 254 thousand pink salmon.

- Afognak District Supplemental Production: Favorable early marine conditions are expected to produce good survival. Fry condition upon release was excellent. The hatchery manager reported significant plankton production and few predators in the nearshore areas at the time of release. It is felt the 1998 return will achieve at least the midpoint estimate of 1.1 million pink salmon.

Only 250 thousand pink salmon are needed for stream escapement and broodstock requirements, leaving 850 thousand pink salmon available for harvest.

- Westside Districts: Brood year escapement into Westside streams was good. Overall, the live-fry density for these districts are good and the fourth highest on record for even-year returns. Water levels were low in most streams during the sampling period. Karluk, Ayakulik, Zachar, Uganik, Baumann's, and Terror all had good fry distribution and survival. Sturgeon and Uyak had fairly poor escapements and fry distribution, yet had fair to good fry indices. Uyak had changed course, with the main waterflow bypassing a normally productive area, but upper and lower densities were very good. Little River, despite good escapements, had low fry densities; heavy snow pack was noted in this area, and some flooding or scouring may have occurred. A total of 5.25 million pink salmon are forecast to return. The midpoint escapement goal is 2.5 million pink salmon, leaving 2.75 million pink salmon available for harvest.

- Alitak District: Brood year escapements into Alitak District streams were very good. Live-fry densities for this district were excellent and are the second highest on record for even-year returns. Fry distribution and survival were good in all streams. Waterflows were low and there was little sign of flooding or scouring except in the Dog Salmon and lower Humpy Rivers. Significant ice scouring was noted in the east fork of the Dog Salmon River but fry densities were still some of the highest on record. A return of 2.2 million pink salmon is expected for this district. The midpoint escapement goal is 324 thousand pink salmon, leaving about 1.876 million pink salmon available for harvest.

- Eastside Districts: Brood year escapements to Eastside district streams were poor. The overall live-fry index for this district is the lowest on record for even-year indices. Survival was mixed. Fairly good live-fry densities were found in Sharatin, Monashka, Pillar, Buskin, American, and Saltery, but record-low densities were found in Seven Rivers, Kaiugnak, and Barling (Barling had good brood year escapements and was sampled late; some fry might have already migrated out, lowering the index). Flooding was evident in some streams, particularly those near the town of Kodiak. Approximately 700 thousand pink salmon are forecasted to return to these districts, and subtracting the midpoint escapement goal of 570 thousand pink salmon leaves only 130 thousand pink salmon available for harvest.

- Mainland District: No sampling was conducted due to budget constraints. Pink salmon brood year escapements to the Mainland District were good. The pink salmon return in 1997 could approach 1.0 million fish. Midpoint escapement requirements are 512 thousand pink salmon, leaving a harvestable surplus of 488 thousand pink salmon.

Kevin Brennan
Fishery Biologist
Kodiak

Ivan Vining
Westward Region Biometrician
Kodiak

Andy Hall
Kodiak Regional Aquaculture Association
Kodiak

Forecast Area: Kodiak, Upper Station (Early Run)
Species: Sockeye Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (thousands)	Forecast Range (thousands)
• Total Production		
Total Run Estimate	98	42–206
Escapement Goal	50	50–75
Harvest Estimate	48	

Forecast Methods

The 1998 Karluk River early-run forecast was estimated using simple linear regression models employing recent brood year (1982–1994) sibling relationships. In constructing and evaluating each of the regression models, standard regression diagnostic procedures were considered and applied where appropriate (e.g., removal of outliers and transformations). Where sibling relationships produced a coefficient of determination (r^2) <0.10, average return by age class was used as the forecast estimate. The total run forecast and range were calculated by summing individual age-class estimates along with upper and lower 80% prediction intervals among all age classes.

Forecast Discussion

The 1998 forecast is about 81 thousand fish less than the 1997 forecast and about 21 thousand fish more than the actual 1997 run of 387 thousand fish. Our confidence in this forecast is fair due to the error realized in the 1997 forecast and the prevalence of large errors in forecasts statewide during 1997. The 1998 run should be composed of approximately 36% four-year-old fish and 52% five-year-old fish. If this run is realized, it will be similar to the recent 10-year average run of 433 thousand fish.

