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INFORMATION ON THE CATCH AND ESCAPEMENT OF CHUM SALMON IN THE ARCTIC-YUKON-KUSKOKWIM REGION IN 1993, WITH A HISTORICAL PERSPECTIVE

By

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INTRODUCTION

Chum salmon runs in the Arctic-Yukon-Kuskokwim (AYK) region (Figure 1) in 1993 were disastrously weak, resulting in greatly reduced commercial fishery catches, and in some areas, special sport, personal use, and subsistence fishery restrictions and closures. In order to meet the widespread need for information on the status of the fisheries and stocks in the AYK region, preliminary commercial catch and escapement information was compiled in a memorandum dated 8 October 1993 entitled *Preliminary Information on Catch and Escapement of Chum Salmon in the Arctic-Yukon-Kuskokwim Region in 1993* by Lawrence S. Buklis, AYK Regional Research Biologist, and John R. Hilsinger, then AYK Regional Supervisor. This report presents an updated reporting and expanded analysis of that information. Data presented in this report are current as of 15 March 1994. Further minor revisions may yet occur.

This report provides an overview of chum salmon commercial catches and escapements in the AYK region. Subsistence catch estimates are not available for all areas in the region on a regular basis. However, in order to assess run shortfalls for each management area at the end of this report, preliminary subsistence catch estimates and some approximations are used for the likely subsistence catch levels in 1993. Sport catch of chum salmon in the AYK region is relatively minor, on the order of a few thousand chum salmon annually for the entire region as a whole. Chum salmon are typically taken incidentally to sport effort directed at other species.

OVERVIEW OF COMMERCIAL CATCHES AND ESCAPEMENTS

Commercial chum salmon fisheries in the AYK region developed in the 1970's, and peaked during the 1980's (Figures 2-5 and Table 1). The bulk of the chum salmon caught in each area is taken in directed fisheries managed for chum salmon, with the exception of Kuskokwim Bay, where chums are managed as incidental to chinook and sockeye salmon. Commercial catch for the region as a whole averaged 214,000 chum salmon during the 1960's, 1,347,000 during the 1970's, 2,335,000 during the 1980's, and 1,503,000 during the 1990's through 1992. For 1993, the commercial catch in the AYK region totalled 360,000 chum salmon. That is the lowest since 1968, which was prior to the development of the commercial chum salmon fisheries, and less than 10% of the peak catch of 3,659,000 chum salmon in 1988. The number and duration of commercial fishing periods was greatly reduced for most areas in the region in 1993.

Escapement assessment for chum salmon stocks in the AYK region has included a variety of methods, including population estimates based upon sonar, weirs, counting towers, tagging, and expanded ground surveys, as well as indices of relative abundance based upon aerial surveys. The latter method has been the most broadly applied due to the vast size of the region, the broad distribution of spawning stocks, and limited program budgets. To provide some historical

perspective on trends in chum salmon escapements in the region, data is presented here for seventeen selected chum salmon stocks (Figures 1 and 6-11, and Table 2). These "indicator" stocks include the Goodnews and Kanektok Rivers for Kuskokwim Bay; the Aniak and Kogrukluk Rivers for the Kuskokwim River; the West Fork Andreafsky, Anvik, and North Fork Nulato Rivers for the Yukon River summer run; the Sheenjek, Delta, Toklat, Fishing Branch, and mainstem Yukon River for the Yukon River fall run; the Kwiniuk and Fish-Niukluk Rivers for Norton Sound; and the Noatak, Lower Kobuk (Squirrel, Salmon, and Tutuksuk composite), and Upper Kobuk Rivers for Kotzebue Sound.

These stocks or stock groups were selected based upon their relative importance, geographic representativeness, and the quality and completeness of historical data. As such these stocks are intended to be indicators of trends in the broader areas they represent. Total chum salmon spawning escapement for the entire region as a whole is not known because spawning escapement estimates are not available for all of the stocks, and many of those available are only aerial survey indices of abundance. The development of main river sonar projects is expected to provide a more comprehensive assessment of total stock size in some portions of the region than has historically been available.

Escapement goals used in this report for the spawning stocks in Alaska are those goals in effect as of the 1993 season, in the same units as the historical escapement data for each stock. In the figures the 1993 escapement goals have been drawn across the entire range of data for each stock to provide a comparative benchmark. Escapement goals for these stocks were first established in the early 1980's or more recently, and may have been modified somewhat since then. Escapement goals for the spawning stocks in the Canadian Yukon used in this report are those recommended by the U.S./Canada Joint Technical Committee (JTC) in 1987 for the Fishing Branch River and in 1990 for the mainstem Yukon River. Once again, these goals have been drawn across the entire range of data to provide a comparative benchmark. Rebuilding efforts are underway to reach those levels by achieving intermediate rebuilding levels in a scheduled manner.

For 1993, spawning escapement goals were not achieved for eleven of the seventeen selected stocks (Goodnews, Kanektok, Aniak, West Fork Andreafsky, North Fork Nulato, Sheenjek, Toklat, Fishing Branch, mainstem Canadian Yukon, Kwiniuk, and Noatak Rivers), they were achieved for five of the stocks (Kogrukluk, Anvik, Delta, Fish-Niukluk, and Upper Kobuk Rivers), and the goal for the Lower Kobuk River was essentially achieved, although distribution of spawners among the three component stocks was not as desired. Note that this evaluation categorizes the West Fork Andreafsky River and the Noatak River as not having achieved their escapement goals. The West Fork Andreafsky River was surveyed prior to optimal timing, while the Noatak River was surveyed prior to optimal timing and under poor survey conditions in 1993. However, for the West Fork Andreafsky River, analysis of historical timing data indicates that the escapement goal was likely not achieved, and for the Noatak River, analysis of passage estimates from a recently developed sonar project indicates that the escapement goal was likely not achieved.

The shortfalls for the stocks that did not achieve their escapement goals were typically more substantial than the margin by which goals were achieved for the other stocks. For example, the Aniak River sonar escapement estimate of 14,200 chum salmon was 235,800 chums short of the goal of 250,000 (the escapement was 6% of the goal), the North Fork Nulato River aerial survey index of 7,700 summer chum salmon was 15% of the minimum goal of >53,000, and the tagging study estimate of 29,900 fall chum spawners for the mainstem Yukon River in Canada was 61% of the 1993 rebuilding step goal of 51,000 spawners, and 37% of the long term minimum goal of rebuilding, which is greater than 80,000 spawners. On the other hand, the greatest margin, in numbers, by which a goal was achieved was for the Anvik River sonar estimate (17,400 summer chums above the minimum goal of >500,000), and the greatest margin, on a percentage basis, was for the Delta River fall chum expanded ground survey estimate (81% above the minimum goal of >11,000). The escapement goals for the Kogrukluk, Fish-Niukluk, and Upper Kobuk Rivers were each met by a margin of less than 2,000 chum salmon counts or index counts.

In order to better follow trends in the escapement data a ratio was developed which serves to compile the information from the seventeen selected stocks into a composite. This ratio, which will be termed an escapement performance ratio, relates the escapement for a stock in a given year to a fixed reference level for that stock. These escapement performance ratios have been calculated by dividing the escapement estimate for a given stock in a given year by the escapement goal for that stock as previously described. A ratio of 1.00 indicates that the escapement estimate for a stock was equal to the 1993 escapement goal for that stock. A ratio less than 1.00 indicates that the escapement was below the goal, and a ratio greater than 1.00 indicates that the escapement was above the goal. The average of the escapement performance ratios across all of the stocks for a given year provides a numerical measure of the composite escapement performance for that year. The trend in that average across years provides a historical perspective by which to compare the 1993 season. The escapement performance ratios for the seventeen stocks across the ten year period 1984-1993 are presented in Table 3. Of the possible 170 escapement performance ratios (17 stocks and 10 years), a total of 140 ratios (82% of the possible total) were calculated. The other 30 stock-year cells (18% of the possible total) are blank in Table 3 due to missing data or poor survey conditions. Figure 12 illustrates the trend in the regionwide escapement performance ratio across the ten year period.

Since escapement goals were not established in the AYK region much before 1984 for most stocks, it is probably not reasonable to extend the analysis any further back. The primary purpose of this approach is to evaluate escapement status for a broad composite of stocks across a number of years. Therefore, a fixed reference level was needed for each stock against which to compare the escapement estimates. Since some of the escapement goals may have changed slightly during the period 1984-1993, or in some cases intermediate rebuilding level goals are put in place in a scheduled manner, this approach is not meant to be a rigorous evaluation of management precision.

Although not intended as an application for the method for the purposes of this report, the average of the escapement performance ratios across the ten-year period for a given stock does provide a numerical measure of the average status of that stock relative to a fixed reference level.

However, it should be noted that use of the escapement performance ratios presented here for that application would need to take into account the number of excluded years for some of the stocks due to either a lack of data or surveys conducted under poor conditions. A more subjective evaluation of the escapement survey data available for such stocks but excluded from the escapement performance ratios, or other ancillary information about those stocks, would be required to better assess their status.

The results indicate that, despite the fishery management actions taken in 1993 and the consequent reduced catches, the escapement performance ratio averaged only 0.77 in 1993. There were six stocks with a ratio below 0.70, and only one stock with a ratio above 1.15 in 1993. By way of comparison, for the 10-year period 1984-1993, the annual escapement performance ratio has averaged 0.95, with 1993 not only below average but the lowest of the ten years. For seven of the ten years examined, escapement performance ratios were calculated for fourteen or more of the seventeen stocks. However, six stocks were excluded from the 1989 average, five from the 1990 average, and four from the 1992 average due to either a lack of data or poor survey conditions. Those years had resulting annual average escapement performance ratios of 0.99, 0.86, and 0.82, respectively. If more of the stocks excluded for those years would have had below average than above average escapement performance ratios, as may be the case given the stocks involved, the annual average escapement performance ratios for those years would have been somewhat lower. It also follows that the 10-year average would have been somewhat lower than the calculated value of 0.95. However, given the moderating effect of the number of other stocks and years in the overall analysis, the shift in annual average escapement performance ratios, or the 10-year average, would not likely have been significant. In any case, the relative interannual trend and evaluation of the 1993 season has not likely been significantly affected by missing or excluded data.

OVERVIEW OF RUN SHORTFALLS FOR 1993

Based on parent year escapements, normal returns per spawner, normal catch levels, and estimates of catch and escapement for 1993, the shortfalls from the runs that should have materialized can be approximated for each management area. These are very approximate estimates given the limited information that is available for these stocks. The estimates should, however, serve to describe the general magnitude of the shortfalls.

Kuskokwim Bay: The Kuskokwim Bay districts are managed for chinook and sockeye salmon. Parent year chum salmon escapement for the four year old return was below escapement goals. Parent year escapement for the five year old return achieved the goal in the Goodnews River but was below the goal in the Kanektok River. Chum salmon catch in the Kanektok River (Quinhagak) district was above average in 1993, while the Goodnews Bay district catch was below average. For 1993 the Goodnews River weir escapement goal of 15,000 was nearly achieved with a weir count of 14,300, while the Kanektok River escapement aerial survey count of 1,300 chums, although flown prior to the standard peak date, was only 4% of the goal of

30,500. However, unlike elsewhere in AYK, there was no obvious large scale run failure for these districts that could not be attributed to parent year escapement levels.

Kuskokwim River: Commercial catch was only 43,000 chum salmon in 1993 compared to an average in the 1980's of over 500,000. The Kuskokwim River subsistence catch estimate of approximately 47,000 chum salmon in 1993 was well below the typical catch level of about 100,000 chums. Special subsistence fishery restrictions and a closure was implemented on the Kuskokwim River during the later portion of the run in 1993 to conserve chum salmon. Adequate escapement was apparently achieved in upper and lower drainage tributaries, however the Aniak River in the middle drainage, which is usually the major producer, had an escapement of only 14,200 compared to the goal of 250,000 chum salmon. It appears that return per spawner was only about 1:15 for the Aniak River (that is, 1 return for every 15 spawners). Since parent year escapement goals were met in the Aniak and Kogrukluk Rivers it is likely that the shortfall on the Kuskokwim River was on the order of 750,000 chum salmon in 1993. This equates to the shortfall from the normal commercial and subsistence catch levels plus the escapement shortfall in the Aniak River. Due to the complete failure of the Aniak River run, the overall Kuskokwim River chum run was about one third of the expected level.

Yukon River Summer Run: Total return to the Yukon River for the summer chum run was approximately 1.1 million. This is based on the Pilot Station sonar estimate plus an estimate of catch below Pilot Station. Total Yukon River commercial catch in 1993 was 140,000 summer chum, while the subsistence catch was approximately 105,000. Although the Anvik River escapement goal of >500,000 summer chum was achieved with a sonar estimate of 517,400, spawning escapements above Pilot Station other than to the Anvik River were well below average. Parent year spawning escapement for the entire drainage was likely on the order of 1 million summer chums. Therefore, return per spawner was approximately 1:1. Even at a conservative return per spawner ratio the 1993 run should have been 2 million summer chum or more. The shortfall is therefore approximately 1 million summer chum salmon, with the run about one half of the expected level.

Yukon River Fall Run: The projection for 1993 was for a total run of 734,000 fall chum salmon. This estimate included an expected poor return of five year old fish due to the poor showing of four year old fish in 1992. Based on the Pilot Station sonar estimate plus an estimate of subsistence catch below Pilot Station the total run was 300,000 to 350,000 fall chums. Parent year escapement was estimated to be on the order of 400,000 fall chums, therefore the return per spawner was below 1:1. The shortfall is estimated to be 400,000 fall chums, with the run less than one half of the expected level. The commercial fishery was not opened for fall chum salmon in 1993. The sport and personal use fisheries were closed beginning in mid-August. The subsistence fishery was restricted to 48 hours per week beginning in mid-August, then closed for most of September to conserve fall chum salmon. The subsistence catch estimate for 1993 was approximately 77,000 fall chum salmon, which was well below the normal harvest level, which has been greater than 150,000 fall chums in nine of the prior ten years.

Norton Sound: Due to the lack of precise run assessment tools in Norton Sound, it is more difficult to assess the magnitude of the run failure. Return per spawner appeared to be about a ratio of 1.25:1 in the Kwiniuk River where a counting tower provides accurate escapement data. Other systems appeared to have returns of approximately 1:1 as well. Most river systems, except in the Nome and Moses Point subdistricts, were near escapement goals with either no commercial catch or a reduced commercial catch. Subsistence restrictions and closures were imposed in the Nome subdistrict and in the Kwiniuk and Tubutulik Rivers of the Moses Point subdistrict. It is likely that the shortfall was on the order of 100,000 chum salmon for Norton Sound. Based on the similarity of return per spawner with the other areas, the Norton Sound run was probably also about one half of the expected level.

Kotzebue Sound: Commercial catch for 1993 was only 71,000 chum salmon, down from the average of 345,000 during the 1980's. No subsistence restrictions were enacted. Based on normal catch rates and estimates of escapement, the Kotzebue Sound run appeared to be about one half of the expected level. Probable overall shortfall was likely on the order of 250,000 chum salmon for Kotzebue Sound.

Regionwide: Chum salmon return per spawner averaged about 1:1 throughout the AYK region and returns were about one half of the expected level in 1993. A notable exception to this was the Aniak River run, which was only a fraction of the expected level. The overall 1:1 return per spawner ratio in the AYK region meant that commercial, sport, personal use, and subsistence fisheries had to be restricted or closed in some areas in order to meet, or even approach, spawning escapement goals. The following table summarizes the approximate chum salmon run shortfalls by area and for the AYK region as a whole in 1993:

Area	Chum Salmon Estimated Shortfall
Kuskokwim River	750,000
Yukon River Summer Run	1,000,000
Yukon River Fall Run	400,000
Norton Sound	100,000
Kotzebue Sound	250,000
AYK REGION TOTAL	2,500,000

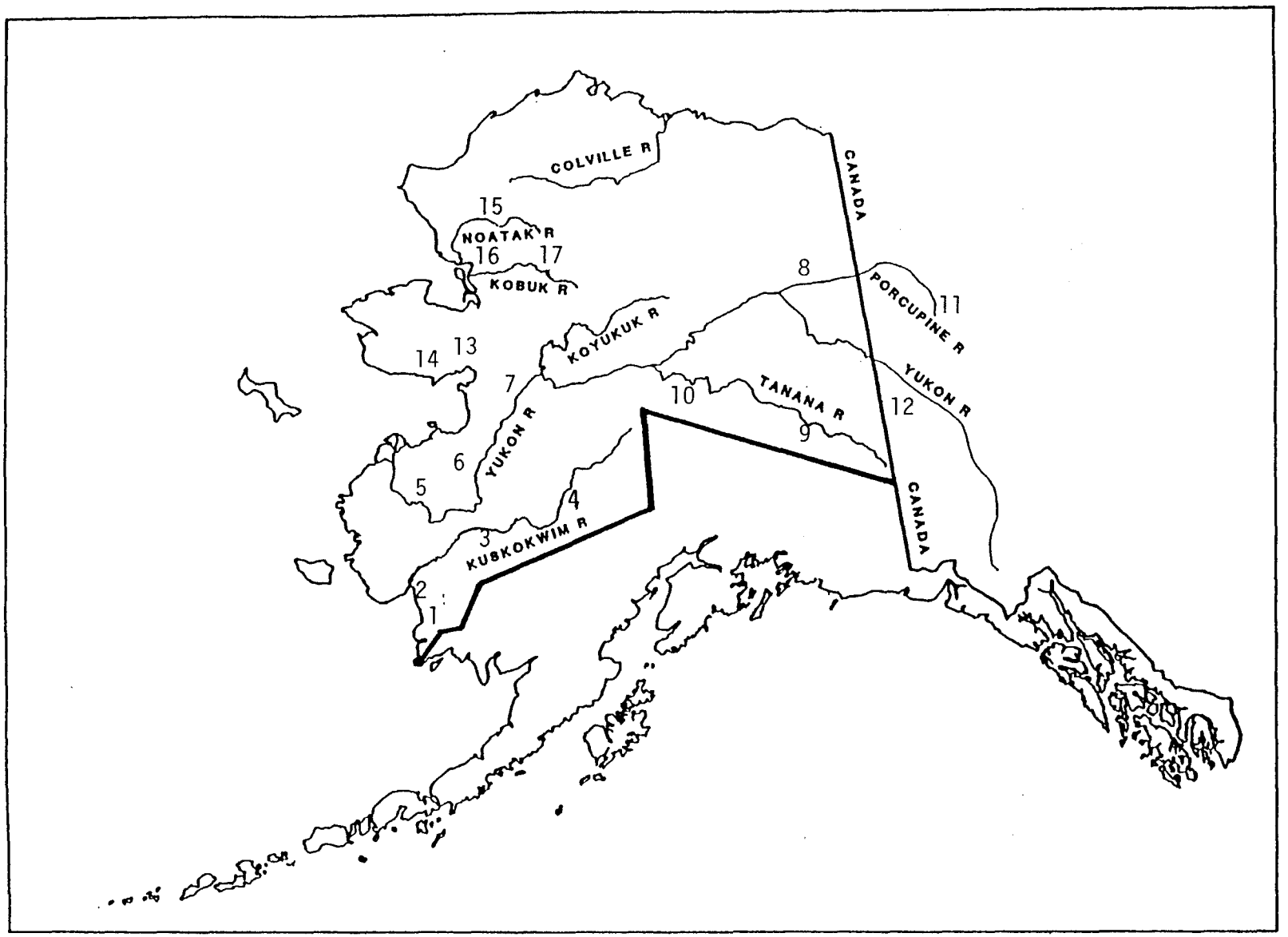

Figure 1. Map of the Arctic-Yukon-Kuskokwim Region, showing approximate escapement monitoring locations for selected chum salmon stocks, as follows: (1) Goodnews River, (2) Kanektok River, (3) Aniak River, (4) Kogrukluk River, (5) West Fork Andreafsky River, (6) Anvik River, (7) North Fork Nulato River, (8) Sheenjek River, (9) Delta River, (10) Toklat River, (11) Fishing Branch River in Canada, (12) Mainstem Yukon River in Canada, (13) Kwiniuk River, (14) Fish-Niukluk River, (15) Noatak River, (16) Lower Kobuk River, (17) Upper Kobuk River.