The projected harvest of 208 thousand fish is based on achievement of the midpoint of the escapement goal range of 200 thousand. The dominant age classes in the run should be 2.2 (34%) and 2.3 (27%).

Lew Coggins
Area Research Biologist
Kodiak

Charles O. Swanton
Regional Research Biologist
Kodiak

Chris Hicks
Fishery Biologist
Kodiak

Forecast Area: Kodiak, Upper Station (Late Run)
Species: Sockeye Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (thousands)	Forecast Range (thousands)
• Total Production		
Total Run Estimate	417	48–848
Escapement Goal	150	150–200
Harvest Estimate	267	

Forecast Methods

The 1998 Karluk River late-run forecast was estimated using simple linear regression models employing recent brood year (1982–1994) sibling relationships. In constructing and evaluating each of the regression models, standard regression diagnostic procedures were considered and applied where appropriate (e.g., removal of outliers and transformations). Where sibling relationships produced a coefficient of determination (r^2) <0.10, average return by age class was used as the forecast estimate. The total run forecast and range were calculated by summing individual age-class estimates along with upper and lower 80% prediction intervals among all age classes.

Forecast Discussion

The 1998 forecast is about 190 thousand fish less than the 1997 forecast and about 152 thousand fish more than the actual 1997 run of 439 thousand fish. Our confidence in this forecast is fair due to the error realized in the 1997 forecast and the prevalence of large errors in forecasts statewide in 1997. The 1998 run should be composed of approximately 50% four-year-old fish and 41% five-year-old fish. If this run is realized, it will be approximately 67% as large as the recent 10-year average run of 883 thousand fish.

The projected harvest of 191 thousand fish is based on achievement of the lower bound of the escapement goal range of 400 thousand. The dominant age classes in the run should be 2.2 (59%) and 3.2 (29%).

Lew Coggins
Area Research Biologist
Kodiak

Charles O. Swanton
Regional Research Biologist
Kodiak

Chris Hicks
Fishery Biologist
Kodiak

Forecast Area: Kodiak, Frazer Lake (Dog Salmon)
Species: Sockeye Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (thousands)	Forecast Range (thousands)
• Total Production		
Total Run Estimate	539	400–1,132
Escapement Goal	140	140–200
Harvest Estimate	399	

Forecast Methods

The 1998 Frazer Lake (Dog Salmon River) forecast was estimated using simple linear regression models employing recent brood year (1981–1994) sibling relationships. In constructing and evaluating each of the regression models, standard regression diagnostic procedures were considered and applied where appropriate (e.g., removal of outliers and transformations). Where sibling relationships produced a coefficient of determination (r^2) <0.10, average return by age class was used as the forecast estimate. The total run forecast and range were calculated by summing individual age- class estimates along with upper and lower 80% prediction intervals among all age classes.

Forecast Discussion

The 1998 forecast is about 374 thousand fish less than the 1997 forecast and about 123 thousand fish more than the actual 1997 run of 416 thousand fish. Our confidence in this forecast is fair due to the error realized in the 1997 forecast coupled with the prevalence of large errors in forecasts statewide for 1997. The 1998 run should be composed of approximately 77% four-year-old fish and 23% five-year-old fish. If this run is realized, it will be approximately 68% of the recent 10-year average run of 767 thousand fish.

The projected harvest of 399 thousand fish is based on achievement of the lower bound of the escapement goal range of 140 thousand. The dominant age classes in the run should be 2.2 (73%) and 2.3 (19%).

Lew Coggins
Area Research Biologist
Kodiak

Charles O. Swanton
Regional Research Biologist
Kodiak

Chris Hicks
Fishery Biologist
Kodiak

Forecast Area: Kodiak, Ayakulik (Red River)
Species: Sockeye Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (thousands)	Forecast Range (thousands)
• Total Production		
Total Run Estimate	710	224–1,267
Escapement Goal	300	200–300
Harvest Estimate	410	

Forecast Methods

The 1998 Ayakulik (Red River) forecast was estimated using simple linear regression models employing recent brood year (1982–1994) sibling relationships. In constructing and evaluating each of the regression models, standard regression diagnostic procedures were considered and applied where appropriate (e.g., removal of outliers and transformations). Where sibling relationships produced a coefficient of determination (r^2) <0.10, average return by age class was used as the forecast estimate. The total run forecast and range were calculated by summing individual age-class estimates along with upper and lower 80% prediction intervals among all age classes.

Forecast Discussion

The 1998 forecast is about 125 thousand fish less than the 1997 forecast and about 266 thousand fish more than the actual 1997 run of 444 thousand fish. Our confidence in this forecast is fair due to the error realized in the 1997 forecast and the prevalence of large errors in statewide forecasts for 1997. The 1998 run should be composed of approximately 38% three-year-old fish and 43% four-year-old fish. If this run is realized, it will be approximately 80% of the recent 10-year average run of 889 thousand fish.

The projected harvest of 410 thousand fish is based on achievement of the upper bound of the escapement goal range of 300 thousand. The dominant age classes in the run should be 1.2 (38%) and 2.2 (41%).

Lew Coggins
Area Research Biologist
Kodiak

Charles O. Swanton
Regional Research Biologist
Kodiak

Chris Hicks
Fishery Biologist
Kodiak

Forecast Area: Kodiak, Spiridon Lake
Species: Sockeye Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (thousands)	Forecast Range (thousands)
• Total Production		
Total Run Estimate	225	153–357
Escapement Goal		
Harvest Estimate	225	153–357

Forecast Methods

The Spiridon Lake 1998 preseason forecast was generated from smolt population estimates by age classes 1995–1997, coupled with average smolt-to-adult survival estimates derived from 1994 to 1997 adult return data. Smolt-to-adult survival has ranged from 17.4% to 39.7% with an average of 28.6% from fry outstocked during 1991–1993. A smolt-to-adult survival of 25% (lower range of 15%, and upper range of 35%) was used, combined with average adult ocean age-composition data from terminal harvest area catches.

Forecast Discussion

The run to Spiridon Lake is the result of a sockeye fry outstocking program with the intent of 100% commercial harvest in traditional fishing areas. The 1998 forecast of 255 thousand represents an approximate 54% (91 thousand fish) increase over the 1997 forecast. Similar to 1997, the 1998 run should be composed of ~85% two-ocean adults, most of which should be age-1.2 (60%) and age-2.2 (25%) sockeye predicated on the ocean age of adult returns being similar to that of 1996–1997. Forecast accuracy cannot, at this time, be determined owing to 1997 run numbers being incomplete. This, coupled with an additional brood source being used during 1995 for which no adult return data exists, impart uncertainty upon this forecast. In the future, after obtaining additional smolt-to-adult survival and adult age-composition data, more rigorous and standard forecast techniques will be employed.

Steve Honnold
Area Development Biologist
Kodiak

Forecast Area: Kodiak, Karluk Lake (Early Run)
Species: Sockeye Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (thousands)	Forecast Range (thousands)
• Total Production		
Total Run Estimate	408	45–849
Escapement Goal	200	150–250
Harvest Estimate	208	

Forecast Methods

The 1998 Karluk River early-run forecast was estimated using simple linear regression models employing recent brood year (1982–1994) sibling relationships. In constructing and evaluating each of the regression models, standard regression diagnostic procedures were considered and applied where appropriate (e.g., removal of outliers and transformations). Where sibling relationships produced a coefficient of determination (r^2) <0.10, average return by age class was used as the forecast estimate. The total run forecast and range were calculated by summing individual age-class estimates along with upper and lower 80% prediction intervals among all age classes.