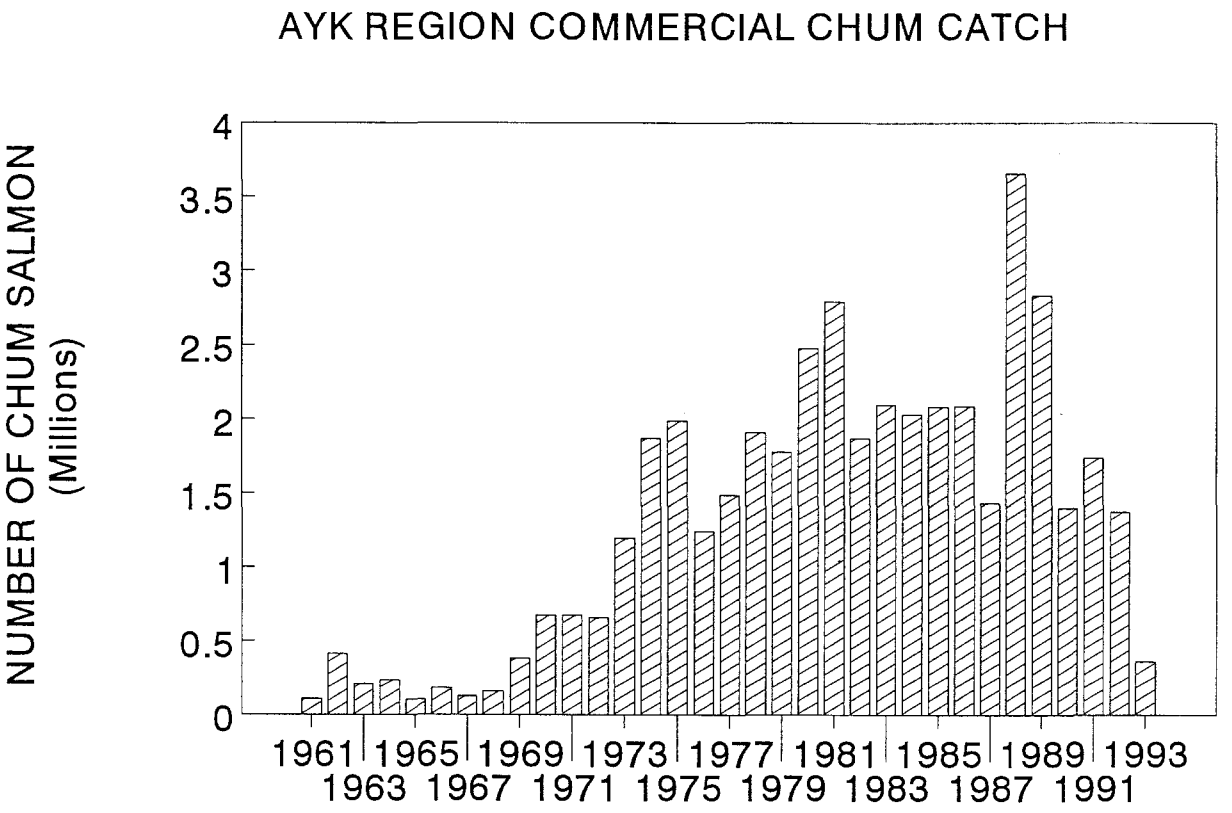

Figure 2. Commercial chum salmon catch in the AYK Region, 1961–1993.

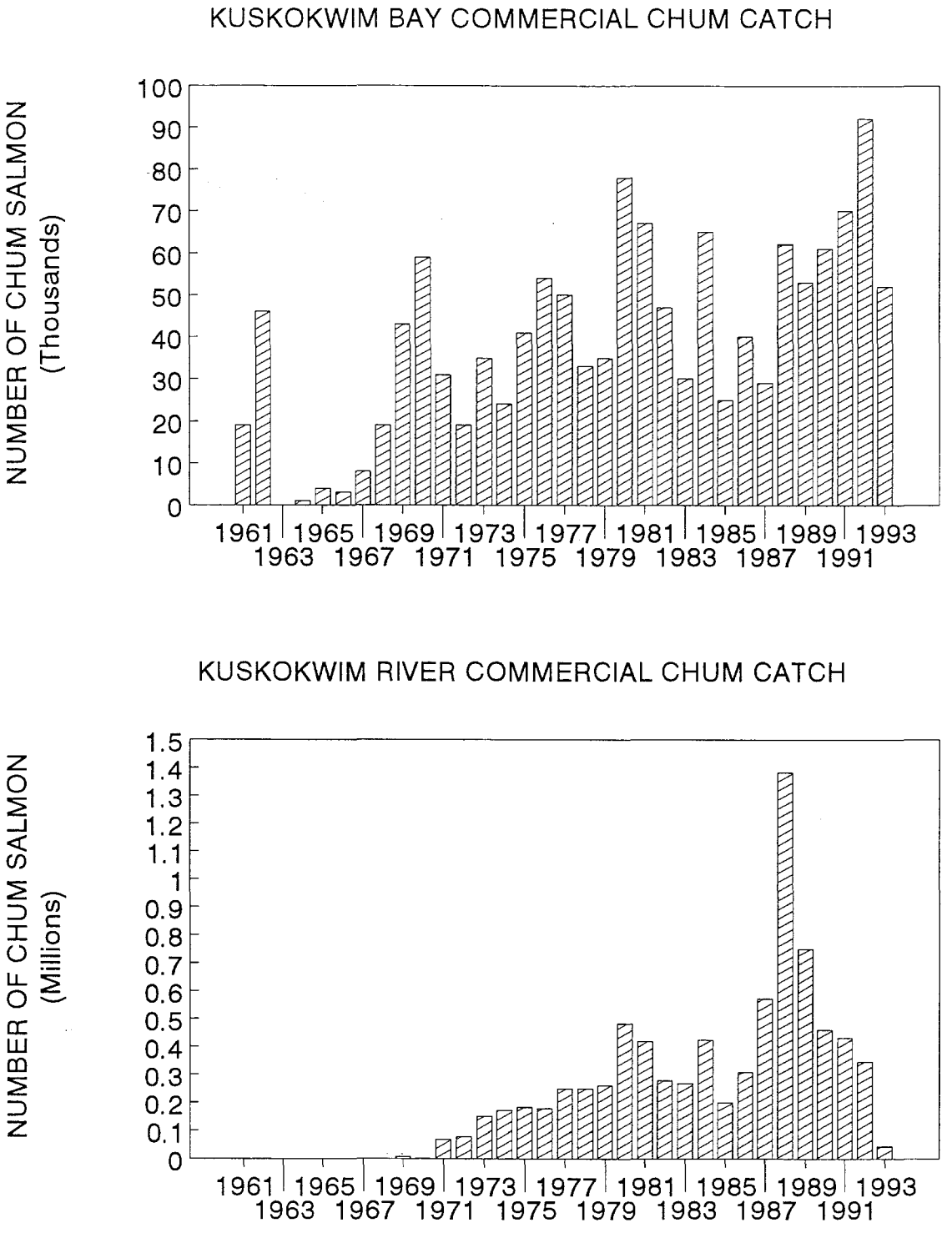

Figure 3. Commercial chum salmon catch in the Kuskokwim Bay and Kuskokwim River areas, 1961–1993.