Forecast Discussion

The 1998 forecast is about 81 thousand fish less than the 1997 forecast and about 21 thousand fish more than the actual 1997 run of 387 thousand fish. Our confidence in this forecast is fair due to the error realized in the 1997 forecast and the prevalence of large errors in forecasts statewide during 1997. The 1998 run should be composed of approximately 36% four-year-old fish and 52% five-year-old fish. If this run is realized, it will be similar to the recent 10-year average run of 433 thousand fish.

The projected harvest of 208 thousand fish is based on achievement of the midpoint of the escapement goal range of 200 thousand. The dominant age classes in the run should be 2.2 (34%) and 2.3 (27%).

Lew Coggins
Area Research Biologist
Kodiak

Charles O. Swanton
Regional Research Biologist
Kodiak

Chris Hicks
Fishery Biologist
Kodiak

Forecast Area: Kodiak, Karluk Lake (Late Run)
Species: Sockeye Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (thousands)	Forecast Range (thousands)
• Total Production		
Total Run Estimate	591	73–1,672
Escapement Goal	400	400–550
Harvest Estimate	191	

Forecast Methods

The 1998 Karluk River late-run forecast was estimated using simple linear regression models employing recent brood year (1982–1994) sibling relationships. In constructing and evaluating each of the regression models, standard regression diagnostic procedures were considered and applied where appropriate (e.g., removal of outliers and transformations). Where sibling relationships produced a coefficient of determination (r^2) <0.10, average return by age class was used as the forecast estimate. The total run forecast and range were calculated by summing individual age-class estimates along with upper and lower 80% prediction intervals among all age classes.

Forecast Discussion

The 1998 forecast is about 190 thousand fish less than the 1997 forecast and about 152 thousand fish more than the actual 1997 run of 439 thousand fish. Our confidence in this forecast is fair due to the error realized in the 1997 forecast and the prevalence of large errors in forecasts statewide in 1997. The 1998 run should be composed of approximately 50% four-year-old and 41% five-year-old fish. If this run is realized, it will be approximately 67% as large as the recent 10-year average run of 883 thousand fish.

The projected harvest of 191 thousand fish is based on achievement of the lower bound of the escapement goal range of 400 thousand. The dominant age classes in the run should be 2.2 (59%) and 3.2 (29%).

Lew Coggins
Area Research Biologist
Kodiak

Charles O. Swanton
Regional Research Biologist
Kodiak

Chris Hicks
Fishery Biologist
Kodiak

Forecast Area: Chignik
Species: Sockeye Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (thousands)	Forecast Range (thousands)
• Total Production		
Early Run (Black Lake)		
Total Run	900	250–1,650
Escapement	400	
Commercial Common Property Harvest	600	
Late Run (Chignik Lake)		
Total Run	1,100	550–2,650
Escapement	250	
Commercial Common Property Harvest	850	
Total Chignik Area Run		
Total Run	2,000	800–4,300
Escapement	650	
Commercial Common Property Harvest [a]	1,350	

[a] Includes portion of harvest by the Southeast District Mainland Fishery.

Forecast Methods

Black Lake

The preseason run forecast to Black Lake was generated with a multiple linear regression model (r^2 = 0.73) employing numbers and length of the prior year's age-1.2 sockeye salmon (1966–1997). We validated the relationship using freshwater age-specific smolt-to-adult survival estimates from 1997 returns applied to 1995 smolt population estimates. The estimates closely mirrored one another; however, only one year of smolt survival data was available. All other age-class estimates are based on recent 10-year average returns.

Chignik Lake

The Chignik Lake forecast is based primarily on 1995 age-2 smolt outmigration numbers coupled with smolt-to-adult survival based on returns from 1997. Two methods were used and contrasted for estimation of the run; the first method used the product of age-2 smolt numbers from 1995 divided by 1994 numbers, then multiplied by 1997 adult run numbers; the second approach used the estimate of age-1.3 Black Lake run for 1998 multiplied by the ratio of age-1 to age-2 smolt-to-adult survival. This assumes most age-1 sockeye salmon are of Black Lake origin while age-2 fish are from Chignik Lake. Accuracy of the 1998 projection is unknown owing to only a single smolt-to-adult survival data point.