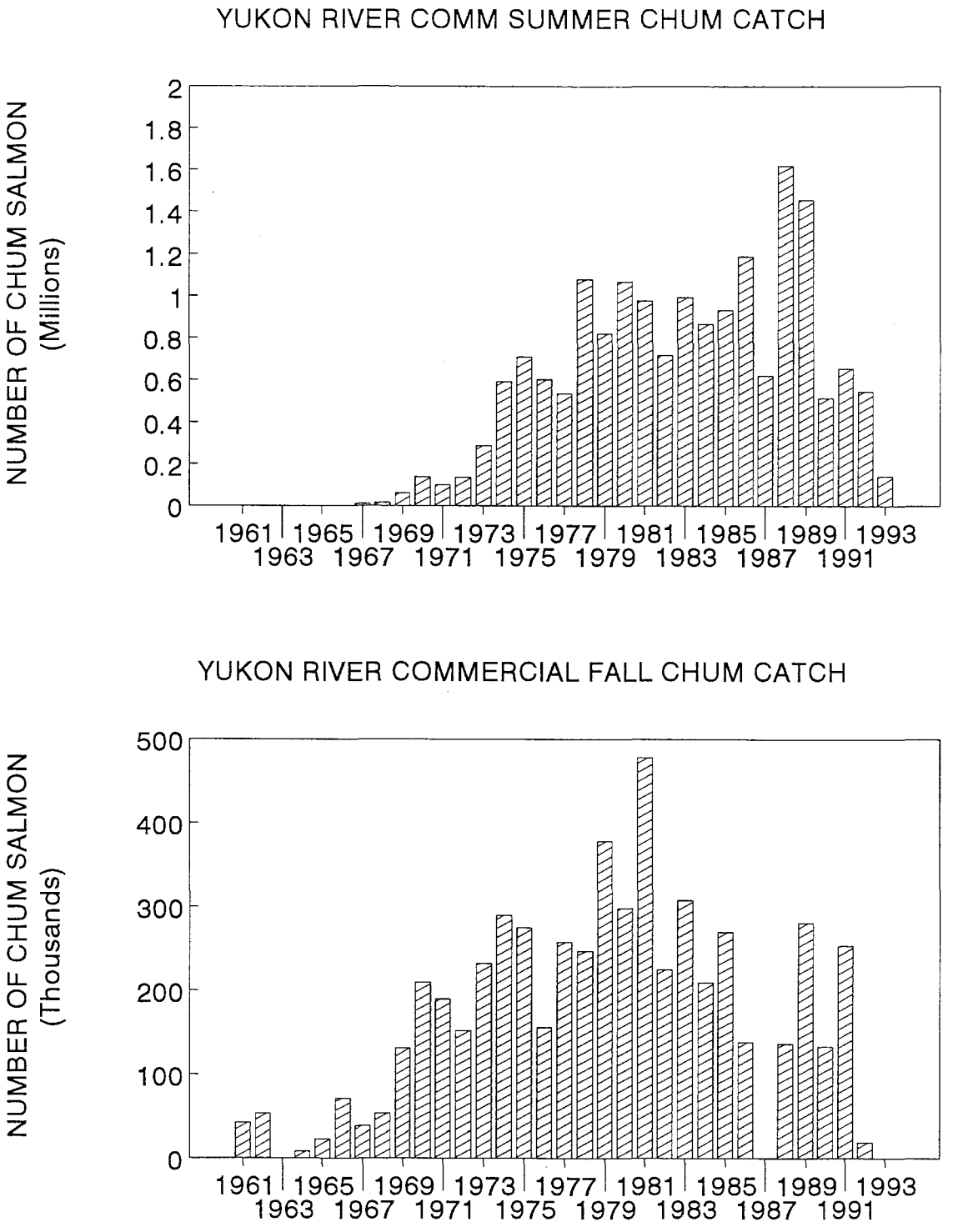

Figure 4. Commercial chum salmon catch in the Yukon River area, 1961–1993.

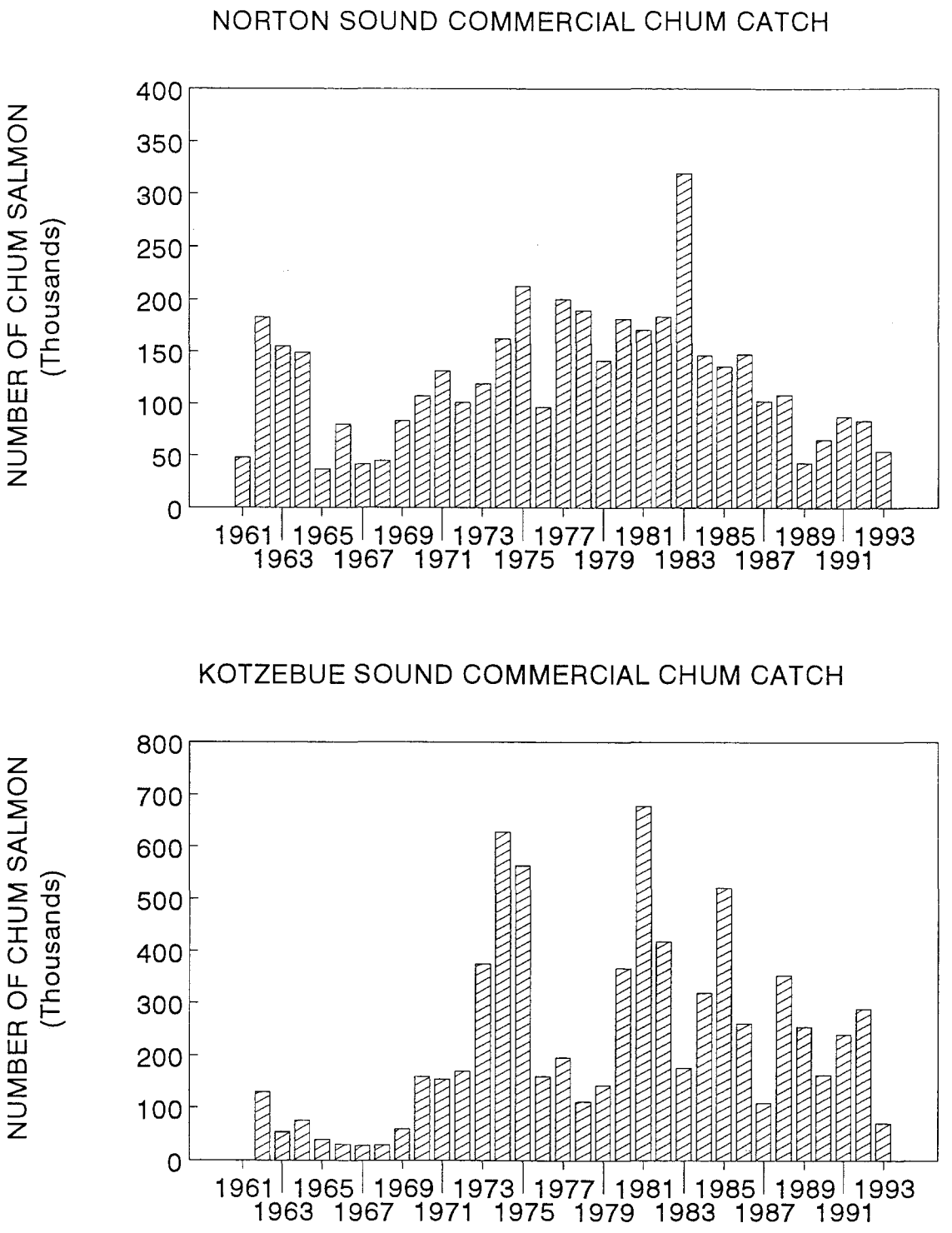

Figure 5. Commercial chum salmon catch in the Norton Sound and Kotzebue Sound areas, 1961–1993.

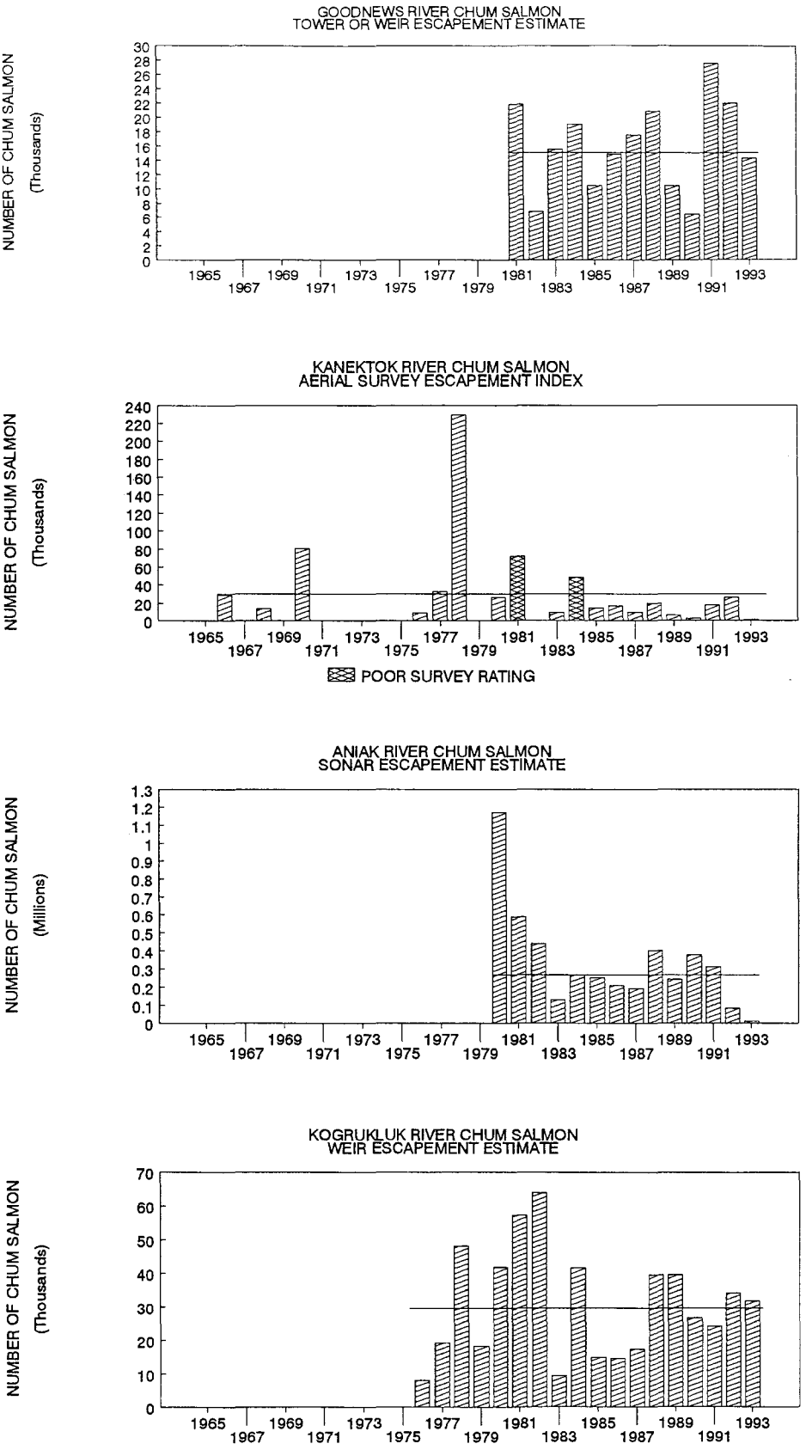

Figure 6. Escapement estimates for selected Kuskokwim Bay and Kuskokwim River chum salmon stocks. Horizontal lines indicate escapement goals as of the 1993 season. They have been drawn across the entire range of data for each stock to provide a comparative benchmark, even though goals were only first established in the early 1980's or more recently, and may have been modified somewhat since then.