Forecast Discussion

- Early Run: The 1998 Black Lake sockeye salmon run is expected to be 0.9 million fish, which is approximately 0.4 million fish less than the 1987–1997 average run of 1.3 million. Contributing

factors for this low projection is the return of 48 thousand age-1.2 sockeye salmon during the 1997 season, the lowest return since 1989 (37 thousand) that anticipated the 1990 run of about 1.0 million. Recently, the 1996 return of 52 thousand age-1.2 sockeye salmon anticipated the return of approximately 0.7 million fish in 1997. Only 12 times from 1966 to the present and twice since 1989 has the return of age-1.2 sockeye salmon been between 30 thousand and 100 thousand. Only one of the returns within this range has resulted in an above average run. Additionally, the 1995 age-1 smolt outmigration (2.6 million) was weaker than that of 1994 (7.0 million), which resulted in a poor return of age-1.3 fish in 1997. Confidence in this forecast is fair. We remain uncertain as to forecast accuracy owing to the overall poor performance of the 1997 preseason forecasts regionwide.

- Late Run: We estimated the 1998 Chignik Lake sockeye salmon run to be 1.1 million fish, which is approximately 0.2 million fish less than the 1988–1997 average run of 1.3 million sockeye salmon. For the 6-year-olds (age 2.3), which typically dominate the run, the parent year (1992) escapement is 406 thousand with a resultant return-per-spawner value of 4.4. In recent years, when one of the runs dominates, it appears to suppress the other. However, neither run is expected to overwhelm the other but return at below-average levels. The methods employed for this forecast remain untested. Therefore, a fair amount of uncertainty exists.

David Owen
Area Management Biologist
Chignik Area

Charles O. Swanton
Regional Research Biologist
Kodiak

Forecast Area: Bristol Bay

Species: Sockeye Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (millions)	Forecast Range (millions)
• Total Production		
Total Run Estimate	32.1	10.8–53.5
Escapement Goal	9.6	
South Peninsula Quota	1.9	
Commercial Common Property Harvest (Inshore) [a]	20.6	

[a] Forecasted sockeye salmon harvests for inshore Bristol Bay fishing districts are as follows: Naknek-Kvichak = 6.9 million; Egegik = 7.5 million; Ugashik = 2.4 million; Nushagak = 3.5 million; and Togiak = 0.3 million.

Forecast Methods

The 1998 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 these four major age classes, a prediction was also made for age-0 sockeye salmon returning to Nushagak-Mulchatna River because of their relative importance to 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 adult returns and either spawners or siblings. Also, regression models based on the relationship between returns and smolts were examined for the Kvichak, Egegik, and Ugashik Rivers. Results from a 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 no model results were used.

We used production data obtained only since 1978 to predict returns to all systems in Bristol Bay. The number of returning adults produced from each spawner has shown a dramatic increase since 1978, and results from hindcasting have shown that recent data provides more accurate and less biased predictions of run size. Nushagak-Mulchatna predictions were based on data from a shorter time interval, 1980–1997, since these were the only available production data.

Mean squared error (MSE) of the total run forecast was calculated using deviations of actual runs from run predictions made for 1987 to 1997. Run predictions for 1987 to 1997 were based on the same methods used for the 1998 forecast (i.e., use of recent-year production data). MSE was used to estimate the standard error and 80% confidence bounds of the total run forecast.

Forecast Discussion

A total of 32.1 million sockeye salmon are expected to return to Bristol Bay in 1998. This prediction is 20% less than the previous 20-year mean (40.4 million; range 10.7 million to 66.3 million), and 26% less than the previous 10-year mean (43.7 million; range 20.5 million to 62.7 million). Runs are expected to exceed spawning escapement goals for all systems.

Inshore harvest is expected to be 20.6 million sockeye salmon. A harvest of this size would be 19% less than the previous 20-year mean harvest of 25.4 million (range 4.9 million to 44.3 million) and 30% less than the previous 10-year mean of 29.5 million (range 12.3 million to 44.3 million). An

additional 1.9 million Bristol Bay sockeye salmon can 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 22.5 million harvest).

Differences in projections among the linear regression models (spawner-return, sibling, and smolt) used for each system suggest actual runs may differ greatly from forecasted runs in the Kvichak, Ugashik, and Nushagak systems. There is a threefold difference in predicted returns to Kvichak River between results based on sibling (5 million sockeye salmon) and smolt (15 million sockeye salmon) models. There is almost a two-fold difference in predicted returns to Ugashik River between results based on smolt (2.4 million) and spawner-return (4.6 million) models. Finally, the prediction for Nushagak River age-0.3 sockeye salmon based on a spawner-return model is 0.3 million, although no age-0.2 sockeye salmon were present in samples from the 1997 run.

Beverly Cross
Research Project Leader
Anchorage

Forecast Area: Bristol Bay, Nushagak District
Species: Chinook Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (thousands)	Forecast Range (thousands)
• Total Production		
Total Run Estimate	159	113–205
Inriver Run Escapement Goal [a]	75	
Commercial Common Property Harvest	84	

[a] The Nushagak inriver goal is 75.0 thousand chinook salmon, which provides for a biological escapement goal of 65.0 thousand spawners and an additional harvest of 10.0 thousand chinook salmon by upriver subsistence and sport fisheries.

Forecast Methods

The 1998 chinook salmon forecast for Nushagak District is the sum of individual predictions for five age classes (age-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 1998 based on age-1.3 returns in 1997). Regression models were based on natural logarithm-transformed data. Predictions from regression models were only used if the slope of the line was significantly different from zero ($\rho < 0.25$). If these criteria were not met, the mean return of an age class was used to predict 1998 returns.

Regression models were used to predict age-1.3, -1.4, and -1.5 returns. Mean returns were used to predict age-1.1 and -1.2 returns. The mean squared error (MSE) of the total run forecast was calculated from deviations of actual runs from hindcasts for 1984 to 1997. Hindcasts were based on the same methods used for the 1998 forecast. The MSE was then used to estimate the standard error and 80% confidence bounds.

Forecast Discussion

The age composition of the 1998 forecasted run is 0.5% (0.8 thousand) age 1.1, 16.9% (26.8 thousand) age 1.2, 37.2% (59.2 thousand) age 1.3, 42.7% (67.8 thousand) age 1.4, and 2.7% (4.3 thousand) age 1.5. The 1998 forecasted run of 158.9 thousand chinook salmon is 16.2% less than the previous 20-year mean run of 189.7 thousand and 11.4% greater than the most recent 10-year mean run of 142.6 thousand. The projected harvest of 83.9 thousand chinook salmon is 21.7% less than the previous 20-year mean harvest of 107.2 thousand and 20.9% greater than the most recent 10-year mean harvest of 69.4 thousand.

Beverly Cross
Research Project Leader
Anchorage

Forecast Area: Alaska Peninsula, Bear Lake (Late Run)
Species: Sockeye Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (thousands)	Forecast Range (thousands)
• Total Production		
Total Run Estimate	1,000	455–1,600
Escapement Goal		80–115
Harvest Estimate	885	

Forecast Methods

The Bear Lake 1998 late-run forecast was derived using simple linear regression models employing recent brood year (1980–1993) sibling relationships. Selection of prediction models using sibling data encompassed analysis of outlier data points, residuals, and using dependent variable transformations (log and square root) where applicable. Model selection for an age-class estimate was based upon identifying that model having a reasonable biological interpretation coupled with possessing low error and a high r^2 value. The forecast range was derived by combining the 80% prediction intervals for each individual age-class estimate.

Forecast Discussion

The 1998 forecast is about 400 thousand fish larger than both the 1997 forecast and realized run of about 487 thousand sockeye salmon. Our confidence in this forecast is fair due largely to the observed error of the 1997 forecast coupled with this being the third year that a formal forecast has been prepared. The 1998 run should be composed of about 50% five-year-old fish and 50% six-year-old fish.