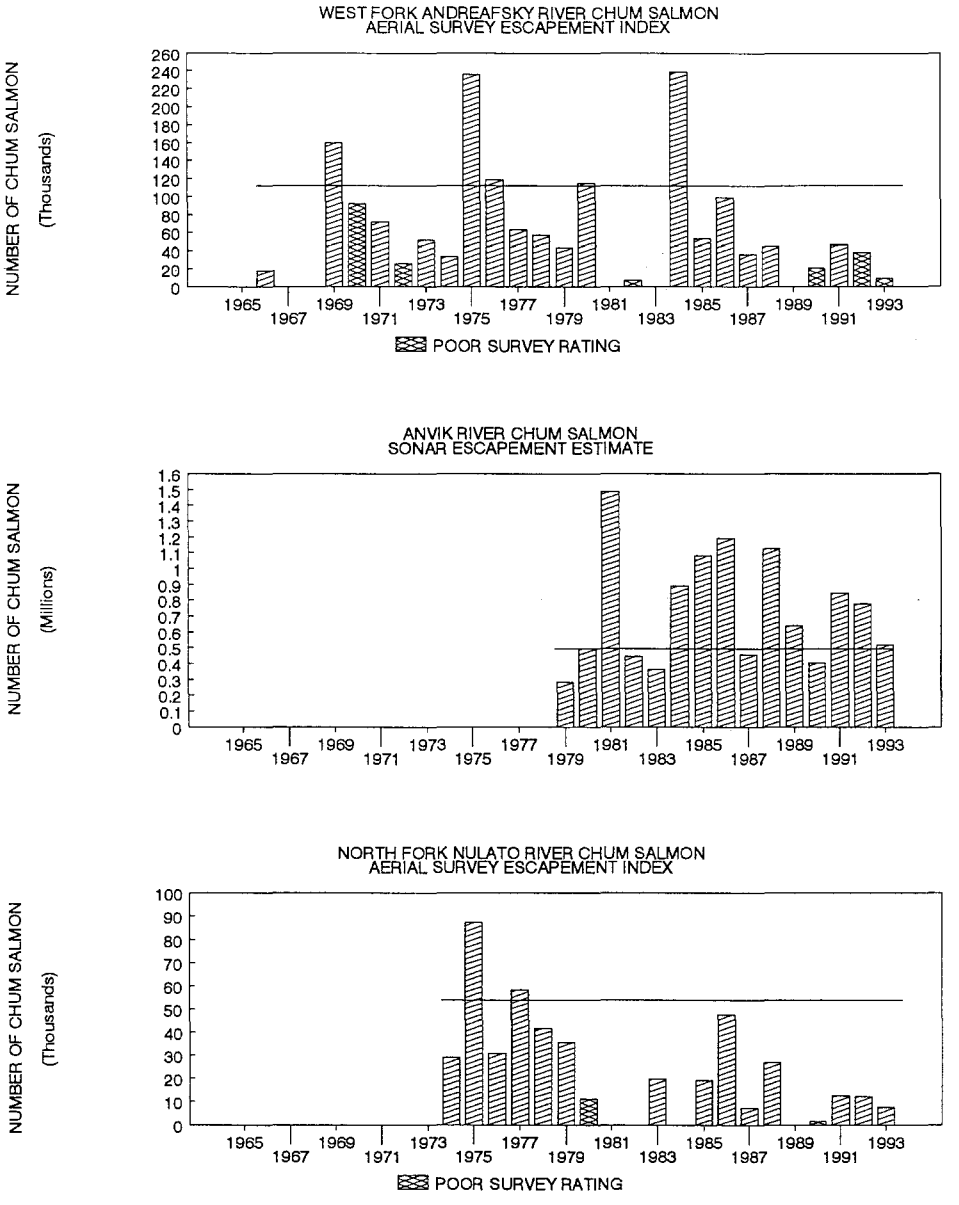

Figure 7. Escapement estimates for selected Yukon River summer chum salmon stocks. Horizontal lines indicate escapement goals as of the 1993 season. They have been drawn across the entire range of data for each stock to provide a comparative benchmark, even though goals were only first established in the early 1980's or more recently, and may have been modified somewhat since then.

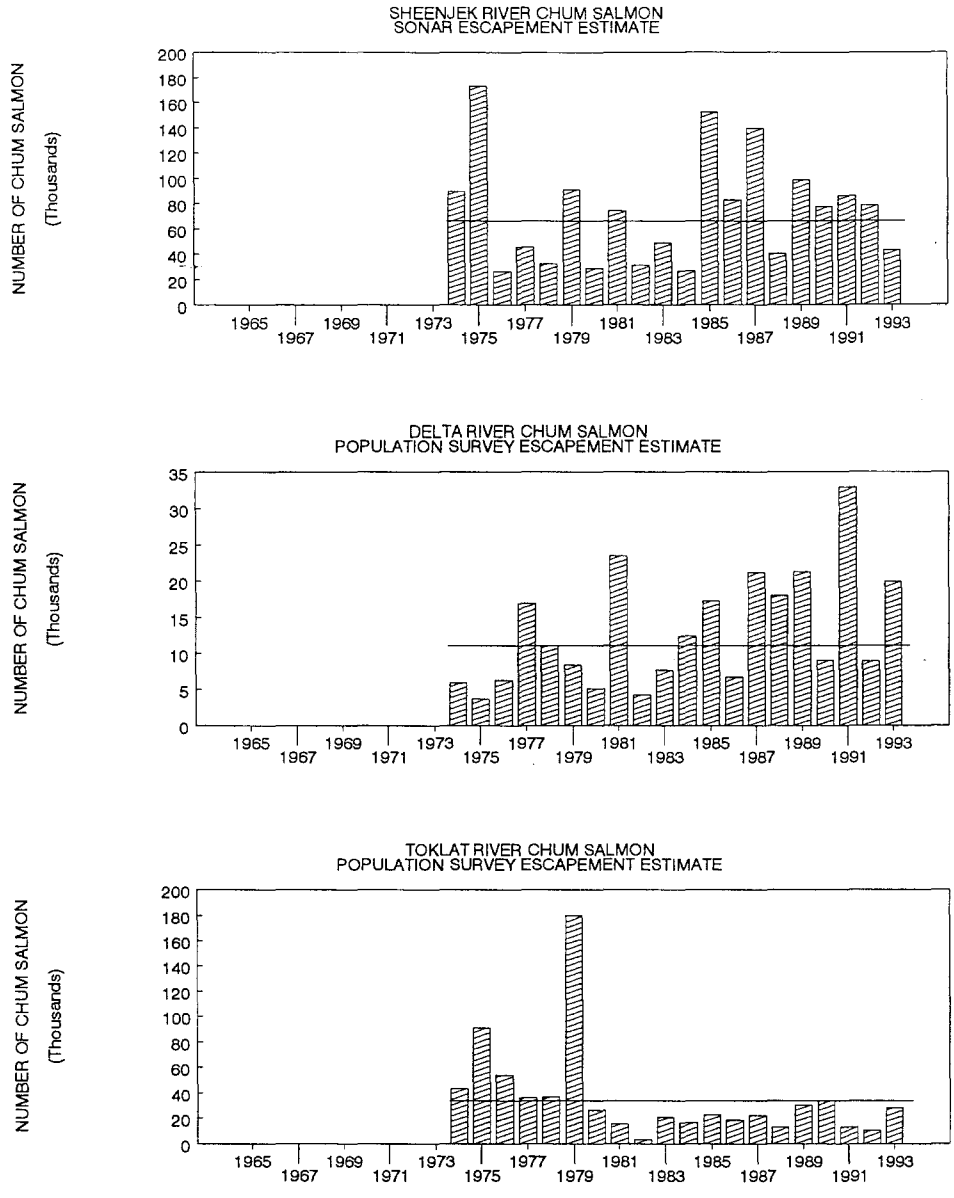

Figure 8. Escapement estimates for selected Yukon River fall chum salmon stocks in Alaska. Horizontal lines indicate escapement goals as of the 1993 season. They have been drawn across the entire range of data for each stock to provide a comparative benchmark, even though goals were only first established in the early 1980's or more recently, and may have been modified somewhat since then.