The projected harvest of 885 thousand is founded upon achievement of the upper end of the escapement goal range of 115 thousand. Age-2.2 and -2.3 fish should contribute about equal amounts to the run. Minor age classes (ages 1.1, 1.2, and 2.1) were not estimated. These minor age classes will invariably contribute to the run and therefore impart error. Forecast accuracy for this system was exceptional during 1997. However, it can be anticipated that this situation will not persist.

Charles O. Swanton
Regional Research Biologist
Kodiak

Chris Hicks
Fishery Biologist
Kodiak

Forecast Area: Alaska Peninsula, Nelson River
Species: Sockeye Salmon

Preliminary Forecast of 1998 Run	Forecast Estimate (thousands)	Forecast Range (thousands)
• Total Production		
Total Run Estimate	415	80–750
Escapement Goal		100–150
Harvest Estimate	345	80–600

Forecast Methods

The Nelson River 1998 forecast was derived using simple linear regression models employing recent brood year (1981–1993) sibling relationships. Selection of prediction models using sibling data encompassed analysis of outlier data points, residuals, and using dependent variable transformations (log and square root) where applicable. Model selection for an age-class estimate was based upon identifying that model having a reasonable biological interpretation coupled with possessing low error and a high r^2 value. The forecast range was derived by combining the 80% prediction intervals for each individual age-class estimate.

Forecast Discussion

This preseason forecast is the first time that a formal prediction for this system has been completed. Our confidence in this forecast is marginal due largely to the unknown aspects of the system. The relationships used in the forecast were about average for sockeye salmon systems observed within the Westward Region. The 1998 run should be composed of 70% five-year-old fish and 30% six-year-old fish.

The projected harvest of 435 thousand is founded upon achievement of the upper end of the escapement goal range of 150 thousand. Age-2.2 fish should compose 70% of the run followed by age-2.3 fish at 30%. Minor age classes (ages 1.1, 1.2, and 2.1) were not estimated. These minor age classes will invariably contribute to the run and therefore impart error.

Charles O. Swanton
Regional Research Biologist
Kodiak

Chris Hicks
Fishery Biologist
Kodiak

Forecast Area: Arctic-Yukon-Kuskokwim

Commercial Harvest Outlook for the Arctic-Yukon-Kuskokwim Region in 1998

The Alaska Department of Fish and Game does not produce formal run forecasts for any salmon runs in the Arctic-Yukon-Kuskokwim (AYK) Region. Salmon run outlooks in the AYK Region are mostly qualitative due to the lack of adequate information with which to develop more rigorous forecasts. For Yukon River fall chum salmon, a quantitative run projection is made based on parent year escapement and expected productivity. The commercial harvest outlook is developed based on that run projection. Commercial harvest outlooks for other salmon runs in the AYK Region are more qualitative assessments. These are typically based upon available parent year spawning escapement indicators, age-composition information, and the likely level of commercial harvest that can be expected to be available from such indicators, given the fishery management plan is in place. However, in some cases the commercial harvest outlook has simply been the range of historical harvest levels. While the commercial harvest outlooks provide for a general level of expectation, the fisheries are managed based upon inseason assessments of the actual runs. Declining salmon markets, particularly for chum salmon flesh since 1994 and salmon roe in 1997, have had a major impact on the commercial fisheries in the AYK Region. A continuation of these market trends in 1998 could result in limited harvest in some areas and lower exvessel values. The 1998 commercial harvest outlook for the AYK Region is broken out by management area and the average outlook harvests are provided in Table 7. The commercial harvest outlook for the Kuskokwim Area (Kuskokwim Bay and Kuskokwim River combined) consists of 32 to 62 thousand chinook, 150 to 220 thousand sockeye, 560 to 820 thousand coho, 22 to 108 thousand pink, and 75 to 490 thousand chum salmon. The commercial harvest outlook for the Yukon River consists of 88 to 108 thousand chinook, 50 to 75 thousand coho, 500 to 800 thousand summer chum, and 150 to 250 thousand fall chum salmon. For Norton Sound, the commercial harvest outlook consists of 5 to 8 thousand chinook, 60 to 80 thousand coho, 500 thousand to 1 million pink, and 40 to 80 thousand chum salmon, and the outlook for Kotzebue Sound is 200 to 350 thousand chum salmon.