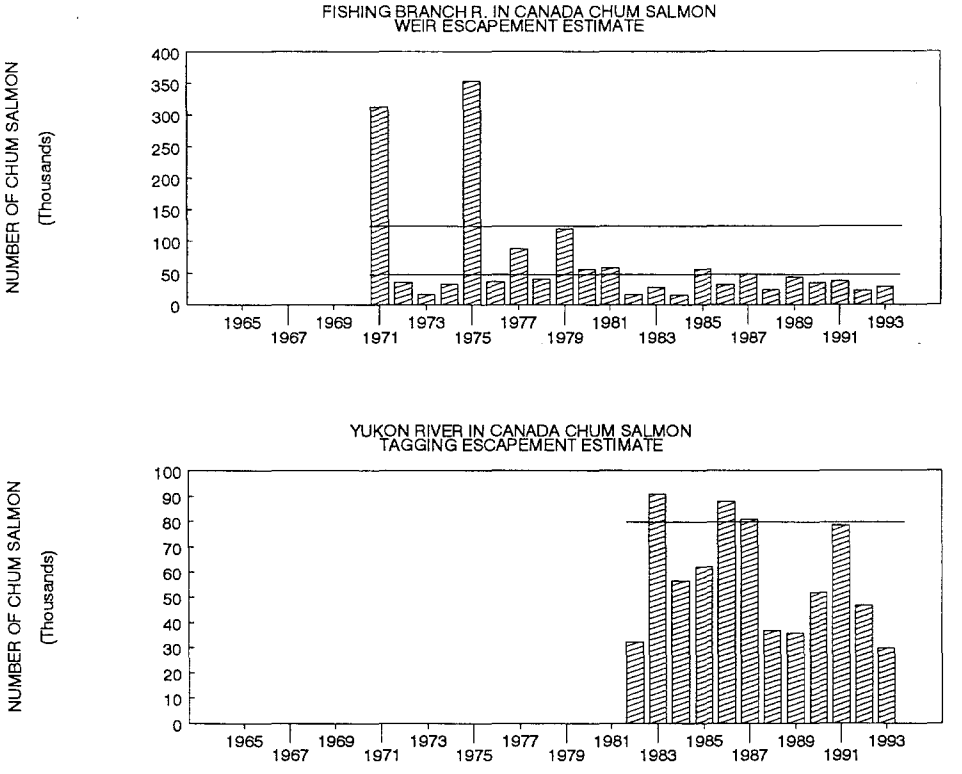

Figure 9. Escapement estimates for selected Yukon River fall chum salmon stocks in Canada. Horizontal lines indicate the escapement goals recommended by the JTC in 1987 for the Fishing Branch River, and in 1990 for the mainstem Yukon River. They have been drawn across the entire range of data for each stock to provide a comparative benchmark. Rebuilding efforts are underway to reach those levels by achieving intermediate rebuilding levels in a scheduled manner.

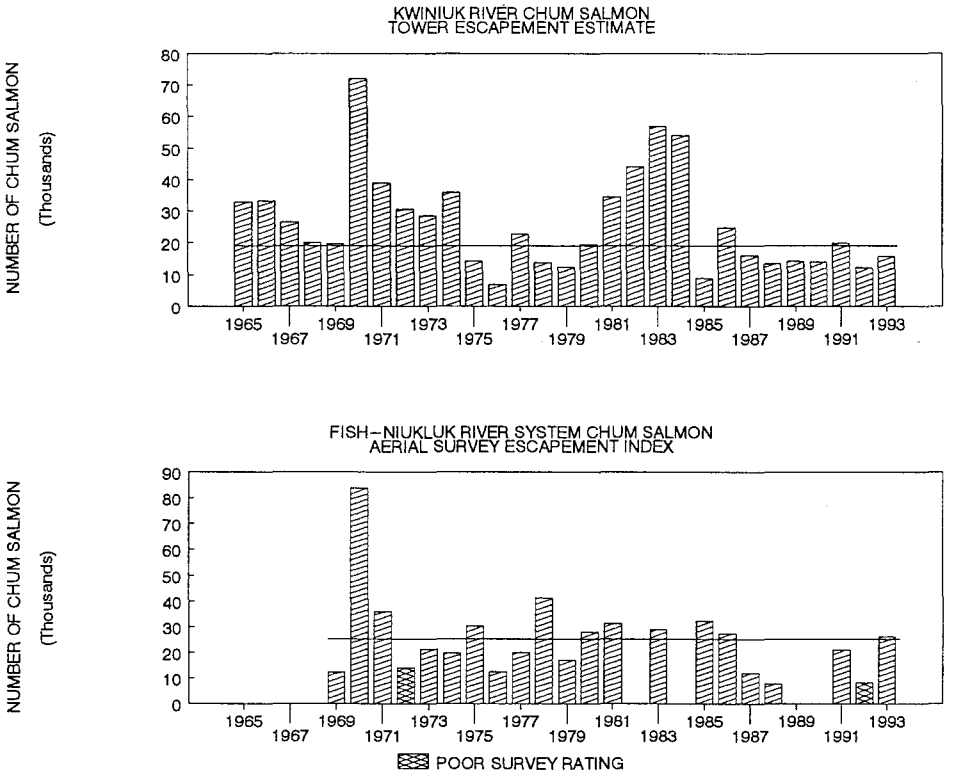

Figure 10. Escapement estimates for selected Norton Sound chum salmon stocks. Horizontal lines indicate escapement goals as of the 1993 season. They have been drawn across the entire range of data for each stock to provide a comparative benchmark, even though goals were only first established in the early 1980's or more recently, and may have been modified somewhat since then.

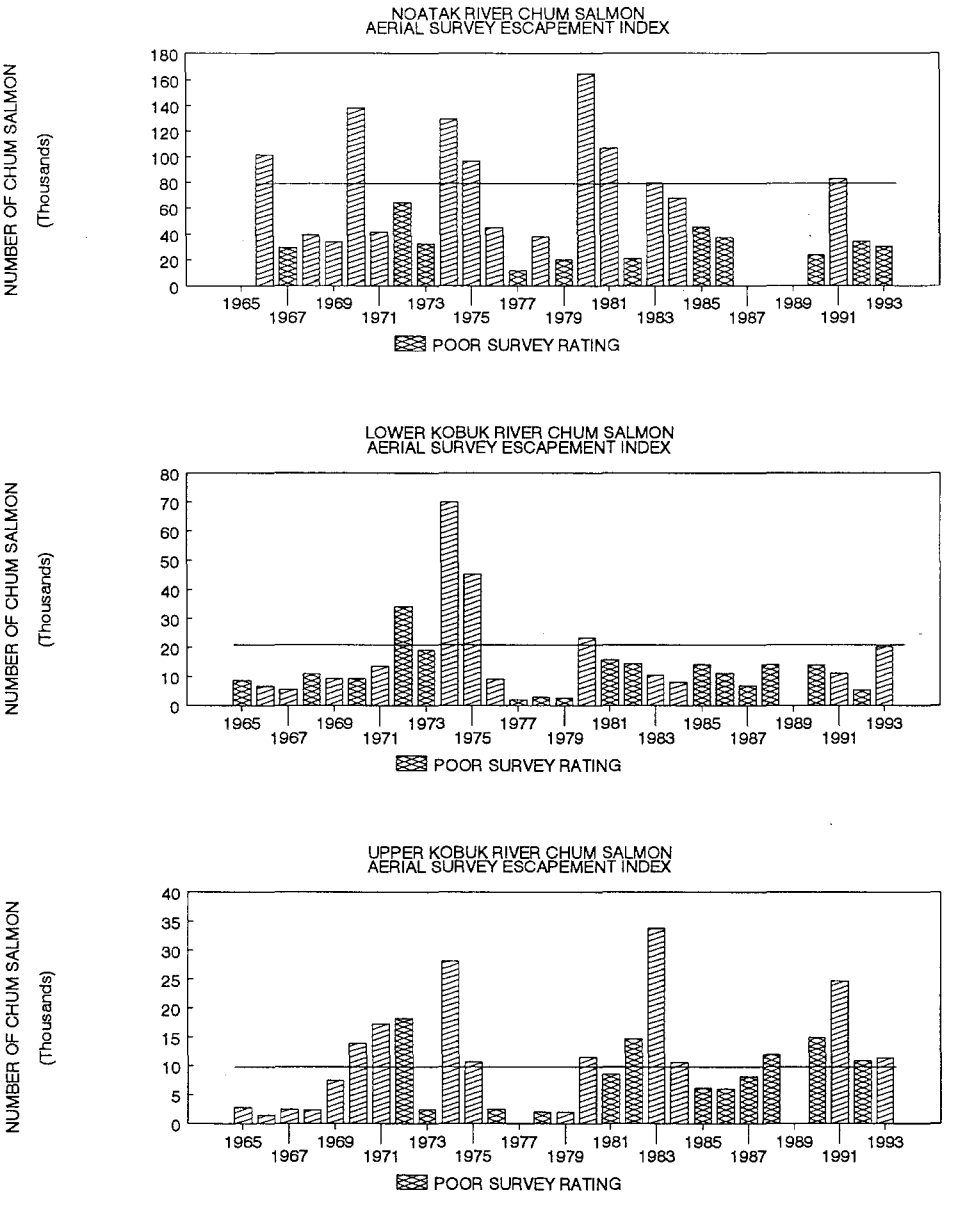

Figure 11. Escapement estimates for selected Kotzebue Sound chum salmon stocks. Horizontal lines indicate escapement goals as of the 1993 season. They have been drawn across the entire range of data for each stock to provide a comparative benchmark, even though goals were only first established in the early 1980's or more recently, and may have been modified somewhat since then. The Lower Kobuk is a composite of the Squirrel, Salmon, and Tutuksuk Rivers.

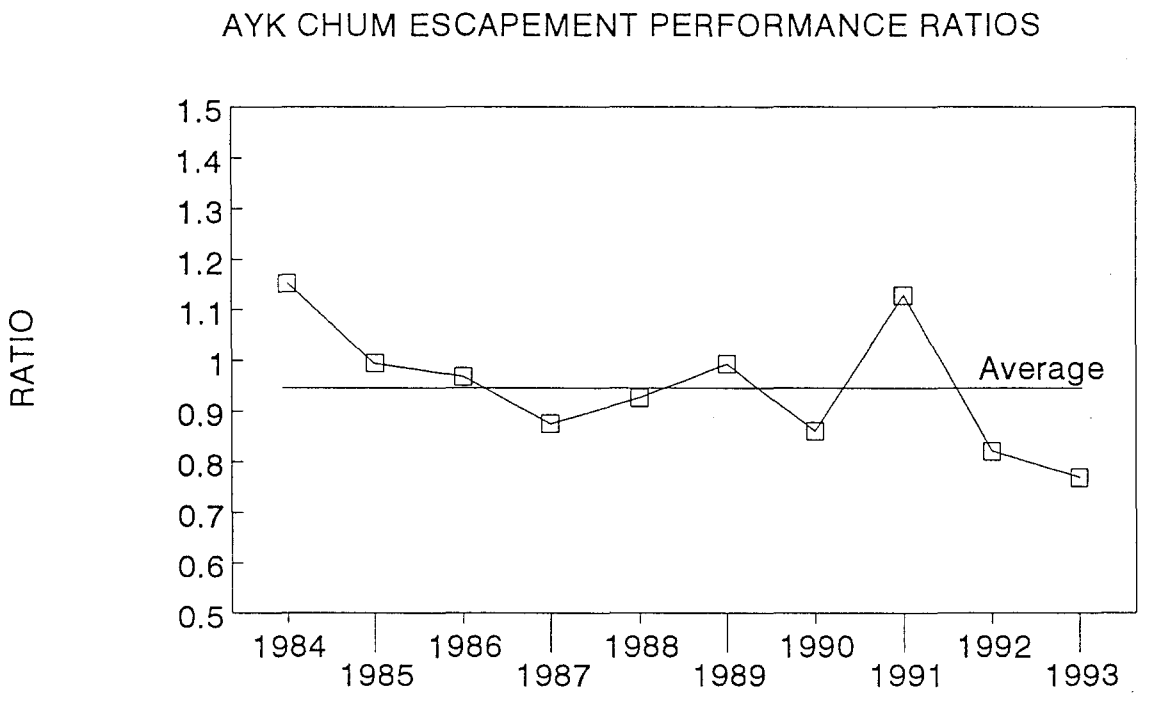

Figure 12. Annual average escapement performance ratios for AYK chum salmon, 1984–1993. Each annual average represents the average escapement performance of seventeen selected indicator stocks relative to a fixed reference level for each stock. The fixed reference levels used were the escapement goals for the stocks as described in Table 3. The horizontal line depicts the average ratio of 0.95 for the 10–year period.

Table 1. Commercial chum salmon catch in the Arctic–Yukon–Kuskokwim Region, 1961–1993. a

Year	Kusko Bay	Kusko River	Yukon R. Summer	Yukon R. Fall	Norton Sound	Kotzebue Sound	AYK Total
1961	19,000	0	0	42,000	48,000	0	109,000
1962	46,000	0	0	53,000	183,000	130,000	412,000
1963	0	0	0	0	155,000	54,000	209,000
1964	1,000	0	0	8,000	149,000	76,000	234,000
1965	4,000	0	0	23,000	37,000	40,000	104,000
1966	3,000	0	0	71,000	80,000	31,000	185,000
1967	8,000	0	11,000	38,000	42,000	29,000	128,000
1968	19,000	0	14,000	53,000	45,000	30,000	161,000
1969	43,000	7,000	62,000	131,000	83,000	59,000	385,000
1970	59,000	2,000	137,000	210,000	107,000	160,000	675,000
1971	31,000	69,000	100,000	190,000	131,000	155,000	676,000
1972	19,000	79,000	136,000	152,000	101,000	170,000	657,000
1973	35,000	149,000	286,000	232,000	119,000	375,000	1,196,000
1974	24,000	172,000	590,000	290,000	162,000	628,000	1,866,000
1975	41,000	182,000	710,000	275,000	212,000	563,000	1,983,000
1976	54,000	178,000	601,000	156,000	96,000	160,000	1,245,000
1977	50,000	249,000	535,000	258,000	200,000	196,000	1,488,000
1978	33,000	249,000	1,078,000	247,000	189,000	112,000	1,908,000
1979	35,000	262,000	820,000	378,000	141,000	142,000	1,778,000
1980	78,000	483,000	1,068,000	298,000	181,000	367,000	2,475,000
1981	67,000	419,000	979,000	478,000	170,000	677,000	2,790,000
1982	47,000	278,000	716,000	225,000	183,000	418,000	1,867,000
1983	30,000	268,000	993,000	308,000	319,000	176,000	2,094,000
1984	65,000	424,000	864,000	210,000	146,000	320,000	2,029,000
1985	25,000	199,000	932,000	270,000	135,000	521,000	2,082,000
1986	40,000	309,000	1,187,000	139,000	147,000	261,000	2,083,000
1987	29,000	574,000	620,000	0	102,000	109,000	1,434,000
1988	62,000	1,382,000	1,617,000	137,000	108,000	353,000	3,659,000
1989	53,000	749,000	1,453,000	281,000	43,000	255,000	2,834,000
1990	61,000	462,000	513,000	134,000	65,000	163,000	1,398,000
1991	70,000	432,000	655,000	254,000	87,000	240,000	1,738,000
1992	92,000	345,000	544,000	19,000	83,000	289,000	1,372,000
1993 b	52,000	43,000	140,000	0	54,000	71,000	360,000
AVG 1961–69	15,889	778	9,667	46,556	91,333	49,889	214,111
AVG 1970–79	38,100	159,100	499,300	238,800	145,800	266,100	1,347,200
AVG 1980–89	49,600	508,500	1,042,900	234,600	153,400	345,700	2,334,700
AVG 1990–92	74,333	413,000	570,667	135,667	78,333	230,667	1,502,667

a Commercial catch presented in numbers of fish, rounded to the nearest thousand. For the Yukon River this includes the estimated number of fish caught to produce roe sales.

b Data for 1993 are preliminary, and current as of 15 March 1994.

Table 2. Spawning escapement estimates or aerial survey indices of abundance for selected chum salmon stocks in the Arctic–Yukon–Kuskokwim Region, 1965–1993. a

Year	Goodnews Twr or Weir (Kusk Bay)	Kanektok Aerial (Kusk Bay)	Aniak Sonar (Kusk Riv)	Kogrukluk Weir (Kusk Riv)	WF Andr Aerial (YR Summ)	Anvik Sonar (YR Summ)	NF Nulato Aerial (YR Summ)
1965							
1966		28,800			18,100		
1967							
1968		14,000					
1969					159,500		
1970		80,100			91,700 c		
1971					71,700		
1972					25,600 c		
1973					51,800		
1974					33,600		29,300
1975					236,000		87,300
1976		8,700		8,100	118,400		30,800
1977		32,200		19,400	63,100		58,300
1978		229,300		48,100	57,300		41,700
1979				18,400	43,400	280,500	35,600
1980		26,000	1,169,500	41,800	114,800	492,700	11,200 c
1981	21,800	71,800 c	589,300	57,200		1,486,200	
1982	6,800		442,500	63,900	7,300 c	444,600	
1983	15,500	9,400	129,400	9,400		362,900	19,700
1984	19,000	48,400 c	267,000	41,500	238,600	891,000	
1985	10,400	14,400	253,100	14,900	52,800	1,080,200	19,300
1986	14,800	16,800	209,100	14,600	99,400	1,189,600	47,400
1987	17,500	9,400	193,000	17,400	35,500	455,900	7,200
1988	20,800	20,100	401,500	39,400	45,400	1,125,400	27,000
1989	10,400	6,300	243,900	39,400		636,900	
1990	6,400	2,500	377,200	26,800	20,400 c	403,600	1,400 c
1991	27,500	18,000	314,200	24,200	46,700	847,800	12,500
1992	22,000	25,700	84,300	34,100	37,800 c	775,600	12,400
1993 b	14,300	1,300	14,200	31,900	9,100 c	517,400	7,700
Esc Goal d	15,000	30,500	250,000	30,000	>116,000	>500,000	>53,000

– Continued –

a Escapement estimates and aerial survey indices of abundance are in numbers of fish, rounded to the nearest hundred. Stocks are a representative few from each area, selected based upon their relative importance and the quality and completeness of historical data. Note that for the Sheenjek River 1974–80, and for the Fishing Branch River 1971, 1976–84, and 1990, escapement estimates are based upon aerial surveys expanded based upon the relationship between aerial surveys and sonar or weir counts at each of those sites, respectively.

b Data for 1993 are preliminary, and current as of 15 March 1994.

c Poor survey conditions or timing of the survey outside of the optimal period resulted in an aerial survey which is lower than would have occurred under standard conditions and timing. Therefore, as an abundance index, such a survey is biased low.

d Escapement goals for these stocks as of the 1993 season, in the same units as the historical escapement data for each stock. Escapement goals for these stocks were first established in the early 1980's or more recently, and may have been modified somewhat since then. Goals for stocks in Canada are those recommended by the JTC, and a rebuilding effort is underway to reach those levels by achieving intermediate rebuilding levels in a scheduled manner. The Lower Kobuk is a composite of the Squirrel, Salmon, and Tutuksuk Rivers.