South Peninsula June Fishery Chum Salmon Guideline Harvest Range

Background

In 1998 the Alaska Board of Fisheries replaced the chum salmon cap in the South Peninsula June Fishery with a "floating" guideline harvest range. This range of chum harvest is now determined annually by two factors: a forecast based on an index of summer chum salmon harvest in western Alaska, and a check to see if the department has any "management concerns" for summer chum salmon in this area. The level of the forecast index in relation to the 33rd and 66th percentiles of the historic series determines the range. For a forecast less than the 33rd percentile, the range covers 350–450 thousand chum salmon. Between the 33rd and the 66th percentile, the range covers 450–550 thousand chum salmon. Above the 66th percentile, the range covers 550–650 thousand chum salmon. If the department identifies a "management concern" for summer chum salmon within the Arctic-Yukon-Kuskokwim (AYK) Region, the department must manage the June fishery for the low end of the guideline harvest range (e.g., 350–400 thousand for the first range). A "management concern" means a chronic inability to meet escapement objectives, despite the use of specific management measures. The term "chronic" refers to the continuing or anticipated inability to meet escapement objectives over a four-year period, which is generally equivalent to a life cycle or generation of chum salmon.

The 1998 June Fishery Guideline Harvest Level

The 1998 forecast for the catch index is 1.1 million summer chum salmon. This catch, if realized, will be in the bottom third of the index series, and therefore restricts the guideline harvest level to 350–450 thousand chum salmon. Because the department has identified conservation concerns for summer chum salmon in eight systems in the AYK area, this further restricts the guideline harvest level to 350–400 thousand chum salmon in the June fishery.

Forecast Methods

The catch index is made up of commercial and subsistence catches of summer chum salmon in the Yukon River (including the subsistence harvest, Yukon area personal use summer chum salmon, and Yukon area test fish given away for subsistence purposes; it excludes sport-caught chum salmon) and commercial chum harvests on the Kuskokwim River, in Norton Sound, and in the Kotzebue area. To produce the forecast for next year's value of this series, this index series is regressed on itself, lagged one year back. The resulting estimated regression equation is given by

$$\text{forecast} = 845.50 + (0.489)\ \text{last year's catch}.$$

Because the mean of both the independent and dependent variables is nearly the same, the resulting forecast is essentially a weighted average of the long-term average of the series (from 1970 to 1996) and the previous year's (1997) value of the index. The weights are approximately given by the regression coefficient, 0.489 and 1 minus the regression coefficient. In other words,

$$\text{forecast} \approx (1\text{-regression coefficient})\ \text{long-term average} + (\text{regression coefficient})\ \text{last year's catch}.$$

Using the actual numbers, the forecast is

1.1 million = (0.510) 1.659 million + (0.489) 0.575 million.

In actual practice, 0.510 does not exactly equal 1-0.489, but these numbers show the principle.

Forecast Discussion

The regression relationship that underlies the forecast is weak, but it provides the best objective forecasting tool I could find. Even so, the current methods are expected to provide a fairly stable forecast tool that will not fluctuate wildly from year to year. The forecast will tend to be near the long-term average in most years — as the forecast is a weighted average of the long-term catch and the previous year's catch, with the weights both near 1/2. For that reason, this method will usually lead to the middle guideline harvest level (450–550 thousand), except when the previous year's catch is very high or very low. But these methods will always miss sudden drops or increases in production. To the extent this forecasting tool works, it is based only on the general tendency of catch levels to remain close to the same level from one year to the next. In this particular case, 1997 was a year of very low catch. The very low 1997 value caused the forecast to be pulled far away from the long-term average and brought the forecast well below the 33rd percentile of the historic values in the index series.

Hal Geiger
Principal Salmon Biometrician
Juneau