Table 2. (Page 2 of 3). a

Year	Sheenjek Sonar (YR Fall)	Delta Pop Sur (YR Fall)	Toklat Pop Sur (YR Fall)	F. Branch Weir (Can) (YR Fall)	Yukon R Tag (Can) (YR Fall)
1965					
1966					
1967					
1968					
1969					
1970					
1971				312,800	
1972				35,100	
1973				16,000	
1974	90,000	5,900	43,500	32,500	
1975	173,400	3,700	91,000	353,300	
1976	26,400	6,300	53,900	36,600	
1977	45,500	16,900	36,500	88,400	
1978	32,400	11,100	37,100	40,800	
1979	91,400	8,400	179,600	119,900	
1980	28,900	5,100	26,400	55,300	
1981	74,600	23,500	15,600	57,400	
1982	31,400	4,200	3,600	15,900	32,000
1983	49,400	7,700	20,800	27,200	90,900
1984	27,100	12,400	16,500	15,200	56,600
1985	152,800	17,300	22,800	56,000	62,000
1986	83,200	6,700	18,900	31,700	88,000
1987	140,100	21,200	22,100	49,000	80,800
1988	40,900	18,000	13,300	23,600	36,800
1989	99,100	21,300	30,400	43,800	35,800
1990	77,800	9,000	33,700	35,000	51,800
1991	86,500	32,900	13,200	37,700	78,500
1992	78,800	8,900	10,800	22,500	46,800
1993 b	43,000	19,900	28,200	28,800	29,900
Esc Goal d	>64,000	>11,000	>33,000	50,000 –120,000	>80,000

a Escapement estimates and aerial survey indices of abundance are in numbers of fish, rounded to the nearest hundred. Stocks are a representative few from each area, selected based upon their relative importance and the quality and completeness of historical data. Note that for the Sheenjek River 1974–80, and for the Fishing Branch River 1971, 1976–84, and 1990, escapement estimates are based upon aerial surveys expanded based upon the relationship between aerial surveys and sonar or weir counts at each of those sites, respectively.

b Data for 1993 are preliminary, and current as of 15 March 1994.

c Poor survey conditions or timing of the survey outside of the optimal period resulted in an aerial survey which is lower than would have occurred under standard conditions and timing. Therefore, as an abundance index, such a survey is biased low.

d Escapement goals for these stocks as of the 1993 season, in the same units as the historical escapement data for each stock. Escapement goals for these stocks were first established in the early 1980's or more recently, and may have been modified somewhat since then. Goals for stocks in Canada are those recommended by the JTC, and a rebuilding effort is underway to reach those levels by achieving intermediate rebuilding levels in a scheduled manner. The Lower Kobuk is a composite of the Squirrel, Salmon, and Tutuksuk Rivers.

Table 2. (Page 3 of 3). a

Year	Kwiniuk Tower (NS)	Fish & Niuk–luk Aerial (NS)	Noatak Aerial (Kotz)	L. Kobuk Aerial (Kotz)	U. Kobuk Aerial (Kotz)
1965	32,900			8,700 c	2,800
1966	33,200		101,600	6,700	1,500
1967	26,600		29,100 c	5,600	2,500
1968	20,000		39,400	10,900 c	2,400
1969	19,700	12,300	33,900	9,400	7,500
1970	72,100	83,900	138,100	9,400 c	13,900
1971	39,000	35,800	41,100	13,500	17,200
1972	30,700	14,100 c	64,300 c	34,200 c	18,200 c
1973	28,600	21,300	32,100 c	19,200 c	2,500 c
1974	35,900	19,700	129,600	70,000	28,100
1975	14,300	30,200	96,500	45,300	10,700
1976	7,000	12,500	44,600	9,100	2,500 c
1977	22,800	20,100	11,200 c	2,000 c	
1978	13,800	41,200	37,800	3,000 c	2,000 c
1979	12,400	17,000	19,700 c	2,600 c	2,000
1980	19,400	28,000	164,500	23,200	11,500
1981	34,600	31,300	106,500	15,700 c	8,600 c
1982	44,100		20,700 c	14,400 c	14,700 c
1983	56,900	28,900	79,800	10,400	33,700
1984	54,000		67,900	8,100	10,600
1985	9,000	32,200	45,500 c	14,200 c	6,200 c
1986	24,700	27,600	37,200 c	11,200 c	6,000 c
1987	16,100	12,000		7,000 c	8,200 c
1988	13,300	7,700		14,200 c	11,900 c
1989	14,300				
1990	14,000		23,300 c	14,100 c	14,900 c
1991	19,800	20,900	82,800	11,200	24,600
1992	12,100	8,200 c	34,300 c	5,300 c	10,900 c
1993 b	15,800	26,100	30,200 c	20,300	11,300
Esc Goal d	19,500	25,500	80,000	20,500	10,000

a Escapement estimates and aerial survey indices of abundance are in numbers of fish, rounded to the nearest hundred. Stocks are a representative few from each area, selected based upon their relative importance and the quality and completeness of historical data. Note that for the Sheenjek River 1974–80, and for the Fishing Branch River 1971, 1976–84, and 1990, escapement estimates are based upon aerial surveys expanded based upon the relationship between aerial surveys and sonar or weir counts at each of those sites, respectively.

b Data for 1993 are preliminary, and current as of 15 March 1994.

c Poor survey conditions or timing of the survey outside of the optimal period resulted in an aerial survey which is lower than would have occurred under standard conditions and timing. Therefore, as an abundance index, such a survey is biased low.

d Escapement goals for these stocks as of the 1993 season, in the same units as the historical escapement data for each stock. Escapement goals for these stocks were first established in the early 1980's or more recently, and may have been modified somewhat since then. Goals for stocks in Canada are those recommended by the JTC, and a rebuilding effort is underway to reach those levels by achieving intermediate rebuilding levels in a scheduled manner. The Lower Kobuk is a composite of the Squirrel, Salmon, and Tutuksuk Rivers.

Table 3. Escapement performance ratios for seventeen selected indicator chum salmon stocks in the Arctic–Yukon–Kuskokwim Region, 1984–1993. For each stock the ratio presented here represents the escapement estimate for a given year divided by a fixed reference level for that stock. For the spawning stocks in Alaska, the reference level used for all years was the escapement goal in effect as of the 1993 season. For the spawning stocks in the Canadian Yukon, the reference level used for all years was the escapement goal recommended by the JTC, although rebuilding efforts are underway to achieve those levels by achieving intermediate rebuilding levels in a scheduled manner. a

Year	Spawning Stocks or Stock Groups (See Footnote b For Names)																	Average
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	
1984	1.27	***1.59***	1.07	1.38	2.06	1.78		0.42	1.13	0.50	0.30	0.71	2.77		0.85	0.40	1.06	1.15
1985	0.69	0.47	1.01	0.50	0.46	2.16	0.36	2.39	1.57	0.69	1.12	0.78	0.46	1.26				0.99
1986	0.99	0.55	0.84	0.49	0.86	2.38	0.89	1.30	0.61	0.57	0.63	1.10	1.27	1.08				0.97
1987	1.17	0.31	0.77	0.58	0.31	0.91	0.14	2.19	1.93	0.67	0.98	1.01	0.83	0.47				0.88
1988	1.39	0.66	1.61	1.31	0.39	2.25	0.51	0.64	1.64	0.40	0.47	0.46	0.68	0.30			***1.19***	0.93
1989	0.69	0.21	0.98	1.31		1.27		1.55	1.94	0.92	0.88	0.45	0.73					0.99
1990	0.43	0.08	1.51	0.89		0.81		1.22	0.82	1.02	0.70	0.65	0.72				***1.49***	0.86
1991	1.83	0.59	1.26	0.81	0.40	1.70	0.24	1.35	2.99	0.40	0.75	0.98	1.02	0.82	1.04	0.55	2.46	1.13
1992	1.47	0.84	0.34	1.14		1.55	0.23	1.23	0.81	0.33	0.45	0.59	0.62				***1.09***	0.82
1993	0.95	0.04	0.06	1.06		1.03	0.15	0.67	1.81	0.85	0.58	0.37	0.81	1.02		0.99	1.13	0.77
Average	1.09	0.53	0.94	0.95	0.74	1.58	0.36	1.30	1.52	0.64	0.69	0.71	0.99	0.83	0.94	0.64	1.40	0.95

a Escapements are estimated using a variety of methods, but the methods are consistent for a given stock across these years. Blank cells are due to either a lack of data or an aerial survey below the escapement goal but conducted with a poor survey rating. Aerial surveys conducted with a poor survey rating but for which an estimate above the escapement goal was obtained are indicated in bold italics. There is one such data point for stock (2) and three such data points for stock (17).

b Stocks are as follows: (1) Goodnews River, (2) Kanektok River, (3) Aniak River, (4) Kogrukluk River, (5) West Fork Andreafsky River, (6) Anvik River, (7) North Fork Nulato River, (8) Sheenjek River, (9) Delta River, (10) Toklat River, (11) Fishing Branch River in Canada, (12) mainstem Yukon River in Canada, (13) Kwiniuk River, (14) Fish–Niukluk River, (15) Noatak River, (16) Lower Kobuk River (a composite of the Squirrel, Salmon, and Tutuksuk Rivers), and (17) Upper Kobuk River.